
MARROW ED8

Forensic Medicine

Comprehensive Question Bank

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Skeletal and Dental Age Determination

Question 1:

A victim of child trafficking was brought to you by the police for age determination. Which of the following would you use as an accurate method for determining the same?

- a) Distal epiphysis of femur
- b) Mineralization of teeth
- c) Fusion of sphenoid-occipital suture
- d) Emergence of teeth

Question 2:

Which of the following is the earliest tooth to erupt in a 7-month-old baby?

- a) Maxillary central incisor
- b) Mandibular central incisor
- c) Mandibular first molar
- d) Maxillary lateral incisor

Question 3:

Which of the following is a superadded permanent tooth?

- a) Central incisors
- b) Canine
- c) Premolar
- d) Molar

Question 4:

Electron microscopy of the surface of tooth enamel revealed a neonatal line. What is your inference?

- a) Congenital malformation
- b) Heavy metal poisoning

- c) Still birth
- d) Live birth

Question 5:

A dentist evaluating a child's teeth notices the presence of mixed dentition. What would be the approximate age of the child?

- a) 2 – 5 years
- b) 6 – 12 years
- c) 12 – 15 years
- d) 15 – 17 years

Question 6:

While examining the skeletal remains from a bomb blast, a forensic expert decides to use the Gustafson's method for identification of the ages of people killed. Which of the following would you not assess in this method?

- a) Tooth length
- b) Attrition changes of occlusal surface
- c) Periodontosis
- d) Transparency of the root

Question 7:

Which of the following is the most reliable criterion for age determination from Gustafson's method?

- a) Periodontis
- b) Root resorption
- c) Secondary dentin deposition
- d) Root transparency

Question 8:

Which of the following methods is used for dental numbering?

- a) Pearson method
- b) Palmer's method
- c) Gleser method
- d) Trotter's method

Question 9:

You receive a dental report from an autopsy of a homicide case, stating that FDI notation tooth number '43' is missing. Which tooth is missing in the victim?

- a) Lower right canine
- b) Lower left canine
- c) Upper right first molar
- d) Upper left first molar

Question 10:

When does the fusion of the spheno-occipital suture usually occur in females?

- a) 10 years
- b) 18 years
- c) 28 years
- d) 24 years

Question 11:

Match the following sutures with their correct age of fusion:

- a) 1-a, 2-d, 3-b, 4-c
- b) 1-b, 2-d, 3-a, 4-c
- c) 1-c, 2-b, 3-a, 4-d
- d) 1-b, 2-d, 3-c, 4-a

Question 12:

Which among the following is the best indicator that a female is more than 16 years of age?

- a) Fusion of distal end of ulna
- b) Fusion of proximal end of ulna
- c) Fusion of medial end of clavicle
- d) Fusion of iliac crest

Question 13:

Which of the following is the most reliable method for estimation of age in adulthood (>25 years)?

- a) Ectocranial fusion of skull sutures
- b) Endocranial fusion of skull sutures
- c) Degenerative changes in pubic symphysis
- d) Degenerative changes in teeth

Question 14:

The secondary ossification centres that appear before birth include all of the following except:

- a) Distal femur
- b) Talus
- c) Distal tibia
- d) Calcaneus

Question 15:

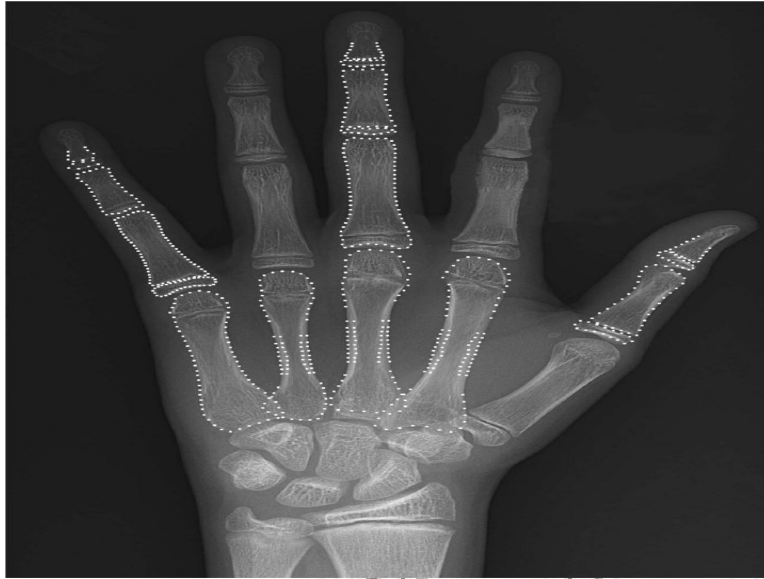
First carpal bone to ossify:

- a) Lunate
- b) Capitate
- c) Hamate
- d) Scaphoid

Question 16:

A child who is a victim under POCSO act is brought to the department of forensic medicine for age estimation. The X-ray image of the hand is shown below. What is the likely age of the

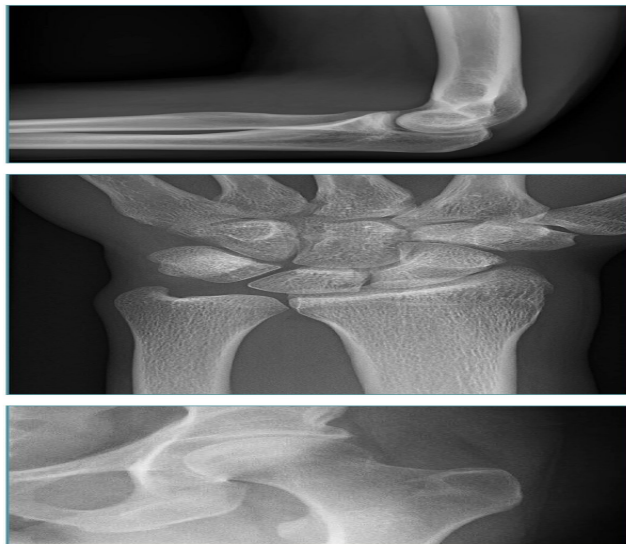
child?



- a) 4 years
- b) 7 years
- c) 10 years
- d) 13 years

Question 17:

A girl was allegedly kidnapped by a man. In court, she says that she is a major and is married to the man. X-ray images of her elbow, wrist and pelvis are given. What is the approximate age of the girl ?



- a) 14 to 15 years
- b) 16 to 17 years
- c) 18 to 19 years
- d) 21 to 22 years

Question 18:

Which among the following statements regarding photosuperimposition is false?

- a) It may be performed on the pelvis
- b) This test is mainly exclusory
- c) It requires an antemortem picture of the victim
- d) 2D images may be used for this test

Answer Key

Question No.	Correct Option
1	b
2	b
3	d
4	d
5	b
6	a
7	d
8	b
9	a
10	b
11	b
12	a
13	c
14	c
15	b
16	d
17	d

Detailed Explanations

Solution to Question 1:

From the given options, mineralization of teeth is the more accurate method of age determination in childhood.

The relationship between the chronological age and dental age is stronger than between chronological age and skeletal age.

Two aspects of tooth development have been used in the estimation of dental age:

- The emergence of teeth - superior part of the crown of the tooth appearing level with the surface of the alveolar bone
- The stage of mineralization of crowns and roots during development

Estimation of dental age using mineralization stages of crowns and roots of developing teeth includes visualization from a radiographic image. This helps in viewing both erupted and unerupted teeth. It is a more accurate method of estimating age than emergence, because emergence is an event whose exact time of occurrence is not accurately known.

The study of dental microstructure is the most accurate method of age determination in childhood. This involves counting perikymata (incremental lines on the surface of tooth enamel).

Note: Eruption is a continuous process by which a tooth moves from its crypt in the jaw bone to its position of occlusion in the mouth. It is different from emergence. Emergence denotes that a tooth has pierced the gingiva.

Solution to Question 2:

The earliest tooth to erupt in a 7-month-old baby (primary dentition) is a mandibular central incisor.

The time of emergence of primary dentition or temporary teeth:

The deciduous teeth all emerge into the mouth by 2.5-3 years.

The time of emergence of secondary dentition or permanent teeth:

Note: 6-13 years is the age of mixed dentition. First molar emerges at 6-7 years. Second molar emerges at 12 years and third molar emerges beyond 18 years of age.

Tooth	Emergence
Mandibular central incisor	6-8 months

Tooth	Emergence
Maxillary central incisor	7-9 months
Maxillary lateral incisor	7-9 months
Mandibular lateral incisor	10-12 months
First molar	12-14 months
Canine	17-18 months
Second molar	20-30 months

Tooth	Emergence
First molar	6-7 years
Central incisors	6-8 years
Lateral incisors	7-9 years
First premolar	9-11 years
Second premolar	10-12 years
Canine	11-12 years
Second molar	12-14 years
Third molar	18-25 years

Solution to Question 3:

The 6 molars are called superadded teeth.

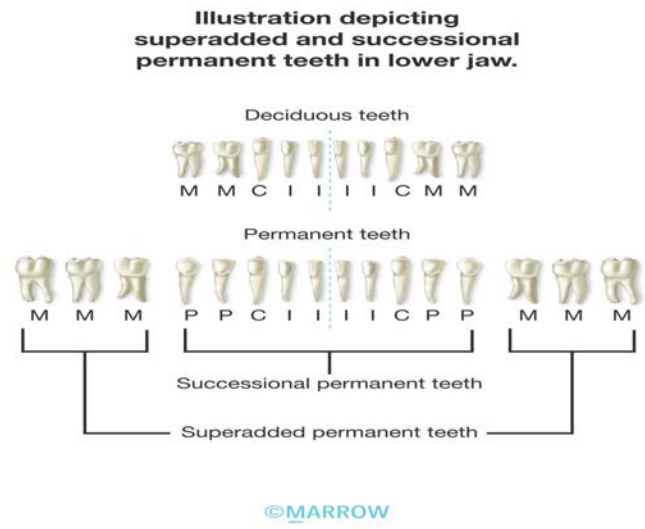
Permanent dentition refers to the teeth which begin to erupt from 6th year of age and remain throughout the life. They are totally 32 in number. The tooth distribution in each jaw is as follows:

- 4 incisors
- 2 canines
- 4 premolars

- 6 molars.

Thus, each jaw has 16 teeth. Among these 4 incisors and 2 canines and 4 premolars are called as successional teeth, which erupt in the place of predecessor deciduous teeth.

The remaining 6 permanent molars (1st, 2nd, and 3rd molar teeth) erupt independently without any predecessor teeth. Hence they are called superadded teeth.



Solution to Question 4:

Neonatal line is an incremental line found on the surface of tooth enamel, that indicates that an infant was live born.

The study of dental microstructure, which involves counting perikymata (incremental lines on the surface of tooth enamel), can provide an accurate method of age determination.

One particularly pronounced incremental line, the neonatal line, can be of medicolegal significance in determining whether an infant was live-born or stillborn. It is formed very soon after birth and can be visualized by light microscopy if the child survived for about 3 weeks or by electron microscopy within 1 or 2 days of birth.

Solution to Question 5:

6 – 12 years is the age of mixed dentition and the number of teeth remains constant at 24.

The period during which both primary and permanent teeth are in oral cavity together is known as mixed dentition period. This is the period where the deciduous teeth get replaced by permanent successors.

Solution to Question 6:

Tooth length is not assessed in Gustafson's method.

Gustafson's method of estimation of age of an individual is based on physiological changes in teeth. It is mainly useful in adults over 25 years of age.

Gustafson's criteria includes:

- Attrition - wear and tear changes of occlusal surface
- Periodontosis - regression of gums surrounding the tooth resulting in loosening of the tooth and falling
- Secondary dentin - deposition of dentin in pulp cavity
- Cementum apposition - deposition of cementum in the root forming incremental lines
- Root resorption - involves both cementum and dentin
- Transparency of the root - This is the most reliable criteria. Canals in dentin get filled with mineral and they become less transparent.

Gustafson's method has now been largely replaced by Lamendin's method.

Other methods of age determination based on teeth:

- Lamendin's method - It evaluates root dentine translucency, periodontopathy, and tooth length
- Miles' method - Uses transparency of the root as a single criterion
- Boyd's method - Determination of age of an infant by counting incremental lines on enamel
- Stack's method - Determination of age by measuring dimensions of teeth
- Variation in racemization of amino acids (especially aspartic acid) in dental pulp with age
- Evaluating the reduction of the pulp chamber through X-rays

Solution to Question 7:

Transparency of the root is the most reliable criterion in Gustafson's method.

Gustafson's method of estimation of age of an individual is based on physiological changes in teeth. It is mainly useful in adults over 25 years of age.

Gustafson's criteria includes:

- Attrition - wear and tear changes of occlusal surface
- Periodontosis - regression of gums surrounding the tooth resulting in loosening of the tooth and falling
- Secondary dentin - deposition of dentin in pulp cavity
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- Root resorption - involves both cementum and dentin

- Transparency of the root - This is the most reliable criteria. Canals in dentin get filled with mineral and they become less transparent.

Solution to Question 8:

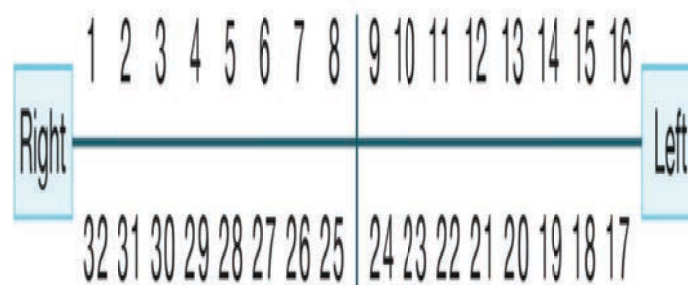
Palmer's notation is used for charting of teeth. Teeth will be numbered from 1 to 8 starting from the central incisor till the third molar in each quadrant.

The image given below shows Palmer's notation for teeth charting.

Palmer Notation															
Permanent Dentition															
Upper Right								Upper Left							
8J	7J	6J	5J	4J	3J	2J	1J	L1	L2	L3	L4	L5	L6	L7	L8
8j	7j	6j	5j	4j	3j	2j	1j	Γ1	Γ2	Γ3	Γ4	Γ5	Γ6	Γ7	Γ8
Lower Right								Lower Left							
Primary Dentition															
Upper Right								Upper Left							
			EJ	DJ	CJ	BJ	AJ	LA	LB	LC	LD	LE			
			Ej	Dj	Cj	Bj	Aj	ΓA	ΓB	ΓC	ΓD	ΓE			
Lower Right								Lower Left							

The 4 most commonly used methods in dental charting are:

1. Universal system: Teeth are numbered 1 – 16 starting from upper right to upper left and 17 – 32 starting from lower left to lower right. The image given below shows the universal dental charting system.

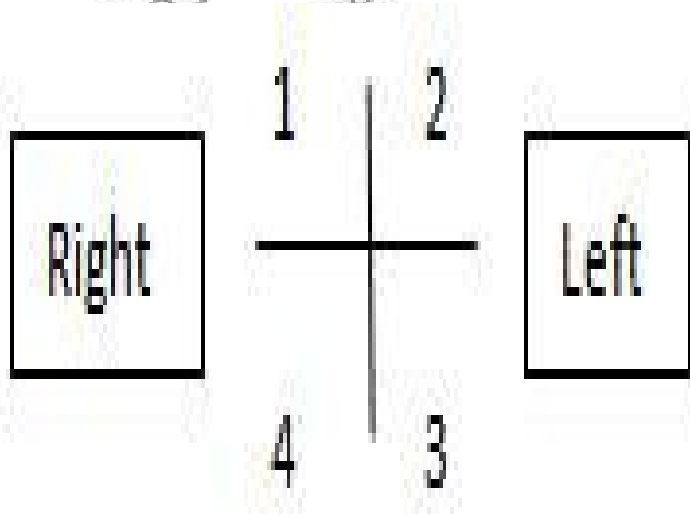


2. Palmer's notation: Teeth will be numbered from 1 to 8 starting from the central incisor till the third molar in each quadrant. The image given below shows Palmer's notation for dental charting.



3. Haderup system: This is similar to Palmer's notation but plus sign (+) indicates upper teeth and minus sign (-) indicates lower teeth.

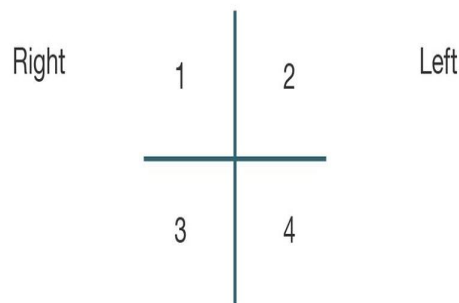
4. FDI (Federation Dentaire Internationale): Number is assigned to each quadrant and that number is placed before tooth's number. The quadrants and teeth are numbered as in the images given below.



Permanent teeth															
patient's upper right								patient's upper left							
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
patient's lower right								patient's lower left							
Deciduous teeth (baby teeth)															
upper right								upper left							
			55	54	53	52	51	61	62	63	64	65			
			85	84	83	82	81	71	72	73	74	75			
lower right								lower left							

Modified FDI: The quadrants numbering is modified as shown below.

Modified FDI Notation



Pearson's, Trotter and Gleser's and Steele's formula are used to estimate the stature of the individual.

Solution to Question 9:

In FDI notation 43, the number 4 indicates the lower right quadrant and the number 3 indicates canine tooth. Hence 43 indicates the lower right canine.

FDI (Federation Dentaire Internationale) represents a number is assigned to each quadrant and that number is placed before tooth's number.

FDI two-digit notation

Permanent teeth															
patient's upper right							patient's upper left								
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
patient's lower right							patient's lower left								
Deciduous teeth (baby teeth)															
upper right							upper left								
			55	54	53	52	51	61	62	63	64	65			
			85	84	83	82	81	71	72	73	74	75			
lower right							lower left								

Solution to Question 10:

The spheno-occipital suture fuses by about 18–20 years in females and by about 20–22 years in males.

The timing of cranial suture closure was one of the first techniques used to estimate the age of adult individuals. The spheno-occipital suture on the skull base is particularly useful for aging young adults. The other cranial sutures show more variation in the timing of closure. Sagittal suture is used for age determination.

Sutures ossify on the endocranial surface before they ossify on the ectocranial surface, and this must also be taken into account when using this method. Overall, this method of age determination is less reliable.

Age of fusion of skull sutures:

Suture	Age of fusion
Metopic suture	2-4 years
Spheno-occipital suture	18-22 years
Posterior third of sagittal suture	30-40 years
Anterior third of sagittal suture	40-50 years
Middle third of sagittal suture	50-60 years
Coronal suture	40-50 years
Sphenotemporal suture	50-60 years
Squamous temporal suture	>80 years

Solution to Question 11:

Age of fusion of skull sutures are:

Ages of commencement and completion of fusion of the different skull sutures are given below:

Suture	Age of fusion
Metopic suture	2-4 years
Spheno-occipital suture	18-25 years
Posterior third of sagittal suture	30-40 years
Anterior third of sagittal suture	40-50 years
Middle third of sagittal suture	50-60 years
Coronal suture	40-50 years
Sphenotemporal suture	50-60 years
Squamous temporal suture	>80 years

Suture	Commencement (years)	Halfway closed (years)	Completion (years)
Spheno-occipital synchondrosis	-	-	20
Coronal suture	25	30	40
Sagittal suture	25	30	40
Lambdoid suture	25	30	45
Masto-occipital suture	45	-	80
Asterion	-	-	50

Solution to Question 12:

Complete union of the distal ulna is considered as a conclusive evidence of age more than 16 years in females.

The appearance of ossification centres is complete by around 5 years. Thus, from birth to 5 years. Thus from birth to 5 years, the calendar of appearance of ossification centres is used for aging. After the age of 5 years, the fusion of epiphyses acts as a calendar up to the age of 25.

The analysis of the hand and the wrist is the recommended method for living age diagnostics. But, this technique frequently does not provide sufficient evidence to place an individual older than or younger than key threshold ages - 16, 18 or 21. Additional radiographs needed to establish the threshold ages of 16, 18 or 21 can be any of the following:

- Proximal humerus
- Distal end of the ulna or radius
- Distal femur
- Proximal tibia
- Iliac crest

The proximal end of the ulna cannot be used to conclusively state that the individual is more than 16 years. This is because complete fusion of proximal end may occur earlier than 16 years.

Establishment of the age of 21 years can be done by evaluation of the medial end of the clavicle. Complete fusion occurs only beyond 22 years of age.

Age	Age determination
<5 years	Appearance of ossification centres
5-16 years	Analysis of hand and wrist
>16 years(male)	Complete fusion of distal radius or ulna
>16 years(female)	Complete fusion of distal ulna
>18 years(male)	Complete fusion of distal femur or proximal tibia
>18 years(female)	Complete fusion of iliac crest
>21 years	Complete fusion of medial end of clavicle

Solution to Question 13:

Estimation of age in adulthood (>25 years) is best estimated by degenerative changes in pubic symphysis.

Physical anthropology has established several methods for determining age in adults which include macroscopic, microscopic, and biomolecular methods.

Macroscopic methods of adult age determination are the most important ones and consist principally in the degree of degeneration of selected articulations such as:

- Pubic symphysis
- Osteochondral surface of the 4th rib

- Auricular surface of the ilium

Suchey and Brooks described six phases of degenerative change in the pubic symphysis.

Until recently, the most commonly used method for estimating age using the architecture of the pubic symphysis was that of Todd, who described 10 stages of pubic symphysis change during aging. More recently, researchers Suchey and Brooks described six phases of degenerative change in the pubic symphysis.

To solve this controversy, the following is suggested:

A two-step procedure has been developed for estimating age:

- If by looking at the skeleton, the age of the individual seems to be within the first 3 phases of the Suchey–Brookes pubic symphysis method, then this should be the method of choice.
- If the subject is classified in the last 3 phases, then one should switch to the Lamendin technique in order to assess age more accurately.
- Currently, age diagnosis at over 60 remains a problem.

In early adulthood, Suchey-Brookes pubic symphysis method is most accurate. In late adulthood, Lamendin technique of dental age estimation is most accurate.

Solution to Question 14:

The ossification centre for distal tibia does not appear before birth. It appears 3 months after birth.

Nearly all secondary centers commence ossification after birth, although a few develop in the last few weeks of intrauterine life. Secondary ossification centres which are already present when an infant is born include:

- Calcaneus
- Talus
- Distal femur
- Proximal tibia
- Cuboid
- Head of humerus

Visualization of the secondary ossification centers of the distal femur and the proximal tibia and commencement of ossification in the calcaneus and talus is usually accepted as signifying a full-term fetus.

Solution to Question 15:

Capitate is the first carpal bone and pisiform is the last carpal bone to ossify.

Age of ossification centres of carpal bones:

Carpal bone	Age of ossification
Capitate	1-3 months
Hamate	2-4 months
Triquetrum	2-3 years
Lunate	2-4 years
Scaphoid	4-6 years
Trapezium	4-6 years
Trapezoid	4-6 years
Pisiform	8-12 years

Solution to Question 16:

The child's age is likely to be 13 years.

In the given X-ray image of the wrist and hand, all the carpal bones are seen. The lower epiphysis of the first metacarpal has not united with the shaft. This suggests that the age of the child is between 8 to 15 years.

Additionally, the presence of the hook of the hamate in the radiograph suggests that the age is between 13-14 years.



The age of ossification of the carpal bones:

The age of fusion of joints:

Carpal bone	Age of ossification
Capitate	1-3 months
Hamate	2-4 months
Triquetrum	2-3 years
Lunate	2-4 years
Scaphoid	4-6 years
Trapezium	4-6 years
Trapezoid	4-6 years
Pisiform	8-12 years
Hook of the Hamate	13-14 years

Bone/ joint	Maximum age at fusion
Elbow joint centers Metacarpals	16 years
Wrist joint centers	19 years
Hip bone centers	22 years

Solution to Question 17:

The most approximate age of this girl is 21-22 years.

Since the ischial tuberosity is fused in this scenario the girl must be aged >21 years.

Bone/ joint	Maximum age at fusion	Interpretation of given x-ray
Elbow joint centres (lower end of humerus, upper end of radius, olecranon to ulna)	16 years	Fused, >16 years
Wrist joint centres (lower end of ulna and radius)	19 years	Fused, > 19 years
Hip bone centres (head of femur, greater and lesser trochanter, ischial tuberosity)	22 years	Fused, > 21 years

Solution to Question 18:

Photosuperimposition is only performed on the skull, not the pelvis.

Photosuperimposition is a well-established technique used for identification. It is done when a potential candidate for the identity of a skull is known to the investigating authority and photographs taken during life are available.

Photographs of the skull are taken in exactly the same orientation in 3 planes as the available photograph. These are then enlarged to exactly the same dimensions as the photograph, and either the negative or a positive print is made on transparent film.

This is then laid over the photograph and adjusted in an attempt to match up the major anatomical landmarks such as:

- Nasion
- Supraorbital ridges
- Angle of the jaw
- Nasal aperture
- External auditory meatus
- Teeth

The test is mainly an exclusory one i.e. if the match cannot be made, then the skull is not that of the person in the photograph. If the match is good or excellent, then it may or may not be the same person.

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Race, Sex and Stature Determination

Question 1:

Which of the following can be determined using the cephalic index?

- a) Race
- b) Sex
- c) Age
- d) Stature

Question 2:

Which of the following best describes a skull belonging to an Indian man?

- a) Dolicocephalic
- b) Mesaticephalic
- c) Brachycephalic
- d) Platycephalic

Question 3:

The forensic department has received the post mortem remains of a partly decayed body recovered from the outskirts near an international airport. They notice that oval cross-section of hair is seen on the scalp. What would have been the likely race of the person?

- a) Negroid
- b) Mongoloid
- c) Caucasoid
- d) Race cannot be determined

Question 4:

Human skeletal remains were found in an abandoned basement in Wuhan. Which of the following would indicate that the victim was a Caucasian?

- a) Taurodontism

- b) Carabelli cusps
- c) Shovel shaped incisors
- d) Lack of the third upper molar

Question 5:

Which of the following is false regarding teeth features and ethnicity?

- a) In Africanoids the cusps of molars are wide and deep and shovel shaped cusps in incisors
- b) Caucasians have carabelli cusps
- c) Upper third molar is most commonly absent in Mongolians
- d) Prominent lingual ridge and labial ridge in mongols

Question 6:

What is the identification of preauricular sulcus useful for?

- a) Skull fusion
- b) Race identification
- c) Sex determination
- d) Age identification

Question 7:

Which of the following statements about sex chromatin is false?

- a) 2 Barr bodies are seen in a person with 47XXY genetic makeup
- b) Barr body may be seen in a genetic male
- c) Davidson body seen in neutrophil nucleus
- d) A common site for sex chromatin sampling is tooth pulp

Question 8:

Which of the following indices are used to determine the sex of an individual?

- a) 2, 3 and 4
- b) 1, 2, 3 and 4

- c) 3, 4 and 5
- d) 1, 2 and 5

Question 9:

You are asked to determine the sex of a person from the skeletal remains found on an empty site. Which of the following bones is most accurate for the same?

- a) Skull
- b) Pelvis
- c) Femur
- d) Clavicle

Question 10:

What is the minimum age beyond which sex determination based on skeleton would be highly accurate?

- a) 18-20 years
- b) 10-12 years
- c) 12-14 years
- d) 14-16 years

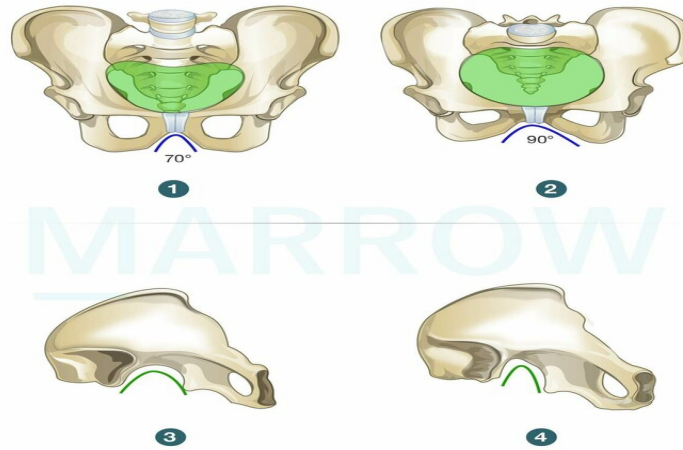
Question 11:

A pelvis is brought for forensic examination. Which of the following characteristics will identify the given pelvis as a male?

- a) 2,3,4,5
- b) 4,5,6
- c) Only 5
- d) 1 and 3

Question 12:

Identify the sex from the pelvic bones.

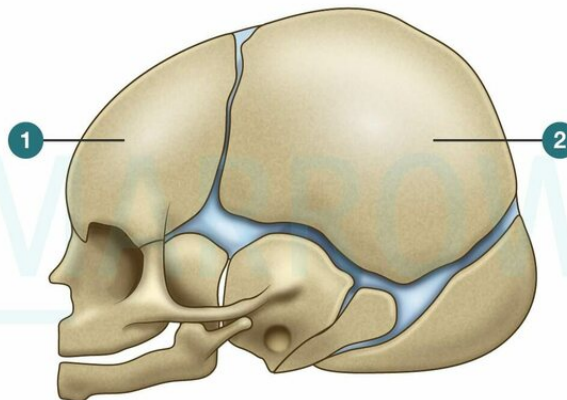


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- a) 1-female, 2-male, 3-male, 4-female
- b) 1-male, 2-female, 3-female, 4-male
- c) 1-female, 2-male, 3-female, 4-male
- d) 1-male, 2-female, 3-male, 4-female

Question 13:

How would the structures marked as 1 and 2 be described in a female skull?



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- a) 1-small, 2-small
- b) 1-large, 2-large

- c) 1-large, 2-small
- d) 1-small, 2-large

Question 14:

What is the Bertillon system used for?

- a) Criminal anthropometry
- b) Cause of death
- c) Manner of death
- d) Time since death

Question 15:

You have measured the femur length to be 40cm from the skeletal remains of an unknown person. What is the approximate height of the individual?

- a) 150 cm
- b) 140 cm
- c) 160 cm
- d) 145 cm

Question 16:

Which of the following can be estimated using Pearson's formula?

- a) Stature
- b) Age
- c) Sex
- d) Race

Question 17:

Crown Rump Length is 21 cm, length of lower limb is 10 cm, gestational age of the fetus will be:

- a) 6 to 7 months

- b) 4 to 5 months
- c) 7 to 8 months
- d) Term

Question 18:

What percent of the stature of an individual is contributed by the length of the vertebral column?

- a) 22
- b) 20
- c) 35
- d) 27

Question 19:

A forensic expert is examining the pelvic bone and lower vertebrae of an unknown individual, to determine the sex. Which of the following is regarded as the best source of information for the same?

- a) Ilium
- b) Pubis
- c) Ischium
- d) Sacrum

Answer Key

Question No.	Correct Option
1	a
2	b
3	c
4	b
5	a
6	c
7	a

8	a
9	b
10	d
11	c
12	b
13	b
14	a
15	a
16	a
17	a
18	c
19	a

Detailed Explanations

Solution to Question 1:

Cephalic index is used to determine the race of the individual.

Formula to calculate cranial index = maximum skull breadth x 100 / maximum skull length

The skull offers the best evidence on racial origins. There are three main racial groups, namely, Caucasian, Mongoloid and Negroid.

All the skulls cannot be accurately differentiated into the 3 broad categories because of racial mixing. The skull of an Indian is caucasian with a few negroid features.

Race determination indices from other bones:

- Upper limb bones - Brachial index
- Lower limb bones - Crural index
- Both upper and lower limb - Intermembral index

Type of skull	Cephalic index	Race
Dolichocephalic	70-74.9	Pure Aryans, Aborigines, Negroes
Mesaticephalic	75-79.9	Europeans, Chinese, Indians
Brachycephalic	80-84.9	Mongolian

Solution to Question 2:

The skull of Indians can be classified as mesaticephalic. This type of skull is of intermediate length and width.

The skull of an Indian is caucasian with a few negroid characteristics. Because of racial mixing, the Indian skull cannot be correctly differentiated into the broad categories of dolichocephalic, mesaticephalic, and brachycephalic.

Note: This is a controversial question. The use of the cephalic index for the determination of race has been discredited and the cephalic index of the entire Indian population cannot be generalized to belong to one category. But the best answer to this question is mesaticephalic.

Type of skull	Cephalic index	Race
Dolichocephalic	70-74.9	Pure Aryans, Aborigines, Negroes
Mesaticephalic	75-79.9	Europeans, Chinese, Indians
Brachycephalic	80-84.9	Mongolian

Solution to Question 3:

Round or ovoid cross section of hair is found in caucasian race.

Race determination from hair:

Hair cross section	Race
Elliptical	Negroids
Round to Ovoid	Caucasoids
Circular/ Cylindrical	Mongoloids

Solution to Question 4:

Carabelli's cusps are most commonly seen only in caucasian races and rare in the other major racial groups. These are small nodules on the lingual surface of maxillary molars.

The image below shows Carabelli's cusps seen in caucasian races.



Features of mongoloid dentition include:

- Shovel-shaped upper central incisors - Posterior surfaces of these teeth have a central depression
- Enamel pearls - Small nodules of enamel on the tooth surface
- Taurodontism (bull-tooth) - Pulp cavity of molars is wide and deep
- A congenital lack of the third upper molar

The image below shows shovel-shaped upper central incisors seen in mongoloid races compared to non-shovel shaped incisors:



Solution to Question 5:

The cusps of molars are wide and deep and cusps of incisors are shovel-shaped in Mongoloid races.

Africanoid races tend to have large teeth and often have more cusps on their molars, even up to eight, with two lingual cusps on the mandibular first premolars as an additional common finding.

In Caucasian races, the lateral incisors in the upper jaw are usually smaller than the central. They also have long pointed canine roots. Small nodules on the lingual surface of maxillary molars, called Carabelli's cusp are most common in Caucasian races.

In mongoloid teeth, enamel pearls and small nodules of enamel on the tooth surface, are much more frequent. The condition of bull-tooth or taurodontism is most common in Mongoloid people. The pulp cavity of molars is wide and deep, and the roots are fused and bent. A congenital lack of the third upper molar is most commonly seen. The lingual and labial ridges are more prominent.

Solution to Question 6:

The preauricular sulcus is useful for sex determination. It is a groove on the iliac bone broad and deep in a female pelvis and narrow and shallow in a male pelvis.

The differences between male and female pelvis are summarized in the table below.

Characteristic	Male pelvis	Female pelvis
General Morphology	Massive, rougher, marked muscle attachments	Less massive, slender, smoother
Overall shape	Deep funnel	Flat bowl
Preauricular sulcus	Narrow, shallow	Broad, deep
Acetabulum	Large, wider, deeper	Small, narrower
Body of pubis	Narrow, triangular, thick	Broad, square
Obturator foramen	Large, oval with base upward	Small, triangular with apex forward
Subpubic angle	V-shaped, narrow, (70°)	U-shaped, rounded, wide, (90°)
Greater sciatic notch	Smaller, narrower, deeper	Larger, wider, shallower
Ischial Tuberosity	Inverted	Everted, more widely separated
Pelvic Brim	Heart-Shaped	Circular or elliptical
Pelvic outlet	Smaller	Larger
Sacroiliac articulation	Large extends to 2 1/2 to 3 vertebrae	Small, oblique, extends to 2 to 2 1/2 vertebrae
Sacroiliac joint surface	Large and less sharply angulated	L-shaped and elevated anteriorly

Characteristic	Male pelvis	Female pelvis
Sacrum	Longer, narrower, with more evenly distributed curvature, promontory well marked. Body of first sacral vertebra is larger.	Shorter, wider; upperhalf almost straight, curve forward in the lower half, promontory less marked. Body of first sacral vertebra is small.

Solution to Question 7:

The number of Barr bodies in someone with 47XXY genetic makeup is 1, not 2. The number of Barr bodies is given by the formula $n-1$, where n is the number of X chromosomes.

Barr body is a small planoconvex mass, lying near the nuclear membrane. It represents the inactivated X chromosome. Barr bodies are seen in 0-4% of genetic males (46XY) and 20-80% of genetic females (46XX).

Sites for sampling for sex chromatin include

- Buccal mucosa
- Tooth pulp
- Hair bulb

Davidson body is a drumstick-shaped mass of chromatin hanging down from neutrophil nuclei. It is seen only in females (0-6%).

Solution to Question 8:

Sternal index, corporobasal sacral index, and ischiopubic index are used to determine the sex of the individual.

The intermembral index and cephalic index are helpful in determining the race of the individual.

Indices for sex determination:

Indices	Calculation (x100)	Male	Female
Ischiopubic index	Length of pubis/Length of ischium	<90	>95
Corporobasal index	Transverse diameter of body of S1 / Breadth of base of sacrum	40-50	35-45
Sciatic notch index	Maximum breadth of greater sciatic notch / Maximum depth of greater sciatic notch	4-5	5-6
Sacral index	Transverse diameter of base of sacrum / Length of sacrum	<114	>114

Indices	Calculation (x100)	Male	Female
Sternal index	Length of manubrium / Length of mesosternum	32-85	44-80

Solution to Question 9:

The whole pelvis is the most reliable bone for sex determination.

Krogman's degree of accuracy in sex determination from adult skeletal remains:

- Entire skeleton – 100%
- Pelvis plus skull – 98%
- Long bones and pelvis >95%
- Pelvis alone – 95%
- Long bones and skull - 90-95%
- Skull alone – 90%
- Long bones alone – 80-90%

Solution to Question 10:

Minimum age of a skeleton beyond which sex determination would be highly accurate is 14–16 years. This is because most marked changes regarding sex differences occur in the skeleton post-puberty.

In prepubertal skeletons, the chance of a correct sex allocation is only 50%. If the pelvis is present, the chances of correct sex allocation increases to about 80%.

Solution to Question 11:

Among the given options, a large acetabulum (only 5) is the characteristic of a male pelvis.

Triangular obturator foramen, U-shaped pubic angle, everted ischial tuberosity, large greater sciatic notch, deep preauricular sulcus are characteristics of a female pelvis.

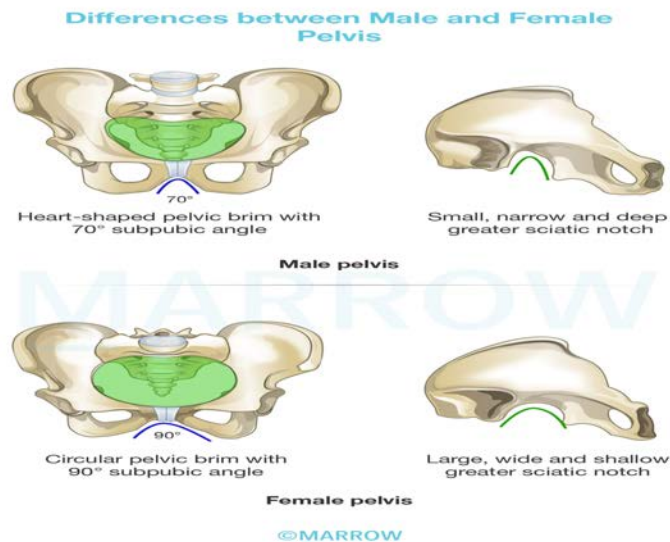
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Subpubic angle	V-shaped, narrow, (70°)	U-shaped, rounded, wide, (90°)
Greater sciatic notch	Smaller, narrower, deeper	Larger, wider, shallower
Ischial Tuberosity	Inverted	Everted, more widely separated
Pelvic Brim	Heart-Shaped	Circular or elliptical
Pelvic outlet	Smaller	Larger
Sacroiliac articulation	Large extends to 2 1/2 to 3 vertebrae	Small, oblique, extends to 2 to 2 1/2 vertebrae
Sacroiliac joint surface	Large and less sharply angulated	L-shaped and elevated anteriorly
Sacrum	Longer, narrower, with more evenly distributed curvature, promontory well marked. Body of first sacral vertebra larger.	Shorter, wider; upper half almost straight, curve forward in the lower half, promontory less marked. Body of first sacral vertebra small

Solution to Question 12:

The images marked as 1 and 4 show characteristics of a male pelvis and 2 and 3 show characteristics of a female pelvis.



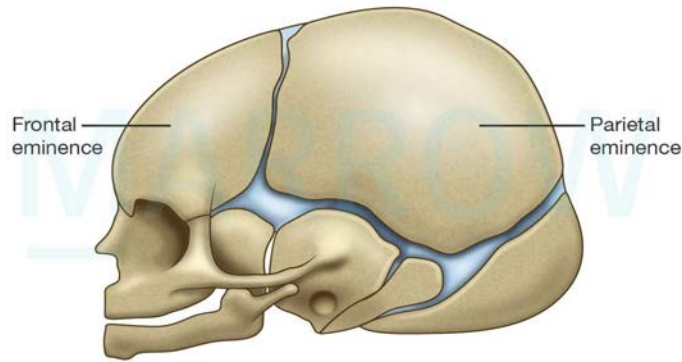
Differences between male and female pelvis:

Characteristic	Male pelvis	Female pelvis
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Solution to Question 13:

The structures marked as 1 and 2 are the frontal and parietal eminences. In a female skull, both frontal and parietal eminences are larger.

Skull Eminences



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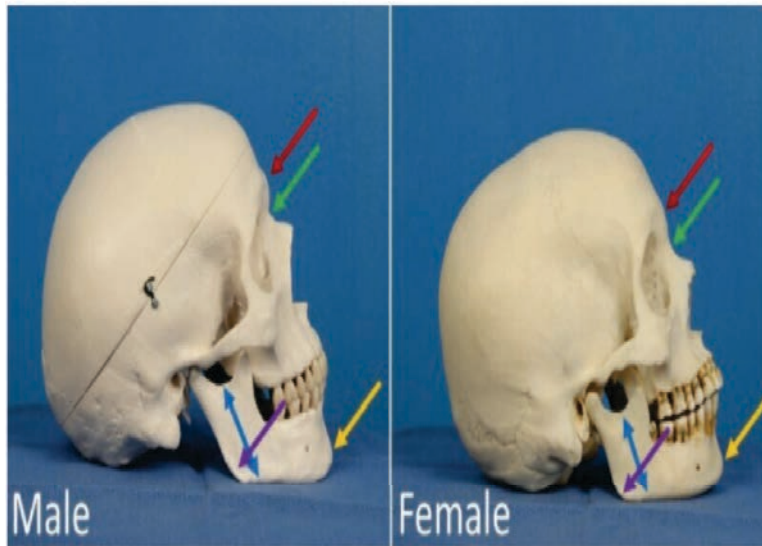
Differentiating features between male and female skull:

The features given above develop after puberty and are modified by senility. Hence, the differences are applicable only between 18-55 years.

The image given below shows a male and female skull.

- The red arrow indicates frontal bossing, which is more apparent in the male skull.
- The green arrow indicates nasal radix which is deeper in the male skull.
- The yellow arrow indicates greater prominence of the chin in the male skull.
- The blue arrow shows a greater mandibular height in the male skull.

Trait	Male	Female
General size	Large	Small
Architecture	Rugged	Smooth
Supraorbital ridges	Prominent	Less prominent
Mastoid process	Prominent	Less prominent
Occipital region	Marked muscle markings	No marked muscle markings
Frontal eminences	Small	Large
Parietal eminences	Small	Large
Orbits	Square with round margins	Round with sharp margins
Mandible	Large, broad ramus	Small, small ramus
Chin shape	U-shaped	V-shaped



Solution to Question 14:

The Bertillon system is used for identification based on anthropometry.

The origins of forensic anthropology can be traced to the end of the nineteenth century when the French criminologist Alphonse Bertillon devised the first classification and identification system to identify criminals, based on anthropometry.

Solution to Question 15:

The approximate height of the individual is 150 cm.

The stature/femur relationship is 3.74. Thus, stature can be calculated by using the formula, stature = femur length \times 3.74 = 40 \times 3.74 = 149.6 cm \cong 150 cm

The relationship between the mean stature and the mean length of the femur appears to be fairly stable around the world. However, this factor tends to overestimate tall and underestimate short individuals.

Solution to Question 16:

Pearson's formula is used for the estimation of stature.

Methods of determination of stature:

1. Pearson's formula: Any bone may be used, but the measurement of one or more of the six long bones provides the most reliable estimates. The descending order of usefulness of bones is femur > tibia > humerus > radius.

2. Trotter and Gleser's method - Formula for stature (cm) = $1.30 (\text{Femur} + \text{Tibia}) + 63.29 (+/-2.99)$
3. Stature/femur relationship - The relationship between the mean stature and the mean length of the femur appears to be fairly stable around the world which is 3.74.
4. Anatomical method - This is the most accurate method. It consists of the sum of the following parameters:
 - Basibregmatic height of the skull
 - Height of the vertebrae from the axis through the first sacral vertebra
 - Bicondylar length of the femur
 - Physiological length of the tibia
 - Articulated height of the talus and calcaneus
 - Constant is added to account for the soft tissues

Note: Pearson also introduced the principle of regression.

Solution to Question 17:

Gestational age of this fetus is 6-7 months.

Crown rump length + length of lower limb = crown heel length

Rule of Haase enables the estimation of the age of the fetus in lunar months from its crown-heel length (in cm).

According to the rule,

- Age in months = Square root of crown-heel length (when the crown-heel length is 25 cm or less/ first 5 months).
- Age in months = crown-heel length divided by 5 (when the crown-heel length is more than 25 cm/ last 5 months).

Here, crown heel length = Crown rump + lower limb length = 31 cm.

Hence, gestational age = $31 / 5 = 6-7$ months.

Solution to Question 18:

The length of the vertebral column is 35% of the stature of an individual

Bone	% of height
Humerus	20
Tibia	22

Bone	% of height
Femur	27
Spine	35

Solution to Question 19:

The greater sciatic notch, which is a part of the ilium is the ideal feature to determine sex.

The sacrum is the least reliable bone for sex determination.

The femur is the most useful long bone for sex determination, due to its length and massiveness.

Pearson and Bell's criteria for sexing of the femur are:

- Vertical diameter of the femoral head - most useful criterion
- Popliteal length
- Bicondylar width
- Oblique trochanteric length

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Fingerprint and Tattoos

Question 1:

Edmond Locard is most famous for?

- a) Study of fingerprints
- b) Theory of exchange
- c) Stature estimation
- d) Forensic ballistics

Question 2:

When are the fingerprint patterns determined?

- a) 8th week of gestation
- b) 4th month of gestation
- c) At birth
- d) 4th week of life

Question 3:

Which among the following is the most common fingerprint pattern?

- a) Loops
- b) Whorls
- c) Tented-arch
- d) Plain-arch

Question 4:

While investigating a case of homicide, the forensic team finds that the fingerprints left behind have no delta formation. Which fingerprint pattern is described here?

- a) Tented arch
- b) Whorl

- c) Plain arch
- d) Composite

Question 5:

Which of the following methods will be used to make latent fingerprint marks visible?

- a) 1, 2 and 4
- b) 2, 3 and 5
- c) 3, 4 and 5
- d) 1, 2 and 3

Question 6:

Up to what depth from the skin surface can fingerprints be obtained?

- a) 0.2 mm
- b) 0.4 mm
- c) 0.6 mm
- d) 0.8 mm

Question 7:

Identical twins have similarities in all of the following except:

- a) Blood group
- b) DNA fingerprinting
- c) Fingerprint pattern
- d) Iris colour

Question 8:

In a peculiar case of robbery, the forensic team finds that no finger prints were left behind despite the footage showing that the thief did not wear any gloves. Which of the following medical conditions could he be suffering from?

- a) Epidermolysis bullosa

- b) Guttate psoriasis
- c) Pemphigus vulgaris
- d) Dermatopathia pigmentosa reticularis

Question 9:

While reading a forensic report, you notice that the identification of the suspect was done through edgeoscopy. What does this method evaluate?

- a) Edges of fingerprint ridges
- b) Sweat pore openings on fingerprint ridges
- c) Patterns on the retina
- d) Fissures and grooves on lip print

Question 10:

A person of interest in a homicide case is on the run from the police. He wishes to remove the tattoo on his left arm which is very prominent. Which of the following methods may be used for the same?

- a) 1, 2, 3 and 4
- b) 1, 2 and 5
- c) 3, 4 and 5
- d) 1, 2, 3 and 5

Question 11:

In tattoos, which of the following colors is least likely to fade over time?

- a) Red
- b) Green
- c) Black
- d) Purple

Question 12:

An unidentified dead body is brought to you for autopsy. You notice a faded tattoo mark on the left arm of the body. All of the following methods would be used to visualize the same except:

- a) Ultraviolet light
- b) Ink blotting
- c) Infrared photography
- d) Rubbing the part and examining with a magnifying lens

Question 13:

A deceased male was brought to the morgue for a post-mortem examination. His relatives reported that he had a tattoo over his skin, which was not found on examination. Which of the following structures would you examine?

- a) Lymph nodes
- b) Liver
- c) Arteries
- d) Skin

Question 14:

A strand of hair is found at a crime scene. Which of the following attributes will indicate that it is of human origin?

- a) Medullary index of 1
- b) Pigment granules present in cortex and medulla
- c) Cuticle completely covers hair shaft
- d) Hair scales have a coronal pattern

Answer Key

Question No.	Correct Option
1	b
2	b
3	a

4	c
5	d
6	c
7	c
8	d
9	a
10	d
11	c
12	b
13	a
14	c

Detailed Explanations

Solution to Question 1:

Edmond Locard is famous for his theory of exchange or Locard's exchange principle.

This theory states that every contact leaves a trace. When two objects come into contact with one another, each will take something from the other object or leave something behind.

Locard is also renowned for his contribution to the improvement of dactylography, an area of study that deals with fingerprints. He developed the science of poroscopy, the study of fingerprint pores, and the impressions produced by these pores.

Solution to Question 2:

Fingerprint patterns are determined by the 4th month of gestation and remain fixed throughout life.

Fingerprints are impressions of patterns that are formed by papillary or epidermal ridges at the fingertips. They begin to appear between 12-16 weeks of intrauterine life. The formation is completed by 24 weeks. At birth, a fine pattern of ridges is seen on the skin of the bulbs of the fingers and thumbs, parts of the palms, and the soles of the feet.

Solution to Question 3:

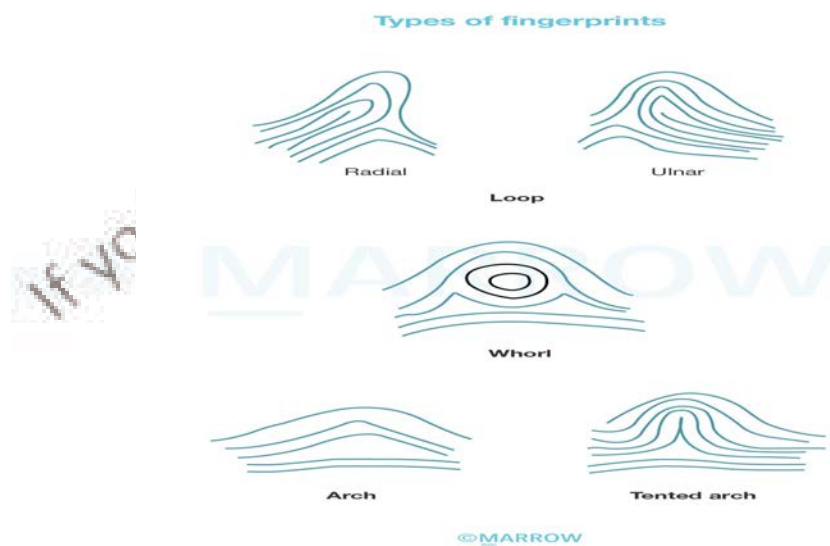
Loops are the most common fingerprint pattern encountered.

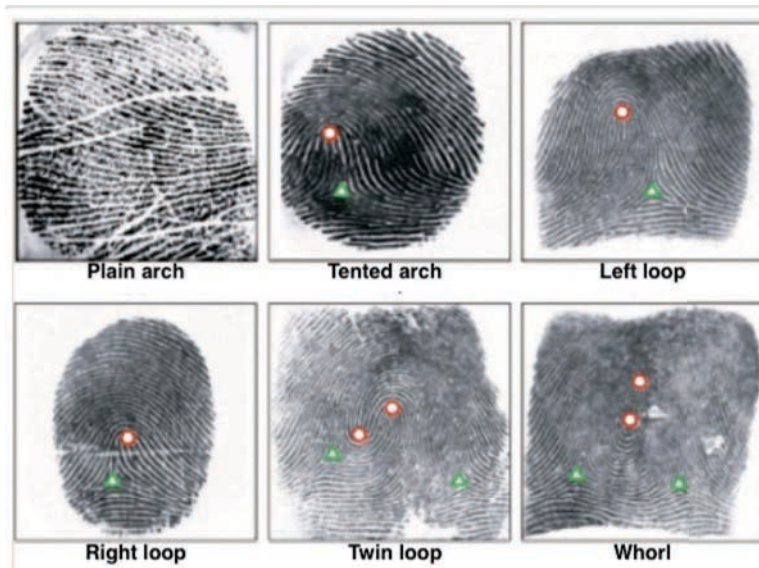
Patterns of fingerprints:

- Loops (60-70%)

- Radial
- Ulnar
- Whorls
- Concentric
- Spiral
- Double spiral
- Almond shaped
- Arches
- Plain
- Tented
- Composite
- Central pocket loop
- Lateral pocket loop
- Twinned loop
- Accidentals

The image given below shows the different patterns of fingerprints.





