



# Aakash

Medical | IIT-JEE | Foundations

Corporate Office: Aakash Tower, 8, Pusa Road, New Delhi-110005, Ph.011-47623456



## AIM - 720

*(Advanced INTENSIVE Mastery for 720)*

MM : 720

CST-II

Time : 3 Hrs. 20 Min.

### Answers

1. (4)	41. (3)	81. (3)	121. (2)	161. (1)
2. (2)	42. (2)	82. (3)	122. (3)	162. (3)
3. (3)	43. (1)	83. (4)	123. (1)	163. (2)
4. (1)	44. (2)	84. (4)	124. (1)	164. (4)
5. (2)	45. (3)	85. (4)	125. (4)	165. (1)
6. (4)	46. (1)	86. (2)	126. (2)	166. (2)
7. (3)	47. (3)	87. (2)	127. (1)	167. (2)
8. (3)	48. (3)	88. (4)	128. (1)	168. (1)
9. (1)	49. (4)	89. (3)	129. (1)	169. (4)
10. (3)	50. (4)	90. (4)	130. (3)	170. (1)
11. (3)	51. (2)	91. (4)	131. (3)	171. (1)
12. (1)	52. (3)	92. (2)	132. (1)	172. (3)
13. (4)	53. (3)	93. (1)	133. (3)	173. (3)
14. (1)	54. (3)	94. (3)	134. (2)	174. (3)
15. (2)	55. (4)	95. (3)	135. (1)	175. (2)
16. (4)	56. (4)	96. (2)	136. (2)	176. (