Solution to Question 4:

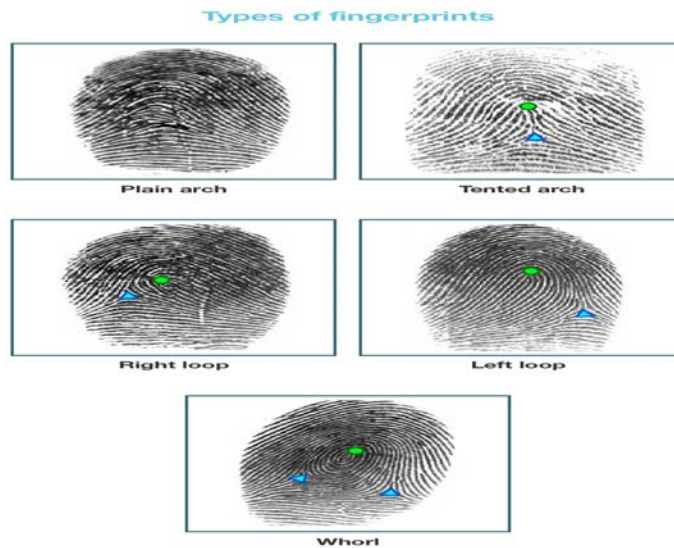
Plain arches have no delta.

Classification of fingerprints into different patterns is based on delta and core formation. Delta is a triangular arrangement formed where three separate ridge line flows come together. Core is the centermost portion of a ridge flow pattern.

The number of delta and core for each pattern is given below.

The image given below shows the delta and core in the different fingerprint patterns. For each type, the position of the core is marked with a green circle, and the delta is marked with a blue triangle.

Pattern	Delta	Core
Loop	1	1
Plain arch	0	0
Tented arch	1 delta at the base of the upthrust	1
Whorl	2	1
Accidental	>2	0



Note: Dactylography or dermatoglyphics is the study of fingerprint patterns. The first fingerprint bureau in India was established in Kolkata.

Solution to Question 5:

Latent prints can be made visible by ultraviolet spectrum lighting, application of lead powder and cyanoacrylate fuming.

Latent prints are those that are left behind through interaction of hands, palms, and feet with the environment. Occasionally these prints are left cleanly so as to be clearly visible to the unaided eye. It is more often the case that the prints are only partially visible or not visible at all without the use of specialized fingerprint-processing methods and equipment.

Methods to enhance fingerprints:

- Lighting or photoluminescence
- White light
- Ultraviolet spectrum
- Physical method - dusting a surface with a fine powder of contrasting color such as:
 - White: Lead carbonate
 - Black: Charcoal
 - Grey: Aluminium dust or chalk powder + mercury
- Chemical
 - Ninhydrin
 - Cyanoacrylate fuming
 - Silver nitrate

Solution to Question 6:

Histological sections up to a depth of 0.6mm from the surface of the skin give satisfactory fingerprints. Since the ridges extend up to the dermis, fingerprints can be obtained from the dermis as well.

Solution to Question 7:

Fingerprint pattern differs in identical twins.

Fingerprints are formed during intrauterine life due to friction ridges. These ridges are created by pressure on the fingers from touching the surroundings. Hence, it is unique to every individual.

Solution to Question 8:

A person suffering from dermatopathia pigmentosa reticularis (DPR) has a lack of fingerprint patterns, and hence will not leave fingerprint marks.

There are two closely related autosomal dominant ectodermal dysplasia syndromes causing complete absence of fingerprints. They are Naegeli–Franceschetti–Jadassohn syndrome (NFJS) and dermatopathia pigmentosa reticularis (DPR).

A permanent damage of fingerprints also occurs in patients with leprosy, electrical injury, and irradiation.

Solution to Question 9:

Edgeoscopy is a method of identification through the examination of the unique details and characteristics found along the edges of individual fingerprint ridges.

Methods of identification using different prints:

- Dactylography - evaluation of finger prints
- Poroscopy - evaluation of sweat pore openings on fingerprint ridges
- Cheiloscopy - evaluation of lip prints
- Podography - evaluation of foot prints
- Rugoscopy - evaluation of palatal rugae
- Ridgeology - evaluation of friction ridges on fingerprints

Note: Locard is known as the father of poroscopy, edgeoscopy and ridgeology.

Solution to Question 10:

Methods for deliberate tattoo removal include:

- Surgical excision
- Scarification with sandpaper
- Application of caustic soda
- Electrolysis
- Q-switch laser method - non-invasive and effective method for removing tattoos without scarring

All other methods depend upon damage to the epidermis and dermis, with consequent inflammation and scar formation. The tattoo is removed but replaced with a cicatrix, which will itself indicate that something pre-existed at that site.

Attempts at the deliberate removal of tattoos are common to remove evidence of identity.

Note: If the tattoo mark is absolutely invisible or has been removed artificially, the pigments used to produce them may be detected by histological examination of the lymph node.

Solution to Question 11:

Black areas in a tattoo are the least likely to fade over years.

This is because the black pigment (carbon particles) are more resistant than the other pigments to transportation by the lymphatic system. Thus, they tend to persist in the skin.

Colors such as blue, green, or red are scavenged by tissue cells and leached into the lymphatic system after a number of years or decades. Light colors such as white, pink, and blue fade faster.

Chemicals used in different tattoo pigments are:

- Black pigment - Carbon
- Green pigment - Potassium dichromate
- Red pigment - Mercuric chloride

If the tattoo mark is absolutely invisible or has been removed artificially, the pigments used to produce them may be detected by histological examination of the lymph node.

Solution to Question 12:

Ink blotting is not used to visualize tattoos.

A faded tattoo mark can be visualized by:

- Ultraviolet light
- Infrared photography
- Rubbing the part and examining it with a magnifying lens

In decomposed bodies, the tattoo marks can be visualized by removing the epidermis with a moist cloth. The lymph nodes near a tattoo mark also show a deposit of the pigment.

Solution to Question 13:

The lymph nodes should be examined in this case.

Some amount of material or dye used for creating tattoo marks is transported through lymph to the regional lymph nodes. Hence, in cases where a tattoo mark has disappeared naturally or has been removed, the lymph nodes must be examined.

Solution to Question 14:

The cuticle completely covers the hair shaft in human hair. It only partly covers the hair shaft in animal hair.

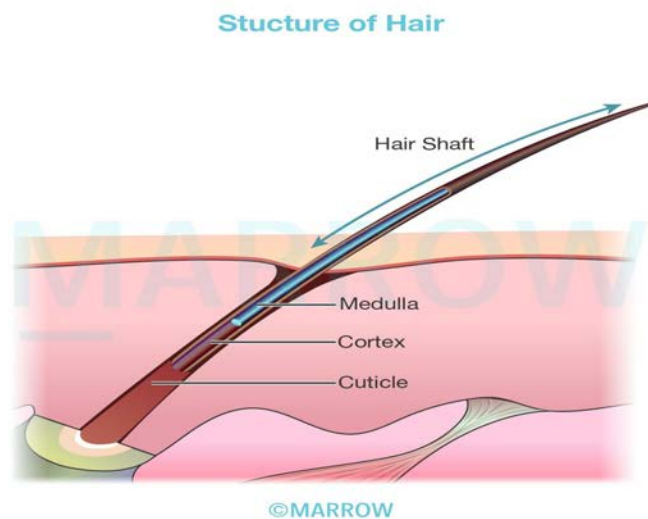
Human hair has 3 parts:

- Cuticle - outermost layer
- Cortex - middle layer
- Medulla - innermost part

Human hair can be identified by the following features:

- Thick cortex i.e. medullary index < 0.3
- Pigment present only in cortex, where it is evenly distributed
- Pattern of scales are imbricate or flattened

The image given below shows the structure of hair.



Note: Medullary index = diameter of medulla / diameter of hair.

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BNS, BNSS, and BSA

Question 1:

Which of the following provisions is included in BNS Section 22/IPC section 84?

- a) Child under 7 years is not liable for the act
- b) A person of unsound mind is not liable for the act
- c) A person who has committed an act under involuntary intoxication is liable
- d) A person who commits an act under voluntary intoxication is not liable

Question 2:

A newspaper editor discloses the identity of a victim of rape without prior permission. He would be tried under which of the following sections?

- a) BNS 71/IPC 376E
- b) BNS 72/IPC 228A
- c) BNS 73/IPC 228A (3)
- d) BNS 74/IPC 354

Question 3:

A middle-aged man tried to abscond so that he could avoid service of summons. Which section of the BNS/IPC respectively deals with this scenario?

- a) 206/172
- b) 208/174
- c) 211/176
- d) 212/177

Question 4:

What section of BNSS/CrPC deals with the power to summon persons by a police officer?

- a) BNSS 33 (CrPC 39)
- b) BNSS 195 (CrPC 175)

- c) BNSS 395 (CrPC 357)
- d) BNSS 456 (CrPC 416)

Question 5:

A drunken person was caught misbehaving in public. What section will he be charged under?

- a) 353 BNS/IPC 505
- b) 79 BNS/IPC 509
- c) 85 BNS/IPC 498A
- d) 355 BNS/IPC 510

Question 6:

A 10-year-old boy was recovered from a warehouse after he went missing 2 days back. The alleged man who got caught for kidnapping the kid will be punished under:

- a) Section 137(1)(a) BNS/ IPC 360
- b) Section 137(1)(b) BNS/ IPC 361
- c) Section 138 BNS/ IPC 362
- d) Section 137(2) BNS/ IPC 363

Question 7:

Section 116 of the BNS (IPC 320) deals with:

- a) Definition of hurt
- b) Definition of grievous hurt
- c) Definition of voluntarily causing hurt
- d) Definition of voluntarily causing grievous hurt

Question 8:

Which BNS section defines the punishment for voluntarily causing grievous hurt by the use of acid?

- a) 118(1)/ 324 IPC

- b) 118(2)/ 326 IPC
- c) 124(1)/ 326A IPC
- d) 124(2)/ 326B IPC

Question 9:

Which BNS section denotes the death of the human being, unless the contrary appears from the context?

- a) 2(14)/ IPC 44
- b) 2(17)/ IPC 45
- c) 2(6)/ IPC 46
- d) 2(3)

Question 10:

Which sections of BNS deal with punishment for murder by an ordinary person and punishment for murder by a life convict, respectively?

- a) Sec 102, Sec 103(1)
- b) Sec 103(1), Sec 105
- c) Sec 103(1), Sec 104
- d) Sec 104, Sec 105

Question 11:

What does BNS section 90/IPC Section 314 deal with?

- a) Causing miscarriage with consent
- b) Causing miscarriage without consent
- c) Death of mother due to miscarriage
- d) Preventing the child being born alive

Question 12:

A woman gave birth to a stillborn baby. She concealed the birth by secret disposal of the dead body. Which of the following statement is false regarding this situation?

- a) She can be imprisoned for a maximum of 2 years
- b) She can be charged under Sec 94 of BNS (IPC 318)
- c) She cannot be charged under Sec 80 of BNS (IPC 304B)
- d) The act is defined under Sec 93 of BNS (IPC 317)

Question 13:

Which of the following constitutional article is not related to children?

- a) 21A
- b) 24
- c) 45
- d) 42

Question 14:

According to the Juvenile Justice Act, which of the following pairs correctly refers to a juvenile?

- a) Option A
- b) Option B
- c) Option C
- d) Option D

Question 15:

Which section of the BNS deals with the use of criminal force on a woman with the intent to outrage her modesty?

- a) 74 (IPC 354)
- b) 75 (IPC 354A)
- c) 76 (IPC 354B)
- d) 77 (IPC 354C)

Question 16:

A 17-year-old boy was brought unconscious to the ER. Later it was found out from his brother that he had taken 10-12 sleeping tablets as his girlfriend broke up with him last week. Which section deals with this scenario?

- a) BNS 108/IPC 306
- b) BNS 109/IPC 307
- c) BNS 110/IPC 308
- d) IPC 309

Question 17:

A newly married woman was found dead in her house. On inquiry, it was informed by the neighbours that the couple used to fight a lot regarding dowry. Which section deals with this scenario?

- a) BNS Section 63 [IPC 375]
- b) BNS Section 80 [IPC 304B]
- c) BNS Section 72 [IPC 228A]
- d) BNS Section 100 [IPC 299]

Question 18:

An unmarried man had consensual sexual intercourse with the wife of his friend. His friend found about the affair and filed an FIR against the man. Under which of the following BNS section can the man be booked?

- a) BNS 318(4)/ IPC 420
- b) BNS 75/ IPC 354 A
- c) IPC 497
- d) None of the above

Question 19:

A woman found out that her husband is having a consensual sexual relationship with another man and that the affair has been going on for a few months. She was deeply aggrieved and committed suicide. Upon investigation, the police found her suicide note wherein she had stated all the facts. Under which of the following section can the husband be booked?

- a) IPC 497

- b) IPC 377
- c) BNS 108/IPC 306
- d) BNS 74/IPC 354

Question 20:

According to the Bharatiya Sakshya Adhinyam, section 39(1) [IEA 45] gives information regarding:

- a) Evidence
- b) Expert witness
- c) Hostile witness
- d) Dying declaration

Question 21:

Which Section of the IPC/BNS deals with the punishment of perjury?

- a) 191/ BNS 227
- b) 192/ BNS 228
- c) 193/ BNS 229
- d) 197/ BNS 234

Question 22:

First-hand knowledge rule is applicable to:

- a) Common witness
- b) Hand writing expert
- c) Doctor
- d) Hostile witness

Question 23:

What does Section 200 of the BNS (IPC 166B) deal with?

- a) Non-treatment of victim by hospital

- b) Public servant disobeying direction under law
- c) Public servant framing an incorrect document
- d) Unlawful engagement in trade by hospital

Question 24:

As per the Medicare Service Persons and Damage to Property in Medicare Service Institutions Act, violence against a registered medical practitioner is considered as:

- a) Non-cognizable and bailable offense
- b) Cognizable and non-bailable offense
- c) Non-cognizable and non-bailable offense
- d) Cognizable and bailable offense

Question 25:

In case of professional misconduct, the patient's records on demand should be provided within:

- a) 72 hours
- b) 42 hours
- c) 24 hours
- d) 7 days

Question 26:

In the civil negligence case against a doctor who bears the onus of proof?

- a) Patient
- b) Police not under rank of sub inspector
- c) Magistrate
- d) Doctor

Answer Key

Question No.	Correct Option
1	b
2	b
3	a
4	b
5	d
6	d
7	b
8	c
9	c
10	c
11	c
12	d
13	d
14	a
15	a
16	d
17	b
18	d
19	c
20	b
21	c
22	a
23	a
24	b
25	a
26	a

Detailed Explanations

Solution to Question 1:

BNS Section 22 (previously IPC section 84) states that the act of a person of unsound mind is not liable for punishment/ prosecution.

The defence under this section requires the following elements to be established:

- The accused was suffering from unsoundness of mind at the time of doing the act.

- The accused was incapable of knowing the nature of the act, or that he was doing what was either wrong or contrary to law.

Solution to Question 2:

Section 72 of BNS (IPC Section 228A) deals with punishment for disclosure of the identity of the victim of rape.

Other options:

Option A: Section 71 BNS (IPC 376E) deals with repeat offenders.

Option C: Section 73 BNS (IPC 228A (3)) deals with printing or publishing any matter relating to court proceedings without permission.

Option D: Section 74 BNS (IPC 354) deals with the assault or use of criminal force on a woman with intent to outrage her modesty.

Solution to Question 3:

Section 206 of BNS (172 of IPC) deals with absconding to avoid service of summons or other proceedings.

Common IPC Sections dealing with summons include:

BNS section	previous IPC Section	Deals with
206	172	Absconding to avoid service of summons or other proceedings
208	174	Non-attendance in obedience to an order from public servant
211	176	Omission to give notice/ information to public servant by person legally bound to give it
212	177	Furnishing false information

Solution to Question 4:

The power to summon persons by a police officer comes under Section 195 of the BNSS, Bhartiya Nagrik Suraksha Sanhita (175 CrPC).

BNSS sections are tabulated below:

BNSS	CrPC	Deals with
33	39	Duty to give information
51	53	Examination of accused by a medical practitioner at the request of a police officer
52	53A	Examination of a person accused of rape by a medical practitioner
53	54	Examination of arrested person by medical practitioner at the request of the arrested person
63-71	61-69	Summons
180	161	The police have the power to examine witnesses
181	162	Oral statements made to the police and recorded by the police should not be signed
184	164A	Examination of the victim of rape
194	174	Police inquest
195	175	Power to summon persons by a police officer
196	176	Magistrate inquest
350	312	Expenses of complaints and witnesses
366366(2)	327	Criminal court is generally deemed to be an open court. In-camera trial for rape
389	350	Summary procedure for punishment for non-attendance by a witness in obedience to the summons
395	357	Order to pay compensation
456	416	Commutation of sentence of death on pregnant women

Solution to Question 5:

Misconduct in public by a drunken person is defined under Section 355 of the BNS (510 IPC).

Important sections of BNS relating to misconduct:

BNS section	IPC section	Section it deals with
85	498A	Husband or relative of husband of a woman subjecting her to cruelty
79	509	Word, gesture, or act intended to insult the modesty of a woman
355	510	Misconduct in public by drunken persons punishable with imprisonment up to 24 hours
353	505	Statements conducing to public mischief

Solution to Question 6:

Punishment for kidnapping is defined under Section 137(2) of the BNS (363 IPC).

BNS section	IPC section	Section it deals with
137 (1) (a)	360	Kidnapping from India
137 (1) (b)	361	Kidnapping from lawful guardianship
138	362	Abduction
137 (2)	363	Punishment for kidnapping
96	366A	Procurator of a child for illicit intercourse (<18 years of age)
141	366B	Importation of girl (<21 years of age) or boy (<18 years of age) from foreign country
97	369	Kidnapping or abducting a child under 10 years with the intent to take any movable property from the child
143	370	Trafficking a person
144	370A	Exploitation of a trafficked person
98	372	Selling children for the purpose of prostitution
99	373	Buying children for the purpose of prostitution

Solution to Question 7:

Section 116 BNS (320 IPC) deals with the definition of grievous hurt.

The injuries caused by grievous hurt are specific in nature like emasculation, loss of sight, loss of limb, fracture, disfiguration, etc. Whereas the injuries caused by hurt are just covered by bodily pain, disease, and infirmity.

In the latest update in Section 116 BNS, the suffering threshold period for grievous hurt is reduced from twenty days to fifteen days.

Important Sections of IPC relating to injuries :

BNS section	IPC section	Deals with
114	319	Definition of hurt
115 (1)	321	Definition of voluntarily causing hurt
115 (2)	323	Punishment for voluntarily causing hurt
116	320	Definition of grievous hurt
117 (1)	322	Definition of voluntarily causing grievous hurt
117 (2)	325	Punishment for voluntarily causing grievous hurt

Solution to Question 8:

Punishment for voluntarily causing grievous hurt by the use of acid is defined under section 124(1) of the BNS (326A IPC).

Important sections of BNS relating to Injuries:

BNS section	IPC section	Deals with	Punishment
117(2)	325	Punishment for voluntarily causing grievous hurt	Up to 7 years of imprisonment and fine
118(1)	324	Voluntarily causing hurt by dangerous weapons or means	Up to 3 years of imprisonment or fine (up to Rs. 20000) or both
118(2)	326	Voluntarily causing grievous hurt by dangerous weapons or means	Imprisonment for life, Imprisonment for a minimum of 1 year to 10 years, and a fine.

BNS section	IPC section	Deals with	Punishment
122(1)	334	Voluntarily causing hurt on provocation	Up to 1 month of imprisonment, or fine up to Rs. 5000 or both
122(2)	335	Voluntarily causing grievous hurt on provocation	Up to 5 years of imprisonment or fine up to Rs. 10,000 or both
124(1)	326A	Voluntarily causing grievous hurt by use of acid	Minimum 10 years imprisonment, extended up to life imprisonment and fine
124(2)	326B	Voluntarily throwing or attempting to throw acid	Minimum 5 years imprisonment, extended up to 7 years, and fine
125(a)	337	Causing hurt by rash or negligent act endangering life or personal safety of others	Up to 6 months of imprisonment or fine up to Rs. 5000 or both
125 (b)	338	Causing grievous hurt by rash or negligent act endangering life or personal safety of others	Up to 3 years of imprisonment or fine up to Rs. 10,000 or both

Solution to Question 9:

BNS Section 2(6) (IPC 46) denotes the death of a human being unless the contrary appears from the context. In simple words, the word death denotes the death of a human being unless the context suggests otherwise.

Option A: BNS 2(14) (IPC 44) defines injury as any harm illegally caused to any person, in body, mind, reputation, or property.

Option B: BNS 2(17) (IPC 45) defines life as the life of a human being unless the contrary appears from the context.

Option D: BNS 2(3) defines a child as any person below the age of eighteen years. This is a new addition and was not there in the IPC.

Solution to Question 10:

Punishment for murder by an ordinary person is defined under Section 103(1) of BNS (or Section 302 IPC).

Punishment for murder by a life convict is defined under Section 104 of the BNS (or Section 303 IPC).

Offences affecting life are given in the table below.

BNS section	IPC section	Deals with
100	299	Culpable homicide (amounting to murder)
101	300	Murder
102	301	Culpable homicide by causing the death of a person other than the person whose death was intended
103(1)	302	Punishment for murder
103(2)	(new addition)	When a group of five or more persons murders on the ground of race, caste or community, sex, place of birth, language, or personal belief, each member shall be punished with death or with imprisonment for life, and shall also be liable to fine
104	303	Punishment for murder by life convict (life imprisonment, or death sentence)
105	304	Punishment for culpable homicide not amounting to murder
106(1)	304A	Causing death by negligence
80	304B	Dowry death
107	305	Abetment of suicide of child or person of unsound mind
108	306	Abetment of suicide
109	307	Attempt to Murder

Solution to Question 11:

BNS Section 90/IPC Section 314 deals with the death of the mother due to miscarriage.

Important sections of IPC relating to miscarriages:

Note: Quick child is a fetus that has developed to such a stage that it moves within the womb of the mother. It shall mean an unborn child whose heart is beating, who is experiencing electronically measurable brain waves, who is discernibly moving, and who is so far developed and matured as to be capable of surviving the trauma of birth with the aid of usual medical care and facilities available in this state.

BNS section	IPC section	Deals with
88	312	Causing miscarriage with consent
89	313	Causing miscarriage without consent
90	314	Death of mother due to miscarriage
91	315	Preventing the child from being born alive or causing it to die after birth
92	316	Causing the death of the quick unborn child by act amounting to culpable homicide

Solution to Question 12:

The given scenario is defined under Section 94 of the BNS (IPC 318), not Sec 93 BNS. Section 80 of BNS (IPC 304B) deals with dowry death.

Section	Deals with	Punishment
BNS 93(IPC 317)	Exposure and abandonment of child under 12 years by parents	Up to 7 years of imprisonment or fine or both
BNS 94(IPC 318)	Concealment of birth by secret disposal of the dead body	Up to 2 years of imprisonment or fine or both

Solution to Question 13:

Article 42 is not related to children. Article 42 says the state shall make provision for securing just and humane conditions of work and maternity relief.

Constitutional Guarantees that are meant specifically for children include:

- Article 21 A - Right to free and compulsory elementary education in the 6 -14 year age group.
- Article 24 - Right to be protected from any hazardous employment till the age of 14 years.
- Article 39 E - Right to be protected from being abused.
- Article 39 F - Right to equal opportunities and facilities.
- Article 45 - Right to early childhood care and education for all children until they complete the age of 6 years.

Solution to Question 14:

According to Juvenile Justice (Care and Protection of Children) Act, 2000, juvenile refers to a boy or a girl who has not completed 18 years of age.

Juvenile Justice (Care and Protection of Children) Act, 2015 allows for juveniles 16 years or older to be tried as adults for heinous offences like rape and murder. Heinous offences are those which are punishable with imprisonment of seven years or more.

Solution to Question 15:

Use of criminal force on woman with the intent to outrage her modesty comes under Section 74 of the BNS (354 IPC).

Important sections of IPC relating to sexual harassment:

BNS section	IPC section	Deals with
74	354	Assault or use of criminal force to woman with intent to outrage her modesty
75	354A	Sexual harassment of nature of unwelcome physical contact and advances or a demand or request for sexual favors, showing pornography
76	354B	Criminal force to women with intent to disrobe
77	354C	Voyeurism
78	354D	Stalking

Solution to Question 16:

Attempt to commit suicide was defined under Section 309 of the IPC.

This provision was, in effect, repealed by Section 115 of the Mental Healthcare Act, 2017. Hence, it was not added to the text of the BNS.

Abetment of suicide (support or aid to commit suicide) is defined under Section 108 BNS (306 IPC). It states that if any person commits suicide, whoever abets the commission of such suicide, shall be punished with imprisonment which may extend to 10 years, and shall also be liable to fine.

Section	Deals with
BNS 107/ IPC 305	Abetment of suicide of child or person of unsound mind
BNS 108/ IPC 306	Abetment of suicide of a sane individual
BNS 109/ IPC 307	Attempt to murder
BNS 110/ IPC 308	Attempt to commit culpable homicide
IPC 309(not added to BNS)	Attempt to commit suicide

Solution to Question 17:

Dowry Death is defined under section 80 of Bharatiya Nyaya Sanhita (BNS) 2023 (IPC 304B).

- If a husband or his relative subjects the woman to cruelty or harassment in demand of dowry within 7 years of marriage, they shall be deemed to have caused her death.
- The punishment for such cases is imprisonment for not less than 7 years but may be extended to life imprisonment.

Option A: Section 63 (IPC 375) deals with rape.

Option C: Section 72 (IPC 228A) deals with imprisonment for up to 2 years and a fine for disclosure of the identity of a rape victim.

Option D: Section 100 (IPC 299) deals with culpable homicide.

Solution to Question 18:

Adultery is not liable for criminal prosecution.

Section 497 of the Indian Penal Code dealing with adultery was invalidated (struck down as unconstitutional being violative of articles 14 and 21) by the Hon'ble Supreme Court of India on 27th September 2018. However, there might be civil liabilities including ground for divorce and dissolution of marriage.

However, BNS retains Section 498 of the IPC as BNS Section 84 which penalizes a man for enticing the wife of another man so that she may have intercourse with any person.

Option A: BNS 318(4)/IPC 420 deals with cheating and dishonestly inducing delivery of property.

Option B: BNS 75/IPC 354A deals with sexual harassment and punishment of sexual harassment. Consensual sexual intercourse is not included in this.

Solution to Question 19:

The husband can be booked under Section 108 of the Bhartiya Nyaya Sanhita (306 of the Indian Penal Code), which deals with the abetment of suicide.

The Hon'ble Supreme Court of India on 27th September 2018 struck down IPC 497 dealing with adultery as unconstitutional. However, the court noted that if any aggrieved spouse commits suicide because of the life partner's adulterous relation then, if the evidence produced, it could be treated as an abetment to suicide.

Consensual sexual intercourse between adults of same-sex no longer comes under the purview of section 377 of IPC (as per the judgment of the Hon'ble Supreme court on 6th September 2018).

Hence, there are no sections corresponding to IPC 497 and 377 in the Bhartiya Nyaya Sanhita (BNS).

Solution to Question 20:

BSA (Bharatiya Sakshya Adhinyam) Section 39(1) [IEA 45] gives information regarding Expert witnesses.

The important Sections under BSA (Bharatiya Sakshya Adhinyam) include:

BSA section	IEA Section	Provision for
2(1)(e)	3	Evidence
26	32	Dying declaration
39(1)	45	Expert witness
110	107	The burden of proving the death of the person known to have been alive within 30 years
111	108	The burden of proving that the person is alive who has not been heard of for 7 years
116	112	Birth during the marriage - conclusive proof of legitimacy
157	154	Hostile witness- question by party to his own witness
165	162	Production of documents

Solution to Question 21:

The punishment of perjury is dealt with under IPC 193, has now been updated to BNS 229.

Perjury is defined as the offence of wilfully telling an untruth or making a misrepresentation under oath.

Solution to Question 22:

The first-hand knowledge rule is applicable to a common witness who gives evidence about the facts observed or perceived by him.

An expert witness is someone who has been trained or is skilled or has knowledge and experience and is able to draw conclusions from the facts observed by him. Doctors, handwriting/ fingerprints/ firearms experts come under this category.

A hostile witness is a person who is supposed to have some interest or motive for concealing a part of the truth or for giving completely false evidence.

Solution to Question 23:

Section 200 of the BNS (166B IPC) deals with the non-treatment of victims by hospitals. Non-treatment of the victim by the hospital is in direct violation of Section 397 of BNSS (Bharatiya Nagarik Suraksha Sanhita) [357C CrPC].

BNS 199 (IPC 166A) deals with public servants disobeying direction under law.

BNS 201 (IPC 167) deals with public servants framing an incorrect document with an intent to cause injury.

BNS 202 (IPC 168) deals with public servants unlawfully engaging in trade.

A comparison of Sections 199 and 200 of the BNS is given in the table below:

Section	199 BNS/ 166A IPC	200 BNS/166B IPC
Deals with	Public servant disobeying direction under law	Non-treatment of victim by hospital
Punishment	Imprisonment for a minimum of 6 months which may extend to 2 years and fine	Imprisonment for 1 year or fine or both
Type of offense	Cognizable (arrestable without a warrant) and bailable	Non-Cognizable and bailable

Solution to Question 24:

As per the Medicare Service Persons and Damage to Property in Medicare Service Institutions (Prevention of Violence and Damage or Loss to Property) Act, violence against a registered medical practitioner is considered a cognizable and non-bailable offense.

As per this law, enacted by many Indian states, violence against registered medical practitioners, registered nurses, medical and nursing students, and paramedical and other auxiliary workers carries a penalty of imprisonment and fine.

Violence means activities of causing any harm, injury, or endangering the life or intimidation, obstruction, or hindrance to any medicare service person while discharging their duty in the medicare service institution or causing damage or loss to the property.

The period of imprisonment may extend from 3 to 10 years in certain states.

Solution to Question 25:

In case of professional misconduct, the patient's records on demand should be provided within 72 hours.

If a doctor does not maintain the medical records of the patients for a period of three years as per the regulation, and refuses to provide the same within 72 hours, when the patient or his/her authorized representative makes a request for it, then it is professional misconduct.

Solution to Question 26:

In the case of civil negligence, the burden of proof is on the patient.

The question of civil negligence arises when a suit is filed in a civil court:

- By a patient or his/her relatives against the doctor for getting compensation from the doctor if he/she has suffered an injury due to the doctor's negligence.
- By a doctor against the patient or his/her relatives to collect the fees, the payment of which has been refused due to alleged professional negligence by the doctor.

In either case, the patient has to prove that the doctor has committed professional negligence.

To prove negligence, all the following four elements must be present:

- Duty - A duty of care by the doctor must exist.
- Dereliction - The physician must maintain the standard of a 'prudent physician' under similar circumstances. If the physician fails to maintain the standard of care, it is called dereliction.
- Direct causation - The negligent act or omission must directly cause the injury without any intervening cause.
- Damage - The negligent act must cause damage of a type that would have been foreseen by a reasonable physician.

Death and Post-Mortem Changes

Question 1:

What is Casper's dictum related to?

- a) Identification of body
- b) Establishing the cause of death
- c) Estimation of time since death
- d) Establishing weapon of injury

Question 2:

You are declaring a patient brain dead by using Harvard criteria. All of the following parameters are checked for, except:

- a) Unresponsiveness to painful stimuli
- b) Isoelectric ECG waves
- c) Loss of elicitable reflexes
- d) No spontaneous muscular movements

Question 3:

Suspended animation can occur in all of the following conditions except:

- a) Drowning
- b) Electrocutation
- c) After anaesthesia
- d) Throttling

Question 4:

What is the cause of death in smoke inhalation?

- a) Histotoxic hypoxia
- b) Ischemic hypoxia

- c) Anemic hypoxia
- d) All of the above

Question 5:

Which of the following is an early sign of death?

- a) Cessation of respiration
- b) Adipocere
- c) Rigor mortis
- d) Cessation of circulation

Question 6:

A critically ill patient who is a registered organ donor collapses even after resuscitative measures. All of the following tests can be used to check the cessation of circulation, except:

- a) Diaphanous test
- b) Winslow's test
- c) Magnus's test
- d) Icard's test

Question 7:

A forensic expert is assisting the police in investigating the death of a woman. On examination, he notices the Kevorkian sign. What is the estimated time since the death?

- a) 5-6 hours
- b) < 1 hour
- c) 3-4 hours
- d) 10-12 hours

Question 8:

What is Zasko's phenomenon related to?

- a) Muscular changes

- b) Decomposition
- c) Eye changes
- d) Skin changes

Question 9:

An ICU patient dies due to cardiac failure. After some time, you notice that the deceased body has become cold. What is this phenomenon known as?

- a) Vibices
- b) Livor mortis
- c) Algor mortis
- d) Postmortem calorcity

Question 10:

All of the following can lead to an increase in temperature of the body in the first two hours following death except:

- a) Cholera
- b) Cyanide poisoning
- c) Septicaemia
- d) Sun stroke

Question 11:

All of the following increase the rate of postmortem cooling except:

- a) Higher humidity and rapid air velocity
- b) Large body surface area
- c) Body immersed in running water
- d) Edema

Question 12:

Identify the following post-mortem change.



- a) Tattooing
- b) Suggilation
- c) Putrefaction
- d) Decomposition

Question 13:

A dead body is found at a crime scene. On examining it, you notice that fixation of hypostasis has already occurred. What is the minimum time required for this finding to occur?

- a) 2 hours
- b) 4 hours
- c) 6 hours
- d) 24 hours

Question 14:

In which of the following cases is glove and stocking hypostasis most likely to be seen?

- a) Hanging
- b) Drowning
- c) Strangulation
- d) Electrocution

Question 15:

What does the following image show?



- a) Postmortem lividity
- b) Bruise
- c) Congestion
- d) Abrasion

Question 16:

A person was found dead by his wife in his garage with his car running. Carbon monoxide gas poisoning was confirmed to be the cause of his death. What will be the color of post mortem staining in this case?

- a) Cherry red
- b) Brick red
- c) Grayish/ black
- d) Chocolate brown

Question 17:

Which of the following is a true statement about pugilistic attitude?

- a) Only postmortem in nature

- b) ATP depletion is the cause
- c) Generalised extension of the body is present
- d) Occurs due to coagulation of muscle protein

Question 18:

The sequential onset of rigor mortis is described by which of the following?

- a) Puppe's rule
- b) Nysten's rule
- c) Casper's dictum
- d) Haber's rule

Question 19:

Which of the following statements are true about cadaveric rigidity in contrast to cadaveric spasm?

- a) 2, 4 and 5
- b) 1, 3 and 4
- c) 2 and 3
- d) 1 and 5

Question 20:

The following postmortem finding is noted on a dead body. This finding is most prominent after how many hours of death?



- a) 12-24 hours
- b) 24-36 hours
- c) 36-48 hours
- d) Less than 12 hours

Question 21:

Which of the following is responsible for postmortem autolysis to occur?

- a) Lysosomes
- b) Peroxisomes
- c) Climate changes
- d) Bacteria

Question 22:

What is the first external sign of putrefaction?

- a) Greenish discoloration of skin over caecum
- b) Marbling over chest and shoulders
- c) Bloating of abdomen and external genitalia
- d) Reddish brown discoloration of inner surface of vessels

Question 23:

Among the following, which organs are the first and the last to putrefy respectively?

- a) Intestine, gravid uterus
- b) Larynx, kidney
- c) Brain, muscles
- d) Larynx, non-gravid uterus

Question 24:

While performing an autopsy, you notice honeycombing of the liver. What does it signify?

- a) Mummification
- b) Putrefaction
- c) Livor mortis
- d) Fatty liver

Question 25:

Putrefaction is likely to be delayed in which of the following poisoning cases?

- a) A case of suicide of a 19-year-old woman by taking multiple tablets of aspirin
- b) Death of a 5-year-old child due to accidental consumption of aconite roots
- c) A 45-year-old man committing suicide by drinking carbolic acid
- d) A 30-year-old man who died due to consumption of malathion

Question 26:

A dead body was recovered from a forest. On close examination, maggots were seen crawling on it. What is the estimated time since the death?

- a) 6-7 days
- b) 3-6 days
- c) 2-3 days
- d) 1-2 days

Question 27:

Which of the following is false regarding adipocere formation?

- a) Facial features are not preserved making identification difficult
- b) It inhibits growth of putrefactive bacteria
- c) It is commonly seen in bodies immersed in water
- d) It has distinct offensive or sweetish smell

Question 28:

What weather is favorable for mummification?

- a) Warm and humid weather
- b) Cold and dry weather
- c) Dry air and hot weather
- d) Cold and humid weather

Question 29:

What is the odor of the mummified body?

- a) Odorless
- b) Pungent
- c) Putrid
- d) Offensive

Answer Key

Question No.	Correct Option
1	c
2	b
3	d
4	c
5	c

6	b
7	b
8	a
9	c
10	b
11	d
12	b
13	c
14	a
15	b
16	a
17	d
18	b
19	d
20	c
21	a
22	a
23	d
24	b
25	c
26	d
27	a
28	c
29	a

Detailed Explanations

Solution to Question 1:

Casper dictum is used in the estimation of time since death.

It states that, one week of putrefaction in the air is equivalent to two weeks in water, which is equivalent to eight weeks buried in soil, given the same environmental temperature.

Note: Forensic taphonomy is the study and interpretation of postmortem processes of human remains i.e. the history of a body following death.

Solution to Question 2:

Isoelectric EEG is included in Harvard criteria for brain death and not ECG.

Harvard criteria for brain death include:

- Unreceptivity and unresponsiveness
- No movements
- Apnoea
- Absence of elicitable reflexes
- Isoelectric EEG (confirmatory)

All these tests should be recorded. If there is no change after 24 hours, then the patient is declared brain dead.

Philadelphia protocol, Minnesota criteria are other criteria used to diagnose brain death.

Solution to Question 3:

Suspended animation is not seen in throttling (manual strangulation).

Suspended animation is a condition where signs of life are absent as functions are interrupted for some time or are reduced to a minimum.

It is seen in the following conditions:

- Vagal inhibition
- Severe syncopal attacks
- Narcotic poisoning
- Shock
- Cerebral concussion
- Insanity
- Newborn infants
- Drowning
- Hypothermia
- Electrocutation
- Sunstroke
- Cholera
- After anesthesia

Solution to Question 4:

Victims of smoke inhalation are affected by carbon monoxide poisoning. In carbon monoxide poisoning, the cause of death is anemic hypoxia.

Carbon monoxide has a higher affinity to hemoglobin compared to oxygen and hence the amount of hemoglobin available for oxygen transport is markedly reduced. It displaces oxygen from its combination with hemoglobin and forms a relatively stable compound known as carboxyhemoglobin. It thus reduces the oxygen content of the blood, and hence, that of the tissues. It acts as a chemical asphyxiant and produces death due to anemic anoxia.

It is important to note that in the case of anemic hypoxia, O₂ content is low but dissolved O₂ is within normal limits so it does not stimulate peripheral chemoreceptors.

Note: Carbon monoxide poisoning causes both anemic (due to CO-Hb) and histotoxic (due to inhibition of cytochrome C oxidase) hypoxia. But the main cause of death is due to anemic hypoxia.

Option A - Histotoxic hypoxia- The most common example is cyanide poisoning. Cyanide inhibits important enzymes in the oxidative phosphorylation process, which is essential to the survival of our cells. Additional oxygen supplementation will not be able to overcome this inhibition, so it will have limited benefit. Hyperbaric oxygen may be helpful to some extent.

Option B - Stagnant hypoxia refers to ischemic hypoxia that results from inadequate circulation due to conditions such as heart failure and hypoxia in the setting of shock. In such conditions, administering intravenous fluids can improve the patient's condition because it is the circulation that is affected. If the shock is prolonged it can result in acute respiratory distress syndrome (ARDS), which can be treated with positive pressure ventilation and not simply by increasing oxygen administration.

Solution to Question 5:

Rigor mortis is an early sign of death.

Immediate signs of death (somatic death):

- Insensibility and loss of voluntary power
- Cessation of respiration
- Cessation of circulation

Early signs of death (cellular death):

- Pallor and loss of elasticity of the skin
- Eye changes
- Primary flaccidity of muscles
- Cooling of the body
- Postmortem lividity/suggilation
- Rigor mortis

Late signs of death:

- Putrefaction
- Adipocere

- Mummification

Solution to Question 6:

Winslow's test is used to check the cessation of respiration. In this test a bowl of water is kept on the chest and movement on the surface of the water is noted.

Tests for confirming cessation of circulation:

- No audible heart sounds on continuous auscultation on the precordial area of the chest for a minimum of 5 minutes and a flat ECG recording for 5 minutes
- Magnus's test (Ligature test) - Fingers fail to show congestion distal to a ligature applied at their base
- Diaphanous test (Transillumination test) - Failure to show redness in the webspace between the fingers on transillumination from behind
- Icard's test - Fluorescent dye on being injected at a given site in a dead body fails to produce any discoloration
- Fingernail test - No blanching and filling of blood in the fingernail on the application of pressure and release

Tests for confirming cessation of breathing:

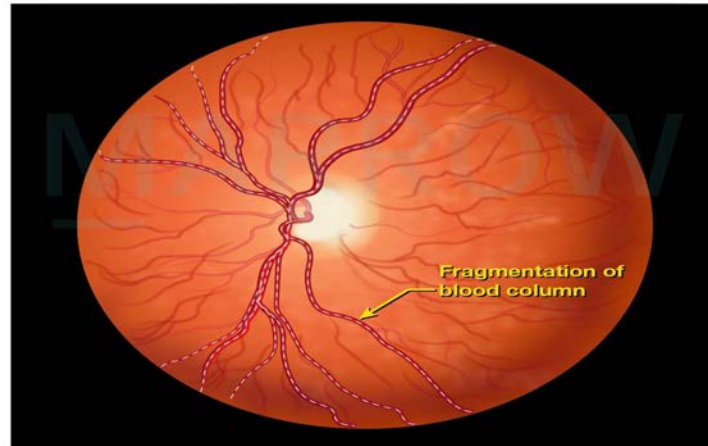
- No audible breath sounds on continuous auscultation of the upper part of the chest and in front of or on the larynx for a minimum of 5 minutes
- Feather test – No movement of a feather held in front of the nose
- Mirror test – Mirror held in front of the nose does not turn dim due to any moisture of breath
- Winslow's test – No movement of the surface of the water in a bowl kept on the chest

Solution to Question 7:

The Kevorkian sign is a postmortem change that occurs in the retinal vessels. It lasts for about 1 hour.

It is characterized by fragmentation of the blood column in the retinal vessels. It appears within minutes after death and lasts for about 1 hour. It can be visualized by using an ophthalmoscope as shown below.

Kevorkian sign



©MARROW

Other postmortem changes occurring in the eye:

- Cornea - dull, hazy, opaque, wrinkled
- Flaccidity of eyeballs occurs due to falling in intraocular pressure. IOP reaches zero at the end of 2 hours after death
- Tache Noir: A film of cell debris and mucus forms two yellow triangles on the sclera on either side of the cornea, with base towards the margin of cornea and apex towards medial or lateral canthus of the eye. It appears within 3-4 hours of death
- Increase in potassium concentration in vitreous - linear increase up to 100 hours following death. It is helpful in determining the time since death

Solution to Question 8:

Zasko's phenomenon/ tendon reaction is related to muscular changes following death.

It is elicited in the quadriceps femoris muscle. Striking the lower third of the muscle about 10 cms above the patella with a reflex hammer causes upward movement of the patella due to contraction of the muscle. It can be seen 1 to 2 hours after death.

Solution to Question 9:

The phenomenon of cooling of the body following a death is called algor mortis/ postmortem cooling.

After death, the body loses heat mainly by conduction and convection. It is one of the early changes occurring after death. Temperature is usually measured in the rectum or abdominal cavity (subhepatic region).

Solution to Question 10:

Cholera, septicemia, and sunstroke lead to an increase in body temperature in the first two hours following death.

Postmortem calorificity is the condition in which the temperature of the body remains raised for about the first two hours after death.

It occurs:

- When the regulation of body temperature has been severely disturbed before death as in sunstroke, pontine hemorrhage
- Increased heat production in muscles due to convulsions as in tetanus and strychnine poisoning
- When there has been increased bacterial activity as in septicemia, cholera

Solution to Question 11:

Edema decreases the rate of postmortem cooling.

Factors increasing the rate of postmortem cooling:

- The greater difference in the temperature between the body and the atmosphere
- Large body surface area
- Children and old aged people
- Higher humidity and rapid air velocity
- A body immersed in running water

Rate of cooling is decreased in:

- Excess fat
- Edema
- Body covered with clothing
- Bodies in small, ill-ventilated room

Solution to Question 12:

The image shows suggilation.

Postmortem lividity (suggilation/ postmortem hypostasis/ postmortem staining/ livor mortis/ vibices) develops in the dependent portions of the body due to engorged vessels showing through the skin.

Solution to Question 13:

Fixation of hypostasis occurs 6 – 12 hours after death.

Purple or reddish-purple discoloration of the skin due to collection of blood in toneless capillaries in dependant parts of the body. It is called postmortem hypostasis/ postmortem staining/ postmortem lividity/ livor mortis/ suggilation/ vibices.

Timing of development of postmortem hypostasis:

- Mottled patches – 1-3 hours following the death
- Uniform area of staining – 3-6 hours following death
- Fully developed and fixation of hypostasis – 6-12 hours

Solution to Question 14:

Glove and stocking hypostasis indicates postmortem staining of legs, feet, hands, and forearm. This occurs in the vertical suspension of the body as in hanging where these parts form the dependant parts.

Sites of postmortem hypostasis depending on the position of the body:

Position of the body	Sites of hypostasis
Supine	Back except for shoulder blades, buttocks, and calves (contact pallor)
Vertical as in hanging	Legs, feet, forearm, and hands (glove and stock hypostasis)
Drowning	Face, the upper part of chest, hands, lower arms
Inverted like in drunken persons	Head and neck

Solution to Question 15:

In the given image, margins are irregular and staining is not uniform. There is no area of contact pallor in the region of shoulder blades. This is indicative of a bruise.

The difference between a bruise and postmortem lividity is given below:

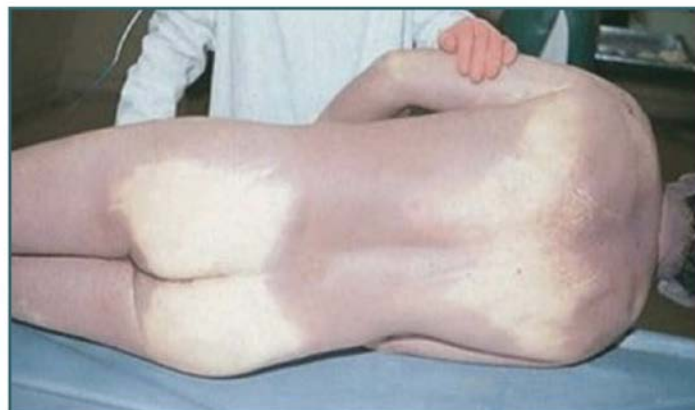
Features	Bruise	Postmortem lividity
Cause	Ruptured vessels (either superficial or deep)	Engorged vessels showing through the skin
Location	At the site of blunt trauma	On dependent parts

Features	Bruise	Postmortem lividity
Margins	Irregular	Clearly defined
Swelling and abrasion	Present	Absent
Contact pallor	Absent	Present on shoulder blades

Bruise



Postmortem lividity



Solution to Question 16:

The color of postmortem staining in carbon monoxide (CO) poisoning is cherry red.

Solution to Question 17:

Pugilistic attitude/ heat stiffening is due to coagulation of muscle proteins.

It is a condition simulating rigor mortis. It occurs when the body is exposed to temperatures above 65°C like in deaths from burning, high voltage electric shock, or from falling into hot liquid.

The mechanism is the coagulation of muscle protein. The flexors, being bulkier than the extensors, contract more and force the limbs into a position of general flexion, the so-called boxer's or pugilistic attitude. It could be due to antemortem or postmortem burns, especially if the body is burnt, charred and black.

Other conditions simulating rigor mortis are – cold stiffening, gas stiffening, cadaveric spasm/cataleptic rigidity.

Solution to Question 18:

Nysten's rule describes the sequential onset of rigor mortis in the various muscle groups.

Rigor mortis (cadaveric rigidity or death stiffening) refers to the stiffening and shortening of muscles following death. The basic sequence of the rigor mortis begins from the head and continues downwards the body. It disappears in the same order of appearance.

The muscles are affected in the given order:

- Involuntary muscles - Heart (left chamber of the heart is affected first)
- Eyelids
- Neck and lower jaw
- Face
- Chest
- Upper extremities
- Abdomen
- Legs
- Fingers and toes

Solution to Question 19:

Cadaveric rigidity is also known as rigor mortis. It is due to the depletion of ATP and indicates time since death. Muscle stiffening is not marked and can be overcome by moderate force. The rigor starts occurring 1-2 hours after death (postmortem nature) and muscles do not respond to electrical stimuli.

Cadaveric spasm / instantaneous rigor/ cataleptic rigidity/ death clutch is a phenomenon where a group of muscles in a state of contraction at the time of death remains contracted after death until molecular death occurs.

Cadaveric spasm is an antemortem phenomenon and occurs immediately after death. There is no stage of primary relaxation. It is seen in cases of deaths coupled with emotional disturbances like:

- In cases of excitement, fear, severe pain
- Exhaustion at the time of death
- Cerebral hemorrhage
- Injury to the nervous system
- Drowning
- Strychnine poisoning

Examples:

- In case of drowning, weeds and grass caught in hand during struggle remain firmly grasped even after death. This indicates that the person was alive when entering the water
- In case of suicides, weapons remain firmly grasped in the hand

Solution to Question 20:

The given picture shows postmortem marbling. It starts in 24 hours and becomes prominent in 36-48 hours.

The blood in the vessels is haemolysed, which stains the vessel walls and the adjacent tissues, giving rise to a marbled appearance. It is greenish-brown or purplish-red discoloration of superficial veins due to the formation of sulfhemoglobin which diffuses into tissues. It is distinctly appreciable on the abdomen, shoulders, chest, and inguinal region.

Solution to Question 21:

Autolysis is the self-digestion of tissues by lysosomes and their digestive enzymes (mainly hydrolases).

The earliest autolytic changes occur in parenchymatous (brain) and glandular tissues. The earliest external sign is the whitish, cloudy appearance of the cornea. It is a sterile process i.e. bacteria are not involved.

Solution to Question 22:

The first external sign of putrefaction is the greenish discoloration of the skin over the region of the caecum.

The disintegration of body tissues is known as putrefaction. It is one of the late signs of death.

Enzyme lecithinase produced by *Clostridium welchii* plays an important role in putrefaction. Sulphmethaglobin is the agent imparting greenish color.

The earliest internal change is reddish-brown discoloration of the inner surface of vessels, especially of the aorta.

Solution to Question 23:

Among the given options, the first organ to putrefy is the larynx and the last to putrefy is a non-gravid uterus.

The decreasing order of organ putrefaction (from first to last):

- Larynx and trachea
- Stomach, intestine, spleen
- Liver and lungs
- Brain
- Heart
- Kidney and the bladder
- Prostate and uterus – non-gravid uterus resists putrefaction whereas the gravid uterus and uterus soon after delivery putrefies rapidly
- Skin, muscle, tendons
- Bones

Solution to Question 24:

Honeycombing of the liver is a sign of putrefaction.

In putrefaction, *Clostridium welchii* produces small clumps in tissue space and produce gas. This tends to increase the size of the liver and it becomes soft and studded with blisters. As bubbles develop in the liver, the organ develops a honeycombed vesicular and foamy appearance.

Solution to Question 25:

Putrefaction is delayed in carbolic acid poisoning.

Putrefaction is the fifth stage, following pallor mortis, algor mortis, rigor mortis, and livor mortis in the decomposition of dead bodies.

It is the decomposition of proteins, the eventual breakdown of the cohesiveness between tissues, and the liquefaction of most organs.

In the matter of death by poisoning, the putrefaction of the body is chemically delayed by poisons. Death by poisons such as carbon monoxide, potassium cyanide, carbolic acid, barbiturates, fluoride, phosphorous, endrin, datura, strychnine, yellow oleander, nicotine, arsenic, mercury, copper, antimony, lead, thallium, chronic alcoholism can resist or delay putrefaction.

Death by septic diseases, puerperal sepsis, kidney diseases with generalized edema can hasten putrefaction.

Option A: It is a case of salicylic acid poisoning.

Option B: It is a case of aconite poisoning.

Option D: It is a case of organophosphate poisoning.

Solution to Question 26:

If a cadaver is recovered in a state of putrefaction and is infested with maggots, the time since death is likely to be 1 to 2 days.

The rationale of forensic entomology is that after death, invasion of an unprotected body by sarcosaprophagous (feeding on dead and decay) insects comes in successive waves.

Different arthropods colonize the body after death and some species pass through complex life cycles. They can be used to determine at least the minimum time since death by studying the stage of the life cycle of the insects.

Estimated time of death according to fly lifecycle (in summers):

- Maggots - 1 to 2 days
- Pupae - 3 to 6 days
- Adult flies - 6-7 days

In winters, the life cycle can be of 8-20 days.

Solution to Question 27:

When the process involves the face, the features are well preserved, which helps to establish the identity.

Adipocere is a modification of putrefaction. In this, the fatty tissues of the body change into a substance known as adipocere. The change is due to the gradual hydrolysis and hydrogenation of fats forming insoluble soaps. These soaps are acidic, which prevents the growth of putrefactive bacteria.

Adipocere has a distinct offensive or sweetish smell, but during the early stages of its production, a penetrating ammoniacal odor is also noticed. A warm, moist, anaerobic environment favors adipocere formation e.g., bodies immersed in water.

Solution to Question 28:

The absence of moisture in the air and the continuous action of dry or warmed air are necessary for the process of mummification.

Mummification is the process of dehydration or drying and shriveling of the cadaver that occurs from the evaporation of water. The natural appearances of the body and general facial features are preserved.

Solution to Question 29:

The mummified body is odorless.

Sold by @Itachibot
If you purchased this from someone else,
you may have been scammed.

Medico Legal Autopsy

Question 1:

Which of the following best describes the legal term corpus delicti?

- a) Medico legal autopsy
- b) The body of offence
- c) Criminal negligence
- d) Exhumation

Question 2:

Which of the following statements is false regarding medico-legal autopsy?

- a) Consent from relatives is required
- b) Legal permission is necessary
- c) Magistrate is the authorizing officer in case of exhumation
- d) In India, all registered medical practitioners can perform an autopsy

Question 3:

An autopsy may be performed at the site of recovery of the body in all of the following cases except?

- a) Putrefied body
- b) Exhumation
- c) District Magistrate orders
- d) Deaths due to RTA

Question 4:

The police hands over the body of a person who died due to hanging to you for an autopsy. Which of the following incisions is preferred in this case?

- a) I shaped incision
- b) Modified Y shaped incision

- c) Y shaped incision
- d) Inverted Y shaped incision

Question 5:

You observe a forensic surgeon doing en masse removal of organs during an autopsy. Which of the following autopsy techniques is he performing?

- a) Virchow technique
- b) Rokitansky technique
- c) Ghon technique
- d) Letulle technique

Question 6:

Match the following.

- a) 1-iii, 2-iv, 3-ii, 4-i
- b) 1-iv, 2-iii, 3-i, 4-ii
- c) 1-ii, 2-iii, 3-iv, 4-i
- d) 1-iv, 2-i, 3-iii, 4-ii

Question 7:

Which of the following organs is tested in Breslau's second life test?

- a) Lungs
- b) Stomach
- c) Liver
- d) Heart

Question 8:

While doing the Raygat's test, an unrespired lung may float due to:

- a) Lung edema
- b) Lung collapse

- c) Putrefaction
- d) Consolidation

Question 9:

An ASHA worker brings the body of a newborn to casualty saying that the child was delivered dead at home. You suspect it as live birth and request an autopsy. All of the following will confirm a live birth except:

- a) Presence of milk in the stomach
- b) Skin exfoliation
- c) Presence of meconium in the large bowel
- d) Closure of fetal channels

Question 10:

A second autopsy is performed in which of the following scenarios?

- a) 1 and 5 only
- b) 2, 4, and 5
- c) 3 and 4 only
- d) 1, 2, and 3

Question 11:

Which of the following metals can be detected even in conflagrated human remains?

- a) Lead
- b) Mercury
- c) Arsenic
- d) Cadmium

Question 12:

A person died following bee stings. Which of the following enzymes is of diagnostic value at autopsy in this case?

- a) Amylase

- b) Chymase
- c) Tryptase
- d) Lactase

Answer Key

Question No.	Correct Option
1	b
2	a
3	d
4	b
5	d
6	a
7	b
8	c
9	c
10	d
11	c
12	c

Detailed Explanations

Solution to Question 1:

Corpus delicti, also known as the body of offense, says that a crime must be proved to have occurred before a person can be convicted of committing that crime.

The main part of corpus delicti is the establishment of the identity of the dead body and infliction of violence in a particular way, at a particular time and place, by the person or persons charged with a crime and none other.

A conviction for an offense does not necessarily depend upon the corpus delicti if there are eyewitnesses or strong corroborative evidence.

In a charge of homicide, it includes:

- Positive identification of the dead body (victim)
- Proof of its death by a criminal act of the accused

Solution to Question 2:

In the case of a medicolegal autopsy, consent of the relatives is not required.

For conducting a medicolegal autopsy:

- Legal authorization is a must
- Magistrate is the authorizing officer in case of exhumation
- Preferably, a forensic pathologist or medicolegal expert does the autopsy. However, in India, due to the lack of adequate qualified experts, all registered medical practitioners can perform this with authorization by the state.

Note: Clinical/ pathological autopsy requires consent from the relatives of the deceased.

Solution to Question 3:

In deaths due to RTA, autopsy is usually performed in an equipped mortuary. An autopsy may be performed at the site of recovery of the body, in the following scenarios:

- Advanced stage of putrefaction as materials of evidentiary value may be lost during transportation
- Exhumation
- If the District Magistrate desires it to be conducted at the site due to some law and order problems

An autopsy is preferably performed in an equipped mortuary.

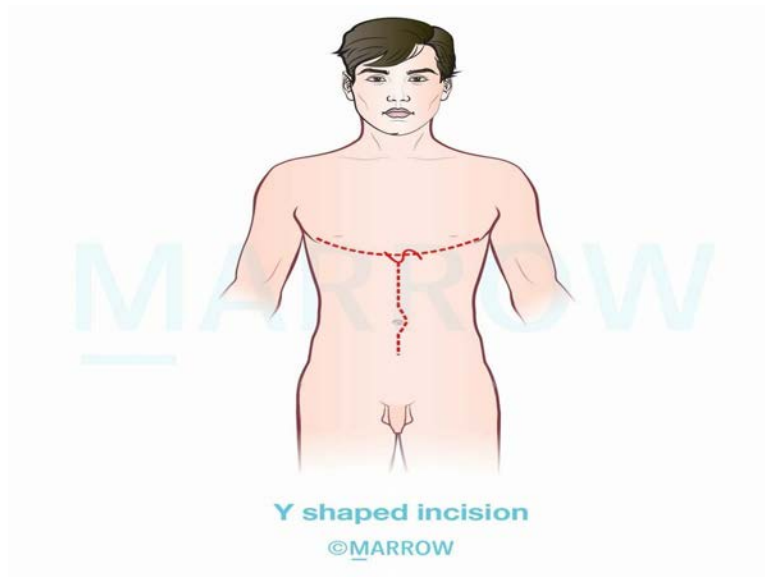
Solution to Question 4:

The incision preferred in the case of asphyxial death due to neck compression (as in hanging) is the modified Y-shaped incision.

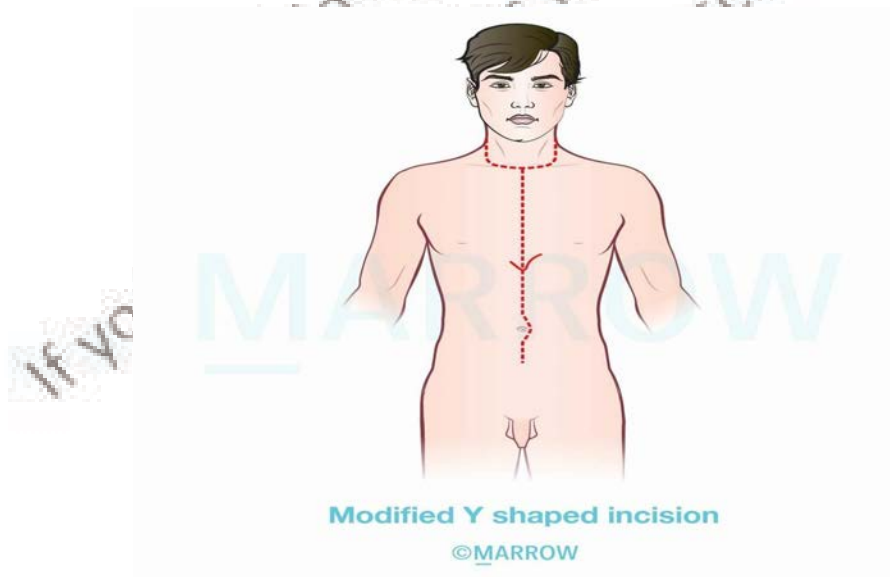
In strangulation, hanging, and any condition where the larynx might be damaged, a modified Y-shaped incision is to be preferred. This incision is used because the skin of the upper neck can then be dissected off the mandible and raised to give a wide approach to the neck structures.

Given below are types of incisions done for an autopsy:

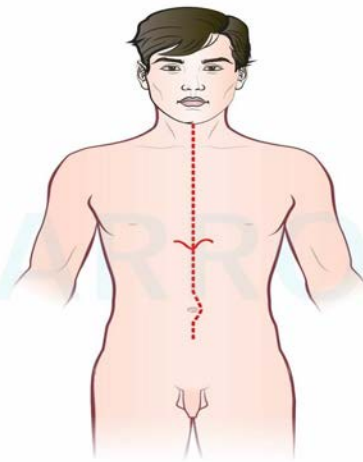
1. Y-Shaped Incision: Commences at the acromial process on the shoulder on either side. It runs downwards and anteriorly beneath the breasts as to meet at the xiphisternum in the midline. It then runs downwards as in an I-shaped incision to the symphysis pubis. It is preferred in females. It is more cosmetically accepted as the incision and the stitches are minimally seen after the autopsy.



2. Modified Y-shaped incision: Commences at the angle of mandible on either side, brought forwards and downwards to meet at the suprasternal notch. It is then run downwards as a midline incision up to the pubic symphysis. Indicated in cases of strangulation or death due to compression of the neck.



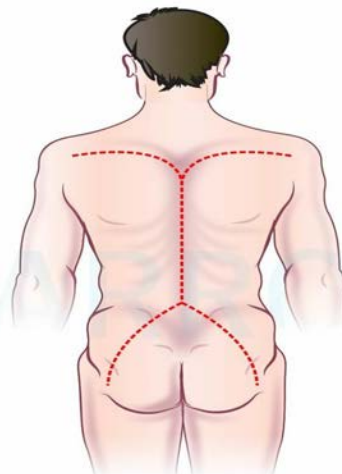
3. I-Shaped Incision: Extends from symphysis mentii to symphysis pubis taking curve towards left around the umbilicus. It is used routinely in practice. It is simple and convenient.



I shaped incision

©Marrow

4. Elongated X-shaped Incision: This is a special incision used to dissect out subcutaneous structures in the back to identify and evaluate the extent of blunt injuries, which are usually missed where superficial imprints are faint, particularly when present on skin not overlying bone. This is helpful in the reconstruction of events prior to death and should be practiced in cases of custodial death.



Elongated X shaped incision

©Marrow

5. Inverted Y-shaped incision is used in infants.

Solution to Question 5:

The en masse removal of organs is done in the Letulle technique.

It is the removal of the cervical, thoracic, abdominal and pelvic organs as a single organ mass. They are subsequently dissected into organ blocks.

Solution to Question 6:

The correct match is:

Negative autopsy: An autopsy in which, the cause of death remains unknown, even after all laboratory examinations including biochemical, microbiological, virological, microscopic, and toxicological examination.

Obscure autopsy: An autopsy done meticulously, but presents with no clear-cut findings as to give a definite cause of death. Further lab investigations are required to know the details of the cause of death in this type of autopsy.

Column A	Column B
Negative autopsy	Cause of death remains unknown even after detailed laboratory investigations
Obscure autopsy	No definite cause of death after an autopsy, further evaluation is needed
Virtual autopsy	Cause of death is assessed by non-invasive methods
Clinical autopsy	Done for academic purpose

Solution to Question 7:

In Breslau's second life test, also known as the stomach bowel test, the stomach and the duodenum are tested.

This test is done to determine whether the baby was born alive or not.

It works on the principle that some air is swallowed during respiration in a live-born child. Detecting the presence of this air in these viscera constitutes the basis for this test.

Procedure :

The stomach and duodenum are removed separately and placed in water. If they float, make a small cut while underwater to see air bubbles coming up. A floating viscera giving out air bubbles when opened underwater is a positive test.

Interpretation:

- A positive test proves live birth even in the absence of a positive hydrostatic lung test. This may happen if there had been some obstruction in the respiratory passages.
- A negative test does not mean stillbirth since air does not necessarily enter the stomach in adequate amounts during the breathing act.

- Putrefaction invalidates the result.

Note: Breslau's first life test is when the same test is performed on the lungs. Also known as Hydrostatic test/ Floatation test / Raygat's test.

Solution to Question 8:

In Raygat's test, an unrespired lung (stillbirth) may float due to gases of decomposition, as seen in putrefaction.

It is also known as the floatation test/ Breslau's first life test/ hydrostatic test. It is done to determine whether the newborn has respired or not:

- If the lung pieces float in water, it means that respiration has taken place, indicating a live birth
- If the pieces sink, respiration has not taken place, signifies stillborn

A respired lung (live birth) may sink in water in the following conditions:

- Lung edema
- Lung collapse
- Pneumonia (consolidation)
- Congenital syphilis

Other tests to determine if respiration has taken place or not are:

- Fodere's test: Weight of lungs before respiration - 30-40g, after respiration - 60-66g
- Ploucquet's test: Weight of lungs before respiration - 1/70 of body weight, after respiration - 1/35 of body weight
- Wredin's test: Assesses the changes in the middle ear. The gelatinous substance in the middle ear is replaced by air if respiration has taken place.

Solution to Question 9:

The absence (and not presence) of meconium in the large bowel is a confirmatory sign of live birth.

Confirmatory signs of live birth:

- Presence of milk in the stomach
- Absence of meconium in the large bowel, exception being breech delivery.
- Exfoliation of skin
- Closure of fetal channels
- Changes in the umbilical cord

Live birth can be excluded if :

- Signs of maceration are present

- Signs of immaturity are present. If the child has not attained the viable age (7 months), it could not have been born alive.

Solution to Question 10:

A second autopsy may be performed when relatives are not satisfied, new circumstances emerge, or investigating officer demands it.

After an autopsy, when a repeat medicolegal postmortem is performed with the authorization by law it is called a second autopsy.

The magistrate/commissioner of the police vested with such power, orders the second autopsy.

A second autopsy may be performed in the following cases:

- The relatives of the deceased are not satisfied with the first autopsy report and they have pointed out certain lapses in the first autopsy.
- The first autopsy was not performed in the light of the circumstances which are now available.
- The investigating authority demands a second autopsy for setting the investigation on the right track.

Solution to Question 11:

Arsenic can be detected even in conflagrated human bones. Hence, it is possible to detect poisoning by arsenic even when the body has been burnt for a long time.

Arsenic is volatile but much of the arsenic in bones is converted into arsenates, which are non-volatile.

In suspected cases of poisoning by arsenic, all the available ashes and burnt bones should be preserved for chemical analysis.

Solution to Question 12:

The given case is of a suspected anaphylactic death in which tryptase is of diagnostic value.

The postmortem diagnosis of anaphylaxis remains difficult due to the lack of specific biomarkers. Mast cell tryptase (MCT) / tryptase is a sensitive measure of mast cell activation, and high levels will be found after severe anaphylactic reactions, especially those causing severe shock.

Diagnostic tests for suspected anaphylactic deaths are serum tryptase and radio-allergosorbent testing (RAST for IgE).

Mechanical Injuries

Question 1:

Identify the injury in the image below.



- a) Abrasion
- b) Laceration
- c) Bruise
- d) Imprint

Question 2:

An abrasion involves which of the following layers of the skin?

- a) Partial thickness of epidermis
- b) Full thickness of epidermis
- c) Epidermis + superficial dermis
- d) Epidermis + dermis

Question 3:

In an abrasion caused by tangential force, which of the following indicates the direction of said force?

- a) Fishtailing of the wound
- b) Epidermal tags
- c) Tailing of the wound
- d) Crushed hair follicles

Question 4:

Abrasions are noted on the body of a person who was found dead at his home. Which of the following indicates that these might be produced after death?

- a) Vital reaction positive
- b) Congestion seen
- c) Present over bony prominences
- d) Bright reddish brown in color

Question 5:

Which of the following statements is falsely matched?

- a) Antemortem wound - positive vital reaction
- b) Antemortem wound - negative vital reaction
- c) Postmortem wound - negative vital reaction
- d) Postmortem wound - no vital reaction

Question 6:

Which of the following statements regarding a bruise is false?

- a) They lie underneath an intact epidermis
- b) They are caused due to capillary bleeding
- c) Blood commonly collects in the subcutaneous layer
- d) It may become visible 1-2 days after the traumatic incident

Question 7:

Which of the following sites is more prone to bruising with blunt trauma?

- a) Shins
- b) Abdomen
- c) Buttocks
- d) Arms

Question 8:

The police brought a victim of alleged domestic violence with a big bruise for evaluation. She claimed that it was inflicted by her husband three days ago after which he had gone out of town. Which of the following is correct while determining the age of this injury?

- a) Histological examination is the most reliable method
- b) The appearance of green colour is the most significant change
- c) Perl's reaction is the most useful criterion
- d) Bright yellow colour indicates that it is less than 18 hours old

Question 9:

A bruise on the upper arm of an alleged victim of the assault has the following appearance. What is the age of the injury based on colour of this bruise?



- a) 2 weeks old
- b) 1-3 days old

- c) 7-12 days old
- d) 4-5 days old

Question 10:

Which of the following is not true about ectopic contusions?

- a) Bruising on the neck may indicate a jaw fracture
- b) Bruising at the nape of the neck indicates fracture of the posterior cranial fossa
- c) A black eye may be from fracture of the anterior cranial fossa
- d) Bruising behind the ear indicates fracture of the middle cranial fossa

Question 11:

You are asked to conduct an autopsy of a person who was found dead at his home. You notice the given findings on the body. Which test can be used to differentiate this from antemortem bruising?



- a) Gettler's test
- b) Incision test
- c) Precipitin test
- d) Breslau's test

Question 12:

The autopsy of a victim reveals similar findings seen in the given image. Which of the following would have caused this injury?



- a) Road traffic accident
- b) Iron rod
- c) Serrated knife
- d) Double edged knife

Question 13:

Which of the following tissues is most resistant to knife penetration?

- a) Muscle
- b) Subcutaneous tissue
- c) Uncalcified cartilage
- d) Skin

Question 14:

An assault victim is rushed to the emergency department with a stab wound. You observe that the wound is wedge-shaped. Which weapon would have most likely produced this wound?

- a) Single-edged knife
- b) Serrated knife
- c) Double-edged knife

d) Screwdriver

Question 15:

In a case of suspected stabbing, you are trying to identify the murder weapon using the wound characteristics. All of the following factors might lead to a false interpretation except:

- a) If the knife tapers beyond the point to which it was driven into the wound
- b) If the knife was driven up to the hilt into the wound
- c) If the weapon was moved after insertion
- d) If the wound is parallel to the Langer lines

Question 16:

What type of injury is scalping?

- a) Contusion
- b) Abrasion
- c) Incised wound
- d) Laceration

Question 17:

Which of the following findings in a patient suggests an incised wound, rather than a split laceration?

- a) Sharp linear injury in underlying bone
- b) Hairs crossing the wound
- c) Tissue strands across the interior of the wound
- d) Bruising around margin of the wound.

Question 18:

You notice tearing of the skin at the ends of a laceration on a victim. What is this finding known as?

- a) Sparrow's foot
- b) Wedging

- c) Fish tails
- d) Swallow tails

Question 19:

You are examining the body of a patient who was found dead at his house. Multiple linear incised wounds are noted on the ulnar border of the forearm. What are these suggestive of?

- a) Defence wounds
- b) Self-mutilation
- c) Tentative cuts
- d) Hesitation wounds

Question 20:

When is leucocyte infiltration into wounds seen?

- a) 0-4 hours
- b) 4-12 hours
- c) 12-24 hours
- d) 1-3 days

Answer Key

Question No.	Correct Option
1	a
2	a
3	b
4	c
5	c
6	b
7	a
8	c
9	c
10	b

11	b
12	b
13	d
14	a
15	d
16	d
17	a
18	d
19	a
20	b

Detailed Explanations

Solution to Question 1:

The given image shows an abrasion.

An abrasion is the most superficial of injuries. It does not penetrate the full thickness of the epidermis.

A pure abrasion does not bleed, as blood vessels are confined to the dermis. However, the dermal papillae are corrugated in nature. Thus, many abrasions enter the dermis and bleeding commonly occurs.

Solution to Question 2:

An abrasion is the most superficial of injuries and is one that does not penetrate the full thickness of the epidermis.

Thus the pure abrasion does not bleed, as blood vessels are confined to the dermis. The dermal papillae are corrugated in nature. Therefore, many abrasions enter the dermis, and bleeding commonly occurs.

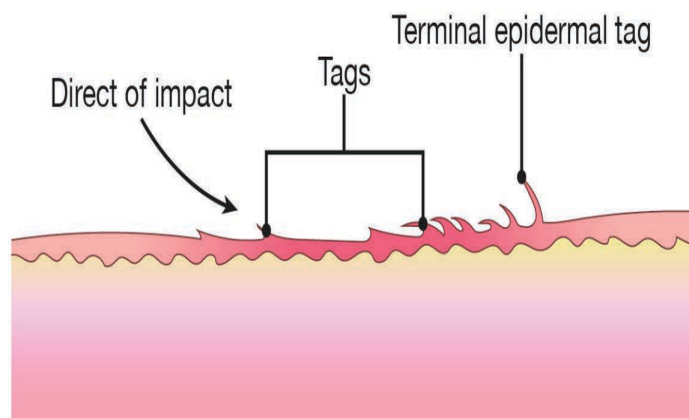
Abrasions are commonly known as grazes or scratches.

Solution to Question 3:

In an abrasion caused by a tangential force, the direction of the force is determined by epidermal tags.

Abrasions caused by a tangential force are known as 'brush abrasion' or 'grazes' or 'brush burn.' It is commonly seen when a body is dragged over a rough surface, such as a road. This scrapes linear

furrows across the skin. The epidermal tags raised by the impact tend to pile up at the distal end. The method of formation of epidermal tags is given in the image below.



- Option A: Fishtailing is the shape of the stab wound caused by a single-edged weapon.
- Option C: Tailing of the wound indicates the direction of injury in incised wounds.
- Option D: Crushed hair follicles are seen at the edge of the wound in a laceration.

Solution to Question 4:

Abrasions present over bony prominences indicate that they might be produced after death. Antemortem abrasions may be located anywhere.

Difference between antemortem and postmortem wounds:

Trait	Antemortem wounds	Postmortem wounds
Site	Anywhere on the body	Usually over bony prominences
Colour	Bright reddish brown	Yellowish, translucent, Parchment like
Exudation	More	Less
Microscopic	Intravital reaction and congestion seen	No intravital reaction and congestion

Solution to Question 5:

Postmortem wounds show no/absent vital reaction because no enzyme activity will be found in a wound sustained after death. This is not the same as a negative vital reaction as it is indicative of decreased enzymatic activity and is seen in antemortem wounds.

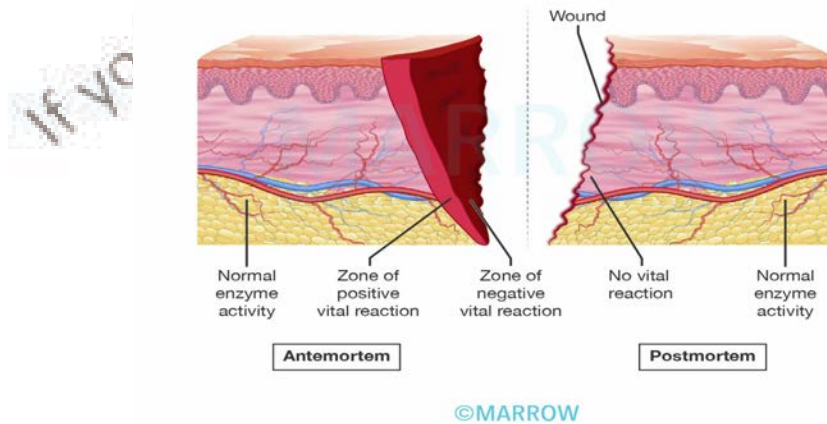
Vital reactions are local tissue reactions at the site of tissue damage. Only antemortem wounds show vital reactions as cells are active at the time of wound infliction. The vital reactions of an antemortem wound are of two zones:

- Negative vital reaction (decrease in enzymatic activity of wound): It occurs in the central necrotic area, close to the edge of the wound where there is irreversible damage to tissues.
- Positive vital reaction (increase in enzymatic activity of wound): It occurs just outside the necrotic area of the wound in order to salvage damaged (but not irreversibly damaged) tissues.

Difference between antemortem and postmortem wounds:

Trait	Antemortem wounds	Postmortem wounds
Site	Anywhere on the body	Usually over bony prominences
Colour	Bright reddish brown	Yellowish, translucent, Parchment like
Exudation	More	Less
Microscopic	Intravital reaction and congestion seen	No intravital reaction and congestion

Vital reaction in antemortem and postmortem wounds



Solution to Question 6:

Contusions/bruises are caused by damage to veins, venules and small arteries. Capillary bleeding would not be visible to the naked eye.

A pure bruise lies beneath an intact epidermis. There is an extravascular collection of blood that has leaked from blood vessels damaged by mechanical impact.

The usual bruise from a blunt impact is situated in the subcutaneous tissues, often in the fat layer. Obese people tend to bruise more easily due to the greater volume of subcutaneous tissue.

Delayed bruising refers to bruises that become more prominent with the passage of hours or days. This is caused by the percolation of blood from deeper tissues upwards towards the epidermis. It is also partly due to continued bleeding from the ruptured vessels.

Solution to Question 7:

The shins are particularly prone to bruising with blunt trauma.

Resilient areas, such as the abdominal wall and buttocks, bruise less with a given impact. The head, chest, and shins are more prone to bruising. This is because these regions have underlying bone and less subcutaneous tissue.

Solution to Question 8:

The most useful criterion for dating a bruise is Perl's reaction for detecting haemosiderin. It becomes positive about 24–90 hours after infliction. Sometimes, there can be an earlier appearance, even down to 12 hours.

Color changes in a bruise cannot be reliably used to estimate the age of a bruise. The most significant change is the appearance of a yellow color. This indicates that the bruise is more than 18 hours old.

Histological examination is unreliable in the accurate dating of bruises.

Solution to Question 9:

The bruise in the given image has a yellow appearance which is attributed to the presence of bilirubin. This finding makes the bruise about 7-12 days old.

Bruises are mechanical injuries that are characterized by the extravasation of blood into subcutaneous or subepithelial tissue spaces. The continuity of the overlying skin is preserved. These injuries are typical consequences of blunt force trauma.

The extravasated blood serves as a sign of inflammation to attract macrophages, which degrade the hemoglobin into various compounds (hemosiderin, haematoidin, and bilirubin). This gives rise to shifting color changes that begin at the wound's periphery and migrate towards the center as time goes on.

Solution to Question 10:

Bruising at the nape of the neck does not indicate a fracture of the posterior cranial fossa.

Ectopic bruises are also called migratory/percolated bruising. They are found at a different location than the actual site of injury. They are caused by the percolation of blood in the subcutaneous tissue from one site to another.

Examples are:

- Black eye - due to actual trauma to the eye, or maybe an ectopic bruise. It may be from trauma to the forehead or from a fracture of the anterior cranial fossa.

The image below shows a black eye.



- Battle sign - bruising seen over the mastoid process. It is from a fracture of the middle cranial fossa.

The image given below shows battle sign.



- Bruising on the neck may indicate a jaw fracture.

Solution to Question 11:

The given image shows postmortem hypostasis. The classic test used to differentiate a bruise from hypostasis is the incision test.

The suspected area is incised to see if the underlying blood is intravascular (hypostasis) or infiltrating the tissues outside the vessels (contusion).

Option A: Gettler's chloride test is used to differentiate between freshwater and saltwater drowning. It is not widely used now.

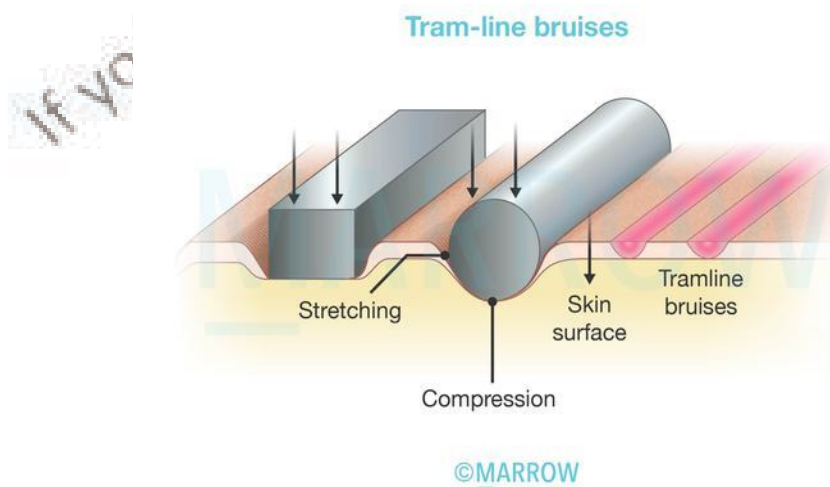
Option C: In the precipitin test, a specific antiserum is made to react with the seminal fluid, blood, or saliva. A positive test will confirm human origin.

Option D: Breslau's second life test is done to determine whether a child was born alive or not.

Solution to Question 12:

The image shows 'tram-line' bruising. It would have most likely been produced by a stick or an iron rod.

It occurs when the skin surface is struck by a rod or rectangular sectioned object. The weapon sinks into the skin on impact. This causes the edges to drag the skin downwards and the traction, tears the marginal blood vessels. The centre compresses the skin. This causes little or no damage to the vessels in the absence of underlying bone.



Solution to Question 13:

The tissue most resistant to knife penetration is the skin, apart from bone or calcified cartilage.

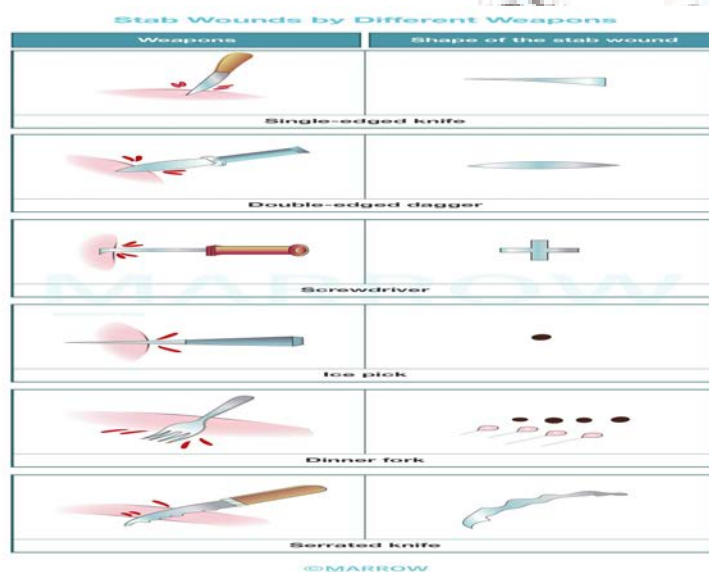
When a knife-point impacts against the skin, the latter dimples, and resists. The tension developed in the stretched skin appears to act as an elastic reservoir and when the threshold of resistance is exceeded, penetration suddenly occurs.

Muscle offers little resistance to penetration. Uncalcified cartilage and subcutaneous tissue are easily penetrated by a sharp knife.

Solution to Question 14:

A wedge-shaped wound is produced by a single-edged knife. A double-edged knife produces an elliptical wound.

The image given below shows the types of wounds produced by different weapons:

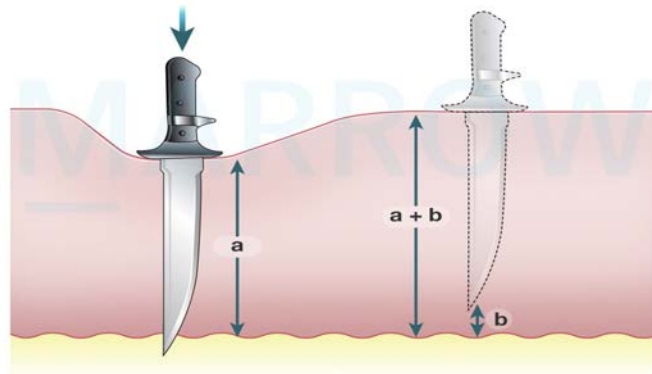


Solution to Question 15:

If the wound is parallel to the Langer lines, it would appear normal. In contrast to a wound that is perpendicular to the Langer lines, which would be longer than normal. This is because such wounds tend to gape more, giving a false interpretation of the weapon.

Option A: The taper of the blade is related to wound size. The length of the wound would be equal to the width of the blade at the point to which it was inserted. Thus the length of the wound varies according to the depth to which it was inserted. Once the blade edges become parallel, the wound size remains constant for further penetration of the knife.

Option B: If a knife is driven up to the hilt, the depth of the wound as measured at autopsy may be greater than the true length of the blade. This is usually seen in the abdomen, and to a lesser extent in the chest. A forceful stab can cause the abdominal or chest wall to indent, allowing the knife tip to reach tissues that would normally be beyond its reach.



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Option C: If the weapon is moved after insertion, it distorts wound characteristics.

Solution to Question 16:

Scalping is a type of laceration. Here, a large area of skin and subcutaneous tissue is rolled off the scalp.

These lesions could be caused by the traction of hair being trapped in machinery. This was formerly a common industrial accident. 'Hairnets' were worn by women factory workers to prevent this.

Flying is also a type of laceration, caused by shearing force. This is where a large area of skin and subcutaneous tissue is rolled off a limb.

Solution to Question 17:

Sharp linear injury in the underlying bone suggests an incised wound, rather than a split laceration.

An incised wound is a clean-cut wound caused by a sharp-cutting instrument.

A split laceration is a type of laceration that usually occurs in areas where the skin overlies bone. An example of such an area is the scalp. Split lacerations can resemble incised wounds.

A laceration can be distinguished from an incised wound by:

- Bruising and crushing of the margins
- Persistence of tissue strands across the interior of the wound, including fascial bands, vessels, and nerves
- Absence of a sharply linear injury in the underlying bone

- In areas covered by hair, as on the scalp, intact hairs will cross the wound
- The image given below shows an incised wound.



The image given below shows a lacerated wound.

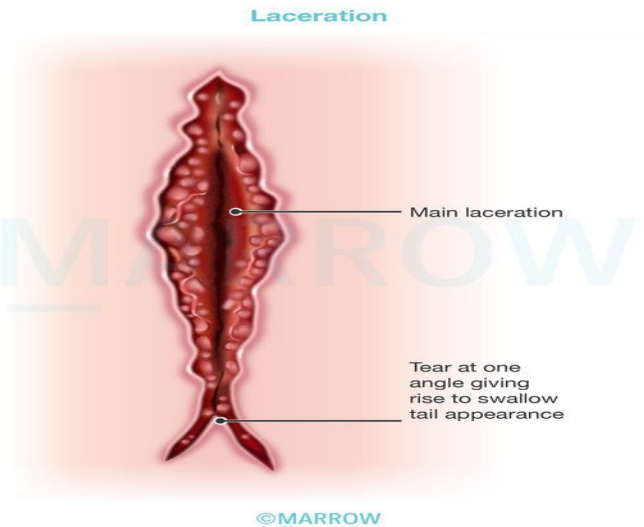


Note: Lacerations are also commonly known as cuts or tears.

Solution to Question 18:

Tearing at the ends of a laceration are called swallow-tails. These are seen at angles diverging from the main laceration itself.

The image below shows swallow-tails in a lacerated wound.



Option A: Sparrow's foot marks are seen in windshield injuries in car accidents.
 Option B: Wedge-shaped injuries are seen in stabbing with a single-edged weapon.
 Option C: Fish-tails: These may be seen in stab wounds where the skin splits at the corner.
 The image below shows fish-tail in a stab wound.



Solution to Question 19:

In the given scenario, multiple linear incised wounds on the inner side (ulnar border) of the forearm are most likely to be defence wounds.

They are sustained when a victim is trying to protect himself from attacks (homicide). The attack may be by fists, feet, and blunt or sharp instruments.

In case of a blunt instrument, fist or feet:

- Bruises are most common along with abrasions
- Commonly on the extensor and ulnar aspect of the forearms, wrists, back of the hand, and knuckles
- May be seen on thighs due to an attempt to protect genitals

In the case of a sharp instrument:

- Seen on the ulnar side of the forearm, wrist, hand, and fingers
- Cuts on the flexures of phalanges occur if the victim tries to seize the weapon

Firearm injury:

- Arms may be used to shield the trunk or head from the blast
- An entrance and an exit wound in the upper arm may be seen
- The missile may then re-penetrate the trunk

Options C and D: Tentative cuts or hesitation wounds are self-inflicted wounds made while attempting to commit suicide. They are usually on the radial side of the forearm.

Solution to Question 20:

Leucocyte infiltration in wounds is seen at 4-12 hours.

Histological changes in wounds

Time after injury	Histological changes
30 minutes-4 hours	Margination of leucocytes in blood vessels Mast cells lose their granules Fibrin appears in the wound
4-12 hours	Leucocyte infiltration (mostly polymorphs) Tissue edema Start of epithelial regeneration
12-24 hours	Mononuclear leukocytes increase Epidermis begins to spread across the wound
24-72 hours	Leukocyte infiltration reaches a peak at 48 hours Granulation tissue appears
3-6 days	Collagen formation
10-15 days	Collagen reaction subsides Vascularity decrease Cell population drops
2 weeks - several months	Consolidation of healing tissues

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Regional injuries

Question 1:

Which is the most common intracranial lesion due to head injury?

- a) Extradural haemorrhage
- b) Subarachnoid haemorrhage
- c) Subdural haemorrhage
- d) Cerebral contusion

Question 2:

Which of the following are true statements regarding scalp injuries?

- a) 1, 2 and 3
- b) 3, 4 and 5
- c) 1, 2 and 5
- d) 2, 3 and 4

Question 3:

What type of skull fracture is shown in the given image?



- a) Diastatic fracture
- b) Pond fracture
- c) Gutter fracture
- d) Depressed fracture

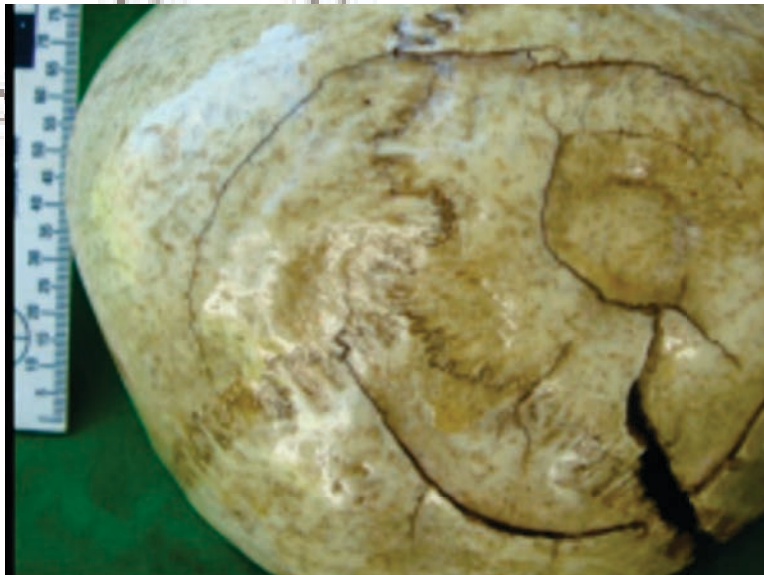
Question 4:

Police are chasing a murderer who jumps from a multistoried building to escape. He lands on his feet but dies immediately on the spot. Which of the following skull fractures is most likely to have caused this fatal injury?

- a) Ring fracture
- b) Hinge fracture
- c) Spider web fracture
- d) Pond fracture

Question 5:

During postmortem examination of the skull of a person who committed suicide on a railway track, the following finding is noted. What is the inference?

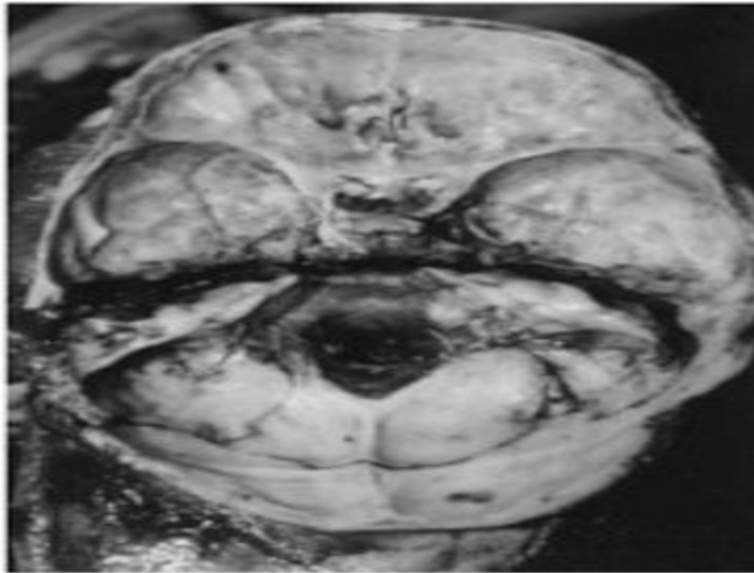


- a) Depressed Fracture
- b) Mosaic Fracture
- c) Diastatic Fracture

d) Pond fracture

Question 6:

Name the type of skull fracture.



- a) Depressed fracture
- b) Hinge fracture
- c) Pond fracture
- d) Comminuted fracture

Question 7:

Which of the following statements about skull fractures is true?

- a) In hammer injury to skull, the most common complication is subdural hemorrhage
- b) Fracture lines on the skull usually cross each other to form a grid-like pattern
- c) At the point of contact with the hammer injury, the inner table of the skull fractures
- d) The most common skull fracture type is the depressed skull fracture

Question 8:

A 65-year-old woman falls in the bathroom and hurts her head. She regains her consciousness after a few minutes and continues with her daily activities. After 3 hours, she again becomes

unconscious and collapses. What is the most likely diagnosis?

- a) Subdural hemorrhage
- b) Cerebral contusion
- c) Extradural hemorrhage
- d) Subarachnoid hemorrhage

Question 9:

Which of the following statements about extradural hemorrhage is false?

- a) Extradural haemorrhage may be ruled out in the absence of a skull fracture
- b) A minimum of 35 ml of blood is required to accumulate for clinical signs to appear
- c) The most common vessel affected is middle meningeal artery
- d) It is the least common type of traumatic brain membrane haemorrhage

Question 10:

A victim of a house fire is brought to you for autopsy. On examination, you find an intracranial collection of blood. It is brown and friable and the adjacent brain tissue shows discoloration. The carboxyhemoglobin level in the extradural blood is found to be the same as in the peripheral blood. What is the likely diagnosis?

- a) Extradural haemorrhage
- b) Subdural haemorrhage
- c) Heat hematoma
- d) A or C, depending on further pathological examination

Question 11:

Which of the following is likely to be seen in an autopsy of a boxer suspected to have died of punch-drunk syndrome?

- a) Cervical spine injury
- b) Subarachnoid haemorrhage
- c) Cerebral concussion
- d) Subdural haemorrhage

Question 12:

Which of the following is a false statement regarding contrecoup injuries?

- a) Fracture of the skull may not occur, even in the presence of severe coup and contrecoup injuries
- b) A fall on the frontal region will produce an occipital contrecoup
- c) A fall on the temporal region will produce a contrecoup in the ipsilateral lobe
- d) The most common site for contrecoup injury is frontal and temporal lobes

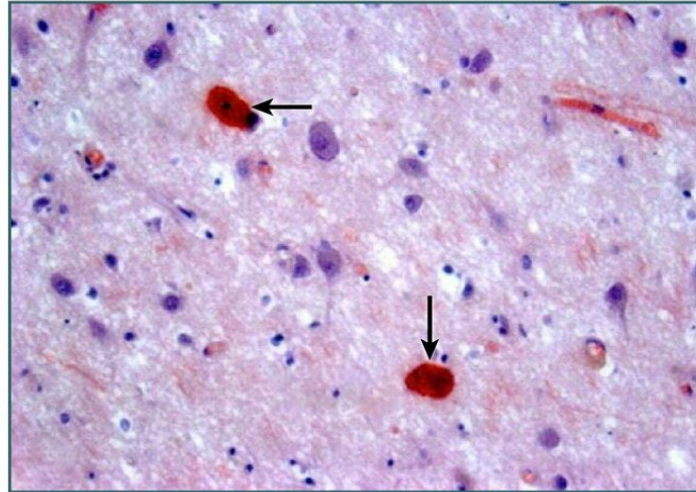
Question 13:

A 48-year-old man was brought unconscious into the ER after he met with a head-on collision accident. His GCS was 4/15 and CT brain did not reveal any significant hemorrhage. MRI brain revealed multiple small elliptical lesions. Which is the most reliable indicator of this condition?

- a) Retraction globes
- b) Amyloid precursor protein
- c) Neurofibrillary tangles
- d) There is no reliable indicator

Question 14:

A patient died after a car accident and the cause was suspected as diffuse axonal injury. Forensic pathological examination revealed the following finding. After how many hours of injury does this finding appear?



- a) 2 hours
- b) 8 hours
- c) 10 hours
- d) 12 hours

Question 15:

While doing an autopsy on a victim of strangulation, you are examining his brain. Which of the following areas of the brain is the most likely to show evidence of hypoxic damage in this victim?

- a) Hippocampus
- b) Thalamus
- c) Pituitary gland
- d) Motor area

Question 16:

Which is the most commonly injured part of the spinal cord?

- a) Lumbar spine
- b) Cervical spine
- c) Thoracic spine
- d) Thoraco-lumbar

Question 17:

Which is the most dangerous type of cervical spinal injury?

- a) Hyperextension injury
- b) Hyperflexion injury
- c) Compression of spine
- d) Lateral flexion injury

Question 18:

A 35-year-old man fell from a ladder and injured his neck while he was painting the roof of a building. He was coming to the hospital with his friend but died before reaching it due to cardiorespiratory arrest. Above what level of cervical vertebrae the fracture must have occurred for this fatal injury?

- a) C7
- b) C6
- c) C5
- d) C4

Question 19:

Which of the following is not a concussion?

- a) Railway spine
- b) Rugger jersey spine
- c) Comotio cordis
- d) Berlin edema

Question 20:

A man walks into the ER with a knife sticking out of his heart. He is likely to survive this injury if the knife has penetrated which of the following chambers?

- a) Left atrium
- b) Right atrium

- c) Left ventricle
- d) Right ventricle

Question 21:

During postmortem examination of a 24-year-old man, ladder rung tears were seen in the aorta. What is the likely mechanism of the sustained injury?

- a) Deceleration trauma
- b) Acceleration trauma
- c) Rotational stress
- d) Compressive force

Question 22:

Which is the most commonly injured organ in blunt trauma of abdomen?

- a) Spleen
- b) Liver
- c) Kidney
- d) Intestine

Question 23:

Where are pincer contusions seen?

- a) Skin
- b) Brain
- c) Liver
- d) Lungs

Question 24:

A person walks into the ER with lacerations on his face which looks like sparrow footmarks. What might be the most likely cause of this injury?

- a) Shattered windshield glass injury

- b) Shot gun injury
- c) Vitriolage
- d) Fall from ladder

Question 25:

A pedestrian hit by a car hurls up on the windshield following which his head strikes the road. How is the head injury described?

- a) Primary impact injury
- b) Secondary impact injury
- c) Tertiary impact injury
- d) Quaternary impact injury

Question 26:

Which among the following is a true statement?

- a) The rear-seats are more dangerous than the front seats in a car
- b) Airbags have greatly improved the safety of cars and are not associated with any injuries
- c) Thoracic injuries are more common in the front-seat passenger than the driver
- d) Tail-gating refers to injuries caused by head-on collision with a car

Question 27:

Which of the following is not a major injury to the unrestrained driver of a vehicle in a deceleration impact?

- a) Lumbar spine injury
- b) Cervical spine injury
- c) Pelvic fracture
- d) Leg fracture

Answer Key

Question No.	Correct Option
1	d
2	d
3	c
4	a
5	b
6	b
7	c
8	c
9	a
10	c
11	d
12	b
13	b
14	d
15	a
16	b
17	a
18	d
19	b
20	c
21	a
22	a
23	d
24	a
25	c
26	a
27	a

Detailed Explanations

Solution to Question 1:

The most common type of intracranial lesion following trauma is cerebral contusion.

A contusion is an effusion of blood into the tissues, due to the rupture of blood vessels caused by blunt trauma. A contusion evolves to form an intracerebral hematoma over hours or days.

The most common type of intracranial hemorrhage following trauma is a subarachnoid hemorrhage.

Note: Trauma is the most common cause of subarachnoid hemorrhage, followed by an aneurysm.

Solution to Question 2:

Contusions may occur in the superficial fascia, in the temporalis muscle, in the loose areolar tissue between galea aponeurotica and the pericranium. They are better felt than seen. Multiple contusions of the scalp may join together and it is often difficult to determine the number of blows inflicted.

The bruises of the scalp are associated with prominent edema.

Subgaleal hematoma remains the same color till it resolves.

Solution to Question 3:

The given image shows a gutter fracture of the skull as part of the outer table is missing.

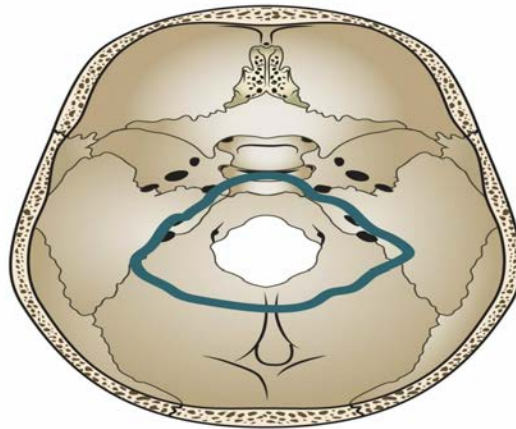
Gutter fractures form a furrow in the outer table of the skull, usually as a result of a glancing blow by a missile from a rifled firearm. They may also be associated with comminuted depressed fractures of inner table of the skull.

Solution to Question 4:

In the given scenario, ring fracture is most likely to have caused the fatal injury. These are the most common fractures that occur due to a fall from height.

These occur in the posterior fossa around the foramen magnum. If the kinetic energy of the fall is not absorbed by fractures of the legs, pelvis, or spine, the impact is transmitted up the cervical spine. This force may be rammed into the skull, carrying a circle of occipital bone with it.

The image given below shows the fracture line of a ring fracture.



Ring Fracture

©Marrow

Solution to Question 5:

The given image shows multiple fracture lines dividing the skull into fragments. Hence, it is a mosaic fracture/ spider-web fracture of the skull.

It is a comminuted depressed fracture that also has fissures radiating from it, forming a spider's-web or mosaic pattern. These fractures are formed due to a significant force striking over a broad area.

The below image shows a spider-web fracture of the skull.



Solution to Question 6:

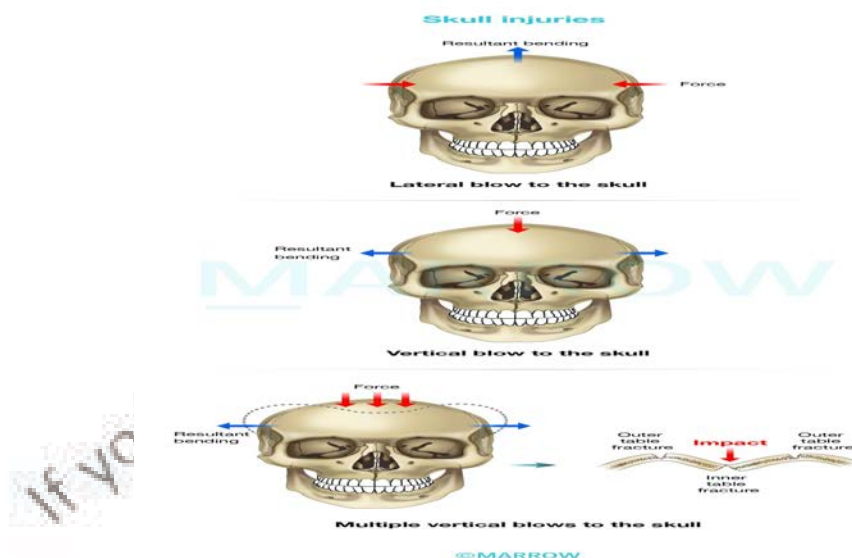
The image shows hinge fracture/ motorcyclists fracture. Here, the base of the skull is divided into 2 halves, each moving independently of the other like a hinge.

Solution to Question 7:

At the point of contact of the weapon (hammer) with the skull, the inner table is likely to fracture. When the skull receives a focal impact there is a momentary distortion of the shape of the cranium. The area under the point of impact bends inwards. As the contents of the skull are virtually incompressible, there must consequently be a compensatory distortion or bulging of other areas. This is the struck hoop analogy.

Both these intruded and extruded areas can be the site of fracturing if the distortion of the bone exceeds the limits of its elasticity. The inner table will fracture where the skull is indented and the outer table will fracture at the margins of the deformed area.

The following images show the mechanism of skull fracture.



Option A: Trauma most commonly causes subarachnoid hemorrhage, not subdural hemorrhage.

Option B: Fractures lines of the skull do not cross each other. This forms the basis for Puppe's rule.

Option D: The most common type of skull fracture is linear.

Solution to Question 8:

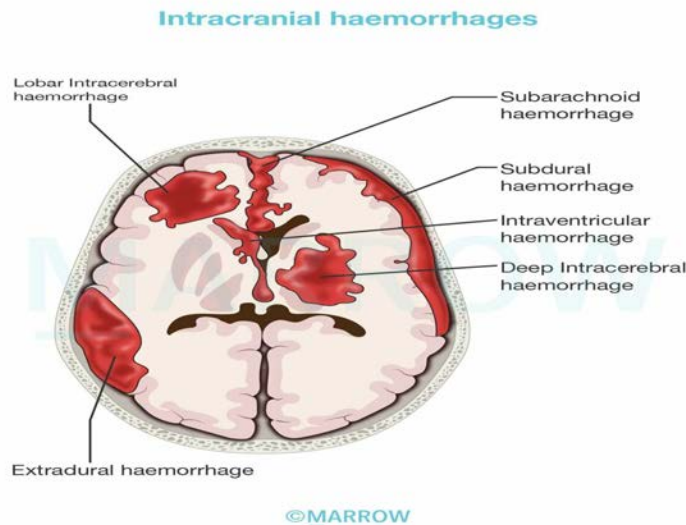
The given clinical scenario describes lucid interval and it is classically associated with extradural/ epidural hemorrhage (EDH).

Patients with EDH present with 3 phases:

- The patient is initially unconscious from the concussive aspect of the head trauma.
- The patient then awakens and has a lucid interval while the hematoma sub-clinically expands.
- As the volume of the hematoma grows, intracranial pressure (ICP) increases, and the patient rapidly becomes lethargic and unconscious.

A lucid interval is a period of normal consciousness and here the person is legally bound by the laws that affect normal people.

The image given below shows the intracranial hemorrhages.



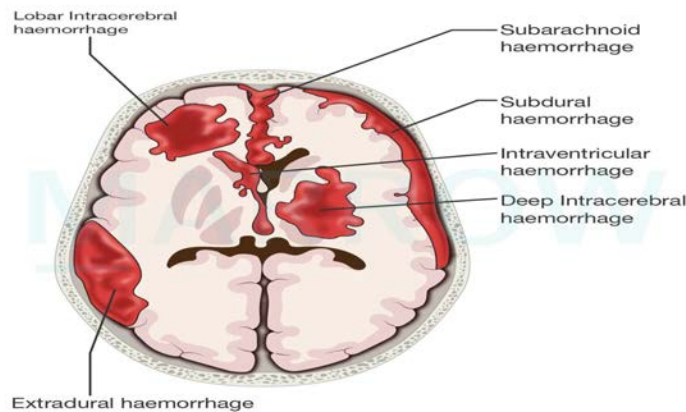
Solution to Question 9:

Extradural hemorrhages (EDH) cannot be ruled out in the absence of a skull fracture.

Most EDH are associated with skull fractures. They usually occur unilaterally in the parieto-temporal area, caused by the rupture of the middle meningeal artery (usually posterior branch). However, they can occur rarely in the absence of any skull fractures or external injuries.

It is the least common type of brain membrane bleeding. A minimum volume of 35 ml is needed before clinical signs are apparent. The clinical signs of an epidural hemorrhage are classically those of a lucid or latent interval.

Intracranial haemorrhages



©Marrow

Solution to Question 10:

The diagnosis in the given scenario is that of a heat hematoma.

Heat hematoma is an artifact that mimics EDH (extradural hemorrhage). This occurs when the head has been exposed to severe external heat sufficient to burn the scalp and skull. The blood may be extruded from the diploë and venous sinuses into the extradural space to produce a heat hematoma. This false hematoma is brown and friable, and the adjacent brain tissue shows hardening and discoloration from the heat.

There is often a significant level of carboxyhemoglobin in the body if the death occurred when the fire was in progress. This should be of the same concentration in the heat hematoma as in the peripheral blood. If the victim suffered a head injury before the fire started (indicating an extradural hemorrhage), then there should be little or no carboxyhemoglobin in the hematoma.

Solution to Question 11:

A subdural hemorrhage is likely to be seen in an autopsy of victims of punch-drunken syndrome.

The punch-drunken syndrome is also known as dementia pugilistica. In this condition, gross findings of the brain include:

- Cortical atrophy
- Slight hydrocephalus
- Perforated septum pellucidum
- Enlargement of the cavum pellucidum
- Tearing of the septal leaves

The cortical atrophy leads to stretching of the bridging veins, which predisposes to a subdural hemorrhage. It is a cumulative process and many episodes of minor head injury add up to produce the typical lesions described.

Solution to Question 12:

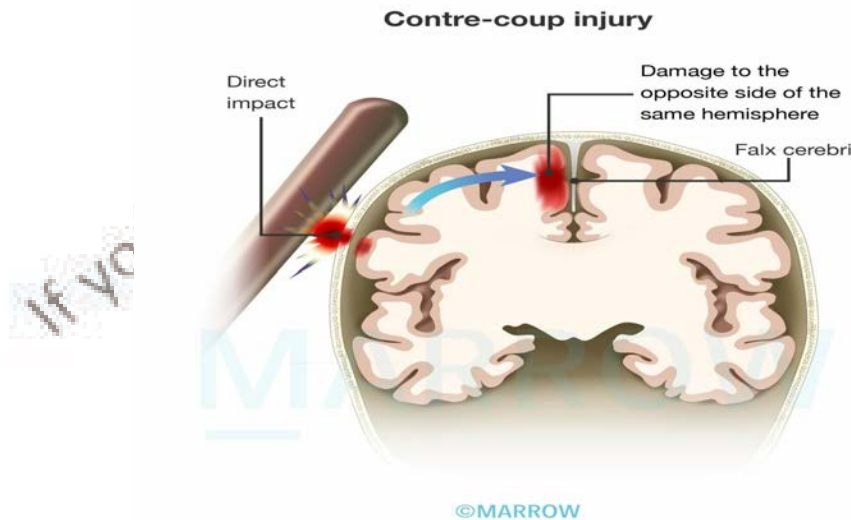
A fall on the frontal region will not produce occipital contrecoup injuries. This is due to the relatively smooth internal surface of the posterior cranial fossa.

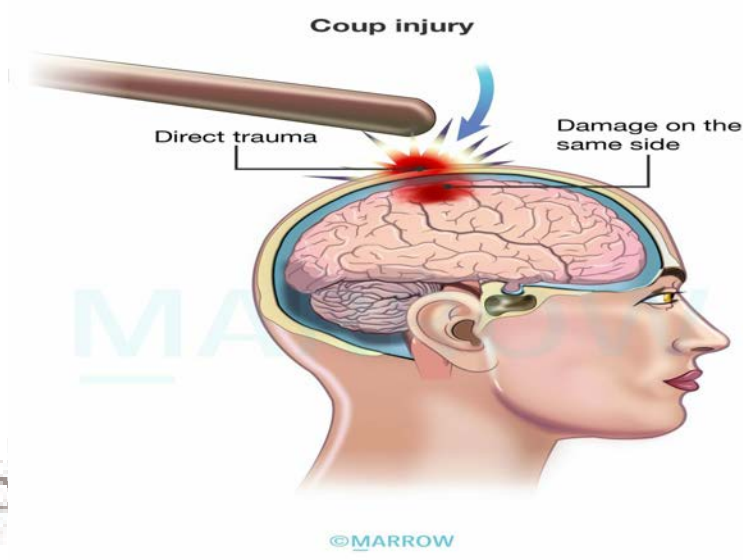
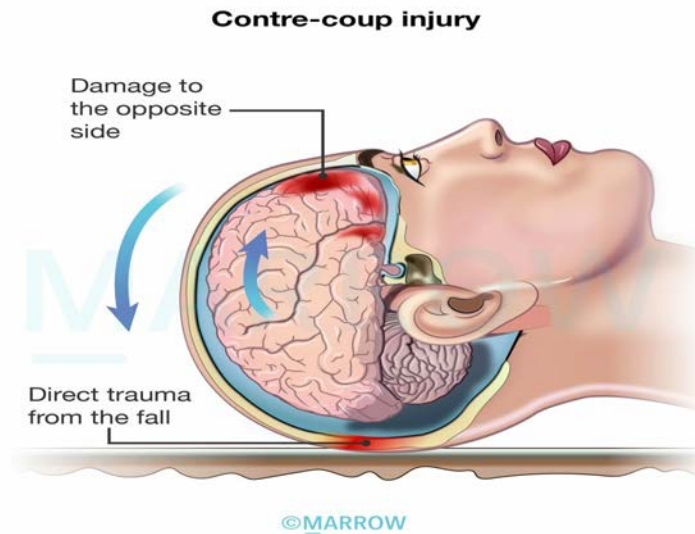
Coup injury is damage that occurs on the same side of the direct trauma. Contrecoup injuries are present opposite to the site of trauma and is due to shear strain.

Fracture of the skull may not occur, even in the presence of severe coup and contrecoup injuries (option A). The skull's anterior and middle cranial fossae have sharp edges. This makes the temporal and frontal lobes highly prone to contrecoup injuries (option D).

A fall on the temporal region can produce a contrecoup injury on the ipsilateral lobe due to the presence of the falx cerebri (option C).

During the impact, the ipsilateral lobe moves in the opposite direction striking the falx cerebri, resulting in contrecoup injury on the same lobe (as the impact) but opposite to the site of initial trauma.





Solution to Question 13:

The given scenario is most likely suggestive of diffuse axonal injury. The most reliable indicator is beta-amyloid precursor protein, seen earliest at 2-3 hours.

Solution to Question 14:

The given image shows retraction balls/ globes which appear at 12-18 hours after injury. Retraction balls are bulbous and clubbed axons. The number of retraction balls begins to decrease 2-3 weeks after injury. This is followed by the appearance of a cluster of microglial cells, astrocytosis, and demyelination.

Solution to Question 15:

From the given options, the hippocampus is most likely to show evidence of damage in the case of a hypoxic brain injury like strangulation. However, third and fourth cortical layers are best for displaying the histological changes of hypoxia.

The parts of the brain most suitable for seeking evidence of hypoxic damage are:

- Boundary zones of the cerebral cortex (the grey matter) - most vulnerable because they lie at the terminal reach of the arterial supply
- Hippocampus (especially CA1 sector = Sommer's area and subiculum)
- Cerebellar folia
- Globus pallidus in the basal ganglia

Solution to Question 16:

The cervical spine is the most commonly injured part of the spinal cord.

The cervical spine accounts for 2/3rd of adult spine injuries. The most common part of the spine to be injured is the upper cervical vertebrae (C1–C4).

The order of frequency of injury to the spinal cord is cervical > thoracolumbar > lumbar > thoracic > sacral level.

Solution to Question 17:

Hyperextension is much more dangerous in causing spinal damage. It is because the weak anterior longitudinal ligament is incapable of preserving the integrity of the cervical spine during hyperextension.

The hyperflexion is protected by the contraction of the strong posterior neck muscles.

Solution to Question 18:

Injury to the brainstem and spinal cord above C4 vertebral level (as C4 vertebrae correspond to C5 spinal level) can be rapidly fatal from disruption of cardiorespiratory regulation centers.

The spinal respiratory center (origin of the phrenic nerve) is mostly composed of the C4 segment of the spinal cord, with a smaller contribution from C3 and C5 segments.

Solution to Question 19:

Rugger jersey spine is not a concussion. It is an X-ray finding, which is characteristic of hyperparathyroidism seen in renal osteodystrophy. However, railway spine, commotio cordis, and Berlin edema are concussions.

A concussion is a violent jerk or shock, or the condition which results from such an injury. The following are concussions of different organs:

- Railway spine - It can occur without any evidence of external injury to the spinal column. It results from a forcible blow on the back, a fall from height, or a bullet injury. It is commonly seen in railway accidents and motor car collisions, also known as the concussion of the spine.
- Berlin edema - It is the edema around the macular region of the retina, caused by a severe blow to the eyeball. It is also known as the concussion of the retina.
- Commotio Cordis - It is the damage to the heart that is frequently fatal. It is due to a sharp non-penetrating blow to the adjacent body surface.

Solution to Question 20:

The patient would survive the injury if it penetrates the left ventricle. In this chamber, the contraction of the layered thick wall may partly or wholly seal the wound, and bleeding can be slight. Hence, chances of survival are high.

The right ventricle is more commonly injured by a stab wound as it presents the largest frontal area. The injury to the right ventricle usually leads to copious bleeding into the pericardial sac. It is because of the inability of the thin wall to close the defect by muscle overlap and contraction.

Solution to Question 21:

Ladder rung tears are multiple parallel intimal tears of the aorta, that are seen in deceleration trauma.

In these injuries, when the thorax is suddenly decelerated, the heart continues to move in the original direction. This causes severe traction on the root of the heart. This leads to ladder rung tears of the aorta.

These may or may not be associated with a complete transection of the aorta. If death is delayed, false aneurysms and dissections may be seen.

Solution to Question 22:

Spleen is the most common organ injured in blunt abdominal trauma.

In blunt trauma, organs that cannot yield to impact by elastic deformation are most likely to be injured, namely, the solid organs (spleen, liver, and kidneys).

The liver is the second most common organ involved in blunt abdominal trauma. The liver is the most commonly injured organ in penetrating trauma.

Solution to Question 23:

Pincer contusions may be seen in trauma to the lungs.

The trauma may lead to bleeding in the lungs, which expands the lower parts of the lungs. The lower margins become trapped in the narrow costophrenic angles causing the contusions.

Solution to Question 24:

The likely cause of injury in the given scenario is shattered windshield glass injury.

In a road traffic accident, the shattered windshield glass produces multiple lacerations, usually on the face. These lacerations resemble sparrow footmarks due to contact with the shattered windscreen glass.

Solution to Question 25:

In this case, head injury is an example of tertiary impact injury. The pedestrian sustained impacts twice (car bumper - primary, windshield - secondary) before hitting on the road.

Injuries to pedestrians:

- Primary impact injuries are caused by the first impact of the vehicle on the victim.
- Secondary impact injuries are further injuries caused by the vehicle.
- Tertiary impact injuries are caused when the victim strikes other objects or falls on the ground after being hit by the vehicle.

Note: In case a pedestrian is hit by the vehicle only once (i.e only primary impact and no secondary impact by the vehicle) and then sustains injuries by falling on the road, it would be an example of secondary injury.

Solution to Question 26:

The rear seats of a car are more dangerous than the front seats.

Option B: Airbags have greatly improved the safety of cars. However, they are associated with injuries themselves like, amputation of fingers, fracture of arms, cervical spine, and head injury.

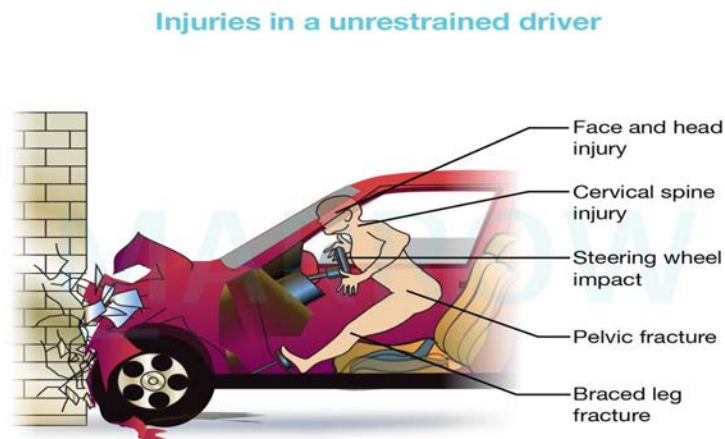
Option C: Thoracic injuries are more common in the driver than the front-seat passenger due to the steering wheel.

Option D: Tail-gating accident occurs when a bike rider drives into the back of a truck. The bike passes underneath, but the head of the motorcyclist impacts on the tail-board. It may also happen to motor cars, and the rear of the truck smashes into the windscreen and driver.

Solution to Question 27:

Lumbar spinal injury is not a major injury to the unrestrained driver of a vehicle in a deceleration impact. However, in these cases, cervical spinal injury is common.

The below image shows major points of injury to an unrestrained driver of a vehicle in deceleration impact.



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Thermal Injuries

Question 1:

Which of the following is not a thermal injury?

- a) Lightning stroke
- b) Burns
- c) Electrical injuries
- d) Gunshot

Question 2:

A person is considered to be hypothermic when their temperature falls below:

- a) 30° C
- b) 32° C
- c) 34° C
- d) 35° C

Question 3:

Temperature regulation by the hypothalamus completely fails below which body temperature?

- a) 28 ° C
- b) 34 ° C
- c) 32 ° C
- d) 30 ° C

Question 4:

An elderly man was brought to the OPD with cold hands and feet. He was found unconscious in a snowstorm near his village. On examination, his temperature showed 32.5°C. Which among the following is least likely to develop in this patient?

- a) Pulmonary edema

- b) Gastric erosions
- c) Acute pancreatitis
- d) Extradural hematoma

Question 5:

A body of a hiker is found naked on a snow trail. It is hypothesized that he actively undressed just minutes prior to his death. Which of the following statements regarding this phenomenon is true?

- a) Indicator of mild to moderate hypothermia
- b) Associated with increased carbon monoxide in circulation
- c) Always associated with hide-and-die syndrome
- d) The mechanism is that of peripheral vasodilation

Question 6:

An elderly woman was found dead during winter in her wardrobe. On house inspection, the heater was found to be broken. She was also identified to be a known case of hypothyroidism. Which of the following most likely explains her scenario?

- a) Myxedema coma
- b) Terminal burrowing behaviour
- c) Paradoxical undressing
- d) Sudden cardiac arrest

Question 7:

A farmer suddenly collapsed on a hot summer afternoon after working on the field since morning. On examination, his pupils were constricted associated with dry hot flushed skin and no sweating. This is seen at a core body temperature above:

- a) 40.5° C
- b) 38.5° C
- c) 39.5° C
- d) 41.5° C

Question 8:

Which of the following scoring systems is used to assess the risk of mortality in a burns patient?

- a) Grant score
- b) Flint score
- c) Baux score
- d) Rockall score

Question 9:

Which of the following statements about burns is true?

- a) Minimum temperature for producing burn is 42°C for 5-6 hours
- b) Minimum temperature for producing burn is 40°C for 3 hours
- c) Minimum temperature for producing burn is 44°C for 5-6 hours
- d) Minimum temperature for producing burn is 44°C for 3 hours

Question 10:

The three-stage classification of burns was provided by:

- a) Dupuytren
- b) Wilson
- c) Heister
- d) Rockall

Question 11:

Which among the following is the most precise method of estimation of burn surface area?

- a) Wallace's rule of nines
- b) Lund-Browder chart
- c) Parkland formula
- d) Dupuytren's classification

Question 12:

What is the primary cause of late mortality in burns?

- a) Laryngeal edema
- b) Multi-organ failure
- c) Hypovolemic shock
- d) Electrolyte imbalance

Question 13:

An autopsy was done on a burn victim. Which of the following is a reliable indicator that the victim was alive while the fire was in progress?

- a) Vital reaction in the burned area
- b) Redness of the exposed skin surface
- c) Elevated carboxyhemoglobin levels
- d) Blistering of the skin

Question 14:

In which of the following injuries is the pugilistic attitude of the victim seen?

- a) Electrical injury
- b) Lightning injury
- c) Burn injury
- d) Blast injury

Question 15:

A victim who allegedly died in a fire at his house was brought in for an autopsy. On examination, he has wounds that appear like lacerations on his forehead and extensor surfaces. There is no sign of bleeding within the deeper tissues in the wound. Which of the following can be an indicator of homicidal death?

- a) There is no evidence
- b) Lacerated looking wounds
- c) Bleeding in the epidural space

d) Elevated HbCO in blood of the heat hematoma

Question 16:

Which of the following statements about heat fractures of the skull is false?

- a) It resembles a spider-web fracture
- b) Seen at the base of the skull
- c) It requires 20 minutes of heat application
- d) It does not involve the suture lines

Question 17:

In a 45-year-old man with a history of burning, the following finding was seen. What is the most likely diagnosis?



- a) Curling ulcer
- b) Marjolin's ulcer
- c) Basal cell carcinoma
- d) Cushing's ulcer

Question 18:

In which of the following condition can Curling's ulcer be seen?

- a) Head injury
- b) Burn victims
- c) Electrical injury
- d) Abdominal trauma

Question 19:

A patient presents with a skin lesion, as shown in the image below. Which of the following is least likely to cause it?



- a) Steam
- b) Chemical fire
- c) Hot water
- d) Molten rubber

Question 20:

A lineman working on an electric pole suffered an electrical injury. Which of the following statements is false about this condition?

- a) The most common cause of death is ventricular fibrillation ending in cardiac arrest
- b) The most dangerous contact path is entry through the right hand and exit through the opposite feet
- c) With repeated exposure, tolerance develops to electric shock

d) Direct current is more damaging than alternating current

Question 21:

While performing an autopsy on a burn victim, the following cutaneous findings were noted. What is the term used to describe these burns?



- a) Crocodile skin
- b) Joule burn
- c) Spark lesion
- d) Filigree burn

Question 22:

Which of the following features of electrical injury will develop if the contact with the electrocuting surface is poorly established?

- a) Crocodile skin
- b) Joule burn
- c) Bone pearl
- d) Spark lesion

Question 23:

The 'hold-on effect' is characteristically seen in

- a) Pugilistic attitude
- b) Immersion foot
- c) Electrical injury
- d) Lightning injury

Answer Key

Question No.	Correct Option
1	d
2	d
3	d
4	d
5	d
6	b
7	a
8	c
9	c
10	b
11	b
12	b
13	c
14	c
15	a
16	b
17	b
18	b
19	b
20	d
21	d
22	d
23	c

Detailed Explanations

Solution to Question 1:

Gunshot wound is not a thermal injury.

Thermal injuries

Thermal deaths are those which result from the effects of systemic/localized exposure to excessive heat and cold.

Heat	Cold	Others
Heat cramps Heat prostration Heatstroke Hyperthermic anhydrosis	Frostbite Trench foot Immersion foot Hypothermia Neonatal cold injury	Burns Scalds Electrical injuries Lightning stroke

Solution to Question 2:

Hypothermia occurs when the body's core temperature drops below 35°C.

- Mild hypothermia – Core temperature 32 to 35°C (90 to 95°F)
- Moderate hypothermia – Core temperature 28 to 32°C (82 to 90°F)
- Severe hypothermia – Core temperature below 28°C (82°F)

Solution to Question 3:

Once the body temperature has fallen below about 85°F (30°C), the ability of the hypothalamus to regulate temperature is lost.

For each 10°F decrease in body temperature, the rate of chemical heat production in each cell is depressed almost twofold. This is the reason for diminished temperature regulation. Sleepiness followed by coma, depresses the activity of the CNS heat control mechanisms and prevents shivering.

Solution to Question 4:

Extradural hematoma is not a common finding in patients with hypothermia.

Autopsy findings of hypothermia:

- Pink discoloration of the skin - due to persistent oxyhemoglobin in the skin capillaries.
- Acute gastric erosions - The stomach mucosa is frequently studded with numerous shallow ulcers called Wischnewski spots. The floor of each spot contains a dark brown plug of altered blood.

- Acute pancreatitis - present in less than half the deaths from proven hypothermia.
- Pulmonary edema.
- Perivascular hemorrhages.

The image below shows Wischnewski spots:



Note: A condition resembling extradural hematoma may be found in burns patients, called heat hematoma.

Solution to Question 5:

The given phenomenon of paradoxical undressing is likely due to peripheral vasodilation.

It is a phenomenon encountered in severe hypothermic states. It is characterized by the act of active undressing, despite low ambient temperatures. Proposed mechanisms are:

- Reflex vasoconstriction, which happens in the first stage of hypothermia, leads to paralysis of the vasomotor center thus giving rise to the sensation that the body temperature is higher than it really is.
- Vasodilatation happens when cold-induced paralysis of the nerves in the vessel walls gives an absurd feeling of heat.

Other associated features include:

- Bruises and scratches of the knees, shanks, and upper limbs caused by late-phase attempts at crawling.
- The hide-and-die phenomenon in some cases.

Solution to Question 6:

The most likely explanation for the given scenario is terminal burrowing behaviour or hide and die syndrome.

An elderly lady with hypothyroidism is more likely to develop hypothermia. About 20% of hypothermia cases are associated with terminal burrowing behaviour.

In some cases the bodies were found in strange situations, i.e. lying under a bed, behind a wardrobe, or on a shelf, etc. indicating that the final positions were a kind of self-protective burrowing-like behaviour.

Solution to Question 7:

The given scenario is suggestive of heatstroke and a core temperature $>40.5^{\circ}\text{C}$ helps establish the diagnosis.

As body core temperature rises, excessive cutaneous vasodilation can lead to a fall in arterial pressure and therefore to a decrease in brain perfusion. This leads to a total loss of thermoregulatory function. As core temperature approaches 41°C , sweating stops, confusion and, ultimately, loss of consciousness occurs.

Solution to Question 8:

The Baux score was used for many years to predict mortality in burns.

Baux score: Mortality risk = age + %TBSA

Advancements in burn care have lowered overall mortality to the point that the Baux score may no longer be accurate. However, age and burn size, as well as inhalation injury, continues to be the most robust indicators for burn mortality.

Solution to Question 9:

The lowest temperature that causes burn damage is 44°C and requires 5-6 hours before a burn appears.

Solution to Question 10:

The three-stage classification of burn degrees was provided by Wilson.

Wilson classification of burns:

- First degree - Erythema and blistering without loss of dermis
- Second degree - Destruction of the full thickness of skin
- Third-degree - Destruction of deeper tissues below the skin

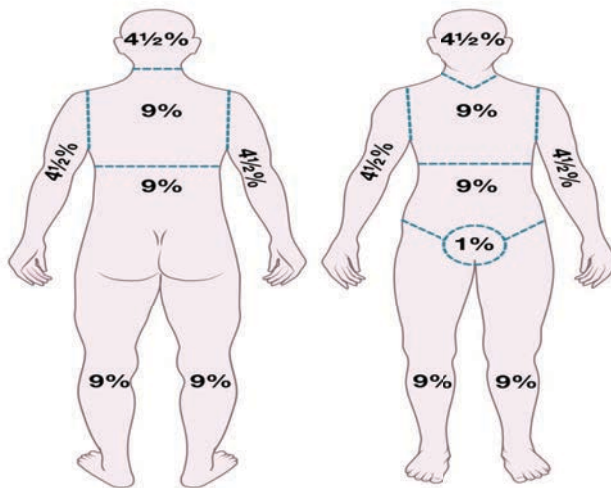
Solution to Question 11:

The Lund-Browder burn diagram is the most precise method of estimation of burn surface area in children and adults.

This allows an accurate age-adjusted determination of burn size for a given depth, allowing for the anatomical differences of children.

Methods of estimation of burn surface area:

Rule of nines (Wallace) - It divides the body into segments that are approximately 9% or multiples of 9%, with the perineum forming the remaining 1%. Because of the proportionately larger heads and smaller legs of infants and children, this method must be modified in pediatric burn injuries.



Use of patient's hand - The area of the back of the patient's hand is approximately 1% of their total body surface area. The number of 'hands' that equal the area of the burn can approximate the percentage of body surface area burned.

Solution to Question 12:

The primary cause of late mortality in burns is septicemia and multiorgan failure.

The primary cause of early mortality in burns is burn shock. The term burn shock describes the rapidly developing hypovolemic circulatory failure seen in the first 72 hours after burns.

Solution to Question 13:

Elevated levels of carbon monoxide in the circulating blood and carbon particles in the air passages and lungs are reliable indicators suggesting that the victim was alive while the fire was in progress.

The carbon monoxide concentration in blood depends on various factors like the concentration of carbon monoxide in the air, blood hemoglobin level, duration of exposure, etc. The presence of carbon particles and elevated Carboxy hemoglobin levels are absolute proof that the victim was alive when the fire occurred. Though there is no definite level that confirms the presence or absence of carboxyhemoglobin in the blood, a level of 10% is needed to confirm unless the person is a heavy smoker.

Solution to Question 14:

The attitude of general flexion called the pugilistic attitude is seen in a burn victim.

Muscle contractures are common where substantial heat has reached the body. The muscle becomes shortened by dehydration and protein denaturation. The flexors, being bulkier than the extensors, contract more and force the limbs into a position of general flexion, the so-called boxer's or pugilistic attitude.

Solution to Question 15:

In the above scenario, there is no evidence that indicates the victim may have died from a homicidal injury and that the fire may have been used to cover up the crime.

The lacerated-looking wounds found in this victim are spurious findings commonly found in burn victims.

Spurious wounds in burns :

- Skin splits - Heated skin contracts markedly and splits often appear. These splits may be anywhere but are especially seen over extensor surfaces and joints, as well on the head. The false split will show no bleeding in the deeper tissues and its position is usually suggestive.
- Heat hematoma - the mass of blood resembling a true extradural hematoma may form between the skull and the dura. This may arise either from venous sinuses or out of the diploic space in the skull through emissary venous channels.

If death occurred during the fire (antemortem), levels of carboxyhemoglobin will be elevated in the blood and the heat hematoma. If the victim died before the fire (postmortem), the levels of carboxyhemoglobin will be little to none.

Solution to Question 16:

Heat fractures of the skull are most commonly seen at the sides of the skull, usually bilaterally.

Fractures to the base of the skull are unheard of in the case of thermal fractures and should be considered to be an antemortem injury.

Heat fractures of the skull take approximately 20 minutes of heat application before the skull starts to crack

The pattern of fracture commonly resembles a spider web. They may cross the suture line but usually do not involve the sutures, even in young persons with un-united sutures.

Solution to Question 17:

The image shows a 'Marjolin ulcer' which is a rare type of SCC (squamous cell carcinoma) that arises in sites of chronic wounds or scars.

The malignant transformation is slow, with an average latency time of approx 30 years.

The tumor may initially present as:

- Ulceration
- Nodules
- Rolled or everted wound margins
- Excessive granulation tissue
- A rapid increase in size
- Bleeding on touch.

Solution to Question 18:

Curling's ulcers are seen in burn victims.

This is seen due to intravascular depletion leading to mucosal ischemia and disruption of the protective mucosal barrier.

H₂ -receptor antagonists or PPIs have proved effective against the development of stress gastritis.

Note: Brain tumors, traumatic head injury, and other intracranial processes including infections can cause increased intracranial pressure. This leads to overstimulation of the vagus nerve. As a result, increased secretion of gastric acid may occur which leads to gastro-duodenal ulcer formation known as Cushing's ulcer.

Solution to Question 19:

The given image shows a scald injury. A chemical fire is going to cause a burn, not a scald.

Scalds are sharply demarcated lesions with reddening, desquamation, and blistering. When tipped or splashed, the hot liquid runs under gravity so that trickle patterns may be seen.

It is caused due to tissue damage from hot liquids like:

- Hot water
- Hot oils
- Molten rubber
- Liquid chemicals
- Steam.

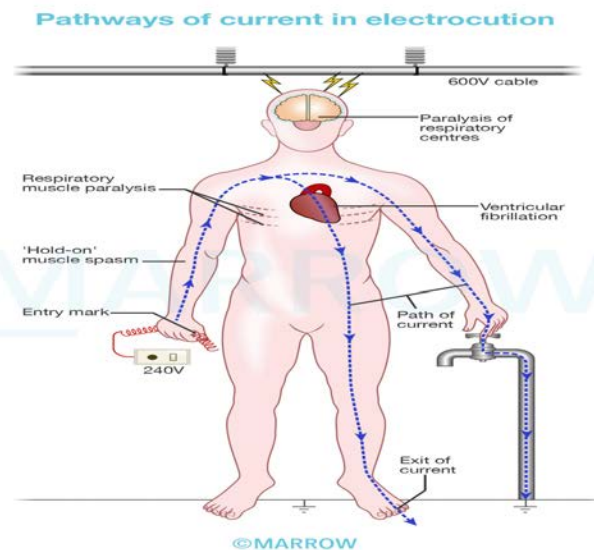
Solution to Question 20:

Alternating current is more damaging than direct current.

It has been claimed that the most dangerous current path is contacted with the right hand and exits through the left foot, as this causes the maximum of the total body current to flow through the heart. when compared with head to feet, left hand to feet, hand to hand, or foot to foot.

Most deaths from electricity are from cardiac arrhythmias, usually, ventricular fibrillation ending in cardiac arrest.

It is commonly said that tolerance can be gained to electric shock and that professional electricians often work on live 240 V conductors with impunity.



Solution to Question 21:

The term used to describe the burns shown in the image is filigree burn or arborescent burn or Lichtenberg's flower or feathering. It is a finding in burns due to lightning.

The fern-like pattern of erythema in the skin indicates the path taken by the electrical discharge. It usually occurs over the shoulder or the flanks within an hour of the injury and disappears in a

day or two. It occurs due to the rupture of small vessels and is seen in a fern-like pattern or the branching of a tree.

Option B: When the skin is in firm contact with an electrical conductor, splitting of the layers of the epidermis or those of the epidermal-dermal junction. This may in turn produce a raised blister known as a Joule burn.

The image below shows a Joule burn:



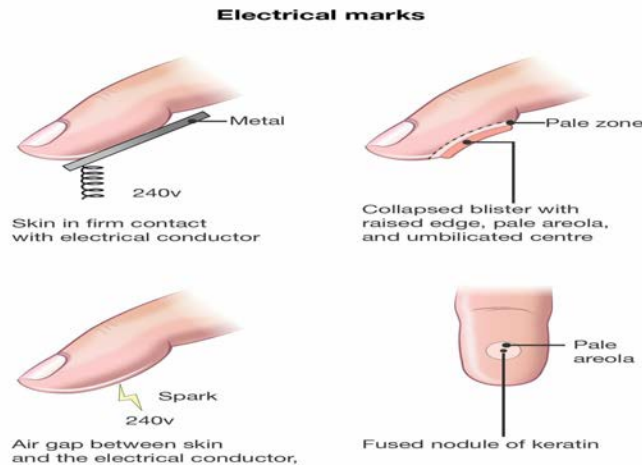
Option C: When the contact is less firm, an air gap is formed between the skin and the conductor. Thus the current traverses the gap as a spark. This leads to a distinct hard brownish keratin nodule raised above the surrounding surface known as a spark lesion.

Option A: Crocodile skin effect is caused by high-tension current burns, where the voltage is in the multi-kilovolt range, sparking may occur over many centimeters. This can cause multiple spark lesions giving rise to a crocodile-skin effect.

The image below shows multiple spark lesions and the inset shows the crocodile skin effect:



Image below shows the various electrical marks.



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Solution to Question 22:

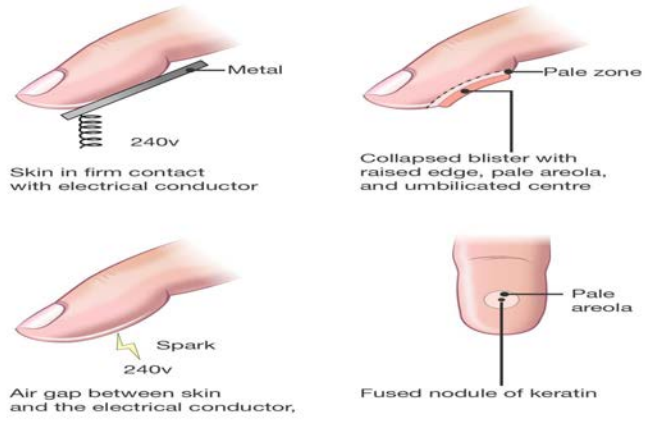
When the contact with the electrocuting surface is not firm, the skin lesion that develops is called a spark lesion.

When the contact is less firm, an air gap (albeit narrow) exists between skin and conductor the current jumps the gap as a spark. This causes the outer skin keratin to melt over a small area. On cooling, the keratin fuses into a hard brownish nodule, usually raised above the surrounding surface.

Various skin lesions in electrical injury:

- When the skin has been in firm contact with an electrical conductor, this may split the layers of the epidermis or the epidermal-dermal junction and produce a raised blister called Joule burns.
- In high-voltage burns, such as those sustained from high-tension grid transmission cables, where the voltage is in the multi-kilovolt range, sparking may occur over many centimeters. This can cause multiple spark lesions giving rise to a 'crocodile-skin' effect.
- The heat generated by the current may melt the calcium phosphate, which is radiologically seen as typical round dense foci called as 'bone pearls' or 'wax drippings'.

Electrical marks



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Solution to Question 23:

The hold-on effect is seen in electrical injuries.

When the entry point is in the hand, the stronger flexor muscles of the arm go into spasm and cause a hold-on effect. Any object being held in the hand is involuntarily clenched and the current thus continues to flow.

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If you purchased this from someone else,
you may have been scammed.

Firearm Injuries and Blast Injuries

Question 1:

What is the study of the processes in a firearm known as?

- a) Forensic ballistics
- b) Internal ballistics
- c) External ballistics
- d) Terminal ballistics

Question 2:

Which of the following is a smooth barrel weapon?

- a) Shotgun
- b) Revolver
- c) Single shot pistol
- d) Machine guns

Question 3:

The term 'choking' as understood in ballistics, applies to which of the following?

- a) Barrel of a shotgun
- b) Ammunition of a shotgun
- c) Barrel of a rifled gun
- d) Mechanism to increase the range of shots fired

Question 4:

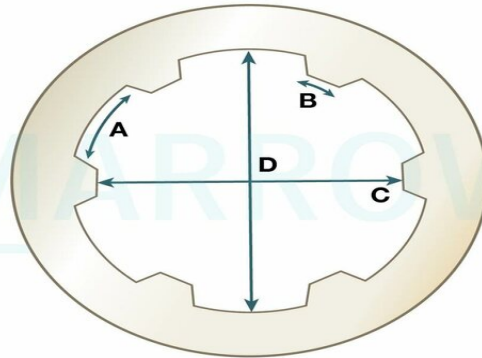
Which of the following is useful in identifying the make and model of a gun?

- a) Primary markings
- b) Secondary markings
- c) Bullet fingerprinting

d) Rifling

Question 5:

Which of the following marked distances is described as the caliber of a rifled gun?



- a) Distance D
- b) Distance C
- c) Distance B
- d) Distance A

Question 6:

Which of the following structures is not found in a shotgun ammunition?

- a) Wads
- b) Metal cylinder
- c) Percussion detonator
- d) Primer

Question 7:

Which of the following are constituents of smokeless gunpowder?

- a) 1, 2 and 5

- b) 2, 4 and 5
- c) 2, 3 and 4
- d) 1, 3 and 4

Question 8:

A patient presents to the E.R. with a history of a gunshot wound sustained while on a hunting trip. X-ray findings are as given below. Which of the following weapons is most likely to produce this type of lesion?



- a) Shotgun
- b) Assault rifle
- c) Sporting rifle
- d) Machine gun

Question 9:

In a patient presenting to the emergency with a firearm injury, you notice peppering around the wound. Which of the following agents is most likely responsible for that effect?

- a) Smoke
- b) Primer
- c) Pellets
- d) Gunpowder

Question 10:

An autopsy of a victim who sustained a revolver gun injury is being done. On examination of the entry wound, singeing of hair can be seen. What is the likely distance between the gun and the victim?

- a) <15 cm
- b) <30 cm
- c) <45 cm
- d) <1 m

Question 11:

In a shotgun-injury victim, you note rat hole appearance of the entry wound. From what range was it most likely fired?

- a) Contact shot
- b) Close range
- c) 15-30 cm
- d) 30 cm - 5 metres

Question 12:

A person has been shot by a full choke shotgun. On examination, the dispersion of pellets is 25 centimetres. The range of firing is most likely to be?

- a) 12.5 metres
- b) 10 metres
- c) 50 metres
- d) 100 metres

Question 13:

What is the retrograde propulsion of tissue from the entry wound towards the firearm known as?

- a) Blowback phenomenon

- b) Retrodispersion
- c) Backward scatter
- d) Backspatter

Question 14:

The skeletal remains of a person were brought to a forensic lab. The following gunshot wounds were found on his skull. Which of the following is true about these wounds?



- a) A is the entry wound
- b) B is the entry wound
- c) A and B both are entry wounds
- d) B is a close-range shot

Question 15:

A gunshot victim is brought to you for an autopsy. On examination, you note 2 wounds. Which of the following is a reliable sign to differentiate entry from an exit wound?

- a) Inverted edges of the wound
- b) Round shape of entry wound
- c) Abrasion collar
- d) Grease ring

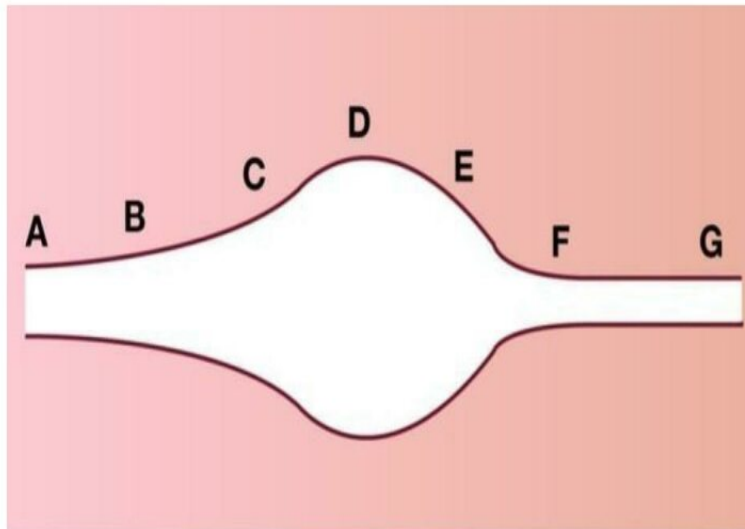
Question 16:

All of the following bullets are modified to ensure that it slows down in the body to impart maximum damage except?

- a) Dumdum bullet
- b) Softheaded bullet
- c) Explosive-tipped bullet
- d) Tracer bullet

Question 17:

The following image shows the resulting wound cavity from a bullet. Which of the following explains the shape of the wound cavity?



- a) Yawing bullet
- b) Tandem bullet
- c) Ricochet
- d) Souvenir bullet

Question 18:

In a case of suspected homicide, the wife has been arrested for allegedly shooting the husband. She was found to be guilty based on the presence of gunpowder residue on her hands. Which of the following tests is most sensitive for the detection of gunpowder residue?

- a) Inductively coupled plasma atomic emission spectroscopy
- b) Neutron activation analysis
- c) Scanning electron microscopy with energy dispersive X-ray analysis
- d) Flameless atomic absorption spectroscopy

Question 19:

The lead fragments when stripped from the bullet as it travels through the body, cause multiple fragments along the wound track. What is this phenomenon called?

- a) Lead snowstorm
- b) Wound peppering
- c) Bullet scatter
- d) All of the above

Question 20:

While recovering a bullet from the crime scene, which of the following should be followed?

- a) Bullet should be picked up with metallic toothed forceps
- b) Bullet should be removed with bare hands
- c) Bullet should be packed in leakproof packaging made of hard plastic
- d) Bullet should be wiped with a clean cloth to remove dirt

Question 21:

A police inspector presents to the E.R. with an abrasion on his forearm as shown in the image below. He gives a history of being shot at while trying to prevent an armed burglary. Identify the type of injury.



- a) Bullet bruise
- b) Bullet graze
- c) Bullet mark
- d) Bullet wipe

Question 22:

What is bullet wipe?

- a) Residual from barrel of gun
- b) Blackening
- c) Gutter fracture of skull
- d) Tattooing

Question 23:

What is the bullet recovered from the victim of a homicidal shooting known as?

- a) Crime bullet
- b) Test bullet
- c) Exhibit bullet
- d) Suspect Bullet

Question 24:

A retired army officer was advised to undergo a complete health check-up. During an examination, the radiologist identifies a bullet present in the body surrounded by a dense fibrous tissue capsule. What type of bullet is it called?

- a) Tandem bullet
- b) Piggyback bullet
- c) Incendiary bullets
- d) Souvenir bullet

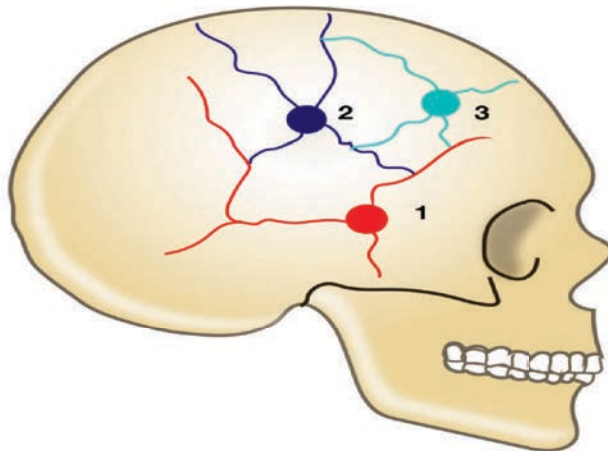
Question 25:

Choose the option with correct matches:

- a) 1-d, 2-b, 3-a, 4-c
- b) 1-b, 2-c, 3-a, 4-d
- c) 1-c, 2-a, 3-b, 4-d
- d) 1-d, 2-a, 3-b, 4-c

Question 26:

A forensic expert receives the skull of a gunshot victim. What is the sequence of gunshots in this case?



- a) 3° 2° 1
- b) 2° 1° 3
- c) 2° 3° 1
- d) 1° 2° 3

Question 27:

What is a Molotov cocktail?

- a) Alcoholic poison
- b) Incendiary bomb
- c) Acid bomb
- d) Rifled firearm

Question 28:

Which is the most severely injured organ in blast injuries in underwater and air respectively?

- a) Intestine, Lung
- b) Lung, Intestine
- c) Tympanic membrane, Lung
- d) Lung, Tympanic membrane

Question 29:

Following a blast, a man was brought from the scene to the emergency with multiple small puncture wounds to the right side of the chest, below the nipple, and multiple small abrasions and bruising over the left lower abdomen. Which of the following mechanisms is responsible for these injuries?

- a) Flying missiles
- b) Blast of air
- c) Explosion burns
- d) Building collapse

Answer Key

Question No.	Correct Option
1	b
2	a
3	a
4	a
5	b
6	b
7	d
8	a
9	d
10	a
11	d
12	b
13	d
14	a
15	d
16	d
17	a
18	c
19	a
20	c
21	b
22	a
23	a
24	d
25	d
26	d
27	b
28	a
29	a

Detailed Explanations

Solution to Question 1:

The study of the processes in a firearm is known as internal ballistics.

Ballistics is the science of mechanics that deals with the flight, behaviour and effects of projectiles. It has the following types:

- Internal ballistics deals with the processes in a firearm.
- External/Exterior ballistics deals with the behaviour of the projectile after leaving the barrel.
- Wound ballistics comprises the changes caused when a missile penetrates a human or animal body.
- Forensic ballistics is the application of ballistics for forensic purposes
- Terminal ballistics deals with the study of the interaction of a projectile with its target.

Solution to Question 2:

Shotgun is a smooth barrel weapon. It is usually designed to be fired from the shoulder, which uses the energy of a fixed shell to fire a number of small spherical pellets called shot, or a solid projectile called a slug.

Types of firearms:

The image given below shows a shotgun.

Rifled weapons	Smooth barrel weapons (Shotgun)
Rifles: Air and gas operated rifles Military and sporting rifles Single shot pistols Revolvers Automatic pistols True automatic weapons (machine guns)	Single barrel Double barrel Slide-action Bolt-action Semi-automatic Automatic



Solution to Question 3:

Choking is a modification applied to the barrel of a shotgun.

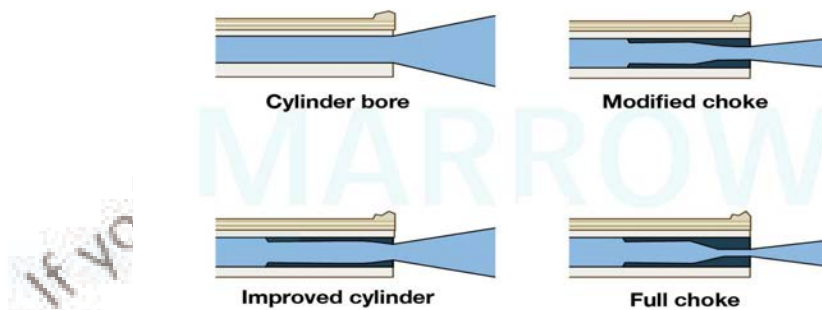
Choke is where the barrel is modified such that it slightly tapers towards the muzzle. This will produce a narrower cone of shot when the ammunition is fired and thus, prevents dispersion of pellets. This can thus affect estimation of range of firing when examining the entry wound.

Types of choking:

- Improved cylinder
- Modified choke
- Half-choke
- Full-choke

Note: The choke is a device towards the tapered end of the muzzle of a shotgun that aids in the estimates of range derived from the size of the wound and controls the shot pattern. It does not increase the range of the shotgun thus making option A the appropriate choice.

Types of Choking



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Solution to Question 4:

Primary markings is specific to the make and model of the gun. These are formed when a bullet passes through a barrel and the sides are marked by the rifling of the barrel.

Irregularities on the inner surface of the barrel itself which are specific for that particular weapon are also seen on the bullet and are called secondary markings / characteristic markings.

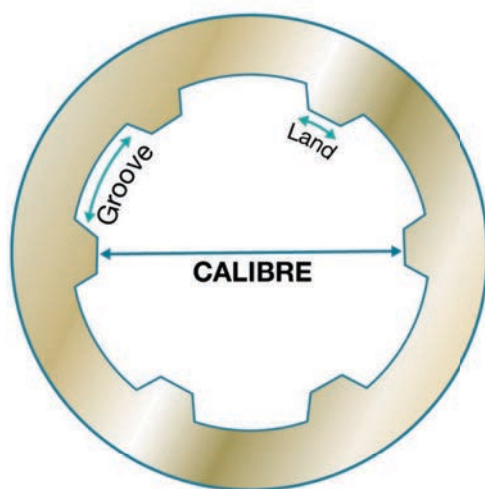
Secondary markings are used for bullet fingerprinting.

Rifling is the process of adding spiral grooves on to the inside of the barrel of a gun. The elevations between the grooves are called 'lands'. These grip the bullet and impart onto it a rotatory movement. This has a gyroscopic effect that increases the stability of the bullet's trajectory and hence the accuracy.

Solution to Question 5:

The caliber of a rifled gun is described as the marked distance C in the image. Caliber is measured as the distance between two diametrically opposite lands.

It is the internal dimension of the barrel and is measured in millimeters or inches.



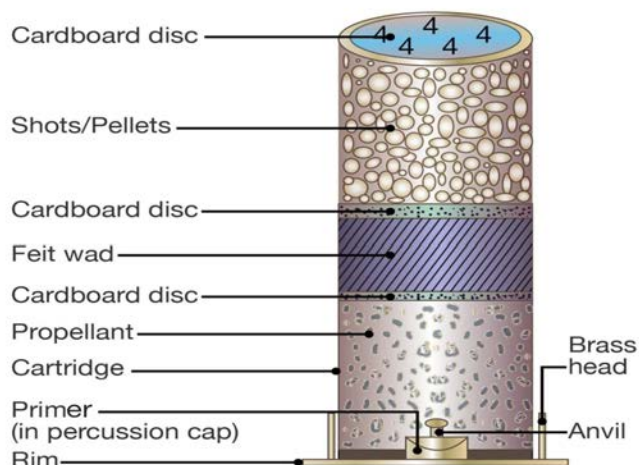
Note: For a smooth barrel weapon, it is measured as the distance between two diametrically opposite points on the inner circumference.

Solution to Question 6:

A shotgun cartridge does not have a metal cylinder. It has a metal base, but the cylinder is made of cardboard.

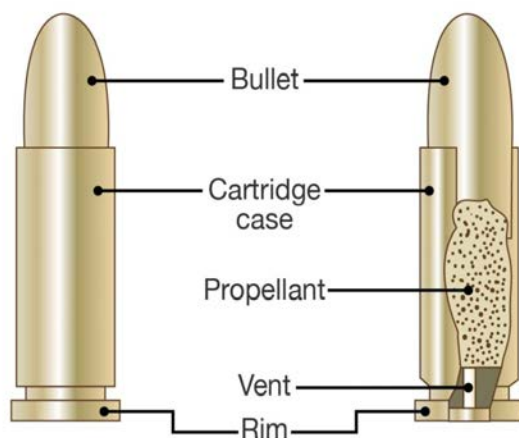
The ammunition for the shotgun is a cartridge made of a cardboard or plastic cylinder fitted into a metal base. The base carries a percussion detonator that is struck by the spring-loaded firing pin when the trigger is pulled. The primer is located in the percussion cup and contains the detonator. The cartridge contains a charge of propellant (gunpowder), above which are 'wads' or pistons of felt, cardboard or plastic discs, or both. Above these is the charge of shot (pellets), which varies greatly in number and size, finally covered by a card or plastic disc.

The image given below shows a shotgun cartridge.



The ammunition of a rifled weapon has a metal cylinder, closed at one end, which is the shell or cartridge. The cylinder carries a percussion detonator in the base, either centrally or peripherally. The shell is loaded with an explosive propellant such as nitrocellulose and the bullet is firmly clamped into the open end.

The image given below shows the cartridge of a rifled gun.



Solution to Question 7:

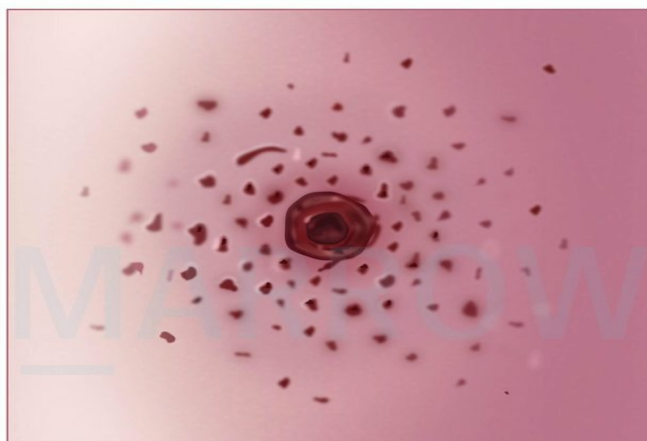
Smokeless gunpowder contains nitroglycerine, nitrocellulose and nitroguanidine.

Solution to Question 8:

The radiograph is suggestive of a close-range shotgun blast injury to the knee. Birdshot pellets are visible within and around the shattered patella, distal femur, and proximal tibia.

The ammunition for the shotgun is a cartridge made of a cardboard or plastic cylinder fitted into a metal base. The base carries a percussion detonator that is struck by the spring-loaded firing pin when the trigger is pulled. The primer is located in the percussion cup and contains the detonator. The cartridge contains a charge of propellant (gunpowder), above which are 'wads' or pistons of felt, and cardboard or plastic discs, or both. Above these is the charge of shot (pellets), which varies greatly in number and size, finally covered by a card or plastic disc.

The image given below shows the entry wound in the case of a shotgun. There is a central round hole, with multiple pellet holes scattered around the central hole. This wound is most likely to have been caused by a shotgun from a range of 1-5 m.



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Solution to Question 9:

Burning, partly burnt and unburnt propellant flakes and grains may pepper the surrounding of the wound. This effect is known as tattooing.

Effects seen in entry wounds:

Effect	Description	Range at which it is seen in s hotgun wound	Range at which it is seen in ri fled gun wound
Burning	Burning of skin and singeing of hair from hot gases	<30 cm	<15 cm
Soiling	From the smoke/soot	<50 cm	<15 cm
Tattooing	Peppering of the skin with un burnt/partially burnt gunpow der	<1 metres	30-45 cm
Rat nibbli ng	Nibbled appearance of the en try wound	>30 cm to 5 metres	Not seen

Solution to Question 10:

Singeing of hair around the entry wound of a revolver gun may be seen up to a distance of 15cm of range of firing.

Features of firearm injuries by revolver or pistol	Contact shot	Close shot	Near shot	Distant shot
	In close contact	Victim lies within the range of flame	Victim lies within the range of powder deposition but outside the flame range	Victim lies outside the range of flame and powder deposition
Approximate distance between victim and firing	Gun in contact with the victim	5-8cm	<50 cm	>50 cm
Muzzle imprint	Seen	Not seen	Not seen	Not seen
Entry wound edges	Large and irregular due to explosion of gases	Circular with inverted edges	Round, equal or smaller than diameter of bullet due to elastic recoil of the skin	Round, equal or smaller than diameter of bullet due to elastic recoil of the skin
Burn	Present	Present	Absent	Absent
Blackening (smoke)	Present	Present	Present (usually present up to 15cm)	Absent
Tattooing	Present	Present	Present	Absent
Grease and collar	Present	Present	Present	Present

Solution to Question 11:

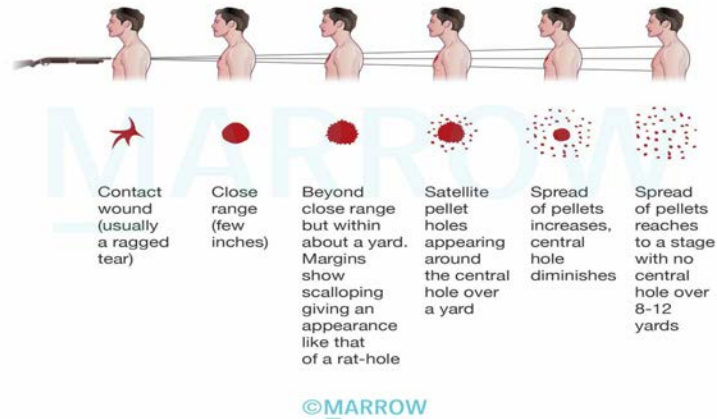
A rat-hole appearance of the entry wound of a shotgun can be seen from 30 cm to 5 meters of range.

Rat-hole wounds:

- Circular rat-hole wound without peripheral satellite pellet holes - 30cm-1m range.
- Central rat-hole wound with peripheral satellite pellet holes - 1m-5m range.

The image given below shows characteristics of shotgun wounds at various ranges.

Characteristics of shotgun wounds at various ranges



Contact shot (soft tissue)

- Single circular wound of size about the diameter of the muzzle
- Muzzle imprint
- No soot soiling, tattooing or singeing.

Contact shot (bone)

- Wound may be ragged and split from gas rebound
- Muzzle imprint
- No soot soiling, tattooing or singeing.

<30cm

- Circular wound
- Surrounding soot soiling
- Singeing - Burnt hair
- Tattooing - Punctate skin lesions from powder particles.

30cm - 1m

- Circular rat-hole wound
- Soot soiling
- Powder tattooing.

1m - 5m

- Central rat-hole wound
- Satellite pellet holes around the periphery
- No soot soiling or tattooing.

>5m

- Diffuse pellet pattern
- No central hole
- No soot soiling, tattooing or singeing.

Solution to Question 12:

The range of firing is most likely to be 10 metres.

Approximate spread of shot in centimetres at various distances :

	5 met res	10 met res	15 met res	20 met res
Cylinder	20	50	60	75
Half choke	13	30	40	50
Full choke	8	25	35	45

Solution to Question 13:

The retrograde propulsion of tissue from the entry wound towards the firearm is known as backspatter.

Gunshot contact wounds and close-range discharges may cause blood and tissue fragments to enter the muzzle. It is due to negative pressure created following the discharge. This is known as backspatter.

Sometimes blood and tissue may soil the hand or arm of the person firing the gun, a matter of considerable significance in forensic science.

Option A: Blowback phenomenon: This is seen at the entry wound in a contact shot against a bone, where the gases rebound against the bone and exit through the entry wound, creating a stellate shaped margin at the entry wound.

Option B & C: Retrodispersion and backward scatter are not effects seen in firearm injuries.

Solution to Question 14:

In the given image, A is the entry wound as it has a clean punched-in appearance on the outer table of the skull. Whereas B is the exit wound as it shows beveling (sloping surface) on the outer table of the skull.

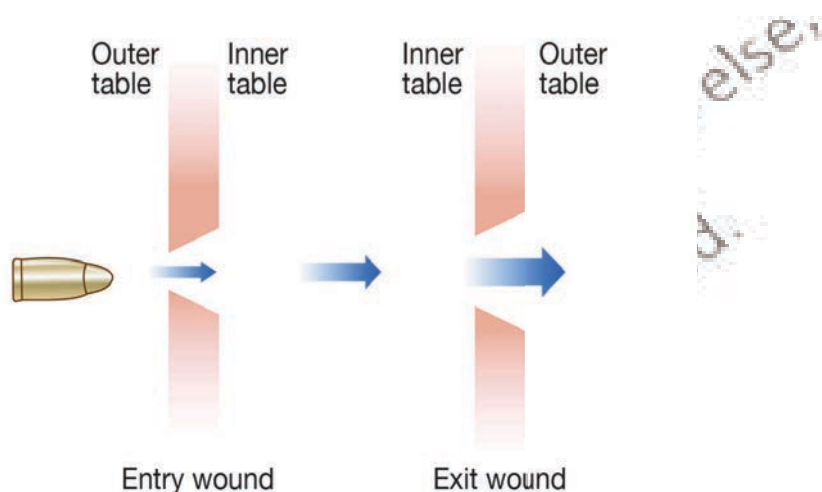
Entry wound: The initial contact of the missile punches a clean hole through the outer table of the skull. Where the bullet emerges internally, the inner table is then unsupported and a cone-shaped

plug is detached, forming a crater that is appreciably larger than the external hole.

- Bevelling: inner table
- Punched out hole: outer table

Exit wound: If the bullet traverses the cranium and penetrates the opposite side, the same pattern occurs, this time with the small hole on the inner table and the crater on the outside.

- Bevelling: outer table
- Punched out hole: inner table



Krönlein shot is a rare injury of the skull caused by a close-range shot. Here, the cranium is blasted open and large pieces of brain matter are ejected out of the skull.

Solution to Question 15:

Grease ring is a reliable sign to differentiate entry from an exit wound.

The abrasion collar or its inner parts may be blackened due to overlying sooty remnants wiped off by the bullet when hitting uncovered skin. This finding is called a grease ring, a ring of dirt or bullet wipe-off. It can be regarded as a reliable sign of entrance.

Option A: Inverted edges cannot be regarded as a reliable sign of entry wound. The edges of an entry wound may be everted by the blowback phenomenon in a contact wound. This occurs when the gases strike a bony surface and are reflected back, everting the entry wound edges.

Option B: The round shape of entry wounds is unreliable as entry wounds and exit wounds may be of many shapes. This depends on many factors, including the range of firing, angle of firing, presence of subcutaneous bone, etc.

Option C: In an abrasion collar the skin immediately around the central hole is discoloured, the so-called 'abrasion collar' or 'contusion ring'. The abrasion ring is primarily due to the massive overstretching and subsequent drying-up of the skin adjacent to the area of projectile impact. It

cannot be taken as a reliable sign of entry wound as an exit wound may have a spurious abrasion collar. This occurs when the exit wound is supported against a hard surface and the emerging bullet slams the wound periphery against this surface.

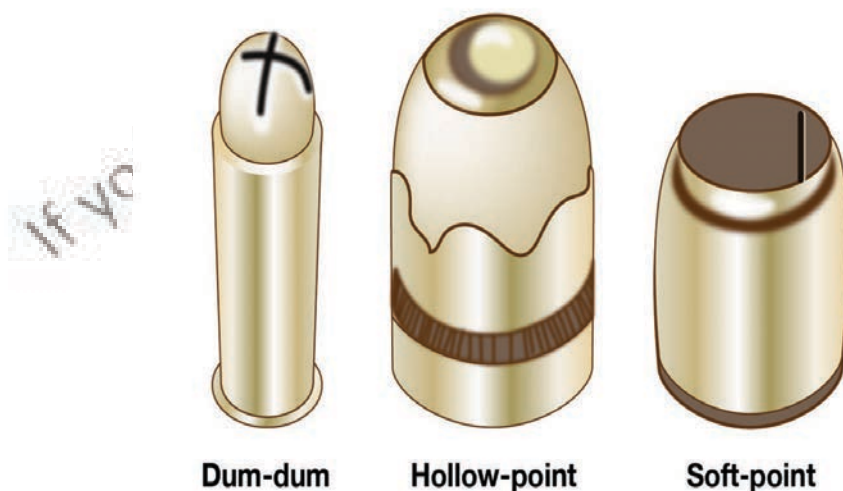
Solution to Question 16:

All the bullets mentioned in the options are modified to ensure that on entering the body, they slow down enough to impart maximum damage except tracer bullets.

For damage to occur, some or all of the kinetic energy of the missile has to be absorbed by the target tissues, where it is dissipated as heat, noise and mechanical disruption. When a missile passes completely through soft tissues, it may retain much of its original kinetic energy and fail to transfer any appreciable amount to the tissues.

To ensure transfer of energy to the tissues, some missiles are especially designed or modified to slow up or stop within the body.

- Softheaded bullets will flatten on impact and some are designed to fragment.
- The dum-dum bullet fragments upon striking and transfers more energy for tissue displacement and disruption.
- Explosive-tipped bullets, cause fire in the target due to the presence of explosives at the tip. They are designed to deform the missile to cause maximum deceleration.



Tracer bullet sparks during flight. It contains a mixture of barium nitrate, powdered magnesium and strontium nitrate.

Solution to Question 17:

The shape of the wound cavity can be explained by yawing of the bullet.

Yawing is a common phenomenon seen with bullets (not with spheres). It is the rotation of the bullet around a lateral axis while passing through dense media such as tissues.

The angle between the trajectory and the long axis of the bullet increases due to destabilising forces until it reaches 90 degrees, i.e., the bullet's long axis is perpendicular to the trajectory. The yawing motion then continues until 180 degrees and the bullet will remain in this stable position where the base is the leading part.

The path of a projectile in a dense medium therefore shows three distinct sections, depending on the respective cross-sectional area:

- Narrow channel
- Increased cavities
- Tail end

Solution to Question 18:

Scanning Electron Microscopy with Energy Dispersive X-ray Analysis (SEM-EDX) is the most sensitive as well as the most commonly used test for detection of gunshot residue.

Tests for detection of gunpowder residue:

- Dermal nitrate (paraffin) test
- Harrison and Gilroy test
- Neutron activation analysis (NAA)
- Flameless atomic absorption spectroscopy (FAAS)
- Inductively coupled plasma atomic emission spectroscopy (ICP-AES) - a variant of Flameless atomic absorption spectroscopy
- Scanning electron microscopy with energy dispersive X-ray analysis (SEM -EDX)

Solution to Question 19:

Lead snowstorm is the phenomenon caused by a firearm wound, when lead fragments are stripped from the bullet as it travels through the body. It causing multiple fragments to be present along the wound track.

This phenomenon is caused by semi-jacketed hunting ammunition used in rifled guns.

Solution to Question 20:

The bullet should be packed in leakproof packaging made of hard plastic.

Precautions to be followed while recovering a bullet from a crime scene:

- Bullets should be handled only by persons wearing double heavy-duty gloves (and not by bare hands - due to risk of contamination).
- To prevent marring of the bullet surface, it should be removed by a plastic forceps or a rubber-tipped bullet extractor.
- The bullet is gently rinsed after collection of any trace evidence on the bullet. The rinsing removes any contaminating body fluids to decrease infective risk.
- The bullet or bullet fragments should be double packed in leakproof packaging with at least one of the containers made out of hard plastic.

Solution to Question 21:

The given clinical scenario is suggestive of a bullet graze.

Bullet graze: the bullet just hits the skin only at an angle and goes off from the site, without any penetration or wound of entry. It produces an abrasion or a laceration depending on the thickness of the skin involved.

Bullet bruise: the bullet here just hits the skin only and drops down to the ground, without any penetration or wound of entry. It produces a bruise alone at the site of impact.

Solution to Question 22:

Bullet wipe is due to the grease, soot or debris from the barrel of the gun.

While examining the clothing of a victim of bullet injury, there is a deposition of various residues surrounding the entrance defect at various ranges known as Bullet wipe. It helps in determining the wounds of inlet and outlet upon the body.

Solution to Question 23:

Bullet collected at surgery or autopsy, from the body of a victim alive or dead is called a crime bullet.

Test bullet is a bullet that is fired from a weapon suspected of being involved in a crime; the test firing is into a gunny bag fixed into a deal wood box. The bullet is then collected for comparison with crime bullet under a comparison microscope, for identifying the crime weapon. This can only be done in relation to rifled weapons.

Exhibit bullet is a crime/test bullet, which is presented in the court as evidence.

Solution to Question 24:

The kind of bullet identified by the radiologist as explained in the given scenario is known as souvenir bullet.

Souvenir bullet is the one which has been lodged in the body for a long time with no fresh bleeding around it and surrounded by a dense fibrous tissue capsule. They can be visualized on X-rays. They are usually a result of bullet lodging in an inaccessible space which may result in more damage on attempted retrieval. e.g. Bullet in the spine.

Other options:

Tandem bullet (Piggyback bullet): This is where two bullets come out with a single shot. Seen with unused or locally made weapons. It may cause confusion with the number of entry and exit wounds.

Incendiary bullets: Type of army bullet used to cause fire in the target.

Solution to Question 25:

The correct match would be as follows:

Puppe's rule: Helps in determining the sequence of bullets to hit the skull, when there are multiple bullet injuries to skull. The fracture line resulting from the later bullet will typically stop at the previously formed one.

Term	Description
1. Puppe's Rule	d. Chronological sequence of bullets fired
2. Kennedy Phenomena	a. Surgical Intervention of a firearm wound leading to an artefact
3. Rayalseema Phenomenon	b. Planting a bullet inside a stab wound
4. Ewing's Postulates	c. Relationship between trauma and new growth

Kennedy's phenomenon: Surgical intervention of a firearm wound leading to an artefact as the evaluation of wound as entry or exit wound becomes difficult.

Rayalaseema phenomenon: Here a person is killed by stab injury, and a bullet is implanted inside to mislead the investigation.

Ewing's postulates: Establishes a relationship between trauma and new growth.

The following postulates should be satisfied before a relationship between trauma and new growth is accepted:

- Evidence of previous integrity of the injured part.
- Undeniable and adequate trauma must be proved.
- There must be a proof of reasonable time interval between injury and appearance of tumour.

- Disease must develop at the exact site of injury.
- The nature of the tumour must be proved.

Solution to Question 26:

The sequence of gunshots, in this case, is 1° 2° 3 according to Puppe's rule.

Puppe's rule states that the path of a second fracture line does not cross the path of an existing fracture line that appears or was caused before it. This helps the forensic expert determine the chronology (order) in which the bullets were lodged into the skull.

Puppe's rule is used in forensic examination of skull fractures caused by multiple blunt force vectors as well, as it is not limited to the examination of bullet injuries only.

Solution to Question 27:

Molotov cocktail is an incendiary bomb that is thrown by hand.

In this crude type of bomb, a bottle is filled with gasoline and a rag to serve as a wick, the wick is lit and thrown at the target.



Solution to Question 28:

In underwater blasts, the intestines suffer the most damage.

A blast causes the most damage at an interface between tissues in contact with the atmosphere, which is why the lung usually suffers the most severe damage. However the most commonly affected structure in air blasts is the tympanic membrane.

The gastrointestinal system suffers from the effect of a blast because, like the lung, it contains air and gases, and is thus not a uniform medium for transit of the shock wave.

Victims of explosions in water suffer a reverse order of gastrointestinal to lung damage.

Note: In air, the ear, especially the tympanic membrane is severely damaged, however, in a cadaver it is not discernible without an otoscopic examination of the tympanic membrane. Nevertheless, lungs are considered to be the severely damaged organ in the air due to variations in density between the alveolar walls and the contained air.

Solution to Question 29:

The given history of multiple small puncture wounds to the right side of the chest, below the nipple, and multiple small abrasions and bruising over the left lower abdomen are highly suggestive of blast injuries sustained due to flying missiles.

Blast injury is a complex type of physical trauma resulting from direct or indirect exposure to an explosion causing a sudden increase or decrease in atmospheric pressure.

T.K.Marshall's (Marshall's triad) described the characteristic injuries associated with bomb explosions. It includes:

- Abrasions
- Bruises/contusions
- Puncture lacerations

Blast injuries are classified as:

- Primary injuries: Effect of transmitted blast waves on gas-containing structures. The external injuries are absent and are characterized by internal injuries. The middle, ear, lungs, and gastrointestinal tract are the most susceptible to this.
- Secondary injuries: Injuries caused by shrapnel and other airborne debris propelled by the explosion. These injuries may affect any part of the body and sometimes result in penetrating trauma. Most casualties are caused by secondary injuries.
- Tertiary injuries: These are caused by blast wind that can throw victims against solid objects.
- Quaternary injuries: All other injuries caused by explosions are not included in the above three categories. eg, flash burns, crush injuries, respiratory effects due to toxic dust, gas, etc.

Option B: Blast of air or blast wave cause primary injuries which involve internal organs without external injury.

Option C: Explosion burns: When the bomb explodes, the temperature of the explosive gases can exceed 2000°C, and the heat radiated momentarily can cause flash burns. It is a quaternary type of blast injury.

Option D: Building collapse can cause crush injuries which is a quaternary blast injury.

Mechanical Asphyxia

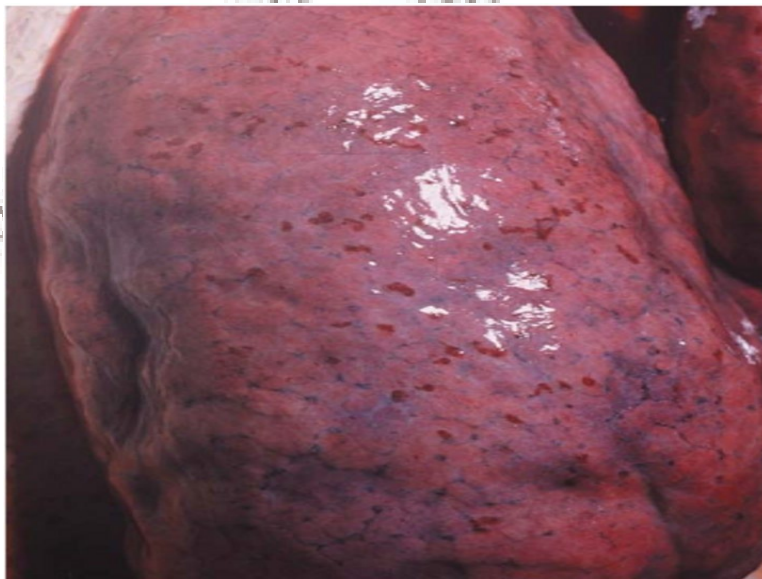
Question 1:

A 33-year-old man who was found dead in his home was taken for a postmortem examination. It revealed clogging of the respiratory tract by semi-digested food particles consisting of rice and vegetable matter. This would fall under which of the following?

- a) Smothering
- b) Entrapment
- c) Strangulation
- d) Suffocation

Question 2:

During the postmortem examination of a 52-year-old man, the forensic surgeon notices the following finding in the lungs. Which of the following is a true statement regarding this?



- a) Caused by rupture of capillaries
- b) These spots are an unreliable indicator of asphyxial death
- c) Expression of E-selectin can distinguish antemortem and postmortem cases
- d) These findings are uncommon in the dependant position

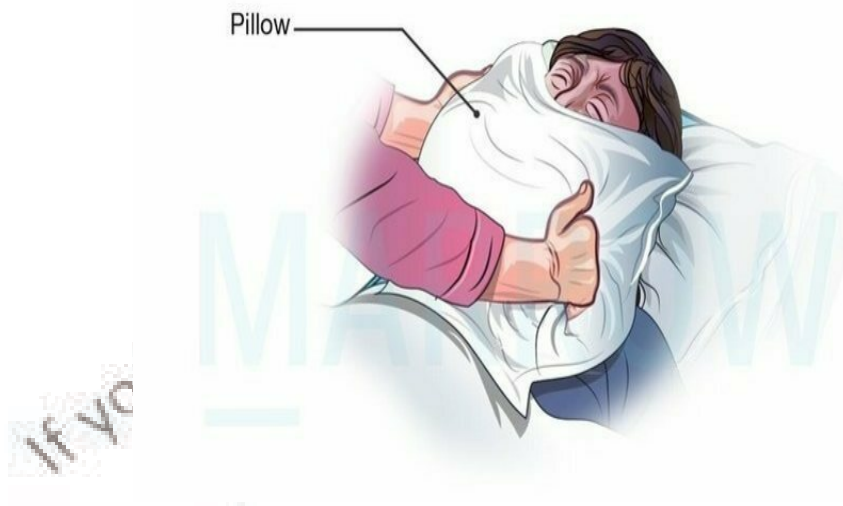
Question 3:

In which of the following types of asphyxia can one see the most marked congestion and cyanosis?

- a) Postural asphyxia
- b) Traumatic asphyxia
- c) Smothering
- d) Ligature strangulation

Question 4:

Which of the following is best described by the image shown below?



- a) Burking
- b) Smothering
- c) Throttling
- d) Choking

Question 5:

Which of the following statements is true regarding smothering?

- a) Congestion of face clearly indicates asphyxial death
- b) Intrathoracic petechiae clearly indicate asphyxial death

- c) Pressure marks on the face clearly indicate smothering
- d) Abrasion around the mouth clearly indicates smothering

Question 6:

The autopsy report of a victim of homicide revealed the cause of death as smothering and traumatic asphyxia. Which of the following best describes the crime?

- a) Burking
- b) Garroting
- c) Throttling
- d) Bansdola

Question 7:

A 56-year-old man collapsed suddenly during dinner with his friends. They brought him to the ER but he was already dead. On asking further history, they revealed that they were drinking before having food. There were no signs of asphyxia, but on autopsy, a bolus of food lodging in the larynx was found. Which of the following statements about this syndrome is true?

- a) Mostly occurs in thin built individuals
- b) Autopsy shows food lodged in the larynx only
- c) Death is due respiratory arrest
- d) Death is often is due to parasympathetic overactivity

Question 8:

A 29-year-old lady was found dead with a ligature mark around her neck. Which among the following findings indicates death due to ligature strangulation?

- a) A pale face with no petechiae
- b) Bleeding from the nose and mouth
- c) Dribbling of saliva from the mouth
- d) Absence of fracture of thyroid cartilage

Question 9:

Which of the following statements regarding laryngeal fractures in cases of strangulation is false?

- a) The most common fracture is that of the thyroid horns
- b) Damage to the larynx is more in ligature strangulation
- c) The greater horns of hyoid is displaced medially
- d) Lack of bleeding indicates postmortem fractures

Question 10:

What is the type of strangulation shown in this image called?



- a) Burking
- b) Garroting
- c) Lynching
- d) Bansdola

Question 11:

While conducting an autopsy on a suspected case of death due to strangulation, which of the following methods is not followed?

- a) Removal of the brain before dissection of the neck
- b) Postmortem MRI of neck before dissection
- c) X ray of the larynx before dissection

d) Incising the internal jugular vessels at the last

Question 12:

A homeless man was found dead and brought to the casualty. The autopsy findings showed a fracture of the thyroid cartilage, bruising and abrasions around the neck. What would be the cause of his death?

- a) Hanging
- b) Throttling
- c) Strangulation
- d) Garroting

Question 13:

A person was brought dead and an autopsy was performed to find the cause of death. The following findings were noted on examination. What is the probable cause of death?



- a) Throttling
- b) Strangulation
- c) Hanging
- d) Mugging

Question 14:

Police were investigating a serial killer who hangs his victims upside down which eventually led to their death. What is the most likely cause of death in these victims?

- a) Suffocation
- b) Traumatic asphyxia
- c) Postural asphyxia
- d) Mechanical asphyxia

Question 15:

Jack knife position causes death due to:

- a) Wedging
- b) Burking
- c) Positional asphyxia
- d) Traumatic asphyxia

Question 16:

A person was walking home from his work when suddenly a robber attacked him. They both started fighting and the robber held him from behind as shown in the image. During this, the victim lost his life due to difficulty in breathing. What is this type of strangulation known as?



- a) Garrotting
- b) Bansdola

- c) Mugging
- d) Burking

Question 17:

The weight of the head, arms and chest act as a constricting force in which of the following types of hanging?

- a) Complete
- b) Partial
- c) Typical
- d) Atypical

Question 18:

15 kg of tension in the ligature around the neck is enough to occlude which of the following structures?

- a) Jugular vein
- b) Jugular vein + Carotid artery
- c) Jugular vein + Carotid artery + Trachea
- d) Jugular vein + Carotid artery + Trachea + Vertebral artery

Question 19:

A victim of suicidal hanging is brought to you for examination. All the following lead to the death of this patient except-

- a) Ischemic neuronal death
- b) Disruption of vertebral column
- c) Laryngeal Spasm
- d) Cardiac Arrest

Question 20:

The body of a person who committed suicide by hanging was brought to your casualty. Which of the following is an unlikely finding to be seen in this case?

- a) The mark completely encircles the neck
- b) The gap in the hanging mark indicates the point of suspension
- c) The hanging mark is situated above the thyroid cartilage
- d) The mark dries to a parchment like consistency postmortem

Question 21:

Which of the following findings will not be seen in suicidal hanging?

- a) Absence of dribbling of saliva
- b) Hypostasis involving hands and feet
- c) Tears of the carotid artery
- d) Ligature mark above the thyroid cartilage

Question 22:

A serial murderer has been sentenced to death by hanging. Where will the knot for the ligature be placed?

- a) Between chin and ear
- b) Below the chin
- c) Occiput
- d) Below the ear

Question 23:

The autopsy finding of a person who died due to hanging showed the presence of hemorrhages in the intervertebral disc of the lumbar spine. What are these called?

- a) Victor's haemorrhage
- b) Simon's haemorrhage
- c) Robert's haemorrhage
- d) Carl's haemorrhage

Question 24:

Seminal stains are found near the penis on the legs of a victim brought to you for autopsy. These stains are an absolute indicator of which of the following?

- a) Autoerotic asphyxia
- b) Any cause of asphyxia
- c) Homicide following sexual activity
- d) None of the above

Question 25:

Which of the following findings is not considered a spurious lesion in the neck, during an autopsy?

- a) Haemorrhage on the posterior surface of the oesophagus
- b) Haemorrhage on the anterior longitudinal ligament
- c) Pale areas in the oesophageal mucosa causing banding
- d) Haemorrhage over the front of larynx

Question 26:

The friend and victim had alcohol and got into an argument over a common girlfriend, following which the friend kills the victim by sitting on his chest and covering his nose and mouth. This is an example of?

- a) Burking
- b) Smothering
- c) Traumatic asphyxia
- d) Overlaying

Answer Key

Question No.	Correct Option
1	d
2	b
3	b
4	b

5	d
6	a
7	d
8	b
9	b
10	b
11	d
12	b
13	a
14	c
15	c
16	c
17	b
18	c
19	c
20	a
21	a
22	d
23	b
24	d
25	d
26	a

Detailed Explanations

Solution to Question 1:

The given scenario is suggestive of suffocation due to aspiration of food particles. It is classified under mechanical asphyxia.

Mechanical asphyxia can be classified depending on the respiratory block:

- Compression / constriction of the neck - Hanging, strangulation, throttling
- Blocking external orifices of respiration, i.e. mouth and/or nostrils - Smothering, overlying, suffocation, gagging
- Impaction of foreign bodies in respiratory tract - Choking
- Compression and mechanical fixation of the chest and abdomen preventing the respiratory movements - Traumatic asphyxia / crush asphyxia
- Inhalation of fluid into the respiratory tract - Drowning

Solution to Question 2:

The image shows petechiae called Tardieu spots. They are an unreliable sign of asphyxial death.

Hemorrhages if larger than 2 mm are called ecchymoses and smaller than 2 mm are called petechiae. They are common non-specific autopsy findings and many are post-mortem in origin, especially in the dependent positions. They are caused by the rupture of small venules (capillary bleeding is invisible to the naked eye).

It is suggested that the elevated expression of P-selectin could be used as a criterion to distinguish between antemortem findings from post-mortem artifacts.

Other non-specific signs of asphyxia are:

- Congestion of the larynx with slight oozing
- Emphysematous, congested lungs with serosanguinous fluid exudates in alveoli
- Cyanosis or dark-colored blood due to accumulation of CO₂.

Solution to Question 3:

The most marked congestion and cyanosis are seen in a case of traumatic asphyxia.

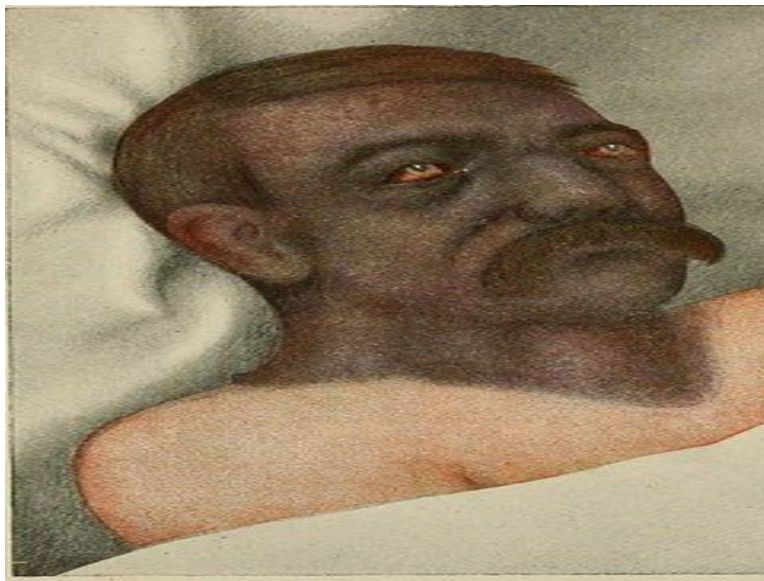
It is the mechanical fixation of the chest (sitting on the chest). It acts by restricting respiratory movements and thus prevents inspiration.

The four signs of asphyxia are as follows.

- Petechial haemorrhages
- Congestion and edema
- Cyanosis
- Engorgement of the right heart and abnormal fluidity of the blood.

These signs are non-specific. But in traumatic asphyxia, there is a marked demonstration of these signs. In no other condition, apart from postural dependency, is the degree of congestion and cyanosis so marked.

The image shows the marked congestion seen in traumatic asphyxia.



Solution to Question 4:

The image depicts smothering. It refers to the blockage of the external air passages, usually by a hand or soft fabric.

Mechanical asphyxia can be classified depending on the respiratory block:

- Compression / constriction of the neck - Hanging, strangulation, throttling
- Blocking external orifices of respiration, i.e. mouth and/or nostrils - Smothering, overlying, suffocation, gagging
- Impaction of foreign bodies in the respiratory tract - Choking
- Compression and mechanical fixation of the chest and abdomen preventing the respiratory movements - Traumatic asphyxia / crush asphyxia
- Inhalation of fluid into the respiratory tract - Drowning

Solution to Question 5:

Abrasions around the mouth, cheeks, lips or lesions within the lips may reliably indicate smothering.

The non-specific signs in deaths due to asphyxia:

- Petechial hemorrhages in the face, eyebrows, eyelids, forehead, ears, conjunctiva, sclera - When they occur in the visceral pleura, they are called Tardieu's spots
- Emphysematous, congested lungs with serosanguinous fluid exudates in alveoli
- Cyanosis or dark-colored blood due to accumulation of CO₂.
- Congestion of the larynx with slight oozing

Pressure marks on the face can occur as a part of normal postmortem changes. Circumoral and circumnasal pallor can be caused merely by passive pressure of the dependent head after death.

Note: The coexistence of these findings, in themselves, does not prove that death resulted from mechanical asphyxia. All these phenomena are non-specific and are in no way peculiar to this mode of death. They are of no value in proving that death resulted from mechanical asphyxia.

Solution to Question 6:

Burking is a combination of smothering and traumatic asphyxia.



Solution to Question 7:

The clinical scenario is most likely suggestive of café coronary syndrome. Death in café coronary syndrome occurs due to parasympathetic overactivity. It is sudden and unexpected and happens rapidly.

This is usually seen in well-built businessmen. In this syndrome, the victim dies during a meal with no signs of respiratory distress or classical signs of asphyxia.

The cause of death in these patients is mechanical asphyxia leading to vasovagal reflex causing reflex cardiac inhibition. The mode of death is cardiac arrest (not the cause of death) presumably from parasympathetic overactivity occurring from stimulation of the laryngeal or pharyngeal mucosa.

Suppressed gag reflex due to gross intoxication with alcohol or large doses of tranquilizers in mental institutions or hospitals might be the predisposing factors. Autopsy reveals a bolus of food, lodged in the pharynx or larynx.

Solution to Question 8:

Bleeding from the nose, mouth, and ears is commonly associated with death due to ligature strangulation.

Solution to Question 9:

Damage to the laryngeal structures is more in manual strangulation than in ligature strangulation.

During manual strangulation the following structures are damaged:

- Hyoid cornua or horns
- Superior thyroid horns
- Cricoid cartilage
- The main ala of the thyroid cartilage

It has been said that such direct violence from the front tends to splay the fractured horns laterally, whereas in manual strangulation the horn tends to fall medially.

If there is no haemorrhage, the fracture must be post mortem. If there is a small bleed, then the lesion can be either antemortem or post-mortem. Large bleeds definitely indicate an antemortem fracture.

Damage to the laryngeal cartilages is much less common in ligature strangulation than in manual strangulation.

Solution to Question 10:

The image shows the tightening of a noose around the neck by twisting a rod within the ligature. This is called garrotting.

This is a mode of ligature strangulation that may be seen in homicide.

This was a form of judicial execution once employed in Spain. The rod-like object used to tighten the ligature is called a Spanish windlass - this may be a ruler, stick, or screwdriver. The method was also used by Thagi's in the past in India, to kill the travelers and rob their belongings in lonely places.

Solution to Question 11:

Incising the internal jugular vessels early in the autopsy is done to relieve venous pressure, especially in cases where strangulation is suspected. This can help prevent artefactual haemorrhages that could otherwise complicate the interpretation of findings.

During an autopsy, it is essential to release the blood in the venous system before dissecting the neck to avoid or reduce artefactual haemorrhages that can occur in the region.

The following methods are also followed while conducting the autopsy:

- Reflect the scalp and remove the brain before dealing with the neck to release venous engorgement
- Multislice spiral computed tomography (MSCT) and magnetic resonance imaging (MRI) or radiography of the neck may be carried out before dissecting.
- If the new techniques of post-mortem imaging are not available an alternative method is to X-ray the isolated larynx before dissection.

Solution to Question 12:

Both bruising around the neck and the fracture of the thyroid cartilage are findings seen in throttling.

Throttling/manual strangulation is when bare hands are used to compress the neck and strangulate.

Mechanism of death:

- Occlusion of blood vessels supplying blood to the brain (carotid arteries).
- Carotid sinus pressure may result in vagus nerve stimulation, resulting in cardiac arrest (vagal inhibition).
- Occlusion of the airway probably - a minor role

Autopsy findings:

- Bruising of the neck- due to the grasping of the neck by the assailant.
- Abrasions on the neck- fingernail marks from assailant or victim.
- Fracture of the thyroid cartilage.
- Inward fracture of the greater cornu of the hyoid bone.

Solution to Question 13:

The given autopsy images are suggestive of throttling.

Thumbnail impression over the neck



Petechial haemorrhages in the eye



Extravasated blood clots surrounding larynx



In throttling, the following mechanisms may lead to death:

- Occlusion of blood supply to the blood to the brain - carotid arteries
- Occlusion of the airway - minor role
- Carotid sinus pressure may result in vagus nerve stimulation resulting in cardiac arrest (vasovagal shock)

Other signs in deaths due to asphyxia:

- Petechial hemorrhages in the face, eyebrows, eyelids, forehead, ears, conjunctiva, sclera
- When they occur in the visceral pleura, they are called Tardieu's spots
- Congested larynx with slight oozing
- Marked venous congestion of internal organs
- Emphysematous, congested lungs with serosanguinous fluid exudates in alveoli
- Dark-coloured blood due to accumulation of CO₂

Option B: Strangulation is a very generalised term used to describe deaths due to violent asphyxia. Eg- ligature strangulation, throttling etc

Option C: In the case of hanging, there will be a ligature mark, injury to the cervical spine etc.

Option D: In case of mugging the neck is compressed or squeezed by holding it between the crook of the elbow or knee. The attack is usually made from behind. Though a victim killed by this method shows signs of asphyxia and other struggle marks, the examination neck will not show any evidence of violence, as the compression was affected by the soft muscles of the arm or leg.

Solution to Question 14:

In an inverted crucifixion, death occurs due to postural asphyxia.

In the case of inverted crucifixion, asphyxia occurs as a result of the impedance of inspiration by the weight of the abdominal viscera upon the diaphragm.

Solution to Question 15:

Jack-knife position leads to positional asphyxia.

It is a position where the victim's thighs and knees are driven against the chest causing indirect compression of the chest and restriction of breathing movements.

Solution to Question 16:

The type of strangulation shown in the given image is mugging.

The term strictly means throttling by pressure from an arm held around the throat. The attack is usually made from behind, the neck being trapped in the crook of the elbow. Pressure is then exerted either on the front of the larynx or at one or both sides by the forearm and upper arm.

Note: The original meaning of 'mugging' has now been confused by its application, especially in North America, to any form of robbery with violence.

Mechanical Asphyxia - Mugging



Solution to Question 17:

The weight of the head, arms, and chest acts as a constricting force in partial hanging.

Types of hanging:

- Complete hanging - the weight of the entire body acts as a constricting force.
- Partial hanging - the bodies are partially suspended, the weight of the head (5-6 kgs), arms, and chest act as a constricting force.



Solution to Question 18:

About 15 kg of tension in the ligature around the neck occludes the jugular vein, carotid artery and trachea.

The force required to occlude the neck structures are as follows:

- 2 kg - occludes the jugular veins.
- 5 kg - occlude the jugular veins and carotid arteries.
- 15 kg - occludes the jugular veins, carotid arteries and trachea.
- 30 kg - occludes the jugular veins, carotid arteries, trachea and vertebral arteries.

Solution to Question 19:

Causes of death in suicidal hangings are not from laryngeal spasms.

Mechanisms of death in pressure on the neck:

- Airway occlusion
- Occlusion of the neck veins
- Occlusion of the carotid arteries
- Vagal cardiac arrest

Death ultimately occurs from cerebral hypoxia and ischemic neuronal death.

Asphyxia	Commonest mode of death
Manual strangulation	Vagal cardiac arrest

Asphyxia	Commonest mode of death
Ligature strangulation	Asphyxia
Judicial hanging	Disruption of vertebral column

Solution to Question 20:

Hanging marks almost never completely encircle the neck unless a slipknot was used.

The hanging mark has the following features:

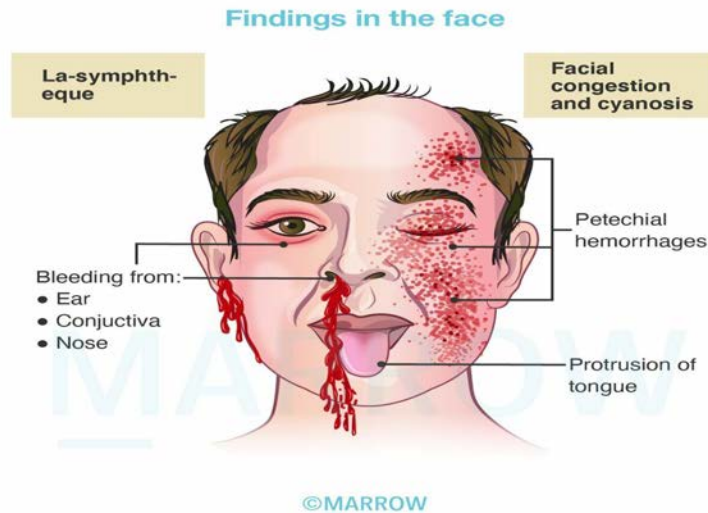
- The point of suspension is indicated by a gap in the skin mark - This gap is usually seen at one or other side of the neck or at the center of the back of the neck. Much less often it is under the chin.
- It is situated higher above the thyroid cartilage - Being directly under the chin anteriorly, passing round beneath the jawbones and rising up at the sides or back of the neck to the usual gap under the knot.
- The mark may be abraded, brown, and dried to a parchment-like consistency after death.
- narrow red zone either above or below (or both sides) of the ligature mark - Due to displacement of blood laterally from under the zone of maximum pressure.

Solution to Question 21:

Dribbling of saliva will be seen in a case of suicidal hanging. This is considered as the surest sign of antemortem hanging as secretion of saliva is a vital function and it cannot occur after death.

Autopsy findings in hanging:

- Post-mortem hypostasis is present in the legs and hands.
- Petechial haemorrhages - these are usually the exception, rather than the rule.
- Ligature mark - above the thyroid cartilage, incomplete, parchment-like consistency
- Soft tissue haemorrhage may be seen.
- Laryngeal fractures - fractures of hyoid and thyroid may be seen.
- Amussat sign - damage to intima and media of the carotid artery
- Simon's sign - haemorrhages on the anterior aspects of intervertebral disks.
- Vertebral artery tears- The vertebral artery can show intimal tears, subintimal haemorrhages, and even rupture.
- A pale face is more commonly seen than congestion of the face.
- Le facies sympathique - eyes remain open and pupils remain dilated due to compression of cervical sympathetic chain on the same side. It indicates antemortem hanging.



Solution to Question 22:

The knot in a case of judicial hanging is placed under the ear in India.

A legal death sentence is carried out by hanging the criminal. The face of the person is covered with a dark mask and he is made to stand on a platform above trapdoors

A rope to allow a drop of five to seven meters according to the weight, build and age of the person, is looped around the neck, with the knot under the angle of the jaw.

Although placing the knot beneath the chin i.e, the submental position is said to be a more effective way, a knot at the angle of the jaw (below the ear) is the most widely practised method of judicial hanging in India

Solution to Question 23:

Simon's haemorrhage / Simon's sign / Simon's symptom is streaky haemorrhage on the anterior aspects of the intervertebral disc, particularly in the lower thoracic and lumbar spine. It is frequently observed in cases of hanging.

Simon haemorrhage has been shown to occur also in the course of traumatic overextension of the spinal column, e.g. in traffic accidents or as a post-mortem artefact in decomposed bodies.

Solution to Question 24:

The finding of emission of semen at autopsy is a non-specific finding and does not indicate sexual activity or any particular mode of death.

The mere emission of semen found at autopsy does not confirm sexual activity in itself, as post-mortem discharge of semen from the meatus is common in any type of death, not only in asphyxia.

Solution to Question 25:

Bleeding over the front and sides of the larynx is usually genuine and not a spurious lesion.

The following are the spurious haemorrhages that occur:

- The posterior surface of the oesophagus
- Anterior longitudinal ligament of the cervical spine
- Banding of the oesophagus - pale areas in the mucosa caused by post-mortem hypostasis.

Artefactual postmortem haemorrhage on the posterior surface of the oesophagus is called Prinsloo and Gordon artefact.

Solution to Question 26:

The given scenario is an example of burking.

Burking is a method of homicidal smothering and traumatic asphyxia where the assaulter kneels or sits on the chest (traumatic asphyxia) and close the nose and mouth with his hands (smothering). This was the method of killing performed by William Burke and William Hare.

Image shows burking



Other options:

Option B: Smothering is a form of asphyxia that is caused by closing the external respiratory orifices either by the hand or by other means or blocking up the cavities of the nose and mouth by

a foreign substance, such as mud, paper, cloth, etc.

Below image shows smothering



Option C: Traumatic asphyxia results from respiratory arrest due to mechanical fixation of the chest, by a heavy substance or object. The normal movements of the chest wall are prevented. There is a gross compression of the chest and usually abdomen by a powerful force, due to which chest expansion and diaphragmatic lowering are prevented. For example stampede deaths, crushing by falls of the earth in coal mines, or earthquakes.

Option D: Overlaying or compression suffocation results due to compression of the chest, so as to prevent breathing. It occurs when an intoxicated parent or other person shares a bed with an infant. The thoracic movements are limited and respiratory exchange is either reduced or completely prevented which leads to death. It is always accidental.

Below image below shows overlaying.



Drowning

Question 1:

What does hydrocution refer to?

- a) Postmortem submersion
- b) Dry lung drowning
- c) Cold water drowning
- d) Electrocutation in water

Question 2:

A 30-year-old fisherman was brought dead. His autopsy findings revealed emphysema aquosum. What is the most probable cause of death?

- a) Wet drowning
- b) Shallow-water drowning
- c) Immersion syndrome
- d) Secondary drowning

Question 3:

On examining a case of wet drowning, you observe weights that are attached to the body to keep it underwater. What does this suggest?

- a) Homicidal drowning
- b) Suicidal drowning
- c) Can be either homicidal or suicidal
- d) Accidental drowning

Question 4:

In the case of typical drowning, which of the following mechanisms is responsible for causing death?

- a) Laryngeal spasm due to inrush of water

- b) Hypoxemia leading to cerebral edema
- c) Vagal inhibition causing cardiac arrest
- d) Pulmonary edema and cardiac arrest

Question 5:

A 45-year-old man drowns while on an arctic cruise by accidentally falling overboard with a horizontal entry into the sea. Which of the following is the most likely cause of death for this individual?

- a) Cerebral edema
- b) Pulmonary edema and heart failure
- c) Vasovagal inhibition
- d) Laryngeal spasm

Question 6:

A dead body of a man was retrieved from a lake. Which of the following electrolyte abnormalities would you expect in him?

- a) Hyponatremia and hypokalemia
- b) Hypernatremia and hyperkalemia
- c) Hyponatremia and hyperkalemia
- d) Hypernatremia and hypokalemia

Question 7:

Which of the following electrolytes is measured in Gettler's test?

- a) Sodium
- b) Potassium
- c) Chloride
- d) Bicarbonate

Question 8:

On postmortem examination of a case of suicidal drowning, you notice the following finding. Which of the following statements is true regarding this finding?



- a) This finding indicates that the person drowned within the last few hours
- b) This change occurs faster in warm water than cold water
- c) The changes in this finding first affect the back of the hand
- d) It is also known as cutis anserina

Question 9:

A 20-year-old woman's body was retrieved from a manhole. You are suspecting antemortem drowning. Which of the following signs will most likely support your diagnosis?

- a) Petechial hemorrhages in the eyes
- b) Cutis anserina
- c) Cadaveric spasm
- d) Skin maceration

Question 10:

Where are Paltauf's hemorrhages seen?

- a) Liver
- b) Lungs
- c) Larynx

d) Middle ear

Question 11:

You are doing an autopsy on a 35-year-old man who was allegedly under the influence of recreational drugs and fell into a ditch. What is the conclusive evidence of death by drowning in this case?

- a) Presence of fluid in the paranasal sinuses
- b) Dilation of right heart and great veins
- c) Diatoms in the body organs
- d) None of them is a conclusive evidence

Question 12:

The body of a missing person was found tied up in a boat. During the autopsy, you notice the presence of the following organism in his brain tissue. Which of the following is not a possible cause for this finding?



- a) Fresh water drowning
- b) Antemortem drowning
- c) Sea water drowning
- d) Postmortem drowning

Answer Key

Question No.	Correct Option
1	c
2	a
3	c
4	d
5	c
6	c
7	c
8	b
9	c
10	b
11	d
12	d

Detailed Explanations

Solution to Question 1:

Hydrocution is the term used for cold water drowning.

Hydrocution/ immersion syndrome refers to sudden death following immersion in cold water. Death results from vagal inhibition of the heart i.e. cardiac arrest occurring due to increased stimulation of the vagus nerve.

Vagus stimulation occurs due to the following mechanisms:

- Sudden entry of water into the nasopharynx or larynx
- Falling or diving into the water in a manner so that it suddenly strikes the abdomen, especially the epigastric region
- Sudden in-rush of cold water into the ears

The types of drowning are:

- Wet drowning/ typical drowning
- Atypical drowning/ dry drowning
- Immersion syndrome/ hydrocution
- Post-immersion syndrome/ secondary/ near-drowning
- Submersion of the unconscious/ shallow-water drowning

Solution to Question 2:

Emphysema aquosum is seen in cases of wet drowning.

Overinflation of the lungs in drowning is known as emphysema aquosum. It is one of the most valuable positive signs of drowning.

The oedema fluid in the bronchi blocks the passive collapse that normally occurs at death. Hence, the lungs are held in the inspiratory position. The impression of the ribs on this overinflated lung leaves visible and palpable grooves on the lateral surface.

Autopsy findings in drowning:

- Froth in the air passages - most useful autopsy sign in drowning. It consists of a proteinaceous exudate and surfactant mixed with the water of the drowning medium.
- Waterlogging of the lung - frothy fluid will exude from the bronchi when the lung is squeezed and from the cut surfaces when they are sectioned with a knife. But, the absence of waterlogging by no means excludes true drowning (e.g. dry drowning).
- Emphysema aquosum - overinflation of the lungs
- Paltauf's spots - subpleural haemorrhages that reflect haemolysis within intra-alveolar haemorrhages
- Dilation of the right heart and great veins - subjective and non-specific finding
- Foreign material in the stomach - watery fluid or even foreign material from the water, such as silt, weed or sand
- Hemorrhage into the middle ears and into the temporal bone - a positive non-specific sign of drowning
- Presence of fluid in the middle ear or paranasal sinuses - not a reliable diagnostic sign of drowning

Note: The autopsy findings in drowning are mostly nonspecific and none give conclusive evidence of drowning. The most useful one is froth in the air passages.

Solution to Question 3:

Attachment of weights to the body to keep it underwater is consistent with both homicidal and suicidal drowning.

Differentiating points:

- Suicidal drowning - determined suicidal person may attach weights to the body or tie his limbs. It is common among women.
- Homicidal drowning - the following additional features may point to a homicidal drowning:
 - Constriction/marks around the neck may be present
 - Evidence of struggle at the banks of the river from where the body was recovered
 - Articles belonging to someone other than the deceased found on the banks of the river associated with those belonging to the deceased

Accidental drowning is the most common form of drowning. It is seen among fishermen, bathers, dock workers, intoxicated, and epileptics. Homicidal drowning is the least common.

Solution to Question 4:

Pulmonary edema and cardiac arrest cause death in a case of typical drowning.

Death in other types of drowning can be due to:

- Dry drowning - laryngeal spasm due to inrush of water
- Near drowning - Hypoxemia leading to sepsis, electrolyte imbalances, pulmonary edema, and cerebral edema
- Immersion syndrome - vagal inhibition causing cardiac arrest

Solution to Question 5:

The given clinical scenario is suggestive of immersion syndrome/ hydrocution/ submersion inhibition. Death results from cardiac arrest due to vasovagal inhibition followed by cardiac arrest.

Vagal stimulation occurs due to:

- Stimulation of nerve endings of the surface of the body by cold water
- Falling or diving into the water in a manner so that it suddenly strikes the abdomen, especially the epigastric region.
- Stimulation of the nerve endings of the mucosa by the entry of cold water into the eardrums, nasal passages, the pharynx, and the larynx.

The mechanism involved in immersion syndrome:

- Diving/falling into the water, feet-first
- Inexperienced "duck-diving"
- Diving/falling into the water with a horizontal entry

People under the influence of alcohol are more likely affected due to the general vasodilation of skin vessels, consequently amplifying the effects of vasovagal inhibition. These effects are increased in people who are attempting suicide/anxious as they have a more active reflex arc.

Option A: Cerebral edema is seen in cases of near-drowning. It is a type of atypical drowning and is also known as post-immersion syndrome or secondary drowning. This type is necessitated by the survival of the drowning victim beyond 24 hours of a submersion episode. Death is due to respiratory decompensation suffered despite responding well to initial resuscitation measures. Mechanisms of death involve hypoxemia which results in sepsis, electrolyte imbalances, pulmonary edema, and cerebral edema.

Option B: Pulmonary edema and cardiac arrest are the cause of death in typical drowning/primary drowning due to inhalation of water into the lungs. There are varying mechanisms for freshwater

and saltwater drowning leading to either ventricular fibrillation or cardiac arrest respectively. Both types of typical drowning have terminal pulmonary edema and heart failure as mechanisms of death.

Option D: In dry drowning death is due to the development of laryngeal spasm and subsequent airway closure. Thick mucus, foam, and froth may develop, producing a plug.

Solution to Question 6:

Freshwater drowning (drowning in a lake) is associated with both hyponatremia and hyperkalemia.

When freshwater (hypotonic to plasma) enters the alveolar spaces, it is rapidly absorbed into the pulmonary circulation resulting in gross local hemodilution. This massive increase in blood volume leads to hemolysis with the liberation of potassium. This causes hyperkalemia with corresponding hyponatremia.

When seawater enters, due to high saline content, reverse osmotic flow occurs. The fluid leaves the circulation and enters the alveolar spaces. This causes hemoconcentration, hypernatremia and pulmonary edema.

Solution to Question 7:

Gettler's test measures the chloride content of left and right side of the heart.

A difference of 25 mg% in chloride concentrations between the two sides of the heart is an indication of death due to drowning. This test was used to identify the cause of drowning.

- Freshwater drowning - chloride content of left heart is lower than that of the right heart
- Saltwater drowning - chloride content of right heart is lower than that of the left heart

Gettler's claims have been refuted and the test is no longer accepted.

Solution to Question 8:

The image given shows the skin maceration or washerwoman's skin. It occurs faster in warm water than in cold water. The signs of immersion are:

1. Maceration of skin/ washerwoman's skin - It begins within minutes in warm water and takes longer in cold water. It refers to the wrinkled, pale, and soaked appearance of the skin when immersed in water. This first appears on areas with an appreciable keratin layer such as the fingertips palms, backs of the hands, and later the soles. The first site affected is the fingerpads. It affects the hands earlier than the feet.

The image given below shows skin maceration.

Skin Maceration



2. Cutis anserina - 'goose-flesh' or piloerection: This is usually found in cold water. The image given below shows cutis anserina.

Cutis Anserina



3. Post-mortem hypostasis - If the water is still, the postmortem hypostasis affects the heads and the limbs. This is because the chest and abdomen float higher because of the lungs and the abdominal gases.

4. Foreign bodies in respiratory passages and stomach - Sand may be found deep in the respiratory passages and stomach, especially if the body has been rolled by the waves on a beach. This is not evidence of live aspiration.

The signs of immersion just indicate that the body was immersed in water. They are not evidence of death from drowning.

In temperate climates, the following is an approximate guide to estimate the duration of immersion:

Finding	Time since immersion
No wrinkling of finger pads	Less than a few hours
Wrinkled fingers, palms, and feet	Few hours to 3 days
Early decomposition (Head and abdomen)	4-10 days
Marbling of veins, peeling of the epidermis	2-4 weeks
Muscle loss with bone exposure	1-2 months

Solution to Question 9:

Cadaveric spasm is an important sign of antemortem drowning. It manifests as closed hands with firmly grasped weed, grass, sticks, etc. floating in the water. When present, it is an important sign suggesting that the victim struggled for existence while in water.

The image given below shows a cadaveric spasm of hand, holding grass, as seen in antemortem drowning.



Solution to Question 10:

Paltauf's hemorrhages are seen in the lungs as subpleural hemorrhages.

They are found when the alveolar walls rupture as a result of increased pressure during forced expirations. They are described in 50–60% of drownings.

Solution to Question 11:

None of the options are considered as conclusive evidence of drowning.

Option A: The presence of fluid in the paranasal sinuses is not a reliable diagnostic sign of drowning.

Option B: Dilation of right heart and great veins is a subjective and non-specific finding.

Option C: At the present time, the diatom test should be used only as an indicative aid and not as legal proof of drowning. Recently, other water organisms have been advocated as tests for drowning, including soft-bodied protozoa and crustaceans.

Solution to Question 12:

The given image shows a diatom. Postmortem drowning does not show diatoms in the brain tissue.

Diatoms are microscopic unicellular or colonial algae present in water. As the diatoms are found in both seawater and freshwater, their presence cannot differentiate between freshwater and seawater drowning.

The presence of diatoms in the brain tissue is suggestive of antemortem drowning, as only a living person can transport diatoms from the lungs to the viscera via circulation.

Sexual Offences and Abortion

Question 1:

Valid consent for sexual intercourse cannot be given by a girl aged less than:

- a) 15 years
- b) 16 years
- c) 18 years
- d) 21 years

Question 2:

A man is convicted for the offense of rape. Which section of the BNS lays down punishment for the same?

- a) Section 63 (IPC 375)
- b) Section 64 (IPC 376)
- c) Section 72 (IPC 228A)
- d) Section 75 (IPC 354A)

Question 3:

For a man to be found guilty of statutory rape, he must have had sexual intercourse with?

- a) A woman who is in intoxicated state
- b) His wife living under decree of separation
- c) Any person other than his wife
- d) A girl below 18 years of age with her consent

Question 4:

A 27-year-old woman comes to the local police station with the complaint of sexual assault. She mentions that she was raped by her husband even though she is legally separated from him for the past two years. After registering the complaint, she is sent to the doctor for medical examination. Which among the following statements is false regarding this situation?

- a) Minimum punishment is 2 years imprisonment
- b) Section 67 of the BNS (376B IPC) deals with such cases
- c) This is a non-bailable offence
- d) This is a cognizable offence on complaint of victim

Question 5:

A police constable who has induced an inmate to have consensual sexual intercourse with him is liable under:

- a) Section 66 BNS (376A IPC)
- b) Section 67 BNS (376B IPC)
- c) Section 68 BNS (376C IPC)
- d) Section 70(2) BNS (376DA IPC)

Question 6:

In India, what is the minimum age for a boy to be charged with rape?

- a) 12 years
- b) 14 years
- c) 18 years
- d) No age limit

Question 7:

In the case of rape of a young child, the hymen is usually:

- a) Ruptured since it is superficially situated
- b) Ruptured since it is very thin
- c) Unruptured since it is deeply situated
- d) Unruptured since it is highly elastic

Question 8:

An 18-year-old girl was brought to the OPD. Genital examination revealed the findings as given below. These findings are indicative of:

- a) True virgin
- b) False virgin
- c) Premenstrual stage
- d) Molestation

Question 9:

A registered medical practitioner is requested by a survivor of sexual violence to examine her. Within what time must the practitioner take a vaginal swab to look for the presence of spermatozoa?

- a) Within 72 hours
- b) Within 36 hours
- c) Within 5 days
- d) Within 48 hours

Question 10:

A 27-year-old woman comes to the local police station with the complaint of sexual assault by an unknown man. On medical examination, mobile sperms are detected in her vagina. Within what time has the assault likely occurred?

- a) 12 hours
- b) 18 hours
- c) 24 hours
- d) 36 hours

Question 11:

While examining a man who is accused of rape, you find the presence of smegma on his corona glandis. Which of the following can be inferred from this finding?

- a) The person has engaged in sexual act recently
- b) The person has not engaged in sexual act in last 24 hours
- c) The person has not engaged in sexual act in last 48 hours
- d) The person has not engaged in sexual act in last 1 week

Question 12:

A 25-year-old lady who was a victim of rape was brought by the lady constable to the gynecologist for examination. During the genital examination, the doctor obtained a sample from in and around the vagina. What test needs to be done on this sample to identify the presence of semen?

- a) Teichmann test
- b) Takayama test
- c) Acid phosphatase test
- d) Kastlemeyer test

Question 13:

A 5-year-old child with a history of perianal pain is brought to the OPD. On subjecting the specimen from the perianal region to a test, it produces yellow rhombic crystals of spermine picrate. What is the test done?

- a) Barberio test
- b) Florence test
- c) Takayama test
- d) Teichmann test

Question 14:

While examining a patient, you notice the presence of a funnel-shaped anus. This indicates that he/she is:

- a) An active agent of sodomy
- b) A habitual passive agent of sodomy
- c) A non-habitual passive agent of sodomy
- d) A person who performs anilingus

Question 15:

A 19-year-old boy is brought to the doctor because his family found him dressed as a woman. He says that he derives sexual pleasure from this act. However, he has no wish to undergo sex-change surgery. What is this type of perversion called?

- a) Transsexualism
- b) Fetishistic transvestism
- c) Frotteurism
- d) Gender dysphoria

Question 16:

Sexual asphyxia is seen in which of the following condition?

- a) Lust murder
- b) Masochism
- c) Sexual oralism
- d) Frotteurism

Question 17:

Which section of the BNS deals with indignity to the human corpse?

- a) BNS Section 292 (IPC 290)
- b) BNS Section 296 (IPC 294)
- c) BNS Section 301 (IPC 297)
- d) BNS Section 302 (IPC 298)

Question 18:

A 28-year-old woman who was sexually abused is now pregnant and wants to undergo an abortion. She was diagnosed with autism at the age of 2 years. According to the MTP Act, consent for this procedure is needed from whom?

- a) The woman only
- b) Her husband only
- c) The woman & her husband
- d) The woman & her family

Question 19:

A 25-year-old unmarried woman discovers that she is pregnant. She wishes to undergo an abortion as it was unplanned. Within what period of gestation is this procedure permissible under MTP Amendment Bill, 2021 for this patient?

- a) 12 weeks
- b) 22 weeks
- c) 24 weeks
- d) 20 weeks

Question 20:

As per the Medical Termination of Pregnancy Act, 2021, induction of MTP in a mentally ill or a rape victim is allowed until what age of gestation?

- a) 20 weeks
- b) 22 weeks
- c) 24 weeks
- d) 28 weeks

Question 21:

You are working as a medical officer at a PHC. A 17-year-old girl presents to you after an alleged sexual assault, the girl refuses physical examination. Which of the following steps would you take to proceed in this case?

- a) 1, 2 and 3
- b) 2, 3 and 5
- c) 1, 2 and 5
- d) 2 and 3

Question 22:

A woman gave birth to twins. The father who believed that they did not belong to him requested DNA testing. After testing, it was found that one child did not belong to him. This case would be best described as?

- a) Superfetation
- b) Superfecundation

- c) Supposititious child
- d) Atavism

Answer Key

Question No.	Correct Option
1	c
2	b
3	d
4	c
5	c
6	d
7	c
8	b
9	a
10	a
11	b
12	c
13	a
14	b
15	b
16	b
17	c
18	a
19	d
20	c
21	a
22	b

Detailed Explanations

Solution to Question 1:

Minimum age of a girl to give consent for sexual intercourse is 18 years.

This was changed from 16 years to 18 years by the Criminal Law (Amendment) Act, 2013.

Solution to Question 2:

Section 64 of the BNS (IPC 376) lays down the punishment for the offense of rape.

Section 64 (1) of the BNS outlines the punishment for rape and section 64 (2) outlines the punishment for rape in custody/rape by a person in a position of authority or trust.

Section 63 of the BNS (IPC 375) outlines the definition of rape.

Section 72 of the BNS (IPC 228A) deals with the disclosure of a rape victim's identity.

Section 75 of the BNS (IPC 354A) deals with sexual harassment.

Solution to Question 3:

Statutory rape is having a sexual relationship with a girl who is below 18 years of age even with her consent.

Sexual intercourse with a woman who is under the influence of sedative drugs like GHB, rohypnol (flunitrazepam) is called date rape.

Sexual intercourse with wife living separately, against her consent is marital rape.

Voluntary sexual intercourse between a married person and a person who is not their spouse is adultery.

Note: Adultery used to be a punishable offence under Section 497 IPC. It was scapped down by the Supreme Court on 27th September 2018, and is no longer punishable.

Solution to Question 4:

Sexual assault by the husband upon his wife during separation is a bailable offense.

Section 67 of the BNS (376B IPC) deals with sexual intercourse by the husband with his wife during separation. It is cognizable (only on a complaint of the victim) and bailable. Punishment is imprisonment for not less than 2 years but which may extend to 7 years and with a fine.

Solution to Question 5:

A person in authority (police constable), who induces or seduces any female (inmate of jail) to have sexual intercourse with him is defined under Section 68 BNS (376C IPC). Such sexual intercourse does not amount to the offense of rape.

Solution to Question 6:

In India, there is no age limit under which a boy is considered physically incapable of committing rape.

In such cases, the development of a child along with the development of sexual organs is taken into consideration while deciding if he is capable of performing rape or not. The court decides the question of potency on case to case basis.

Solution to Question 7:

In the case of a young child, the hymen is deeply situated and usually intact after intercourse. As the vagina is very small, it is impossible for the penetration of the adult organ to take place.

In children, there are few or no signs of general violence, as the child is unaware of the assault and incapable of resisting. A few indicators for inquiry are:

- Pain on urination and/or defecation
- Abdominal pain
- Inability to sleep
- Sudden withdrawal from peers/adults
- Feelings of anxiety
- Nervousness
- Helplessness
- A feeling of ending one's life

Solution to Question 8:

The given findings are suggestive of a false virgin.

The examination findings of a separated labia majora, a flabby labia minora, and a fourchette tear are indicative of forceful penetration.

Hymen usually gets ruptured with the first act of sexual intercourse. However, in some cases, hymen remains intact in spite of sexual intercourse. It is indicative of a false virgin.

Solution to Question 9:

A vaginal swab of a rape victim demonstrates spermatozoa if the vaginal swab is taken within 72 hours after an assault.

However, a vaginal swab can be taken within 96 hours to demonstrate semen.

Evidence on the outside of the body and on materials such as clothing can be collected even after 96 hours.

Solution to Question 10:

Mobile sperms in the vagina can be usually detected up to 6-12 hours after intercourse.

Once deposited, the sperms may be recovered up to 72 hours from the vagina but they lose their motility.

This evidence is useful in estimating the time of the assault. Venereal diseases and wounds can also be used to estimate time of assault. The absence of spermatozoa in the female genital tract does not rule out the possibility of a sexual assault.

Spermatozoa can be detected on the body upto 72 hours and semen upto 96 hours, after an assault.

Solution to Question 11:

The presence of smegma on the corona glandis indicates that the person has not engaged in a sexual act in the last 24 hours.

Smegma requires about 24 hours to collect. It gets removed by bathing or washing or intercourse. The absence indicates sexual activity might have been performed in the last 24 hours as it gets rubbed off during intercourse. The presence of smegma absolutely negates the possibility of complete penetration.

Solution to Question 12:

The acid phosphatase test is used to identify seminal stains.

The prostatic secretion contains acid phosphatase. Semen recovered from the vagina retains acid phosphatase concentrations up to 36 hours after its deposition. It is expressed in Bodansky units. The acid phosphatase test is conclusive in case of the absence of demonstrable sperms or aspermia.

The absolute proof of semen is finding at least one unbroken spermatozoon or electrophoretic LDH isoenzyme detection of sperms.

Solution to Question 13:

The test done in the scenario is the Barberio test.

It is used to detect seminal fluid. When saturated aqueous or alcoholic solution of picric acid is added to the spermatic fluid, yellow needle-shaped rhombic crystals of spermine picrate are

produced.

Florence test:

- Used to detect: semen
- Stain used: 10% hydrochloric acid and Florence solution (potassium iodide, iodine, and water)
- Finding: If semen is present, dark brown rhombic or needle-shaped crystals of choline iodide appear immediately

Takayama test (Haemochromogen crystal test):

- Used to detect: bloodstains
- Stain used: Takayama reagent
- Finding: If bloodstain is present, pink feathery crystals of haemochromogen or reduced alkaline haematin appear in a few minutes

Teichmann test (Haemin Crystal Test):

- Used to detect: bloodstains
- Stain used: glacial acetic acid and a small crystal of sodium chloride
- Finding: If bloodstain is present, faint yellowish-red to brownish-black rhombic crystals of haemin or haematin chloride appear. When hydrogen peroxide is added, the haematin crystals give bubbles of gas

Solution to Question 14:

A funnel-shaped anus is present in the habitual passive agent of sodomy.

Eunuchs are male prostitutes acting as passive agents in sodomy. They belong to 2 groups - Hijrahs (castrated) and zenanas (with intact genitalia).

Examination findings in a habitual passive agent of sodomy:

- Shaved anal hair
- Funnel-shaped anus
- Dilated and lax anal sphincter
- Anal fissures and scars
- Smooth anal mucous membrane
- Lateral buttock traction test: On applying lateral traction to the buttock, there will usually be a reflex contraction of the anus. But in a habitual passive sodomite, complete relaxation of the sphincter occurs.

Solution to Question 15:

The given scenario is suggestive of fetishistic transvestism.

It is a paraphilia characterized by recurrent sexually arousing fantasies, sexual urges, or behavior involving the wearing of clothes of the opposite sex and appearing as a member of the opposite sex. It is also called transvestic fetishism. It is usually seen in males who obtain sexual pleasure by wearing female clothes.

Fetishistic transvestism is a paraphilia whereas transvestism is a gender identity disorder. There is no hormonal/genital abnormality in fetishistic transvestism.

Option A: Transsexualism refers to an obsessional desire to become a member of the opposite sex and seek surgery for anatomical alterations.

Option C: Frotteurism refers to a person who obtains sexual gratification by contact with another person (rubbing his private parts against female buttocks, breasts, or thighs, in public places). It is punishable under Sec 292 BNS (Section 290 IPC), with a fine of up to 1000 rupees.

Option D: Gender dysphoria is a term that describes a sense of unease that a person has due to a mismatch between their biological sex and their gender identity. This sense of unease or dissatisfaction can lead to depression and anxiety and can have a harmful impact on daily life.

Solution to Question 16:

Sexual asphyxia (autoerotic asphyxia/asphyxiophilia) is seen in masochism and transvestism.

Pressure on carotid vessels/partial airway obstruction leads to cerebral hypoxia and impaired consciousness. This causes erotic hallucinations and sexual pleasure. A controlled degree of mechanical asphyxia is produced, but accidental deaths can happen.

Option A: Lust murder is an extreme case of sadism where murder serves as a stimulus for a sexual act. Death is not accidental, as is in the case of sexual asphyxia.

Option C: Sexual oralism is obtaining sexual pleasure from the application of the mouth to the sexual organs.

Option D: Frotteurism is a perversion mostly seen in males, where they obtain sexual gratification from rubbing their genitalia on unsuspecting females.

Solution to Question 17:

BNS Section 301 (IPC 297) deals with indignity to the human corpse.

BNS Section	IPC section	Deals with	Punishment
292	290	Punishment for public nuisance	Fine Up to Rs.1000
296	294	Obscene acts and songs	Up to 3 months of imprisonment or fine or both

BNS Section	IPC section	Deals with	Punishment
301	297	Trespassing on burial places/ wounding the feeling of any person /indignity to any human corpse	Up to 1 year of imprisonment or fine or both
302	298	Intentionally tries to wound someone's religious feelings by speaking words, making sounds, gestures, or placing objects within that person's hearing or sight	Up to 1 year of imprisonment, a fine, or both.

Solution to Question 18:

According to the MTP Act, for medical termination of pregnancy, consent is needed from the woman only.

Consent of the husband is not necessary. Abortion cannot be performed at the request of the husband if the woman is not willing.

Written consent of the guardian or family is required only when the woman in question is mentally ill or a minor. A diagnosis of autism wouldn't affect the decision-making capacity of the woman.

Solution to Question 19:

As per the Medical Termination of Pregnancy (Amendment) Act, 2021, Medical Termination of Pregnancy (MTP) for contraceptive failure is permissible up to 20 weeks. This bill was passed by Rajya Sabha on 17th March 2021.

Features of the Medical Termination of Pregnancy (Amendment) Bill:

- Enhancing the upper gestation limit from 20 to 24 weeks for special categories of women which includes survivors of rape, victims of incest, and other vulnerable women (like differently-abled women, minors), etc.
- Up to 20 weeks in case of contraception failure
- Opinion of only one provider will be required up to 20 weeks of gestation and of two providers for termination of pregnancy of 20-24 weeks of gestation.
- Upper gestation limit not to apply in cases of substantial fetal abnormalities.
- Name and other particulars of a woman whose pregnancy has been terminated shall not be revealed except to a person authorized in any law for the time being in force.
- The ground of failure of contraceptives has been extended to women and their partners.

Solution to Question 20:

As per the Medical Termination of Pregnancy (Amendment) Act, 2021, the induction of MTP in a mentally ill woman or a rape victim is allowed until 24 weeks.

Features of the Medical Termination of Pregnancy (Amendment) Act 2021:

- Enhancing the upper gestation limit from 20 to 24 weeks for special categories of women, which includes survivors of rape, victims of incest, and other vulnerable women (like differently-abled women, minors).
- Opinion of only one provider will be required up to 20 weeks of gestation and of two providers for termination of pregnancy of 20-24 weeks of gestation.
- Upper gestation limit does not to apply in cases of substantial fetal abnormalities.
- Name and other particulars of a woman whose pregnancy has been terminated shall not be revealed except to a person authorized in any law for the time being in force.
- The ground of failure of contraceptives has been extended to women and their partners.

Note: The bill was passed by Rajya Sabha on 17th March 2021.

Solution to Question 21:

In the given scenario, you need to start treatment for STI, inform the police, and record refusal of consent for examination.

Examination of a sexual assault victim shouldn't be forced upon, but an informed refusal is to be documented after explaining to them the consequences of choice.

Medical treatment and testing for pregnancy have to be done for all victims of sexual assault free of cost and police should be informed as per Section 397 of BNSS (357-C of CrPc).

As the girl is under 18 years of age, as per POCSO (The Protection of Children from Sexual Offences) act 2012, the medical practitioner should initiate treatment for exposure to sexually transmitted diseases (STDs) including prophylaxis for identified STDs (including HIV if suspected) and possible pregnancy and emergency contraceptives should be discussed with the victim and her parent/guardian.

Solution to Question 22:

The given clinical scenario where one twin is found to not belong to the father of the other twin is suggestive of heteroparental superfecundation.

Superfecundation is the fertilization of 2 different ova in the same menstrual cycle (as suggested by the same gestational age) by separate acts of coitus. It can occur even after artificial reproductive therapy. Hence, after embryo transfer, intercourse must be avoided. Heteropaternal superfecundation is used to refer to instances of two different males fathering fraternal twins. This leads to the possibility of twins also being half-siblings. This may give rise to the doubt of adultery and infidelity.

Option A: Superfetation is the fertilization of 2 different ova released in different menstrual cycles (i.e ovulation and fertilization during pregnancy). This can occur within 12 weeks of pregnancy after which the decidual space is obliterated and a detailed evaluation will reveal disparities in gestational ages.

Option C: Supposititious child is also known as a fictitious child. In such cases, a woman pretends to be pregnant and generally substitutes a male child for a female child born of her, or after an abortion. This is done for the purpose of claiming property.

Option D: Atavism is the reappearance of a characteristic in an individual after several generations of absence. For example, the child may not resemble his parents but resemble his ancestors. This is attributed to the recombination of genes.

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Childhood Violence, Infanticide and Starvation

Question 1:

USG done on a pregnant woman shows Spalding's sign. Which of the following is most likely?

- a) Mummification of fetus
- b) Fetal macrosomia
- c) Down's syndrome
- d) Maceration of fetus

Question 2:

In which of the following conditions is Robert's sign seen?

- a) Foetal distress
- b) Postmature foetus
- c) Premature foetus
- d) Foetal death

Question 3:

You are performing an autopsy on a fetus born dead at 6 months. Which of the following is least likely to be seen in this case?

- a) Mummification
- b) Adipocere
- c) Resorption
- d) Maceration

Question 4:

In which of the following conditions is a false positive hydrostatic test in fetus seen?

- a) Putrefied fetus
- b) Congenital syphilis

- c) Atelectasis
- d) Pneumonia

Question 5:

You are using Haase's rule for the estimation of fetal age in a pregnant woman. Which of the following parameters is used here?

- a) Biparietal diameter
- b) Head circumference
- c) Crown heel length
- d) Femoral length

Question 6:

X-ray of a child shows nobbing fracture. Which of the following is the most likely cause?

- a) Battered baby syndrome
- b) Munchausen syndrome
- c) Sudden infant death syndrome
- d) Hyperabduction shoulder injury

Question 7:

A 5-year-old boy is brought to OPD with complaints of pain over the forearm. On detailed examination, several wounds with cigarettes burns are found. X-ray showed a spiral fracture of the radius. Which of the following is least likely seen in this condition?

- a) Subdural hematoma
- b) Periosteal shearing
- c) Multiple injuries at same stage of healing
- d) Soft tissue swelling

Question 8:

A 14 year old girl presents to the emergency room with fracture forearm and says she has tripped and fell. On examination you notice multiple cigarette burns on her forearm. What

will you do next?

- a) Conduct a thorough examination
- b) Seek a social worker's help
- c) Inform higher authorities immediately
- d) Inform your colleagues

Question 9:

A 2-month-old previously healthy baby was brought to the casualty when the parents found that the baby was not breathing while asleep. Following resuscitative measures, the baby was still apnoeic, pulseless, and asystolic. You suspected sudden infant death syndrome in this child. Which of the following is not a risk factor of this condition?

- a) Sharing a bed with a family member
- b) Sleeping on hard surfaces
- c) Sleeping in prone position or on the side
- d) Overheating while sleeping

Question 10:

An unmarried mother purposefully drowned and caused the death of her newborn infant in the bathtub. She will be punished under which of the following?

- a) Section 40 of BNS (IPC 102)
- b) Section 103 of BNS (IPC 302)
- c) Section 91 of BNS (IPC 315)
- d) Section 108 of BNS (IPC 306)

Question 11:

Posthumous child is a

- a) Child delivered after the death of parents
- b) Child delivered after the death of biological father
- c) Child born out of wedlock
- d) Fictitious child

Question 12:

According to POCSO, aggravated sexual assault includes:

- a) Sexual assault done by police officer
- b) Threatening
- c) Gang penetrative sexual assault
- d) All of the above

Question 13:

An 11-year-old girl was found to be quiet and shy in her classroom with intermittent crying, for the past few days. It was discovered that her uncle was touching her genitalia inappropriately. The duty of the principal is to report this to?

- a) Magistrate
- b) Police
- c) Child Welfare Committee
- d) Parents

Question 14:

Autopsy of a patient shows an entire absence of fat in the omentum, mesentery and internal organs. Which of the following most likely leads to this?

- a) Starvation
- b) Cancer
- c) Liposuction
- d) Wasting Diseases

Question 15:

An old man who was lying on the roadside is brought to the casualty by the police. On detailed history, he reveals that he has had no food for the past few weeks. On examination, he is severely emaciated. What is the likely finding in the gall bladder?

- a) Gall bladder distended
- b) Atrophy of gall bladder

- c) Gall stones
- d) Cholecystitis

Answer Key

Question No.	Correct Option
1	d
2	d
3	b
4	a
5	c
6	a
7	c
8	a
9	b
10	b
11	b
12	a
13	b
14	a
15	a

Detailed Explanations

Solution to Question 1:

USG showing Spalding’s sign is suggestive of maceration of the fetus. This sign refers to the overlapping of the fetal skull bones caused by the collapse of the fetal brain.

Maceration is a process of aseptic autolysis occurring after the intrauterine death of the fetus. The prerequisite for the process of maceration to occur is that the dead fetus should be in utero for 3-4 days and should be surrounded by the liquor amnii. If air enters the liquor amnii after the death of the fetus, putrefaction occurs instead of maceration.

Note: Mummification is the term for a dry decomposition of a dead body, or conversion to waxy substances, called adipocere.

Solution to Question 2:

Robert's sign is a radiological sign which refers to the presence of a gas shadow within the chambers of the heart or the greater vessels like aorta. It is seen in cases of foetal death in utero. It is a sign of maceration.

Solution to Question 3:

Adipocere formation cannot be an autopsy finding in the given scenario since fetuses under 7 months do not show this change.

Adipocere is the formation of a soft greyish-white, waxy, greasy material with an offensive, sweet rancid smell, occurring in fatty tissues. It is due to postmortem hydrolysis or hydrogenation of the fats. It is a modification of putrefaction. It is seen most commonly in bodies immersed in water or in a damp, warm environment. Fetuses under 7 months do not show this change.

If the pregnancy with the dead fetus continues, it may be gradually resorbed or mummified. Mummification occurs when the foetus dies from a deficient supply of blood, when liquor amnii is scanty, and when no air enters the uterus. It is also a finding in fetus papyraceous, which is the intrauterine demise of a fetal twin, where it is compressed between the membranes and the uterine wall.

The most important post-mortem change in an intrauterine death is maceration, which is an autolytic process by which there is self-disintegration of the body by cellular enzymes. This can occur if the death of the fetus happens days to months before the delivery.

Solution to Question 4:

The hydrostatic test is falsely positive in the case of putrefied fetus.

Hydrostatic test is done to determine whether the newborn has respired or not. It is also known as floatation test/ Breslau's first life test/ Raygat's test.

If the lung pieces float in water, it means that respiration has taken place, indicating a live birth. If the pieces sink, respiration has not taken place, which means it is stillborn.

An unrespired lung (stillbirth) may float, giving a false positive test, due to gases of decomposition, as seen in putrefaction.

Solution to Question 5:

Rule of Haase enables the estimation of the age of the fetus in lunar months from its crown-heel length (in cm).

According to the rule:

- When the crown heel length ≤ 25 cm, Age in months = Square root of crown heel length

- When the crown heel length \geq 25 cm, Age in months = crown heel length divided by 5

Note: Haase's modification of Morrison's law states that during the last 5 months, the length in centimeters divided by 5 gives the age in months.

Eg : crown heel length = 30 cm, gestational age = 6 months.

Solution to Question 6:

Nobbing fracture is a feature of battered baby syndrome (infantile whiplash syndrome).

In battered baby syndrome, violent squeezing of the chest from side to side causes fracture of costochondral junctions and fracture along the posterior angles of the rib.

After callus formation, which takes around 2 weeks, it gives a string of beads appearance in paravertebral region on X-ray, also known as nobbing fractures.

Munchausen syndrome is also known as the factitious disorder imposed on self. Patients deceptively misrepresent, simulate, or cause symptoms of an illness and/or injury in themselves, even in the absence of obvious external rewards such as financial gain, housing, or medications.

Sudden infant death syndrome (SIDS) is defined as the sudden death of an infant, which remains unexplained after a thorough case investigation, including the performance of a complete autopsy, examination of the death scene, and review of the clinical history.

Solution to Question 7:

The given clinical scenario is suggestive of battered baby syndrome. The classical feature of this condition is injuries inflicted are of different ages and in different stages of healing. This is due to the repetitive nature of child abuse.

A battered child is one who has received repetitive physical injuries as a result of non-accidental violence, produced by a parent or guardian, there may also be deprivation of nutrition, care, and affection.

This syndrome must be considered in any child:

- In whom the degree and type of injury varies with the history given
- When injuries are of different ages and in different stages of healing
- When there is a purposeful delay in seeking medical attention despite serious injury
- Who exhibits evidence of fracture of any bone, subdural hematoma, failure to thrive, soft tissue swelling or skin bruising
- Who dies suddenly

Skeletal survey, which includes the following, should be done in a case of suspected child abuse:

- AP views of the entire skeleton
- Dedicated views of hands and feet

- Lateral views of appendicular skeleton, skull, and spine

Solution to Question 8:

A child who has been physically abused should undergo a thorough physical examination at first. This should be followed by a psychiatric interview.

When the child is brought to the emergency room, a detailed and spontaneous account of the injury should be obtained promptly from parents or other caregivers before secondary details and rationalizations cloud the information provided.

Solution to Question 9:

Sleeping on hard/ firm surfaces is not associated with sudden infant death syndrome (SIDS).

Crowded sleeping areas with many pillows, blankets, and stuffed toys, or old, soft mattresses are associated with an increased risk of SIDS.

SIDS is also known as a 'cot' or 'crib' death. Usually, the parent finds the infant expired in the crib after putting them to sleep. It is an unexpected death in a healthy infant, whose autopsy may not reveal a cause of death.

70% of cases of SIDS are found at autopsy to have intrathoracic petechiae in the pleura, epicardium, and thymus. However, this feature is considered to be an agonal phenomenon. The presence of this feature alone should not raise concern for manual suffocation.

Most cases of SIDS occur between 1-7 months of age but can occur up to 2 years. The risk increases with male infants, multiple births, colder climates, and lower socioeconomic status families.

Ways to reduce the risk of SIDS include:

- Avoiding sharing a bed with the infant
- Abstinence from smoking
- Using hard/firm bedding and keeping the sleeping area clear
- Ensuring the infant sleeps supine
- Keeping the room temperature comfortable
- Breastfeeding

Option A: Sharing a bed with a family member is associated with SIDS. The risk is augmented if the parent has consumed alcohol or sedative medications.

Option C: Sleeping prone or on the side is strongly associated with SIDS. The risk of regurgitation and choking is high in infants who sleep prone. These positions are associated with instability.

Option D: Overheating while sleeping can occur if the baby has a fever or has been placed in excessive clothing or in a warm room. Overheating has been associated with SIDS.

Solution to Question 10:

The woman will be punished under BNS Section 103 (IPC 302), which deals with the punishment for murder. This offence is punishable with death or imprisonment for life, and shall also be liable to a fine.

Other relevant sections include:

- BNS Section 93 (IPC 317) - Abandoning a child of <12 years
- BNS Section 94 (IPC 318) - Concealment of birth

Option A: BNS Section 40 (IPC 102) deals with the commencement and continuance of the private defence of the body.

Option C: BNS Section 91 (IPC 315) deals with acts done before birth with the intent to prevent a child from being born alive or to cause to die after birth.

Option D: BNS Section 108 (IPC 306) deals with punishment for abetment to suicide.

Solution to Question 11:

The child delivered after the death of the biological father, or a child delivered after the death of the biological mother, usually when delivered by a cesarean section is a posthumous child.

Illegitimate child is a child born out of wedlock i.e. when the parents are not married.

Supposititious child or fictitious child is when a woman pretends to go through pregnancy and delivery. Later, she produces a living child as her own for obtaining money or for the purpose of claiming the property.

Solution to Question 12:

Sexual assault done by a police officer is an aggravated sexual assault according to POCSO (Protection of Children from Sexual Offences).

The POCSO act defines a child as any person below eighteen years of age. It defines various forms of sexual offenses which include:

- Sexual harassment - Threatening
- Sexual assault - Any act with sexual intent that involves physical contact without penetration.
- Aggravated sexual assault - Similar to sexual assault along with the criteria explained under the term aggravated
- Penetrative sexual assault - An act with sexual intent that involves physical penetration of the penis or any object into the vagina, mouth, urethra, or anus.

- Aggravated penetrative sexual assault - Similar to penetrative sexual assault along with the criteria explained under the term aggravated
- Pornography

The term aggravated is used for those assaults done:

- By a person in a position of trust or authority such as a police officer, security force, relative, doctor
- In the course of communal violence
- On mentally & physically disabled
- Gang sexual assault
- Using deadly weapons
- Causing grievous hurt

Depending on if there was penetration or not, it can be aggravated sexual assault (if there is no penetration) or aggravated penetrative sexual assault (if there was penetration). Both are different.

The Act prescribes stringent punishment graded as per the gravity of the offence, with a maximum term of rigorous imprisonment for life and fine.

Note- Gang penetrative sexual assault comes under aggravated penetrative sexual assault and not under aggravated sexual assault. Therefore, option C cannot be correct in this case.

Solution to Question 13:

The principal has to report this case to the police.

The POCSO Act, 2012 is a comprehensive law for the protection of children from the offences of sexual assault, sexual harassment, and pornography. This is done while safeguarding the interests of the child at every stage of the judicial process by incorporating child-friendly mechanisms for reporting, recording of evidence, investigation, and speedy trial of the offence through designated special courts.

Section 21(1) of the POCSO Act, 2012 requires mandatory reporting of cases of child sexual abuse to the law enforcement authorities and applies to everyone including parents, doctors, and school personnel. Failure to report a suspicion of child abuse is an offence under the Act.

Solution to Question 14:

In starvation, fat is almost completely absent in the subcutaneous tissues and also in the omentum, mesentery and all the internal organs. This is never seen in wasting diseases.

Solution to Question 15:

The given clinical scenario points to starvation. In this condition, the gall bladder is distended.

In starvation, bile does not get secreted into the duodenum due to the absence of food entering the stomach and intestine. Hence, bile gets accumulated in the gall bladder which gets distended.

The feeling of intense hunger lasts for 30–48 hours. A person can survive for 10–12 days without food and water and for 6–8 weeks without food alone.

Loss of 40% of body weight is usually fatal. Loss of 70–90% of body fat and 20% of body protein is fatal. There is a reduction in the weight and size of all organs except the brain.

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Poisoning: General Considerations

Question 1:

What is the science dealing with toxins produced by animals, plants, and microbes called?

- a) Toxicology
- b) Toxology
- c) Toxinology
- d) Ecotoxicology

Question 2:

Which of the following substances are irritant poisons?

- a) 1, 4 and 5
- b) 2, 3 and 5
- c) 3 and 4
- d) 4 and 5

Question 3:

Which of the following is considered as an ideal homicidal poison?

- a) Thallium
- b) Arsenic
- c) Aconite
- d) Strychnine

Question 4:

A farmer is found guilty of leaving his pesticides carelessly in the kitchen. It caused his wife to unknowingly consume pesticides and suffer from poisoning. Which section of the BNS would he be charged with?

- a) BNS Section 229 (IPC 193)
- b) BNS Section 286 (IPC 284)

- c) BNS Section 106 (IPC 304A)
- d) BNS Section 123 (IPC 328)

Question 5:

A servant adds sleeping pills to his master's food with the intention of robbery. Under which section of the BNS would he be charged?

- a) BNS Section 106 (IPC 304A)
- b) BNS Section 122 (IPC 334)
- c) BNS Section 123 (IPC 328)
- d) BNS Section 117 (IPC 322)

Question 6:

You are a registered medical practitioner working at a PHC. A patient is brought to you with a history of consuming poison in a suicide attempt. Which of the following statements is true?

- a) It is mandatory to inform the police before starting any treatment
- b) It is mandatory to register a police complaint prior to inpatient admission
- c) It is mandatory to inform the police regardless of whether suicidal, accidental or homicidal
- d) It is mandatory to call the police to the hospital prior to discharge

Question 7:

Which of the following routes of administration of a poison leads to the most rapid onset of action?

- a) Intravenous injection
- b) Application to a mucosal surface
- c) Inhalation of gaseous form
- d) Application to a wound

Question 8:

A woman was drugged with a substance, which was slipped into her coffee without her knowledge by a man at her workplace. The man confessed that he tried to make her notice

him by adding a love philter to her coffee. Which of the following would he have used?

- a) CNS depressants
- b) Deliriants
- c) Stupefying agents
- d) Aphrodisiacs

Question 9:

During a post-mortem examination, the forensic expert reports a peculiar chocolate-colored discoloration of the body. It did not blanch on pressure. Which of the following statements is false regarding this scenario?

- a) The discoloration is due to formation of methemoglobin
- b) This condition is associated with poisoning by nitrates
- c) The discoloration is likely to disappear in 24-48 hours after death
- d) The victim could have been saved by the timely use of methylene blue

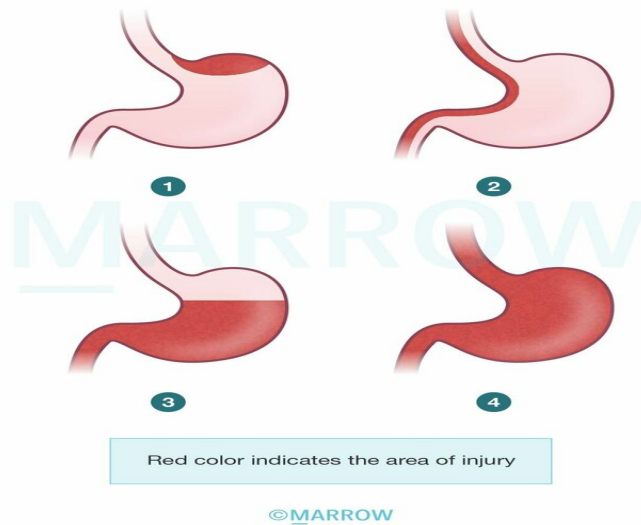
Question 10:

A deceased man is being evaluated for suspected poisoning. During an autopsy, you get a peculiar garlicky smell from the nose and mouth of the body. Which of the following agents would you suspect?

- a) Thallium sulphate
- b) Hydrogen sulphide
- c) Cyanide
- d) Phosphorus

Question 11:

A patient was brought in with a history of consumption of acid. His last meal was one hour ago. What pattern of gastric mucosal injury would you expect to see in this patient?



- a) Image 1
- b) Image 2
- c) Image 3
- d) Image 4

Question 12:

Which of the following poisons cause bluish discoloration of the stomach mucosa on post mortem examination?

- a) Oxalic acid
- b) Sodium amytal
- c) Soneryl
- d) Arsenic

Question 13:

Which of the following is associated with phenomenon of drug automatism?

- a) Alcohol
- b) Cocaine
- c) Datura
- d) Lysergic acid

Question 14:

Gastric lavage can be performed in case of poisoning by:

- a) Sulphuric acid
- b) Strychnine
- c) Carbolic acid
- d) Kerosene oil

Question 15:

In which of the following patients is performing gastric lavage an absolute contraindication?

- a) A patient with a history of kerosene consumption
- b) A patient with a history of acetaminophen overdose
- c) A patient with a history of tricyclic antidepressant overdose
- d) A patient with a history of opioid poisoning

Question 16:

You have been asked to administer gastric lavage to a patient with salicylate poisoning. Which of the following positions is most appropriate for performing this procedure?

- a) Right lateral position
- b) Supine position
- c) Left lateral position
- d) Erect position

Question 17:

Which of the following tube is ideally used for performing gastric lavage in patients with suspected poisoning?

- a) Ryle's tube
- b) Ewald tube
- c) Salem-sump tube
- d) Sengstaken-Blakemore tube

Question 18:

A patient presents to the ER with suspected poisoning. Which of the following is the next best step for management in this case?

- a) Induction of emesis by giving ipecac
- b) Administrations of cathartics
- c) Perform stomach dilution with normal saline
- d) Administer the antidote

Question 19:

A 20-year-old woman was rushed to the ER due to an attempted suicide by ingesting an unknown substance. Administration of activated charcoal will have no effect if the patient ingested which of the following substances?

- a) Barbiturates
- b) Lead
- c) Carbamazepine
- d) Salicylate

Question 20:

How is multi-dose activated charcoal useful in cases of poisoning?

- a) Gastrointestinal decontamination
- b) Enhanced elimination of toxin
- c) Administration of antidote
- d) Neutralisation of toxin

Question 21:

Dimercaprol is indicated as an antidote in patients with which of the following poisoning?

- a) Iron
- b) Thallium
- c) Arsenic
- d) copper

Question 22:

A 35-year-old man presents with complaints of constipation, abdominal cramps, and tingling in the extremities. His bloodwork shows a lead level of 50 µg/dL. What is the antidote preferred for this patient?

- a) Dimercaprol
- b) DMSA
- c) Penicillamine
- d) DMPS

Question 23:

With regard to forced alkaline diuresis, which of the following pairs is true?

- a) 1
- b) 2
- c) 3
- d) 4

Question 24:

Why is forced acidic diuresis not recommended as a treatment in case of poisoning?

- a) It can cause acute liver injury
- b) It can cause lung injury
- c) It can cause cardiac arrhythmia
- d) It can cause rhabdomyolysis

Question 25:

While considering hemoperfusion, which of the following properties of poison are not important?

- a) 1, 2 and 5
- b) 1, 2 and 3
- c) 2 and 3

d) 4 and 5

Answer Key

Question No.	Correct Option
1	c
2	d
3	a
4	b
5	c
6	c
7	c
8	d
9	c
10	d
11	b
12	b
13	a
14	c
15	a
16	c
17	b
18	d
19	b
20	b
21	c
22	b
23	d
24	d
25	c

Detailed Explanations

Solution to Question 1:

The science dealing with toxins produced by animals, plants, and microbes is called toxinology. Toxicology is the science dealing with properties, actions, toxicity, fatal dose, detection, and estimation of poisons.

Solution to Question 2:

Phosphorus and lead are inorganic irritant poisons.

Sodium hydroxide, ammonia, and sulphuric acid are all corrosive poisons.

Solution to Question 3:

Thallium is considered an ideal homicidal poison because poisoning with thallium resembles natural death.

When considering suicide with poison, the suicide victim prefers to terminate life as quickly as possible with the least agony. Whereas for an act of homicide with poison, the criminal would like to kill his victim without creating any suspicion in the mind of the victim or people around.

Following are the characteristics of ideal suicidal and homicidal poisons:

Thallium and organic compounds of fluorine satisfy some of the criteria for an ideal homicidal poison.

Arsenic and aconite are commonly used as homicidal poisons but are not considered ideal homicidal poisons.

Note: Though no single poison would fulfill all the characteristics mentioned in the table given above, a few examples mentioned are often considered.

Characteristics	Suicidal	Homicidal
Accessibility to the poison	Easy and free	Not particular
Antidotes availability	Nil	Nil
Clinical diagnosis	Difficult	Difficult
Cost of the poison	Cheap	Not particular
Metabolism and excretion	Not particular	Rapid
Onset of signs and symptoms	Quick and fatal	Slow and fatal
Postmortem detection	Difficult	Difficult
Signs and symptoms	Nil/ few	Resemble diseases
Solubility in food/drinks	Positive	Positive
Examples	Opium, cyanide, barbiturates, organophosphorus compounds	Arsenic, aconite, thallium, etc

Solution to Question 4:

He would be charged with Section 286 (IPC 284) of the Bharatiya Nyaya Sanhita. This section deals with negligent conduct with respect to poisons.

BNS Section 123 (IPC 328) deals with causing hurt through poison, with intent to commit an offense. In this case, the farmer had no intent of committing any offense and the poisoning was due to negligence. Hence BNS Section 123 does not apply here.

BNS Section 106 (IPC 304A) deals with causing death by act of negligence. In this case, the farmer's wife suffered poisoning, her death is not mentioned. Hence, BNS Section 106 does not apply here.

BNS Section 229 (IPC 193) deals with punishment for false evidence.

Solution to Question 5:

This man would be charged with BNS Section 123 (IPC 328) which deals with administering poison/ any stupefying, intoxicating, or unwholesome drug, with the intention of causing hurt or committing an offense.

Option A: BNS Section 106 (IPC 304A) deals with causing death by negligence.

Option B: BNS Section 122 (IPC 334) deals with voluntarily causing hurt / grievous hurt on sudden provocation.

Option D: BNS Section 117 (IPC 322) deals with voluntarily causing grievous hurt.

Solution to Question 6:

All cases of Poisoning, whether suicidal, homicidal or accidental are categorised under Medicolegal cases.

In the given clinical scenario, the patient attempts to suicide by poisoning which is labelled as MLC(Medicolegal case) and warrants the need to inform the police. Considering the legal implications, there may be a biased history from relatives or friends or acquaintances; wherein it is always advisable to report each and every suspected case of poisoning to the police and the question of suicide/ homicide/ accident to be considered by the police. The treatment must not be withheld before informing the police.

Solution to Question 7:

The most rapid onset of action of poison is associated with inhalation in gaseous form/ vapors.

Routes of administration in the decreasing order of onset of action are:

- Inhalation (most rapid)
- Intravenous
- Intramuscular, subcutaneous, intradermal injection
- Application to a wound
- Application to a serous surface
- Application to a mucous surface
- Ingestion
- Application to unbroken skin

Solution to Question 8:

A love philter is a magical potion that is supposed to make the person who receives the potion love the one who gave it. These are usually aphrodisiacs.

Some aphrodisiacs that are used as love philter are:

- Cantharides
- Arsenic
- Alcohol
- Opium
- Cocaine
- Cannabis

The use of a love philter might lead to accidental poisoning.

Solution to Question 9:

The chocolate-brown discoloration which does not blanch on pressure is suggestive of postmortem hypostasis/ lividity. It usually develops within 4 hours and persists until putrefaction.

Chocolate-coloured post-mortem lividity is associated with nitrates, nitrites, aniline, bromates, chlorates. It is due to the formation of methemoglobin.

Toxicity from nitrates can be treated with methylene blue to reverse the formation of methemoglobin.

Solution to Question 10:

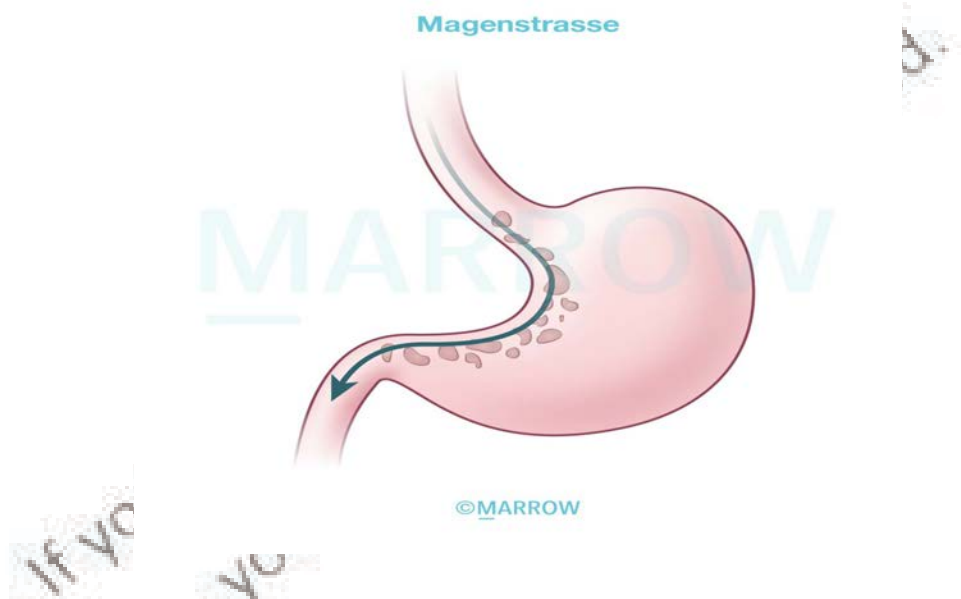
This scenario is suggestive of phosphorus poisoning as it is associated with a garlic-like odor, usually around the mouth and nose of the victim.

Other substances associated with a garlic-like odor are arsenic, thallium carbonate, and zinc phosphide.

Solution to Question 11:

The area marked in image 2 depicts the most likely pattern of gastric mucosal injury in this patient.

The pathway that fluids (acid, alkali, water) take in a food-filled stomach is known as magenstrasse. It is present along the lesser curvature of the stomach. This is where the greatest damage to gastric mucosa takes place, in corrosive injury.



In an empty stomach, the maximum injury occurs to the lower half to two-thirds of the body, with sparing of the fundus (image 3).

Solution to Question 12:

In sodium amytal poisoning, the capsules stain the stomach mucosa and its contents, turquoise blue. Bluish discolouration of the stomach mucosa is also seen in copper sulphate poisoning.

The appearance of the gastric mucosa in specific poisons:

Poison	Appearance of Gastric Mucosa
Arsenic	Red velvety mucosa

Poison	Appearance of Gastric Mucosa
Sulphuric acid	Brown or black with erosion perforation and Carbonization
Carbolic acid	Grey leathery and thickened mucosa
HNO ₃	Yellow
HCN	Pink
KCN	Brick red to brown
Phosphorous	Yellow or grey white
Sodium amytal, Copper sulphate	Blue

Solution to Question 13:

CNS depressants and alcohol are associated with the phenomenon of drug automatism.

Drug automatism develops due to the depressant effect of these drugs. It leads to the development of an 'automatism state', where the patient takes additional doses of the drug, without realizing it. This can lead to accidental poisoning.

Solution to Question 14:

Gastric lavage can be performed in case of carbolic poisoning.

In carbolic acid poisoning, if the patient survives for 48 hrs, there will be carboluria followed by anuria. The victim will pass dark, smoky urine which soon turns olive green on standing due to oxidation of hydroquinone and pyrocatechol.

It is a corrosive acid, however, it hardens the GI mucosa producing a leather bottle stomach and anesthetizes the nerve endings. This allows for gastric lavage.

Contraindications of gastric lavage:

- Corrosives poisoning (except carbolic acid)
- Convulsants/CNS stimulants
- Comatose patients
- Volatile poison
- Upper GI pathology (eg. esophageal varices)
- Hypothermic patient
- Severe heart disease

- Advanced pregnancy

Sulphuric acid and kerosene are corrosives and strychnine is a convulsant. Hence gastric lavage is not done in these poisonings.

Solution to Question 15:

Gastric lavage is not done in a case of kerosene poisoning. It can cause aspiration and pneumonitis.

Gastric lavage is rarely indicated as the procedure has numerous complications. It may be considered in cases where there is recent (<1 hour) ingestion of life-threatening amounts of a toxin, for which there is no treatment once absorbed.

With drugs that slow down gastrointestinal motility or cause pylorospasm (e.g., anticholinergics, opioids, salicylates), lavage can be done up to 24 hours.

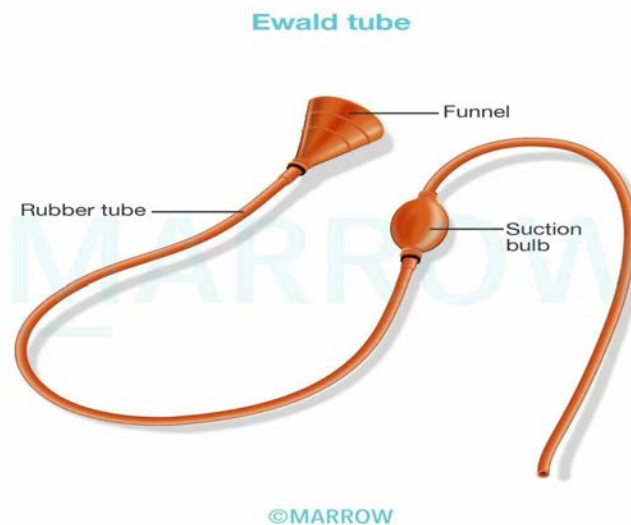
Solution to Question 16:

The left lateral position is the ideal position for performing gastric lavage.

Position the patient on the left side with the head down at an angle of 20 degrees. The patient's mouth should be at a lower level than the larynx, to prevent aspiration.

Solution to Question 17:

The tube used for performing gastric lavage is an Ewald tube. It is also known as Boa's tube, stomach tube, or orogastric lavage tube.



Gastric lavage is the administration and evacuation of small volumes of liquid through an orogastric tube to remove toxic substances within the stomach. In adults, small amounts of warm water or saline are administered and, via a siphoning action, removed again. In children, normal saline is used, as children are more at risk of developing hyponatremia if lavaged with water.

In an unconscious patient, gastric lavage is performed after induction of general anesthesia with the patient intubated, to prevent aspiration.

Solution to Question 18:

The next best step in the management of the patient with suspected poisoning is to either administration an antidote or enhanced the elimination of the poison.

The following modalities of gastrointestinal decontamination have been used in the past but are no longer routinely recommended:

- Emetics
- Cathartics
- Dilution was historically recommended following the ingestion of acidic or alkaline corrosives to decrease the concentration and prevent tissue damage.
- Gastric lavage is rarely indicated and is associated with high rates of complications.

Solution to Question 19:

Activated charcoal is not effective in case of poisoning with heavy metals like lead, corrosives, cyanide, hydrocarbons, and alcohol.

Indications for use of activated charcoal:

- Ingestion within the previous 1 hour [except in cases of poisons that slow gastric emptying (anticholinergics) or after ingestion of a substance that leads to bezoar formation (salicylates), it may be given after one hour]
- The toxic substance should be known to be adsorbed by activated charcoal
- The benefits of administration should outweigh the risks

Contraindications to use of activated charcoal:

- Non-toxic ingestion
- Toxin not adsorbed by activated charcoal
- Unprotected airway
- Possibility of upper GI perforation

Solution to Question 20:

Multidose activated charcoal (MDAC) is used for the enhanced elimination of a toxin.

In some instances, patients may benefit from the repeated administration of activated charcoal. MDAC facilitates the passage of substances from plasma into the intestinal lumen, enhancing elimination. Currently, MDAC is indicated for only the following poisons:

- Carbamazepine
- Theophylline
- Phenobarbital
- Salicylates
- Dapsone
- Quinine

The techniques used for general management of poisoning can be classified into

Mechanism	Techniques
Gastrointestinal decontamination	Orogastric lavage Activated charcoal Whole bowel irrigation
Enhanced elimination	Multi-dose activated charcoal Urinary alkalization Extracorporeal removal (Hemodialysis, Hemoperfusion)
Administration of antidote	Mechanical antidotes Chemical antidotes Physiological antidotes Pharmacological antidotes

Solution to Question 21:

Dimercaprol (BAL) is an antidote for gold, arsenic (except arsine), or acute mercury poisoning (except non-alkyl mercury). It is also an adjunct to edetate calcium disodium in acute lead poisoning.

Dimercaprol has also been approved by the FDA to treat Wilson's disease but not acute copper poisoning. The use of dimercaprol in the management of poisoning for other heavy metals has not been validated.

Note: Mnemonic: B.A.L. for M.A.L. (Mercury, arsenic, and lead).

Solution to Question 22:

The given clinical scenario is suggestive of lead poisoning. Calcium EDTA and DMSA (succimer) are the preferred antidotes for lead poisoning.

In a patient highly exposed to lead, chelation with oral DMSA (succimer) is recommended.

In case of acute poisoning with encephalopathy, IV or IM Calcium EDTA is given along with dimercaprol. Calcium EDTA redistributes lead to the brain and increases the risks of leading to encephalopathy, which is prevented by dimercaprol.

Solution to Question 23:

Urinary alkalinization (forced alkaline diuresis) is most effective for weak acids, primarily eliminated by the renal tract. It is performed with sodium bicarbonate.

Acetazolamide should not be used to produce alkaline urine, because it may worsen toxicity by causing a concomitant systemic acidosis. It results in an increase in the amount of the unionized drug in the blood and enhanced tissue distribution. It may also compete with acidic drugs for tubular secretion and thereby inhibit their elimination.

Drugs most commonly treated with forced alkaline diuresis are salicylates and phenobarbital.

Solution to Question 24:

Forced acidic diuresis is not indicated in any scenario as its potential risks (such as rhabdomyolysis, acute renal injury) outweigh any potential benefits.

Note: Though some books say that acidic diuresis is indicated in few poisoning, it is only theoretic. Forced acidic diuresis is never indicated due to the associated risks.

Solution to Question 25:

Hemoperfusion uses adsorbents like a charcoal filter, which comes into direct contact with blood, partially overcoming molecular weight and protein-binding limitations.

Properties of toxins to be considered for hemodialysis and hemoperfusion:

	Hemodialysis	Hemoperfusion
Toxin requirements	Low volume of distribution Low protein binding Low endogenous clearance Low molecular weight	Low volume of distribution Low endogenous clearance Bound by activated charcoal
Indications	Salicylates Lithium Alcohols Metformin	Theophylline Carbamazepine

Organophosphorus Poisoning

Question 1:

Poisoning with which of the following compounds causes mydriasis?

- a) Diazinon
- b) Phosdrin
- c) Endrin
- d) Paraoxon

Question 2:

A 36-year-old woman presents to the casualty with diarrhea, miosis, and altered sensorium. Her husband reveals that she has ingested rat poison in an attempt to commit suicide. What is the likely mechanism that is responsible for her clinical presentation?

- a) Inhibition of acetylcholinesterase
- b) Carbamylation of carboxylic esterase
- c) Oxidation of hemoglobin to methemoglobin
- d) Free radical mediated damage

Question 3:

Which of the following statements is false regarding the clinical syndromes seen in patients with organophosphate poisoning?

- a) CNS symptoms can be seen in acute toxicity
- b) Intermediate syndrome can be treated with atropine
- c) Chronic toxicity can manifest as symmetrical sensorimotor axonopathy
- d) Muscle wasting can be seen in organophosphate-induced delayed neuropathy

Question 4:

A 25-year-old woman, who was admitted with accidental rodenticide ingestion, was started on atropine. All of the following symptoms would improve in response to therapy except:

- a) Bradycardia
- b) Urinary incontinence
- c) Muscle cramps
- d) Hypotension

Question 5:

A local informer revealed that decades-old nerve gas cylinders were being smuggled across the border. On arrival of the police at the crime scene, the accused opened fire. One of the bullets accidentally impaled the canister near the police officer. Which of the following symptoms would you expect to see in him?

- a) Hallucinations
- b) Miosis
- c) Chest pain
- d) Joint pain

Question 6:

A 45-year-old woman, who is being treated for organophosphate poisoning with atropine, is started on pralidoxime. Which of the following symptoms would regress due to the action of pralidoxime alone?

- a) Miosis
- b) Tongue fasciculations
- c) Abdominal cramps
- d) Hypotension

Question 7:

Which of the following statements is true about the intermediate syndrome in organophosphorus poisoning?

- a) Signs of cholinergic excess are seen
- b) There is no specific treatment
- c) There is weakness of neck extensors
- d) Respiratory failure is not a complication

Question 8:

A 38-year-old gardener presents with blurred vision, breathlessness, and muscle fasciculations. He gives a history of spraying the solution given in the image a day prior to his symptoms. All of the following are specific indicators of the likely diagnosis except:



- a) Prolonged QTc interval
- b) Miosis and muscle fasciculations
- c) Resolution of cholinergic symptoms upon atropine administration
- d) Fall in RBC cholinesterase levels

Question 9:

You are suspecting organophosphorus poisoning in a farmer who presented with chronic fatigue and urinary incontinence. What would be the most accurate investigation to assess potential toxicity?

- a) Plasma cholinesterase
- b) RBC cholinesterase
- c) Serum levels of organophosphorus compounds
- d) Urinary levels of organophosphorus compound metabolites

Question 10:

In organophosphorus poisoning, clinical manifestations occur when pseudocholinesterase levels fall below:

- a) 95% of normal
- b) 75% of normal
- c) 60% of normal
- d) 50% of normal

Question 11:

A 7-year-old girl is rushed to the casualty in an unconscious state as she has consumed ant chinks 2 hours ago. On examination, you note the presence of miosis and crackles on chest auscultation. She is hypotensive with PR of 50 bpm, RR of 36 /min, and ECG showing prolonged QTc. You start treating her with atropine sulphate IV. Which of the following will you consider as the therapeutic endpoint?

- a) Pupillary dilation
- b) Increase in heart rate
- c) Normal ECG
- d) Clear chest on auscultation

Question 12:

In patients with organophosphate poisoning, which of the following treatment modalities has proven mortality benefits?

- a) Hemodialysis
- b) Pralidoxime
- c) Oxygen supplementation
- d) Urinary alkalinization

Question 13:

What is the most common cause of mortality in patients with organophosphate poisoning?

- a) Cardiac arrhythmias
- b) Renal failure
- c) Hypovolemic shock

d) Respiratory failure

Question 14:

Which of the following statements regarding carbamate poisoning is true when compared to organophosphorus poisoning?

- a) It is associated with faster aging of the cholinesterase enzyme
- b) It can also lead to the intermediate syndrome
- c) Severe CNS toxicity can be seen
- d) Pralidoxime is the mainstay in management

Answer Key

Question No.	Correct Option
1	c
2	a
3	b
4	c
5	b
6	b
7	b
8	a
9	b
10	d
11	d
12	c
13	d
14	b

Detailed Explanations

Solution to Question 1:

Endrin is an organochlorine compound. Poisoning with this compound causes mydriasis. There is no specific antidote for organochlorine poisoning.

Diazinon, phosdrin, and paraoxon are organophosphates and they cause miosis. Organophosphate poisoning is treated with atropine and oximes.

Classification of insecticides:

- Organophosphorus compounds
- Parathion
- Paraoxon
- Chlorthion
- Diazinon
- Malathion
- Phosdrin
- HETP (hexaethyl tetraphosphate)
- TEPP (tetraethyl pyrophosphate)
- Organochlorine compounds
- DDT (dichloro diphenyl trichloroethane)
- Gammahexa-chlorobenzene
- Endrin
- Aldrin
- Endosulfan
- Carbamates
- Aldicarb
- Carbaryl
- Carbofuran
- Pyrethrin and pyrethroids

Solution to Question 2:

The given clinical scenario is suggestive of organophosphorus (OP) poisoning. Clinical effects are due to the inhibition of acetylcholinesterase.

Inhibition of cholinesterase leads to the accumulation of acetylcholine at the nerve synapses and neuromuscular junctions. This results in overstimulation of acetylcholine receptors resulting in a cholinergic crisis.

The types of cholinesterases are:

Acetylcholinesterase or RBC cholinesterase is helpful in the diagnosis of OP poisoning but has no prognostic significance.

It is hypothesized that inhibition of neuropathy target esterase enzyme may be responsible for organophosphate-induced delayed neuropathy (OPIDN).

The mechanism of action of the other agricultural poisons are:

Type	Location
Acetylcholinesterase or true or RBC cholinesterase	RBC membranes Nervous tissue Skeletal muscle
Butyrylcholinesterase or plasma cholinesterase or pseudocholinesterase	Serum Liver Pancreas Heart Brain
Neuropathy target esterase	Brain Kidney

Compound	Mechanism of action
Carbamates	Carbamylation of carboxylic esterase
Chlorate salts (sodium or potassium chlorates)	Oxidation of hemoglobin to methemoglobin
Paraquat	Free radical-mediated damage

Solution to Question 3:

Intermediate syndrome is unresponsive to atropine and oximes. The syndrome occurs due to prolonged cholinesterase inhibition and muscle necrosis. Maintenance of nutrition, physiotherapy, prevention of bed sores and other routine measures to minimise discomfort along with ventilatory care are management options.

Four clinical syndromes are identified with respect to organophosphate exposure. They include:

- Acute poisoning - This results in CNS, muscarinic, nicotinic, and somatic motor manifestations.
- Intermediate syndrome - It is usually observed 1-5 days after OP exposure. It is characterized by paralysis of neck flexors, muscles innervated by cranial nerves, proximal limb muscles, and respiratory muscles.
- Chronic toxicity - It is seen primarily in agricultural workers with daily exposure. It manifests as symmetrical sensorimotor axonopathy.
- Organophosphate-induced delayed neuropathy - This is characterized by cognitive dysfunction, extrapyramidal symptoms, and peripheral neuropathy. It can lead to flaccid paralysis and muscle wasting.

Solution to Question 4:

Atropinization in organophosphate (rodenticide) poisoning does not cause regression of nicotinic symptoms like muscle cramps. Hence, oximes are used for the reversal of nicotinic symptoms.

Atropine is effective against muscarinic receptors. It can be used to treat muscarinic symptoms like bradycardia, urinary incontinence, and hypotension.

Solution to Question 5:

Nerve gases are organophosphate compounds in the gaseous form. It manifests with cholinergic signs and symptoms, such as miosis. It was used in chemical warfare.

The nerve gases include:

- Soman
- Sarin
- Tabun
- VX

Solution to Question 6:

Pralidoxime causes reversal of tongue fasciculations (nicotinic symptoms).

Since atropine does not bind to nicotinic receptors, it is ineffective in treating neuromuscular dysfunction. Pralidoxime (2-PAM) and other oximes, such as HI-6 and obidoxime, are cholinesterase-reactivating agents. Hence, its coadministration with atropine is effective in treating both muscarinic and nicotinic symptoms.

Pralidoxime reactivates the acetylcholinesterase, which had been deactivated in organophosphate poisoning. Pralidoxime attaches to the anionic site of the enzyme that remains unoccupied. Then it reacts with the phosphorus atom of the organophosphorous compound which is attached to the esteric site to form a phospho-oxime complex. It then dissociates from the enzyme, regenerating the active enzyme.

Pralidoxime should not be administered without concurrent atropine, in order to prevent worsening of symptoms due to transient oxime-induced acetylcholinesterase inhibition.

Note: Muscle cramps are nicotinic symptoms. However, abdominal cramps are muscarinic symptoms.

Solution to Question 7:

There is no specific treatment for the intermediate syndrome in organophosphate (OP) poisoning.

The intermediate syndrome is seen in 20-50% of acute OP poisoning cases. This syndrome develops one to several days after the poisoning, during the recovery from cholinergic manifestations. In some cases, it can occur when patients have completely recovered from the

initial cholinergic crisis.

Clinical features include paralysis of:

- Neck flexor muscles
- Muscles innervated by the cranial nerves
- Proximal limb muscles
- Respiratory muscles - respiratory support may be needed

Symptoms or signs of cholinergic excess are absent in this syndrome.

There is no specific treatment for the intermediate syndrome and intervention is exclusively supportive.

Solution to Question 8:

The given clinical scenario is suggestive of malathion (organophosphate) poisoning. In this condition, prolonged QTc interval is a non-specific finding. However, it correlates with the severity and mortality in severe cases.

The reliable indicators of OP poisoning are:

- Miosis and muscle fasciculations
- Decrease in RBC cholinesterase levels
- Absence/ resolution of cholinergic symptoms after an initial dose of atropine

Solution to Question 9:

RBC cholinesterase enzyme activity is the most accurate indicator to assess potential organophosphorus (OP) toxicity. It is an indicator of synaptic cholinesterase inhibition.

However, plasma butyrylcholinesterase is easier to assay and more easily available. Hence, it is more commonly used.

Measurement of parent compound in blood and metabolites urine are rarely carried out in a clinical setting.

Note: The correlation between cholinesterase activity, clinical symptoms, and atropine dose is inconsistent. Hence, treatment should be guided predominately by clinical symptoms.

Solution to Question 10:

In organophosphorus poisoning, clinical signs and symptoms are observed when pseudocholinesterase level falls below 50% of normal.

Severity of symptoms correlates with pseudocholinesterase levels:

RBC cholinesterase enzyme activity is the most accurate indicator to assess potential organophosphorus toxicity. However, plasma butyrylcholinesterase is easier to assay and more easily available. Hence, it is more commonly used.

Severity of OP poisoning	Levels of pseudocholinesterase
Mild	40-50%
Moderate	10-40%
Severe	<10%

Solution to Question 11:

The given clinical scenario is suggestive of acute organophosphorus poisoning which is treated with atropine sulphate. Clear chest on auscultation indicates clearing of tracheobronchial secretions and cessation of bronchoconstriction. Hence, it is considered as the therapeutic endpoint of atropinization.

Tachycardia and mydriasis are not appropriate markers for therapeutic improvement, as they may indicate continued hypoxia, hypovolemia, or sympathetic stimulation.

Treatment of organophosphorus poisoning:

- Decontamination
- Airway management
- Stomach wash - water with or without KMnO₄
- Atropine sulphate at a dose of 2-4 mg IV - highly effective in counteracting the peripheral muscarinic effects and antagonize CNS effects at higher doses
- Oximes - used early as they have more pronounced action on nicotinic sites

Solution to Question 12:

Oxygen supplementation has proven clinical and mortality benefits in patients with organophosphate (OP) poisoning who develop respiratory failure.

Pralidoxime is not beneficial in terms of reducing mortality, need for ventilator support, and incidence of intermediate syndrome. Despite theoretical and experimental benefits and clinical use worldwide, the current evidence is inadequate. However, until further research has been undertaken, all patients poisoned with organophosphorus agents are recommended to be treated with an oxime.

Urinary alkalization, hemodialysis, and hemoperfusion have no role in the treatment of OP poisoning.

Note: Gastric lavage and activated charcoal administration are beneficial only in patients who present within 2 hours following ingestion of OP compounds.

Solution to Question 13:

The most common cause of death in organophosphate poisoning is respiratory failure. It usually occurs within 24 hours in untreated patients, secondary to paralysis of respiratory muscles.

Solution to Question 14:

Carbamates can also lead to the intermediate syndrome.

Option A: Carbamate-cholinesterase bond undergoes rapid, spontaneous hydrolysis which leads to regeneration of the enzyme within a few hours. This is called reversible carbamylation. Hence, aging (conversion of the inhibited enzyme into a non-reactivable form) does not occur and the effect of carbamate toxicity is of a shorter duration.

Option C: Carbamates do not effectively penetrate the CNS in adults. Hence, there is less CNS toxicity.

Option D: Pralidoxime is contraindicated in carbamate poisoning because it may potentiate the toxicity of carbamates due to its transient oxime-induced cholinesterase inhibition.

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Corrosives and Asphyxiants

Question 1:

Which of the following pairs of corrosives and their mechanism of action is incorrect?

- a) Carbolic acid - Coagulation necrosis
- b) Ammonia - Liquefactive necrosis
- c) Hydrofluoric acid - Liquefactive necrosis
- d) Sodium hydroxide - Coagulation necrosis

Question 2:

Which of the following statements regarding upper GI involvement in corrosive poisoning is true?

- a) With acids, involvement of the esophagus is more than the stomach
- b) With alkali, involvement of the stomach is more than the esophagus
- c) With acids, involvement of the esophagus and stomach is roughly equal
- d) With alkali, there is more superficial injury than with acids

Question 3:

Which of the following is not contraindicated in patients with caustic esophageal injury?

- a) Endoscopy within 12 hrs
- b) Emetics for gastrointestinal decontamination
- c) Neutralizing agents
- d) Nasogastric intubation

Question 4:

In which of the following conditions will you use calcium gluconate for management in an emergency?

- a) 2, 3 only
- b) 1, 4 only

- c) 1, 3 and 4
- d) 1, 2 and 4

Question 5:

The autopsy done in a case of poisoning reveals the leather bottle appearance of the stomach. Which of the following is the likely poison ingested by the patient?

- a) Oxalic acid
- b) Vitriol
- c) Phenol
- d) Nitric acid

Question 6:

The color of urine in a 25-year-old girl who ingested some unknown poison is given in the image below. Which of the following is likely to have been ingested by her?



- a) Hydrofluoric acid
- b) Kerosene
- c) Carbolic acid
- d) Oxalic acid

Question 7:

Which of the following is not expected in a patient who died after ingestion of oil of vitriol?

- a) Chalky white teeth are visible
- b) The pupils are dilated
- c) Blotting paper stomach is visualised during autopsy
- d) Tongue is yellow in color

Question 8:

Which of the following chemicals is wrongly matched with their relevant IPC/CrPCs?

- a) Thallium - Section 33 BNSS (39 CrPC)
- b) Sulphuric acid - Section 124 BNS (326A IPC)
- c) Sulphuric acid - Section 80 BNS (304B IPC)
- d) Oxalic acid - Section 335 BNS (463 IPC)

Question 9:

A 30-year-old psychiatric patient consumed some liquid from a bottle accidentally. Clinical examination shows a peculiar rash as shown in the image. What is the likely cause of this presentation?



- a) Formic acid
- b) Hydrochloric acid
- c) Boric acid

d) Carbolic acid

Question 10:

Which of the following is classified as a simple asphyxiant?

- a) Carbon Monoxide
- b) Cyanide
- c) Helium
- d) Ammonia

Question 11:

The post mortem staining in a patient with suspected poisoning shows bright red color. Which of the following types of hypoxia would have occurred in this patient?

- a) Histotoxic hypoxia
- b) Anemic hypoxia
- c) Hypoxic hypoxia
- d) Stagnant hypoxia

Question 12:

Which of the following is true regarding cyanide poisoning?

- a) Ingestion of peach seeds can cause this
- b) Bitter almonds odor is a consistent finding
- c) Patients with achlorhydria are more severely affected
- d) It inhibits cytochrome reductase in the electron transport chain

Question 13:

Which of the following eye manifestations is not expected in patients with chronic cyanide toxicity?

- a) Tobacco amblyopia
- b) Tropical ataxic neuropathy

- c) Leber hereditary optic neuropathy
- d) Behr hereditary optic atrophy

Question 14:

Which of the following is false regarding postmortem findings in cyanide poisoning?

- a) The cranial cavity should be opened first in a case of suspected cyanide poisoning
- b) Spleen is said to be the best specimen for cyanide analysis
- c) Damage to the basal ganglia is a common finding
- d) Rigor mortis sets in late

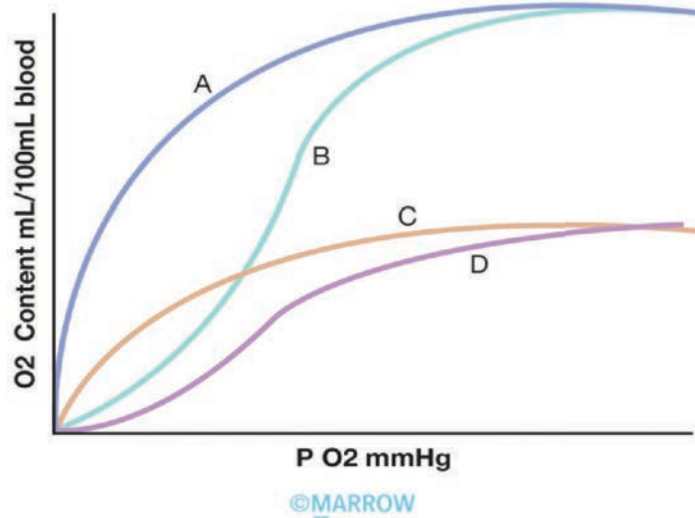
Question 15:

Which of the following is the drug of choice for cyanide toxicity?

- a) Amyl nitrite
- b) Sodium nitrite
- c) Dicobalt EDTA
- d) Hydroxocobalamin

Question 16:

In the following oxygen-dissociation curve, which curve indicates poisoning with carbon monoxide?



- a) Curve A
- b) Curve B
- c) Curve C
- d) Curve D

Question 17:

Which of the following mechanisms is responsible for the rebound effect seen with carbon monoxide poisoning?

- a) Binding of carbon monoxide to myoglobin
- b) Binding of carbon monoxide to hemoglobin
- c) Inhibition of cytochrome oxidase a3
- d) Conversion of hemoglobin from T state to R state

Question 18:

Blood carboxyhemoglobin level is measured in a patient who is rescued from a burning building. Beyond which level would it be considered fatal?

- a) 25%
- b) 70%
- c) 60%
- d) 40%

Question 19:

You notice the given post mortem finding in a 45-year-old patient. Which of the following is the likely cause for this?



- a) Nitrites
- b) Carbon monoxide
- c) Hydrogen sulphide
- d) Potassium chlorate

Question 20:

On autopsy of a person with suspected poisoning, a characteristic finding of softening of basal ganglia is found. Which of the following is most likely responsible?

- a) Carbon monoxide poisoning
- b) Phosphorus poisoning
- c) Hydrogen sulfide poisoning
- d) Opioid poisoning

Question 21:

A young woman presents with a headache and flu-like symptoms. Her symptoms began after she installed a gasoline-powered electrical generator inside her home. Which of the following is most likely in this patient?

- a) A decrease in oxygen saturation on pulse oximetry
- b) A positive Hoppe-Seyler's test
- c) A decrease in dissolved oxygen levels on ABG
- d) Necrosis of the cerebellum on CT brain

Question 22:

A 55-year-old male is brought to the emergency department with a history of fire-related smoke inhalation. Which of the following is not an indication for hyperbaric oxygen therapy in this patient?

- a) Loss of consciousness
- b) COHb level of 17%
- c) Severe metabolic acidosis with ph 6.9
- d) ST, T wave changes in electrocardiogram

Answer Key

Question No.	Correct Option
1	d
2	c
3	a
4	d
5	c
6	c
7	d
8	c
9	c
10	c
11	a
12	a
13	d

14	d
15	d
16	c
17	a
18	c
19	b
20	a
21	b
22	b

Detailed Explanations

Solution to Question 1:

Sodium hydroxide is a strong alkali. It is associated with liquefactive necrosis.

Solution to Question 2:

The involvement of the esophagus and stomach with acid ingestion is roughly similar on endoscopy.

Acids cause more superficial injury, due to eschar formation which prevents penetration of acid. In contrast, alkalis cause deeper injury.

Alkali ingestion causes more damage to the esophagus than to the stomach or duodenum.

Solution to Question 3:

Endoscopy within 12 hrs is not contraindicated in patients with caustic esophageal injury. Endoscopy done after 24 hrs increases tissue friability.

Agents and procedures contraindicated in caustic ingestions are :

- Gastric lavage and administration of activated charcoal
- Use of emetics - because vomiting will result in repeat exposure of the airway and GI mucosa to the caustic agent and may precipitate perforation
- Neutralization and dilution therapy - There is no proven benefit. Additionally, neutralization of the acid with sodium bicarbonate will lead to the production of carbon dioxide, leading to gastric distension and the risk of perforation.
- Nasogastric intubation - This is done blindly and has the potential to exacerbate potential airway injuries.

Note: Oral intubation with direct visualization is the first choice for definitive airway management.

Solution to Question 4:

Calcium gluconate is used in the management of hypocalcemia (in oxalic acid and hydrofluoric acid poisoning), and cardiotoxicity (in hyperkalemia and hypermagnesemia).

Calcium gluconate is not used in the management of hypomagnesemia and hypokalemia.

Solution to Question 5:

The autopsy finding of leather bottle appearance of gastric mucosa is characteristic of carbolic acid (phenol) poisoning.

Leather bottle appearance refers to the hardening of the gastric wall. Therefore, gastric lavage can be done in phenol poisoning unlike other corrosives where gastric lavage is contraindicated.

Note : Sulphuric acid produces a blotting paper appearance of gastric mucosa.

Solution to Question 6:

The given image shows olive green colored urine which is known as carboluria. It is seen after ingestion of carbolic acid.

In carbolic acid poisoning, if the patient survives for 48 hrs, there will be carboluria followed by anuria. Carboluria is due to oxidation of hydroquinone and pyrecatechol on exposure to air.

Solution to Question 7:

Tongue turns jet black in color after contact with sulphuric acid. Yellowing of tissue is found with nitric acid. (Xanthoproteic reaction).

Characteristics of sulphuric acid poisoning:

- Tissues turn jet black in color, except teeth which are chalky white
- On autopsy, the stomach has a blotting paper-like consistency
- Most commonly associated with perforation of the stomach
- The mind remains clear till death
- Fatal dose: 5-10ml
- Fatal period: 12-24 hours.

Sulphuric acid is the most common substance associated with vitriolage. Vitriolage is the throwing of sulphuric acid on another individual.

Solution to Question 8:

Sulphuric acid is not linked to section 80 BNS (304B IPC).

Chemicals in toxicology and their relevant IPCs:

- Oxalic acid - used to remove writing, erase signatures and forgery. Section 335 BNS (463 IPC) defines making a false document whereas section 336 BNS deals with forgery.
- Sulphuric acid - the most common substance used for vitriolage. Vitriolage is covered under Section 124 BNS (326A of IPC) - voluntarily causing grievous hurt by the use of acid.
- Thallium - ideal homicidal poison. Any case of suspected homicidal poisoning that is brought to the attention of a doctor should be mandatorily reported under Section 33 BNSS (39 CrPC).

Solution to Question 9:

The given image shows the characteristic boiled lobster appearance. It is seen in poisoning with boric acid.

In severe poisoning with boric acid, a beefy red skin rash, most often affecting palms, soles, buttocks, and scrotum, is seen. The intense erythema is followed by extensive exfoliation.

Boric acid is used as an antiseptic and insecticide.

Solution to Question 10:

Helium is classified as a simple asphyxiant.

An asphyxiant is a toxic or non-toxic gas which causes respiratory embarrassment and leads to unconsciousness or death by asphyxiation.

Asphyxiants can be classified into:

Asphyxiant	Description	Examples
Simple Asphyxiants	Inert gases that displace oxygen	Noble gases Carbon dioxide Hydrocarbons
Chemical Asphyxiants	Reduce the body's ability to absorb, transport or utilize oxygen	Carbon monoxide Cyanide Hydrogen sulphide
Irritant Asphyxiants	Damage the respiratory tract	Ammonia Formaldehyde Methyl isocyanate

Asphyxiant	Description	Examples
Systemic Asphyxiants	Produce significant systemic toxicity by specialized mechanisms	Carbon monoxide Cyanide

Solution to Question 11:

The bright red post mortem staining is seen in cyanide toxicity. It is associated with histotoxic hypoxia.

Histotoxic hypoxia in cyanide toxicity is due to its inhibition of complex IV of ETC (cytochrome oxidase a3).

Toxins that inhibit complex IV of electron transport chain include:

- Cyanide
- Carbon monoxide
- Hydrogen sulfide.

Solution to Question 12:

The ingestion of peach seeds can cause cyanide poisoning. It is due to the presence of amygdalin in its seeds.

Option B: The bitter almond odor associated with cyanide poisoning can only be detected by 60% of the population. The ability to detect this odor is an x-linked recessive trait.

Option C: Cyanides are less effective in persons suffering from achlorhydria (since HCl acts on cyanides to liberate hydrocyanic acid)

Option D: Cyanide inhibits cytochrome oxidase (Complex IV) in the ETC, not cytochrome reductase (Complex III).

Solution to Question 13:

Behr hereditary optic neuropathy is not associated with chronic cyanide toxicity.

Eye manifestations in chronic cyanide toxicity:

- Tobacco amblyopia:
- Occurs predominantly in male cigarette smokers
- Manifests as progressive visual loss
- Results from an inherent inability to detoxify cyanide
- Tropical ataxic Neuropathy (TAN):

- A demyelinating condition
- Associated with excessive cassava consumption
- Leber's hereditary optic Neuropathy:
- Gradual loss of central vision
- Occurs due to a defect in cyanide metabolism.
- Deficiency of rhodanese is one proposed mechanism.

Solution to Question 14:

In deaths due to cyanide poisoning, rigor mortis sets in early and persists longer.

Option A: In case of suspected cyanide poisoning, cranial cavity should be opened first as the odor of bitter almonds is well marked in the brain tissue.

Option B: Spleen is said to be the best specimen for cyanide analysis, since it has the highest concentration of the poison owing to its presence of RBCs.

Option C: The basal ganglia are particularly sensitive to cyanide toxicity. Basal ganglia injury may be due to either direct cellular injury or secondary to hypoxic effects.

Solution to Question 15:

Hydroxocobalamin and sodium thiosulfate are the preferred antidotes in cyanide toxicity.

- If hydroxocobalamin is available, give hydroxocobalamin and sodium thiosulfate.
- If hydroxocobalamin is not available, give amyl nitrite and sodium nitrite and sodium thiosulfate. Avoid nitrites if the patient has contraindications to nitrites.

Hydroxocobalamin is preferred over sodium nitrite as it does not interfere with the oxygen-carrying capacity of the blood. Also, sodium nitrite can induce fatal methemoglobinemia in patients who are critically ill from another cause.

Mechanism of action of antidotes:

Dicobalt EDTA can also bind cyanide, but it causes severe side effects.

Mechanism of antidote		Example
Binding of cyanide	Direct binding of cyanide, followed by clearance	Hydroxocobalamin
Induction of methemoglobinemia	When cyanide binds methemoglobin, a relatively less toxic cyanomethemoglobin is formed	Sodium nitrite Amyl nitrite

Mechanism of antidote		Example
Use of sulfur donors	This involves maximizing the availability of sulfur donors for rhodanese, a ubiquitous enzyme that detoxifies cyanide by transforming it to thiocyanate	Sodium thiosulfate

Solution to Question 16:

Curve C indicates poisoning with carbon monoxide (CO).

CO binds to hemoglobin and prevents O₂ binding (therefore the decrease in the V_{max}).

CO binds to hemoglobin with an affinity that is 250 times that of O₂ to form carboxyhemoglobin. This means that when the partial pressure of CO is only 1/250 that of O₂, equal amounts of CO and O₂ will bind to hemoglobin. Thus, the hemoglobin that can now bind to O₂ is reduced to 50% causing a reduction in the graph's height.

CO also increases the O₂ affinity of remaining free hemoglobin sites which causes a left shift of the O₂ - hemoglobin dissociation curve.

Curve A - Myoglobin O₂-dissociation curve (Myoglobin has a higher affinity towards O₂ than hemoglobin. Hence, it shows a hyperbolic curve with a left shift)

Curve B - Normal Hb O₂-dissociation curve

Curve D - Curve showing anemia

Solution to Question 17:

Rebound effect in carbon monoxide poisoning is due to binding of carbon monoxide to myoglobin.

About 15% of CO present in extracellular tissues combines with myoglobin. A rebound effect with delayed return of symptoms is due to late release of CO from myoglobin with subsequent binding to hemoglobin.

Solution to Question 18:

Carbon monoxide poisoning is fatal above carboxyhemoglobin levels of 60%.

Normal carboxyhemoglobin levels:

- 3% in nonsmokers
- 10-15% in smokers

Serious toxicity is associated with levels more than 25%.

Solution to Question 19:

The given image shows cherry red postmortem lividity. It is characteristic of carbon monoxide poisoning.

Solution to Question 20:

Softening of the basal ganglia is a characteristic postmortem finding in case of carbon monoxide poisoning.

Softening of basal ganglia is seen in:

- Carbon monoxide poisoning
- Cyanide poisoning

Solution to Question 21:

The patient is most likely suffering from carbon monoxide poisoning due to the usage of generators indoors. Hoppe-Seyler's test can be used for the diagnosis of CO poisoning.

Tests that may be used for the diagnosis of CO poisoning:

- Hoppe-Seyler's test
- Kunkel's test
- Spectroscopy
- Potassium ferricyanide test
- Katayama's test.

Option A: Pulse oximetry should never be used to evaluate CO poisoning as a standard pulse oximeter cannot distinguish between oxyhemoglobin and carboxyhemoglobin.

Option C: An arterial blood gas analysis will show no decrease in the levels of dissolved oxygen, as this is not affected by CO. CO decreases the oxygen saturation of hemoglobin but has no effects on oxygen dissolved in plasma.

Option D: CT brain in a case of CO poisoning shows necrosis of the globus pallidus.

Note: Never use gasoline-powered electrical generators indoors, even if windows and doors are open. CO is a colorless, odorless gas that can kill without warning.

Solution to Question 22:

The given clinical scenario is suggestive of carbon monoxide poisoning. Carboxyhemoglobin levels more than 25% is an indication for hyperbaric oxygen therapy in carbon monoxide poisoning.

Indications for hyperbaric oxygen therapy in carbon monoxide poisoning:

- CO level more than 25%
- CO level more than 15% in pregnant women
- Loss of consciousness
- Severe metabolic acidosis
- Evidence of end-organ ischemia (eg, ECG changes, chest pain, or altered mental status).

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Alcohol Poisoning

Question 1:

Which of the following alcohols causes the most inebriation?

- a) Methanol
- b) Ethanol
- c) Isopropyl alcohol
- d) Glycerol

Question 2:

Which of the following does not enhance absorption of alcohol?

- a) High protein food
- b) High strength alcoholic beverage
- c) Carbonated drinks
- d) Warm alcohol drinks

Question 3:

All of the following factors are responsible for a higher level of blood alcohol concentration in women, as compared to men, except:

- a) Weight
- b) Renal elimination
- c) Gastric alcohol dehydrogenase
- d) Body fat percentage

Question 4:

A 25-year-old man with acute alcohol intoxication was being tested in the ER. When stimulated by pinching, his pupils dilated with a slow return. What is this sign called?

- a) McEwan's sign
- b) Burton sign

- c) Corrigan sign
- d) Peary sign

Question 5:

Which of the following is the most common sign seen in patients undergoing alcohol withdrawal?

- a) Insomnia
- b) Tremors
- c) Hallucinations
- d) Sweating

Question 6:

Which of the following syndromes is not closely associated with patients who consume excess liquor?

- a) Marchiafava-Bignami syndrome
- b) Holiday Heart syndrome
- c) Wernicke-Korsakoff syndrome
- d) Snowfield vision

Question 7:

A 30-year-old man is brought to the ER with complaints of excessive vomiting following alcohol ingestion. On examination, you notice slurred speech and horizontal gaze nystagmus. What will be the likely alcohol content in this patient?

- a) Around 30 mg%
- b) Around 40 mg%
- c) Around 60 mg%
- d) Around 80 mg%

Question 8:

Which of the following is the most reliable method for the determination of blood alcohol concentration in patients?

- a) Cavett's test
- b) Breath alcohol analyser
- c) Gas-liquid chromatography
- d) ADH method

Question 9:

The most accurate breath analyzers work on the basis of which of the following principle?

- a) Infrared spectrophotometry
- b) Chemical oxidation and photometry
- c) Semiconductor gas sensors
- d) Thin-layer chromatography

Question 10:

A man is heartbroken because his girlfriend recently left him to marry another man. He decides to get drunk that night, to cope with his feelings. On waking up the next morning, he finds that he has set fire to her car. Which of the following statements is true with respect to the man?

- a) He is guilty under Sec 84 IPC (Sec 22 BNS)
- b) He is guilty under Sec 85 IPC (Sec 23 BNS)
- c) He can be charged under Sec 510 IPC (Sec 355 BNS)
- d) He can be charged under Sec 86 IPC (24 BNS)

Question 11:

Which of the following drugs enhances the metabolism of alcohol?

- a) Disulfiram
- b) Fomepizole
- c) Acamprosate
- d) Metadoxine

Question 12:

A 26-year-old man dies due to accidental poisoning, after consumption of illicit liquor containing methanol. What is this phenomenon referred to as?

- a) Hoax tragedy
- b) Hanks tragedy
- c) Hogan's tragedy
- d) Hooch tragedy

Question 13:

A patient with calcium oxalate monohydrate crystals in the urine is diagnosed with ethylene glycol poisoning. What is the drug of choice for treating this condition?

- a) Sodium bicarbonate
- b) Fomepizole
- c) Thiamine
- d) Ethanol

Question 14:

A 30-year-old drowsy male was brought to the casualty. His pulse was 130/min, respiratory rate -30/min. His lab reports are given below. He showed improvement on nasogastric aspiration and administration of sodium bicarbonate, calcium gluconate, and 4-methyl pyrazole. What substance did he most likely consume?

- a) Formaldehyde
- b) Ethylene glycol
- c) Paraldehyde
- d) Methyl alcohol

Question 15:

In patients with methanol poisoning, what is the rationale behind treating them with ethanol?

- a) Metabolism of methanol is accelerated
- b) Metabolism of methanol is slowed down

- c) Reacts with methanol to form an inactive metabolite
- d) Ethanol reverses the actions of methanol

Question 16:

A 28-year-old man is brought to the casualty by his friend with complaints of vomiting and blurring of vision. On further probing, his friend gives the history of the consumption of a bottle of illicit liquor. His ABG shows a high anion gap metabolic acidosis. Which of the following statements would be incorrect regarding his management?

- a) Intravenous fomepizole is drug of choice
- b) Intravenous ethanol is an alternative drug
- c) Hemodialysis is not effective
- d) Folinic acid can also be used

Answer Key

Question No.	Correct Option
1	c
2	a
3	b
4	a
5	b
6	d
7	d
8	c
9	a
10	d
11	d
12	d
13	b
14	b
15	b
16	c

Detailed Explanations

Solution to Question 1:

Isopropyl alcohol causes the most inebriation among the given.

Inebriation or drunkenness caused in descending order:

- Isopropyl alcohol
- Ethyl alcohol
- Methyl alcohol

Toxicity or organic damage caused in descending order:

- Isopropyl alcohol
- Methyl alcohol
- Ethyl alcohol

All alcohols cause clinical inebriation, such that the intensity of its inebriating effects is directly proportional to its molecular weight.

Alcohol	Molecular weight
Methanol	32
Ethanol	46
Isopropanol	60
Ethylene glycol	62

Solution to Question 2:

High protein food retards absorption of alcohol. Food (especially fats and proteins) decreases absorption.

The following factors enhance absorption of alcohol:

- Empty stomach
- Strength of alcohol drink
- Carbonated drinks - the bubbles greatly increase the surface area carrying alcohol
- Warm alcohol drinks - warm drinks dilate gastric mucosal capillaries and are quickly absorbed

Solution to Question 3:

There are no significant gender differences concerning renal elimination affecting the Blood Alcohol Concentration(BAC) levels.

BAC following the ingestion of ethanol is influenced by many factors. These include:

- Weight - Women on average are smaller than men, so have less fluid in their bodies for alcohol distribution
- Body fat percentage - Since women have greater body fat, their aqueous compartment is smaller and hence they achieve a higher BAC.
- Gastric alcohol dehydrogenase - Some ethanol is broken down in the stomach by gastric alcohol dehydrogenase, which lowers the amount available for absorption. This enzyme is present at higher levels in men than in women.

Solution to Question 4:

The given scenario is suggestive of McEwan's sign.

Pupils are contracted, but stimulating the person (e.g., pinching or slapping) causes them to dilate, with a slow return. This is a characteristic finding of ethanol toxicity, seen at BAC levels >250 mg%.

Solution to Question 5:

Tremors/ Tremulousness or 'shakes' or 'jitters' is the most common sign of alcohol withdrawal. This occurs about 6-8 hours after their last drink.

Effects of alcohol withdrawal include:

- Weakness
- Tremors
- Insomnia
- Loss of appetite
- Vomiting
- Diarrhea
- Restlessness
- Exaggerated reflexes
- Fluctuating blood pressure
- Hallucinations

Solution to Question 6:

Snowfield vision is seen in methanol poisoning.

Consumption of excess alcohol is associated with:

- Holiday heart syndrome:
- Seen after an episode of heavy drinking
- Presents with cardiac arrhythmia (atrial fibrillation or ventricular arrhythmia).
- Marchiafava-Bignami syndrome:
- Caused by widespread demyelination of the corpus callosum, optic tracts, and cerebellar peduncles.
- Characterized by disorientation, epilepsy, ataxia, dysarthria, hallucinations, spastic limb paralysis, personality, and intellectual deterioration.
- Wernicke-Korsakoff syndrome is characterized by:
- Wernicke's encephalopathy - nystagmus, ophthalmoparesis, confusion, and ataxia
- Korsakoff psychosis - memory loss and confabulation.

Solution to Question 7:

In isolated ethanol intoxication, the occurrence of horizontal gaze nystagmus indicates a BAC level of around 80 mg/dl. It has a 70-80% sensitivity.

Horizontal gaze nystagmus has been shown to correlate highly with both BAC and cognitive impairment.

The HGN test assesses lack of smooth pursuit, sustained endpoint nystagmus, and induced nystagmus prior to a lateral gaze angle of 45 degrees.

BAC levels corresponding to the clinical features are:

Blood alcohol concentration	Effects
0 to 50mg%	No significant or mild euphoria
50 to 100mg%	Decreased inhibition, increased self-confidence, decreased attention span, slurring of speech, alteration of judgment, nystagmus
100 to 150mg%	Mental confusion, emotional instability, loss of critical judgment, ataxia, impaired memory, sleepiness

Blood alcohol concentration	Effects
150 to 300mg%	Loss of muscular coordination, staggering gait, drowsiness, exaggeration of emotions, dizziness, disorientation, decreased pain response
300 to 400mg%	Stupor, marked incoordination, possibly coma
400mg% and above	Anesthesia, depression of response, respiratory failure, deep coma, death

Solution to Question 8:

Gas-liquid chromatography is the most reliable method for the assessment of blood alcohol levels. The tests used for estimation of alcohol concentration can be classified as follows:

Test	Example
Chemical	Widmark method Cavett method
Biochemical	ADH method
Physical	Gas-Liquid Chromatography

Solution to Question 9:

The most accurate breath analyzers work based on the principle of infrared spectrophotometry. Infrared spectroscopy is the measurement of the interaction of infrared radiation with the matter by absorption, emission, or reflection.

Solution to Question 10:

This man can be charged under Sec 86 IPC (Sec 24 BNS).

According to this section, an act is considered a crime only if done with certain knowledge or intent, a person who commits the act while intoxicated will be assumed to have had that knowledge as if they were not intoxicated. This assumption does not apply if the person was intoxicated without their knowledge or against their will.

Option A: Section 84 IPC (Sec 22 BNS) - Act of a person of unsound mind—No act is an offence which is undertaken by a person who, at the time of doing it, by reason of unsoundness of mind, is incapable of knowing the nature of the act or understanding of what is being done is either wrong or contrary to law. This does not apply to the man, who was not of unsound mind. Section 84 IPC (Sec 22 BNS) does apply in the case of delirium tremens.

Section 85 IPC (Sec 23 BNS)- No act is an offence which is done by a person who at the time of doing it, by reason of intoxication, is incapable of knowing the nature of the act or what he is doing is either wrong or contrary to law; provided that what intoxicated him was administered to him without his knowledge or against his will. Here, Section 85 IPC (Sec 23 BNS) does not apply because the alcohol was not administered to him against his will.

Option C: Section 510 IPC (Sec 355 BNS) - Misconduct by a drunken person in public is punishable with imprisonment of up to 24 hours. This does not apply here as the man was not caught committing the crime while in a state of intoxication.

Solution to Question 11:

Metadoxine enhances the metabolism of alcohol. It is reported to double the rate at which ethanol blood levels decrease with time compared with the patient's own metabolism.

It is not yet approved by the FDA for use in acute ethanol intoxication, and its use should be considered experimental.

Solution to Question 12:

Hooch tragedy may occur due to consumption of cheap illicit liquor containing methanol (which is often a component of 'bootlegged alcohol'), particularly by the lower socio-economic classes.

Solution to Question 13:

Fomepizole is the drug of choice for the treatment of ethylene glycol poisoning.

Treatment of ethylene glycol poisoning:

- Fomepizole (preferred) or ethanol (if fomepizole is unavailable) - inhibits the enzyme alcohol dehydrogenase
- Sodium bicarbonate - correct systemic acidosis
- Hemodialysis - for elevated toxic alcohol levels, severe acid-base derangements, or evidence of end-organ toxicity
- Co-factors (folic acid, thiamine, and pyridoxine) - optimizes non-toxic metabolic pathways for the elimination of parent alcohol or its metabolites

Solution to Question 14:

The given scenario point towards ethylene glycol poisoning.

Ethylene glycol is converted to glyoxyaldehyde by alcohol dehydrogenase. Glyoxyaldehyde causes kidney damage.

Methanol is converted to formaldehyde by alcohol dehydrogenase. Formaldehyde causes retinal damage like blurring of vision/loss of vision.

The principles of treatment for both these conditions are the same. It predominantly involves using fomepizole or ethanol to inhibit the metabolic conversion of these relatively non-toxic alcohols to their toxic metabolites.

Solution to Question 15:

Ethanol has a higher affinity for alcohol dehydrogenase than methanol. Hence, the metabolism of methanol is slowed down on ethanol administration.

Formic acid, the metabolite of methanol is highly toxic. Therefore, slowing down the metabolism reduces the toxic effects.

Solution to Question 16:

The given scenario is suggestive of methanol poisoning. Hemodialysis is effective and used in severe cases.

A serum methanol concentration greater than 50 mg/dl is an indicator for hemodialysis. It can be used to remove both methanol and its toxic metabolite formic acid from the blood.

Fomepizole, an alcohol dehydrogenase inhibitor is indicated in methanol toxicity. It acts by inhibiting the formation of toxic formic acid.

Intravenous ethanol is an alternative to fomepizole. It has a higher affinity to alcohol dehydrogenase than methanol. Therefore, a saturation of ADH enzymes results in less formation of toxic formic acid.

Folate-dependent systems are responsible for the oxidation of formic acid to CO₂. Both folic and folinic acid are often administered during methanol toxicity but the exact benefit is yet to be determined.

Inorganic Irritants - Metallic and Non-metallic

Question 1:

Which of the following poison can be found even in skeletonized remains of the body?

- a) Arsenic
- b) Mercury
- c) Thallium
- d) Lead

Question 2:

Which of the following is the most toxic form of arsenic?

- a) Aceto arsenate
- b) Arsine
- c) Arsenite
- d) Arsenic oxide

Question 3:

A person presents to the emergency department with suspected poisoning due to ingestion of arsenic-containing pesticides 6 hours ago. Which of the following would you not expect to find?

- a) Mees lines on nails
- b) Cholera like gastroenteritis
- c) Garlic odour of the breath
- d) Acute tubular necrosis

Question 4:

A woman was slowly poisoning her husband by adding arsenic to his food daily. Which of the following is unlikely to be seen in him?

- a) Acrodynia

- b) Hyperkeratosis of palms and soles
- c) Blackfoot disease
- d) Bowen disease

Question 5:

Arsenic poisoning can mimic all of the following except?

- a) Addison's disease
- b) Guillain-Barre syndrome
- c) Diabetes insipidus
- d) Korsakoff's syndrome

Question 6:

A 34-year-old man presented to the ER with severe dehydration and weakness. History was suggestive of multiple episodes of watery diarrhea and non-bilious vomiting since morning. His breath reeked of garlic odor. ECG showed QT prolongation. Which of the following samples must be collected for a definitive diagnosis?

- a) 24 hour urine sample
- b) Blood sample
- c) Hair sample
- d) Fingernail sample

Question 7:

A 43-year-old man working in the mining industry presents with painful paraesthesias of his hands and feet. Examination of the limbs reveals the following findings. Which of the following is the drug of choice for his condition?



- a) Penicillamine
- b) Succimer
- c) Calcium disodium EDTA
- d) Dimercaptopropane sulfonate

Question 8:

A 23-year-old woman presents with complaints of tremors and ataxia. History is significant for regular exotic seafood intake. On examination, the following finding is noted. You are suspecting heavy metal poisoning. Which of the following explains the mechanism of the suspected poison?



- a) Binding to sulfhydryl groups on enzymes
- b) Inhibition of acetylcholinesterase
- c) Facilitation of glutamatergic synapses
- d) Inhibition of GABA-ergic synapses

Question 9:

Which of the following is not a feature of patients with hydrargyrisms?

- a) Coarse intentional tremors
- b) Erythema of palms and soles
- c) Shyness and memory loss
- d) Bowen's disease

Question 10:

A 33-year-old man is brought to the emergency department with a history of having swallowed mercury from a thermometer. History is suggestive of intellectual disability since childhood. What is your next step of action?

- a) Gastric lavage and activated charcoal administration
- b) Whole bowel irrigation
- c) No treatment is required
- d) Chelation with oral succimer

Question 11:

A 45-year-old man has come with complaints of insomnia, memory loss, and orofacial numbness. On examination, the patient has coarse tremors in his hands and lips. History is suggestive of an intake of bluefin tuna on a regular basis. You suspect an intoxication of a particular poison. Which of the following will be an effective treatment?

- a) Dimercaprol
- b) Succimer
- c) DMPS
- d) Supportive care

Question 12:

A 33-year-old patient is being evaluated for longstanding anemia. On clinical examination, you notice the given finding. Which of the following metal poisoning is associated with this characteristic finding?



- a) Thallium
- b) Arsenic
- c) Lead
- d) Beryllium

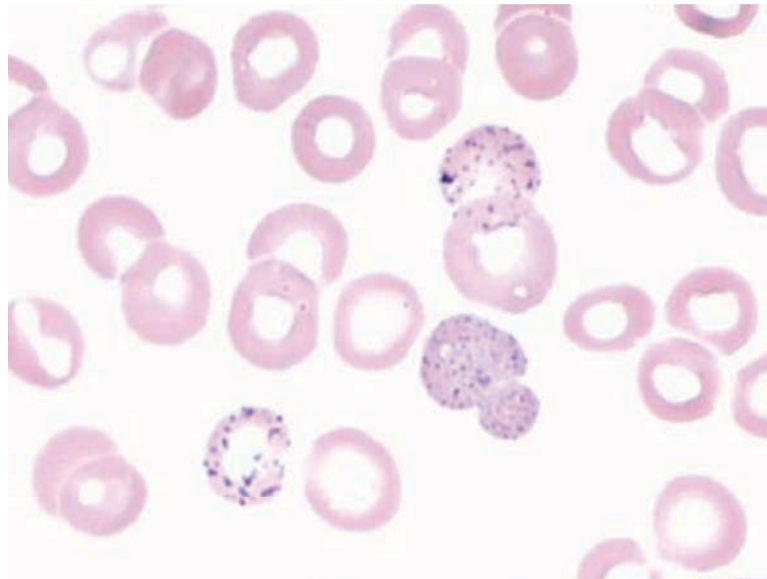
Question 13:

A 5-year-old girl is brought by her mother with complaints of abdominal pain and frequent tripping. She lives with her grandparents in a seventy-year-old house and has a history of eating paint from the wall. Which of the following enzyme defect is the likely cause of her condition?

- a) ALA synthase
- b) ALA dehydratase
- c) Heme synthase
- d) Coproporphyrinogen oxidase

Question 14:

The peripheral smear of a patient with suspected heavy metal poisoning is as shown below. What is the mechanism responsible for this?



- a) Inhibition of ALA synthase
- b) Inhibition of ferrochelatase
- c) Inhibition of ALA dehydratase
- d) Inhibition of pyrimidine 5' nucleotidase

Question 15:

A 53-year-old man working in the paint industry is being evaluated for foot drop. Lead poisoning is suspected. Which of the following is the key test to diagnose this condition?

- a) 24-hour urinary lead
- b) Venous blood lead levels
- c) Serum zinc protoporphyrin
- d) Serum free erythrocyte protoporphyrin

Question 16:

Saturnine gout is seen in:

- a) Lead poisoning
- b) Cadmium poisoning
- c) Beryllium poisoning

d) Mercury poisoning

Question 17:

A patient presents to you with a history of anemia, foot drop, and behavioral changes. On examination, there are bluish-gray lines on the gum. The image shows the radiograph of the knee of the patient. Deposition of which substance is responsible for this finding in the X-ray?



- a) Mercury
- b) Phosphorus
- c) Lead
- d) Calcium

Question 18:

A patient with altered mental status, after a thorough evaluation, is diagnosed with lead toxicity-induced encephalopathy. Which of the following is not true regarding this condition?

- a) Worsened with the use of dimercaprol
- b) Chelation therapy should be started based on clinical suspicion itself
- c) Most commonly seen in toddlers
- d) Occurs at blood lead levels \geq 100 mcg/dl

Question 19:

Metal fume fever is commonly associated with which of the following poisoning?

- a) Lead
- b) Arsenic
- c) Zinc
- d) Thallium

Question 20:

The ouch-ouch disease is due to the toxicity of which of the following?

- a) Thallium
- b) Cadmium
- c) Chromium
- d) Zinc

Question 21:

Luminescent stools are associated with which of the following?

- a) Mercury
- b) Cadmium
- c) Phosphorus
- d) Oxalic acid

Question 22:

Alkali disease of livestock is caused by an excess of which of the following minerals?

- a) Selenium
- b) Manganese
- c) Molybdenum
- d) Chromium

Question 23:

Arrange the following in the correct order of symptomatology seen in iron toxicity:

- a) 2 > 3 > 1 > 4
- b) 2 > 3 > 4 > 1
- c) 3 > 2 > 4 > 1
- d) 3 > 4 > 1 > 2

Answer Key

Question No.	Correct Option
1	a
2	b
3	a
4	a
5	c
6	a
7	b
8	a
9	d
10	c
11	d
12	c
13	b
14	d
15	b
16	a
17	d
18	a
19	c
20	b
21	c
22	a
23	c

Detailed Explanations

Solution to Question 1:

Arsenic can be found even in skeletonized remains of the body. It delays putrefaction and can be found in bones, hair, and nails for several years.

It becomes fixed in the cancellous tissues of the long bones by the conversion of phosphates to arsenates. The elimination of arsenic in this form is much slower and can be detected in the bones for several years after death.

Heavy metals such as lead, copper, mercury, including metalloids like arsenic and antimony, may be found in bones for a prolonged period in cases of chronic poisoning. They are also deposited in hair, nails, etc. For these reasons, when heavy metal poisoning is suspected, these specimens are collected in addition to the routine viscera and body fluids.

Solution to Question 2:

Arsine gas is the most toxic form of arsenic (acute exposure).

The toxicity of arsenic compounds can vary greatly. In general, arsenic compounds can be ranked from highest to lowest toxicity:

- Inorganic trivalent (+3) compounds
- Organic trivalent (+3) compounds
- Inorganic pentavalent (+5) compounds
- Organic pentavalent (+5) compounds
- Elemental arsenic

Inorganic arsenic is generally more toxic than organic arsenic. Forms of arsenic that are more rapidly absorbed are more toxic, while those most rapidly eliminated tend to be less toxic. Arsenite and arsenate forms are highly soluble in water.

Solution to Question 3:

The given scenario is indicative of acute arsenic poisoning. Mees lines are unlikely to be found in a patient with arsenic ingestion 6 hours ago. It is seen in chronic poisoning.

Features of acute arsenic poisoning:

- Severe watery diarrhea (like cholera)
- QTc prolongation and cardiac arrhythmias
- Acute encephalopathy
- Renal injury with acute tubular necrosis
- Garlic odor of breath and stools

Mees lines are horizontal 1 to 2 mm white lines on the nails, also called transverse leukonychia. They occur due to a disturbance in the nail matrix keratinization. It may be seen 4 to 6 weeks after acute arsenic ingestion. These can also be seen in thallium poisoning.

The image given below shows Mees lines.



Solution to Question 4:

Acrodynia (pink disease) is a feature of mercury poisoning, not arsenic poisoning.

Features of chronic arsenic exposure:

- Skin lesions-
- Hyperpigmentation (raindrop pigmentation resembling measles) or hypopigmentation
- Hyperkeratosis of palms and soles.
- Nail changes (Mees lines)
- Skin carcinomas and Bowen disease
- Peripheral vascular disease leading to Blackfoot disease (gangrene)
- Neurologic manifestations -
- Polyneuropathy
- Painful paraesthesia of hands and feet
- Cardiovascular - coronary heart disease and stroke
- Endocrine - Diabetes Mellitus type 2

Note: Some people take arsenic daily as a tonic or as an aphrodisiac and they acquire tolerance to 250–300 mg or more in one dose. Such people are known as arsenophagists.

The image below shows hyperkeratosis of palms.



Solution to Question 5:

Chronic low-dose arsenic exposure can mimic diabetes mellitus type 2 and not diabetes insipidus.

Clinical features of chronic arsenic poisoning can resemble the following:

- Addison's disease - due to hyperpigmentation on chronic exposure
- Guillain-Barré syndrome - sensorimotor peripheral neuropathy one to three weeks after the exposure
- Korsakoff's syndrome - chronic encephalopathy with delirium, hallucinations, disorientation, agitation, and confabulation can occur in chronic exposure
- Cholera like gastroenteritis - occurs in acute poisoning

Solution to Question 6:

The given clinical scenario points towards the diagnosis of acute arsenic poisoning. For a definitive diagnosis, the arsenic levels are measured in 24-hour urine samples.

If the baseline urinary level is within normal limits and arsenic intoxication is still suspected, hair and nail clippings should be harvested for laboratory analysis. Due to the rapid distribution of arsenic in tissues, blood arsenic levels are unreliable.

Solution to Question 7:

The given images (raindrop pigmentation and Mees lines) along with the clinical features are suggestive of chronic arsenic poisoning. Chelation therapy for subacute or chronic severe arsenic

toxicity is succimer (DMSA). It is an oral hydrophilic analog of BAL.

For acute arsenic toxicity, the following can be used:

- BAL (British anti-Lewisite)
- DMSA (Dimercaptosuccinic acid)
- DMPS (Dimercaptopropane-1-sulfonate)

BAL tends to remain the initial chelating drug for severe, acute arsenic toxicity. For other cases, DMSA or DMPS may be used.

The images given below shows characteristic raindrop pigmentation and Mees lines, seen in chronic arsenic poisoning.

Rain drop pigmentation in arsenic poisoning



Note: Arsenic is used industrially as an alloying agent and in the processing of glass, pigments, textiles, paper, metal adhesives, wood preservatives and ammunition. Arsenic is also used in the hide tanning process and, to a limited extent, in pesticides, feed additives, and pharmaceuticals.

Solution to Question 8:

The given image (acrodyndia) and the clinical features point towards a diagnosis of chronic organic mercury poisoning (methyl mercury). Mercury acts as a poison by binding to sulfhydryl groups on enzymes.

Mechanisms of toxicity of mercury:

- High-affinity binding of divalent mercury to sulfhydryl groups of proteins in the cells is an important mechanism for producing nonspecific cell injury or even cell death.
- Both inorganic and methylmercury damage mitochondria and disrupt intracellular calcium homeostasis
- Methylmercury also affects the MAPK signaling pathway
- Methylmercury has also been shown to disrupt microtubules in neurites

Orofacial paresthesias is the initial common symptom of chronic mercury poisoning followed by headache, tremor, and fatigue. Other features include mild GI, renal, and pulmonary abnormalities.

In severe cases, the following features are seen:

- Ataxia
- Muscle rigidity and spasticity
- Blindness
- Hearing deficits
- Dementia (neurotoxicity)

Solution to Question 9:

Hydrargyris means mercury poisoning. Bowen's disease is associated with chronic low-level exposure to arsenic, not mercury.

Features of chronic mercury poisoning:

- Tremors - most consistent manifestation. They are:
 - Danbury tremors - fine muscle fasciculations punctuated every few minutes by coarse shaking or jerky movements, intentional type. Progression of tremors is hands ° lips° tongue° arms and legs.
 - Hatter's shakes - Severe impairment of daily activities involving delicate movements like shaving, writing, holding a tumbler or spoon.
- Concussio mercurialis - most severe form, literally no activity is possible.
- Erethism mercurialis - Shyness, memory loss, and change in personality
- Nephrotic syndrome and renal tubular anomalies

- Acrodynia (pink disease) - Seen in small children and characterized by a generalized rash; edema and erythema of the palms, soles, and face.

Solution to Question 10:

The mercury found in a glass thermometer is elemental mercury. The absorption of elemental mercury by the GI tract is usually negligible, unless the mucosa is damaged. Hence, no treatment is required.

For ingestion of inorganic and organic mercury salts, the following steps are followed:

- Aggressive IV hydration
- GI decontamination, including gastric lavage
- Activated charcoal

Dimercaprol and succimer are the preferred chelators for mercury poisoning.

Solution to Question 11:

The given clinical scenario is suggestive of encephalopathy and peripheral neuropathy related to chronic mercury poisoning (Minamata disease). There is no effective treatment for patients with toxic chronic exposure to organic mercury, and hence only supportive care is provided

This is most commonly associated with the consumption of mercury-rich fish (such as shark, swordfish, bonito, mackerel, marlin, and bluefin tuna).

Symptoms are generally resistant to treatment with chelators. Dimercaprol (BAL) should not be used, because it increases the mobilization of mercury to the brain. Treatment with oral DMSA is unlikely to reverse the neurologic damage. Hence, there is no effective treatment for Minamata disease.

For patients with toxic exposure to elemental mercury or inorganic mercury, the following are effective:

- DMSA (succimer)
- DMPS
- BAL (dimercaprol)

For severe acute organic mercury poisoning, succimer is used.

Solution to Question 12:

The image is showing characteristic Burtonian lines, which are seen in lead poisoning and mercury poisoning.

These are bluish-grey gingival lead lines that occur with chronic exposure to lead poisoning.

The image given below shows Burtonian lines on the gums.



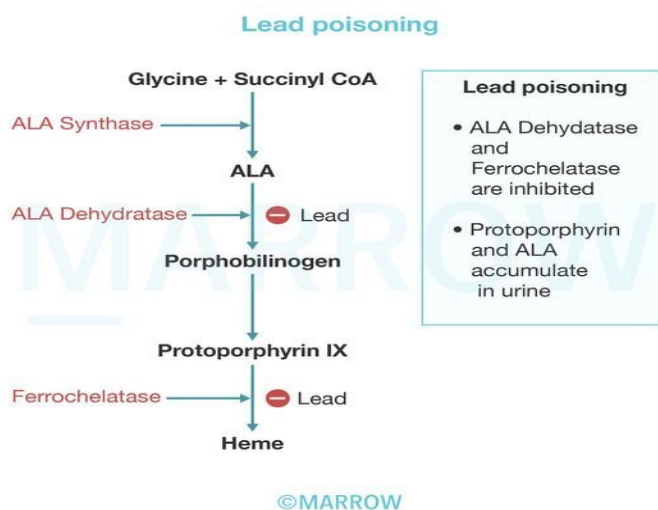
Solution to Question 13:

This given clinical scenario is suggestive of lead intoxication. The enzyme defective in this condition is ALA dehydratase.

The most common cause of lead poisoning in children is seen due to lead paint which was used in the older times.

It is toxic because it can substitute for calcium in many fundamental cellular processes. It crosses red blood cell membranes as well as the blood-brain barrier and enters the neuroglia cells which support brain function.

The fatal dose of lead acetate is 20 g. The fatal period is 1-2 days.



Solution to Question 14:

The given image shows basophilic stippling, which occurs due to inhibition of pyrimidine 5' nucleotidase.

Basophilic stippling in red blood cells occurs due to impaired clearing of cellular RNA degradation products (due to inhibition of pyrimidine 5' nucleotidase).

This finding is seen in the following:

- Lead toxicity
- Arsenic toxicity
- Sideroblastic anemia
- Thalassemias

Solution to Question 15:

The blood lead levels are the best single test for evaluating lead toxicity.

Levels at or ≥ 5 micrograms/dL (0.24 micromol/L) are considered elevated in children.

The edetate calcium disodium provocation test and testing for erythrocyte protoporphyrin (e.g., free erythrocyte protoporphyrin, zinc protoporphyrin) and urinary lead levels are no longer recommended.

Solution to Question 16:

Saturnine gout is seen in chronic lead intoxication or poisoning.

The features of saturnine gout are the same as primary gout but it affects the knee more than the first metatarsophalangeal joint and tophi rarely develop. Lead exposure should be suspected if a patient presents with the triad of:

- Saturnine gout
- Hypertension
- Renal insufficiency (renal failure and interstitial fibrosis)

Solution to Question 17:

The X-ray is suggestive of lead lines seen in lead toxicity which are due to the deposition of calcium at the growth plates.

The radiodensity of the lead line is due to persistent mineralized metaphyseal cartilage and not to a primary osseous change or lead itself. It is the result of a lead-induced inability of cartilage-resorbing cells to degrade the mineralized matrix. This impairs the resorption of metaphyseal cartilage.

Solution to Question 18:

Dimercaprol (BAL) must be administered in lead toxicity-induced encephalopathy.

Lead encephalopathy is suspected when a patient presents with:

- Acute onset of persistent vomiting
- Alteration of mental status and/or seizures

Emergency initiation of chelation therapy must be done if it is suspected clinically.

Encephalopathy due to lead poisoning typically occurs in toddlers age 15 to 30 months old, with blood lead levels >100 microgram/dl. Children with lead encephalopathy should receive combined chelation therapy with dimercaprol and calcium disodium edetate (CaNa₂EDTA).

Note: Administration BAL worsens symptoms in methyl mercury poisoning, not in lead poisoning.

Solution to Question 19:

Metal fume fever is most commonly associated with zinc oxide.

It is an influenza-like syndrome with fever, myalgias, profuse sweating, and other symptoms that usually occur 3–10 hours after heavy exposure to a variety of metal oxides. It is also known as Smelter's shakes or metal shakes.

It can also be associated with copper and magnesium.

Solution to Question 20:

Itai-Itai disease (Japan), also called ouch-ouch disease is due to bone pain caused by cadmium.

Cadmium causes nephrotoxicity leading to hypercalciuria. This subsequently causes osteomalacia leading to bone pain.

Solution to Question 21:

Luminescent stools are seen in acute phosphorus poisoning. The vomitus and stools will be luminous in the dark.

The stools may give rise to faint fumes, constituting the smoky stool syndrome.

Solution to Question 22:

Excess of selenium causes alkali disease in livestock.

Clinical types of selenium intoxication:

- Acute selenosis
- Subacute selenosis (i.e., blind staggers type)
- Chronic selenosis (i.e., alkali disease type)

Alkali disease occurs when animals consume moderate levels of selenium for a period of weeks to months.

The usual clinical signs of chronic selenosis in horses, cattle, and swine are loss of hair (horses and cattle lose long hair from the mane and tails), emaciation, hoof lesions, weight reduction, and lameness.

Solution to Question 23:

The correct order of symptomatology in iron toxicity is 3 > 2 > 4 > 1.

Symptoms of iron toxicity are divided into 4 stages:

- Stage 1 (few hours after ingestion): vomiting, abdominal pain, gastrointestinal bleeding, shock, acidosis, and coma
- Stage 2 (6-24 hours): Asymptomatic phase
- Stage 3 (24-48 hours): Metabolic acidosis, jaundice, hypoglycemia, shock, coma with hepatic and renal failure.
- Stage 4 (1-2 weeks): Late complications such as gastric stricture and pyloric stenosis.

Iron exerts its toxic effects by increasing capillary permeability, release of hydrogen ions, inhibition of mitochondrial function, and direct corrosive action on the gastric mucosa. Ingestion of 20 to 30 grams is considered to be fatal and the fatal period is around 24-30 hours. Desferrioxamine is the mainstay of treatment with supportive gastric lavage, administration of egg and milk to form iron-protein complexes, oral MgOH solution, and hemodialysis in severe cases.

Postmortem changes in iron toxicity include:

- Hemorrhagic necrosis of gastric mucosa with perforation of gastric or jejunal wall
- Acute hepatic necrosis
- Degenerative renal tubular changes

Organic Irritants - Plant and Animal Poisons

Question 1:

Which of the following plants is commonly referred to as poison hemlock?

- a) Ricinus communis
- b) Abrus precatorius
- c) Conium maculatum
- d) Nerium odorum

Question 2:

A 5-year-old child dies after consuming poisoned hemlock by accident. What is the likely mechanism by which the death occurred in this patient?

- a) Inhibition of cytochrome oxidase
- b) Anticholinesterase activity
- c) Inhibition of glycine reuptake
- d) Overstimulation of nicotinic receptors

Question 3:

Which among the following is not a cardiac poison?

- a) Nicotiana tabacum
- b) Nerium odorum
- c) Cerbera thevetia
- d) Cicuta maculate

Question 4:

A patient is brought due to accidental exposure to the following plant roots while experimenting with herbs. Which of the following associated finding may be seen?



- a) Hippus
- b) Hunaan hand
- c) Jamaican vomiting sickness
- d) St Anthony's fire

Question 5:

A person died after the consumption of seeds, which were found to be of the given plant. What is the main mechanism by which this plant poison acts?



- a) Inhibition of protein synthesis

- b) Stimulation of sodium channels
- c) Direct cardiotoxicity
- d) Anticholinesterase action

Question 6:

A cattle poison named sui is associated with which of the following plant poisons?

- a) Ricin communis
- b) Croton tiglium
- c) Semecarpus anacardium
- d) Abrus precatorius

Question 7:

A man presents with multiple bruises over his left arm. He puts allegations that his neighbor assaulted him. You are suspecting malingering. Which of the following may have been used to simulate these bruises?

- a) Ricinus communis
- b) Semecarpus anacardium
- c) Abrus precatorius
- d) Croton tiglium

Question 8:

A patient presents to you with a history of having ingested one of the seeds shown in the image below. Which of the following is not true?



- a) It acts by blocking the action of GABA in the spinal cord
- b) Ingestion of one crushed seed causes fatality
- c) Death is associated with postmortem calorificity
- d) Person remains conscious till death

Question 9:

Which of the following is the characteristic clinical feature seen in a patient with aconite poisoning?

- a) Nausea and vomiting
- b) Hypotension and bradycardia
- c) Tingling and numbness
- d) Miosis and fasciculations

Question 10:

A 35-year-old man presented with cardiac dysrhythmia. On probing, he says he consumed the leaves of the plant shown in the image. What is the active principle of this plant?



- a) Cerebra thevetia
- b) Aconitine
- c) Thevetoxin
- d) Digitonin

Question 11:

A woman presented with vomiting and diarrhea followed by chest pain and palpitations. Later, it was revealed that due to her unfaithfulness, her husband poisoned her with foxglove. Which of the following is the most specific treatment for this condition?

- a) Digoxin immune Fab
- b) IV hydration
- c) Atropine administration
- d) Potassium supplementation

Question 12:

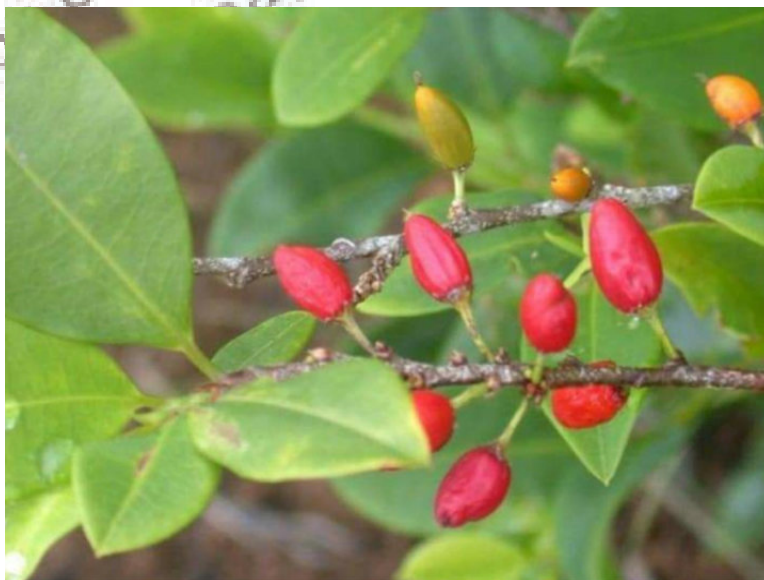
Which of the following is incorrect regarding the image shown?



- a) Only the roots of this plant are poisonous
- b) Causes AV block
- c) Drug of choice for poisoning is Atropine
- d) Mitha zaher is one of the variety of this plant

Question 13:

Identify the plant which produces a deliriant toxin.



- a) Erythroxylum cocca
- b) Datura

- c) Hyoscine
- d) Digitalis purpura/cannabis

Question 14:

A 28-year-old man presented with dry mouth, urinary retention, and constipation after consuming an unknown substance. On examination, his PR - 110bpm, and his pupils were dilated. What did he most likely consume?

- a) Heroin
- b) Morphine
- c) Malathion
- d) Belladonna

Question 15:

A woman had gone on a trip to West African countries. She ate some fruit while trying out the local cuisine. After some time she developed severe nausea and vomiting. She was taken to a nearby clinic and on examination her blood sugar levels were low. What is the most likely diagnosis?

- a) Hippus
- b) Jamaican vomiting sickness
- c) Ophitoxemia
- d) St. Anthony's fire

Question 16:

A 22-year-old man was using mushrooms for recreational purposes. On one of his bad days, he overdosed on them and presented to ER with symptoms of poisoning. What is the drug of choice for this condition?

- a) Physostigmine
- b) Atropine
- c) Adrenaline
- d) Diazepam

Question 17:

A 35-year-old male came to the OPD with complaints of an increase in his heart rate and palpitations. On examination, there was episodic tachycardia and occasional extrasystole. Ocular examination showed visual field defects. Which of the following is the likely cause?

- a) Cocaine
- b) Nicotine
- c) Cannabis
- d) Atropine

Question 18:

Common krait belongs to which of the following families?

- a) Colubridae
- b) Elapidae
- c) Viperidae
- d) Crotalinae

Question 19:

A scuba diver while on one of his adventures was bitten by a sea snake. What is the predominant feature of this condition?

- a) Muscle necrosis
- b) Bleeding profusely
- c) Muscle paralysis
- d) Slurred speech

Question 20:

Identify the following poisonous snakes.



1



2



3



4

- a) 1-b, 2-c, 3-d, 4-a
- b) 1-c, 2-d, 3-b, 4-a
- c) 1-b, 2-a, 3-d, 4-c
- d) 1-c, 2-d, 3-a, 4-b

Question 21:

A patient has been bitten by a snake and the relatives have brought the snake with them. Which of the following findings will assure you that the snake is non-poisonous?

- a) Long and canalized fangs
- b) Compressed tail
- c) Small head scaled
- d) Incomplete belly scales

Question 22:

Which of the following family of snakes can exert voluntary control over the injection of venom when biting?

- a) Boidae
- b) Elapidae
- c) Colubridae
- d) Pythonidae

Question 23:

While camping in a forest, your friend is bitten by a snake. You rush to provide first aid. Which of the following measures can be done in this scenario?

- a) Suction and incision
- b) Ice water immersion of the bitten limb
- c) Application of tourniquet
- d) Application of constriction bands

Question 24:

A 44-year-old man presents with an erection of the penis for the past 5 hours. He says he was camping in a forest the night before and something must have bitten him. Which of the following is responsible for this?

- a) Common krait
- b) Spanish fly
- c) Bee sting
- d) Rattle snake

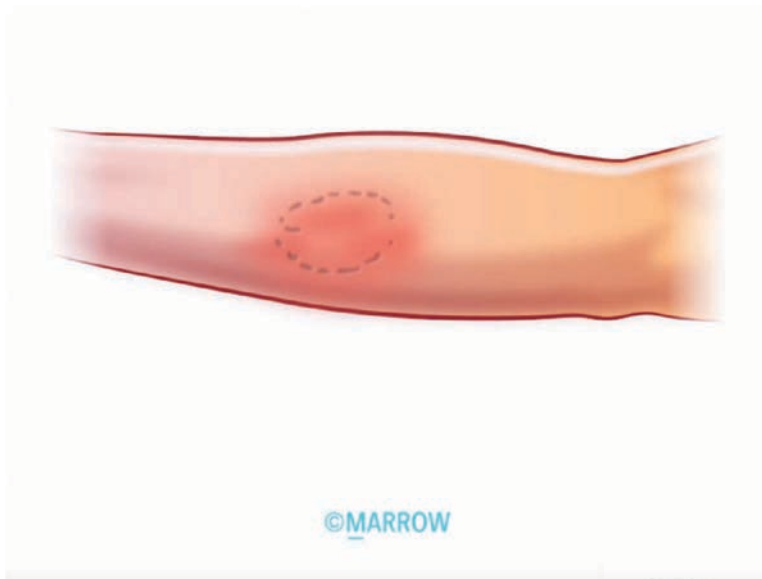
Question 25:

Which of the following acts as a physiological antidote to scorpion venom?

- a) Physostigmine
- b) Norepinephrine
- c) Prazosin
- d) Atropine

Question 26:

All of the following statements are true about the given condition except:



- a) Swabs should be taken immediately after moistening with sterile water
- b) It is most commonly caused by incisors and canines
- c) Photograph is taken with two scales at right angle to one another in the vertical plane
- d) 3D imaging is possible in the given condition

Answer Key

Question No.	Correct Option
1	c
2	d
3	d
4	a
5	a
6	d
7	b
8	a
9	c
10	d
11	a
12	a
13	a
14	d

15	b
16	b
17	b
18	b
19	a
20	a
21	d
22	b
23	d
24	b
25	c
26	c

Detailed Explanations

Solution to Question 1:

Conium maculatum is commonly referred to as poison hemlock.



Solution to Question 2:

Death from poison hemlock (*Conium maculatum*) occurs due to the overstimulation of nicotinic receptors.

All parts of poison hemlock contain coniine and similar alkaloids that are structurally and functionally analogous to nicotine. The mechanism of poisoning is two-fold:

- Non depolarising muscle blockade at the neuromuscular junction leading to flaccid paralysis and respiratory paralysis.
- Initial overstimulation followed by rapid depression by the nicotinic receptors.

These cause symptoms such as salivation, mydriasis, initial tachycardia followed by bradycardia, coma and death. Typically, ingestion of poison hemlock is due to misidentification because of its similarity in appearance to wild carrots.

Solution to Question 3:

Cicuta maculate (water hemlock) is a convulsant, not a cardiac poison.

The following are considered cardiac poisons:

- Digitalis purpurea - contains digitoxin, digitalin, digitonin, and digoxin
- Nerium odorum (Oleander) - contains oleandroside (oleandrin) and nerioside (nerin) which resemble digitalis in action
- Cerbera thevetia (yellow oleander) - contains thevetin and thevetoxin, similar to digitalis in action.
- Cerbera odollam - closely related to cerebra thevetia
- Aconite - Aconitine is the major component
- Quinine
- Nicotine

Solution to Question 4:

The image shows roots resembling horseradish, suggestive of the aconite plant. Hippus is associated with aconite poisoning.

Hippus is an abnormal exaggeration of the rhythmic contraction and dilatation of the pupil, independent of changes in illumination or in fixation of the eyes.

Poisoning with aconite has never been common. Most reported cases are accidental in nature, resulting from therapeutic misadventures. Aconite is used in herbal medicines, or to increase the intoxicating effect of alcoholic beverages.

Option B: Hunan hand is due to capsicum annum. Dermatitis and burning of hands and fingers known as Hunan hand. This is common among the pickle industry workers, who use their hands for handling chilly paste or powder for a prolonged period.

Option C: Jamaican vomiting sickness, is a syndrome characterized by vomiting and hypoglycemia, seen in ingestion of the unripe ackee fruit.

Option D: St Anthony's fire is the burning pain seen in gangrene caused by ergot poisoning.

The image below is of horseradish, given for comparison.



Solution to Question 5:

The image shown is of the *Ricinus communis* (castor oil) plant. Ricin acts by inhibiting protein synthesis.

The main toxic element of the castor oil plant is ricin, a toxalbumin. It exerts its toxicity by entering cells and inhibiting protein synthesis. The entire plant is toxic, but the seeds contain the highest amount of toxalbumin.

Solution to Question 6:

Abrus precatorius is commonly used as a cattle poison in the form of suis.

Toxic principles of *Abrus precatorius* are:

- Abrin
- Abrine
- Abralin

Medicolegal importance - It is a commonly used cattle poison in Indian villages by injecting the seed extract into the animal in the form of certain fine needle-shaped structures known as suis (meaning needle in Hindi).

These are prepared by mixing the seed extract with opium, datura, and spirit/water and then blended into a paste, shaped into fine needles dried in the sun, and used to kill cattle by driving it deep into the animal body by blowing through a hollow bamboo pipe.

The image given below shows seeds of *Abrus precatorius*.



Solution to Question 7:

Semecarpus anacardium can be used to produce fake bruises.

When the juice of the seed is applied to the skin, it causes irritation, itching, and a painful blister. The lesion resembles a bruise.

The image shows Semecarpus anacardium seeds which are black, cone, or heart-shaped with a rough projection at the base.



Solution to Question 8:

The image shows seeds of *Strychnos-nux vomica* which contains strychnine. It is a competitive antagonist of glycine at the postsynaptic receptors in the motor neurons of the anterior horn of the spinal cord. This leads to increased activity in the motor neurons.

The fatal dose is 15-30 mg of strychnine or one crushed seed. If death is preceded by a severe convulsion, as in strychnine poisoning, it causes an increase in the body temperature called postmortem calorificity.

The toxin strychnine does not affect any receptors in the brain and the person remains conscious till death. Strychnine poisoning is characterized by conscious seizures.

Solution to Question 9:

The characteristic finding of aconite toxicity is numbness and tingling.

Aconite is also known as monk's hood or wolf's bane. The roots are the most poisonous part of the plant and are mistaken for horseradish root.

The toxic principle is aconitine. It acts on the voltage-sensitive sodium channels of the cell membranes of excitable tissues. Aconitine first stimulates and then paralyzes the peripheral terminations of sensory and secretory nerves, CNS, and nerves of the myocardium, skeletal and smooth muscles.

Patients present mainly with a combination of gastrointestinal, cardiovascular, and neurological features. Numbness and tingling are characteristic features. The fatal period is 2-6 hours.

Aconite is commonly used for homicidal poisoning because:

- Cheap and easily available
- Short fatal period
- Extremely unstable and destroyed by putrefaction

Solution to Question 10:

The plant in the image is *Digitalis purpurea*. Its active principle is digitonin.

Digitalis purpurea contains digitoxin, digitalin, digitonin, and digoxin. It can cause cardiac dysrhythmia in acute toxicity.

Solution to Question 11:

Digitalis purpurea is also known as foxglove. The most specific antidote for its poisoning is digoxin-immune Fab fragments.

Digitalis is a cardioactive steroid that acts by inhibiting the sodium/potassium (Na^+/K^+) ATPase pump. Acute toxicity closely resembles that caused by digoxin and includes early GI symptoms, followed by cardiac dysrhythmias.

Digoxin immune Fab fragments should be administered to those with serum potassium >5 mEq/L in patients with acute toxicity.

The following image shows the *Digitalis purpurea* plant.



Solution to Question 12:

The image is of aconite. All parts of this plant (especially the roots and seeds) are poisonous.

Varieties of this plant are monkhood, mitha zaher, bish, and bikh.

It is a cardiac poison and causes AV block, bradycardia. Atropine is used in the treatment of its toxicity.

Solution to Question 13:

The given plant is *Erythroxylum coca*.

Cocaine is the principal alkaloid found in the cultivated varieties of coca.

Solution to Question 14:

The given clinical scenario with dilatation of the pupil indicates *Atropa belladonna* consumption.

Atropa Belladonna acts by inhibiting the muscarinic effects of acetylcholine. All the parts of the plants are toxic. The active principle is 1-hyoscyamine.

Heroin, morphine, and malathion cause constriction of the pupil.

Solution to Question 15:

The given clinical scenario with hypoglycemia as the predominant feature is most likely Jamaican vomiting sickness.

Ackee fruit grows on the *Blighia sapida* tree, and it is a common ingredient in West African and Jamaican cuisine. Unripe ackee fruit contains heat-stable toxins hypoglycin A and B. The resulting clinical syndrome, which is characterized by severe vomiting and hypoglycemia, is Jamaican vomiting sickness.

Option A: Hippus is an abnormal exaggeration of the rhythmic contraction and dilatation of the pupil seen in aconite poisoning.

Option C: Ophitoxemia is snake envenomation.

Option D: St. Anthony's fire is the burning pain seen in gangrene caused by ergot poisoning.

Solution to Question 16:

The drug of choice for mushroom poisoning is atropine.

Stropharia semeglobata, *Hypholoma fasciculare*, and *Lactarius vellereus* are among the poisonous varieties of mushrooms found in India. It presents with signs of parasympathetic excess and hence atropine is the drug of choice.

Atropine is of no value in the delayed onset of mushroom poisoning that occurs after ingestion of *Amanita phylloides*.

Solution to Question 17:

The given clinical scenario is suggestive of nicotine poisoning.

Chronic poisoning of nicotine also known as nicotine addiction leads to a condition called tobacco heart. It is characterized by irregularities of the heart with occasional extrasystoles and angina. It also causes amblyopia and narrowing of the field of vision.

Effects on CVS and eyes by different poisons are given below:

Poison	Effect on CVS	Effect on ocular system
Cocaine	Tachycardia Systemic arterial hypertension MI (due to coronary vasoconstriction) Tachyarrhythmias Dilated cardiomyopathy Aortic dissection & rupture	Madarosis (Loss of eyebrow/eyelashes) Corneal abrasions/ulcerations CRAO Bilateral blindness

Poison	Effect on CVS	Effect on ocular system
Nicotine	Irregularities of heart with occasional extrasystole Episodes of chest pain suggestive of a ngina	Amblyopia Narrowing of field of vision Blindness
Cannabis	Tachycardia Palpitation Hypertension	Bloodshot eyes (conjunctival congestions), Occasional mydriasis Nystagmus
Atropine	Tachycardia Arrhythmias	Dilated pupil (Mydriasis) Diplopia

Solution to Question 18:

Common krait belongs to the Elapidae family.

Note: Crotalinae is a subfamily of Viperidae. Pit Viper belongs to the family Viperidae and the subfamily Crotalinae, so if the question is about Viper any of the two options can be selected as the correct answer based on the choices given in the question.

Family	Species
Colubridae	Boomslang Keel snake Twig snake
Elapidae	Cobra Krait Sea snakes
Viperidae	Pit viper Russell's viper

Solution to Question 19:

The venom of sea snakes is myotoxic. Myotoxin causes a non-enzymatic mechanism that leads to severe muscle necrosis.

Solution to Question 20:

The correct match is:

Poisonous snakes



Russell viper



Saw scaled viper



King cobra



Common krait

Solution to Question 21:

Incomplete belly scales are usually seen in non-poisonous snakes.

In poisonous snakes, belly scales are large and cover the entire belly.

Solution to Question 22:

Snakes of the Elapidae family are found to be able to control the injection of venom when they are biting.

Because of this, they can decide when to inject venom and when not to, this leads to the frequent occurrence of a dry bite in the case of Elapidae (they choose not to inject venom).

Crotalinae snakes (pit viper) which are part of the Viperidae family, also have voluntary control over the injection of venom and 25% of their bites are dry.

Solution to Question 23:

Constriction bands may be useful, especially when immediate medical care is not available.

A constriction band is an elastic bandage or Penrose drain, thick rope, or piece of clothing wrapped circumferentially above the bite. It is applied with enough tension to restrict superficial venous and lymphatic flow while maintaining distal pulses and capillary filling.

Measures that can be done in the case of snakebite:

- Apply firm pressure over the bitten area, which delays absorption of venom

- Pressure immobilization is recommended for elapid and sea-snake bites, but not for viper bites as it may cause local necrosis
- Clean the wound with soap and water, or iodine and cover with a sterile dressing
- Immediately apply a broad firm bandage (Sutherland wrap) on the bitten area and around the limb. As much of the limb should be bandaged as is possible. It should be tight enough to occlude the superficial venous and lymphatic return, but not the arterial or deep venous flow. A pressure of 50 to 70 mm Hg is maintained
- In bites on the trunk, head, or neck, apply firm pressure over the bitten area
- Immobilize the limb, as movement can accelerate the spread of venom
- Make the patient lie on one side in the recovery position so that the airway is clear, in case of vomiting or fainting

Measures contraindicated in the case of snakebite:

- Suction and incision of the wound
- Electric shock treatment of wound site
- Application of tourniquets because they obstruct arterial flow and cause ischemia
- Ice water immersion of the bitten limb

Solution to Question 24:

The given scenario with the persistent erection of the penis for > 4 hours is indicative of priapism. It can occur with the bite or ingestion of the Spanish fly.

Spanish fly is green in color with shiny wings of the same color. Cantharidin is an animal poison produced by cantharides (Spanish fly or blister beetle). It causes vesicle or blister formation and priapism.

The insect as such or the powder of dried body has the toxic (active) principle cantharidin. The route of absorption is skin and other mucosal surfaces.

The image given below shows cantharides/ Spanish fly/ blister beetle.



Solution to Question 25:

Prazosin acts as a physiological antidote for scorpion venom.

The venom is a clear, colorless, proteinous toxalbumen, having a hemolytic and neurotoxic effect. Its toxicity is more than that of snakes, but only a small quantity is injected. The venom is a potent autonomic stimulator, resulting in the release of massive amounts of catecholamines from the adrenals.

If the scorpion has hemolytic venom, the reaction is mainly local and simulates the viper snake bite. The scorpion sting will have only one hole in the center of the reddened area. The extremity will have edema, pain, and reddening. This usually lasts for one to two hours.

The symptoms produced by a neurotoxic venom are similar to a cobra bite. There is usually no marked reaction in the local area. Nausea, vomiting, extreme restlessness, fever, various types of paralysis, cardiac arrhythmias, convulsions, coma, respiratory depression, and death may occur within hours from pulmonary edema or cardiac failure.

Prazosin can counteract the alpha-adrenergic effects of autonomic stimulation, such as hypertension.

Solution to Question 26:

The above image shows a human bite mark. The photograph is taken with two scales at the right angle to one another in the horizontal plane.

Human bites are usually semi-circular or crescentic caused by the front teeth (incisors, canine).

Swabs of bite marks should be taken immediately using a swab moistened with sterile water. A sample of the control area adjacent to the mark and of the victim's saliva should also be taken using swabs moistened with sterile water.

3D imaging is done in which the image is measurable with high precision.

A plastic substance such as rubber is laid over the bite mark which produces a permanent negative cast.

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CNS - Narcotics and Deliriants

Question 1:

Match the following drugs of abuse with their common names.

- a) 1-e, 2-a, 3-b, 4-c, 5-d
- b) 1-c, 2-e, 3-d, 4-a, 5-b
- c) 1-d, 2-c, 3-a, 4-e, 5-b
- d) 1-e, 2-c, 3-b, 4-d, 5-a

Question 2:

Which of the following preparation is incorrectly matched with its source?

- a) Bhang - stem and leaves
- b) Majoon - pie prepared from a mixture of cannabis and different substances
- c) Hashish - resin from flowering heads
- d) Ganja - dried flower tops

Question 3:

The method shown in the image below is called chasing the dragon. Which drug is taken through this route?



- a) Cocaine
- b) LSD
- c) Heroin
- d) Marijuana

Question 4:

Which of the following is false regarding opioid intoxication?

- a) Hallucination results from stimulation of kappa receptors
- b) Bronchospasm is due to histamine release
- c) Opioid-induced acute lung injury is a rare complication
- d) Opioid intoxication can be ruled out in absence of miosis

Question 5:

A person is brought to the ER in an altered mental state. His friends give a history of heroin abuse for the past 6 months. On examination, he had pinpoint pupils, PR- 70bpm, BP- 90/60 mmHg, and SpO₂- 90% at room air. What is the most important step in treating this patient's condition?

- a) Airway protection and ventilatory maintenance
- b) Gastric lavage and activated charcoal administration
- c) Intravenous naloxone administration
- d) Administration of intravenous flumazenil

Question 6:

A patient presented with yawning, feeling of anxiety, nausea, and vomiting. On examination, increased sweating, and secretions from the eyes and nose were noted. What is the most likely diagnosis?

- a) Organophosphate toxicity
- b) Opioid withdrawal
- c) Opioid overdose
- d) Cannabis toxicity

Question 7:

Which of the following drugs is metabolised by plasma cholinesterase?

- a) Morphine
- b) Cocaine
- c) Methamphetamine
- d) Barbiturates

Question 8:

A person is caught in an airport for a case of smuggling of drugs. Suspecting that he has swallowed packets of cocaine, which of the following is the best modality to identify them?

- a) Endoscopy
- b) X-ray scan
- c) MR imaging
- d) CT imaging

Question 9:

A drug dealer was arrested and strips of dried blotting paper printed with colorful graphics were confiscated from him. Which of the following substances is commonly sold like that?

- a) Cocaine
- b) Cannabis
- c) Lysergic acid diethylamide
- d) Methamphetamine

Question 10:

Bad trips are characteristically associated with the intake of which drug?

- a) Phencyclidine
- b) Cocaine
- c) Cannabis

d) Lysergic acid diethylamide

Question 11:

Which of the following complication is likely to be seen in a person with chronic use of ice?

- a) Amotivational syndrome
- b) Run amok
- c) Meth mouth
- d) Magnan syndrome

Question 12:

A person with suspected marijuana consumption is brought by the police for urine drug testing. He claims single use of marijuana at a party. Up to how many days can the drug be detected in his urine?

- a) 1 day
- b) 3 days
- c) 7 days
- d) 30 days

Question 13:

Which of the following drugs causes dissociative anesthesia?

- a) Phencyclidine
- b) Alcohol
- c) Lysergic acid diethylamide
- d) Amphetamine

Question 14:

The most common drug which causes physical dependence is?

- a) Ketamine
- b) Heroin

- c) LSD
- d) Phencyclidine

Question 15:

From which part of the plant shown below is the toxic principle derived?



- a) Seeds
- b) Unripe fruit capsule
- c) Flowers
- d) Stem and leaves

Question 16:

What substance does the following poisonous plant contain?



- a) Physostigmine
- b) Atropine
- c) Cocaine
- d) Digitoxin

Question 17:

A patient presents to the ER with irrelevant slurred speech. On examination, a dry mouth, dry and hot skin, and dilated pupils are noted. What is the most probable diagnosis?

- a) Alcohol intoxication
- b) Datura poisoning
- c) Organophosphate poisoning
- d) Opioid poisoning

Question 18:

A 38-year-old woman was found unconscious in her room by her husband. Beside her, he found an empty bottle of phenobarbital which she was prescribed for seizures. He rushed her to the ER. All of the following can be done to manage this case except:

- a) Gastric lavage by activated charcoal
- b) Hemodialysis to remove the drug
- c) Flumazenil as an antidote

d) Alkaline diuresis to excrete the drug

Answer Key

Question No.	Correct Option
1	b
2	c
3	c
4	d
5	a
6	b
7	b
8	d
9	c
10	d
11	c
12	b
13	a
14	b
15	b
16	b
17	b
18	c

Detailed Explanations

Solution to Question 1:

The correctly matched pairs are:

Drug of abuse	Common name
1. Heroin and cocaine	Speedball
2. Phencyclidine and cocaine	Beam me up
3. Heroin	Brown sugar

Drug of abuse	Common name
4. Methamphetamine	Ice
5. Datura	Railway platform poison

Solution to Question 2:

Hashish is prepared from the resin exuding from leaves and stem of the plants.

Various cannabis preparations:

Cannabis Preparation	Source
Bhang	Traditionally used as a drink prepared from stem and leaves
Majoon	A traditional solid pie prepared from a mixture of cannabis and other different materials
Ganja	Dried flowering tops and leaves of the plant
Hashish/Charas	Resin exuding from leaves and stem

Solution to Question 3:

Chasing the dragon is a method used to take heroin.

In this, users inhale a thick, white pyrolysate that is generated by heating heroin base on aluminum foil using a hand-held flame. This means of administration produces heroin concentrations similar to those observed following IV administration.

Other methods used to take drugs are:

- Mainlining - Intravenous injection
- Insufflation - Snorting
- Skin popping - Subcutaneous injection

Solution to Question 4:

Miosis is not universally present in intoxication from every opioid. Its absence cannot be used to rule out opioid intoxication. Normal or even enlarged pupils have been documented secondary to diphenoxylate, meperidine, morphine, pentazocine, and propoxyphene toxicity.

Opioid intoxication:

- Mental status depression
- Analgesia
- Miosis
- Orthostatic hypotension
- Nausea and vomiting
- Histamine release resulting in localized urticaria
- Ileus secondary to decreased GI motility
- Urinary retention secondary to increased vesical sphincter tone
- Respiratory depression, bronchospasm (histamine release), acute lung injury (rare complication)

Opioid receptor	Effects
mu	Analgesia Sedation Miosis Respiratory depression Cough suppression Euphoria Decreased GI motility
kappa	Analgesia Sedation Miosis Decreased GI motility Dysphoria Hallucinations
delta	Analgesia Antidepressant effect

Solution to Question 5:

The clinical features suggest opioid intoxication. Airway protection and ventilatory maintenance are the most important treatment steps. It is because respiratory depression is the major morbidity and the cause of all mortality.

After adequate ventilation is ensured, administer naloxone. Single-dose activated charcoal can be administered in case of opioid ingestion occurred within one hour.

Flumazenil is the antidote for benzodiazepine poisoning.

Solution to Question 6:

The given clinical scenario is suggestive of opioid withdrawal.

The features of opioid withdrawal are:

- Feeling of anxiety
- Yawning
- Lacrimation, diaphoresis, rhinorrhea
- Diffuse myalgias progressing to piloerection
- Mydriasis
- Nausea, profuse vomiting, diarrhea, abdominal cramping

Treatment of opioid withdrawal:

- Symptoms can be rendered more tolerable by the administration of the central α_2 -agonist like clonidine
- Antiemetics and antidiarrheal agents
- Daily administration of a verified dose of methadone PO is recommended to inhibit withdrawal symptoms and reduce craving

Solution to Question 7:

Cocaine is metabolized by butyrylcholinesterase/ pseudocholinesterase.

Cocaine is primarily metabolized in the liver, but, it is alternatively metabolized by pseudocholinesterase also.

Morphine, methamphetamine, and barbiturates are metabolized only in the liver.

Solution to Question 8:

CT imaging is the best modality to identify cocaine packets in a body packer.

Body packers are people who swallow a large number of well-sealed packets in order to smuggle drugs across international borders.

Body stuffers are patients who swallow cocaine following police pursuit to conceal the evidence. The swallowed packets are often poorly wrapped and can leak or perforate.

Both methods can result in severe toxicity and death.

Management:

- No signs of toxicity - Give single-dose activated charcoal and institute whole-bowel irrigation with polyethylene glycol electrolyte solution to gently hasten packet elimination
- Symptomatic patients - Provide sedation and symptomatic care, and obtain immediate surgical consultation for operative removal of the packets
- Endoscopy or colonoscopy is not done because the manipulation may rupture the packets.

Solution to Question 9:

Lysergic acid diethylamide (LSD) is most commonly sold as small squares of dried blotter paper printed with colorful graphics.

It is a colorless, tasteless, odorless, water-soluble substance. A heavy user of LSD is called an acid head.

Solution to Question 10:

Lysergic acid diethylamide (LSD) use may be associated with bad trips and flashbacks.

The psychedelic effects of LSD depend on the user's prevailing mood, expectations, and surrounding environment. Effects may be perceived as pleasurable or horrifying. Profound distortions in the perception of sensory stimuli, time, emotions, and memories occur. It may cause users to experience paranoia, depression, extreme panic, or an acute psychotic reaction known as a dysphoric reaction or bad trip.

Prolonged and sometimes permanent psychosis, known as flashbacks or hallucinogen persisting perception disorder, can occur.

Solution to Question 11:

Methamphetamine is also known as ice. Habitual meth users might get meth mouth (advanced tooth decay).

Option A: Amotivational syndrome - Chronic use of cannabis may lead to amotivational syndrome with lethargy, lack of interest in day-to-day activities.

Option B: Run amok - Run-amok is a psychic disturbance resulting from continued use or sudden consumption of cannabis. It is characterized by a peculiar homicidal mania. The person is not held responsible for his acts since run amok is considered a disorder of mind and not intoxication.

Option D: Magnan syndrome - A type of tactile hallucination seen in chronic users of cocaine where they feel as if grains of sand are lying under the skin or insects are creeping on the skin (formication).

Other named effects of drug use:

- Crack dancing - Choreo athetosis and repetitive movements are associated with cocaine and amphetamine intoxication and appear related to dopamine dysregulation.
- Crack eye - A syndrome of corneal abrasions and ulcerations secondary to smoke and irritation associated with crack cocaine use is known as the crack eye.
- Crack baby - describes children who were exposed to crack as fetuses in the US.
- Bad trip - Profound distortions in the perception of sensory stimuli, time, emotions, and memories occur with the use of LSD. It may cause users to experience paranoia, depression, extreme panic, or an acute psychotic reaction known as a dysphoric reaction or bad trip.

- Flashbacks - Prolonged and sometimes permanent psychosis, known as flashbacks or hallucinogen persisting perception disorder, can result from LSD use.
- Carphologia - Carphologia (or carphology) is a lint-picking behavior that is often a symptom of a delirious state. Usually associated with Datura poisoning.

Solution to Question 12:

After a single use of marijuana, tetrahydrocannabinol (active principle of Cannabis) can be detected in urine tests for up to 3 days.

Marijuana or Cannabis consists of the dried flowering tops and leaves of the plant Cannabis sativa. Hashish is prepared from the resin of the stems and leaves of this plant.

With long-term use, cannabinoids can be detected up to 30 days or longer after abstinence.

Solution to Question 13:

Phencyclidine causes dissociative anesthesia.

Phencyclidine is also known as angel dust (powdered form). It is often coadministered with crack cocaine (beam me up). The primary action is the blockade of NMDA receptors.

Dissociative anesthesia is a form of anesthesia characterized by catalepsy, catatonia, analgesia, and amnesia. It does not necessarily involve loss of consciousness and thus does not always imply a state of general anesthesia.

Solution to Question 14:

Heroin is the most common drug which can cause physical dependence.

Physical dependence is defined as a condition where withdrawal of a drug after its prolonged use causes physiological and emotional illness, often referred to as the withdrawal syndrome. Neither physical dependence nor withdrawal symptoms occur with hallucinogens. Although it is necessary to note that a user can develop a psychological dependence on the insight-inducing experiences of episodes of hallucinogen use. Hence, all 3 hallucinogens - ketamine, LSD, and Phencyclidine (PCP) does not cause physical dependence.

According to the world drug report 2019, released by the United Nations office on drugs and crime (UNODC), the most common drugs used across the world (in decreasing order) include:

- Cannabis
- Opioids
- Amphetamine and prescription stimulants
- Ecstasy
- Cocaine

Among the opioids, the commonly used group of drugs are opiates which include drugs like opium, morphine, and heroin.

Solution to Question 15:

The plant shown in the image is *Papaver somniferum*. The toxic part of the plant is the unripe fruit capsule from which the toxic principle is derived.

Solution to Question 16:

The plant in the given image is *Datura stramonium*. It contains atropine.

All *Datura* species contain anticholinergic alkaloids like atropine, scopolamine, and hyoscyamine.

Solution to Question 17:

The given clinical scenario is suggestive of *Datura* poisoning.

The two species are jimson weed (*Datura stramonium*) and angel's trumpet (*Datura candida*).

Seeds or other parts of the plant can be ingested or smoked. Poisoning leads to delirium, hallucinations, and seizures. Additionally, other classic anticholinergic effects, such as mydriasis, tachycardia, dry mouth and skin, blurred vision, urinary retention, and hyperthermia may present.

Gastric emptying is often delayed, and the small, plentiful seeds can become trapped among the gastrointestinal folds after ingestion. Thus gastric decontamination can be an important therapy.

Physostigmine, a reversible acetylcholine esterase antagonist, is an effective treatment for severe anticholinergic poisoning.

Solution to Question 18:

The given clinical scenario suggests barbiturate poisoning. Flumazenil is a benzodiazepine antagonist and has no effect on barbiturate toxicity. There is no antidote for barbiturate poisoning.

Management of barbiturate poisoning:

- Maintain airway, breathing, circulation
- Electrolyte balance
- Gastric lavage
- Alkaline diuresis by giving sodium bicarbonate

- Hemodialysis in severe cases

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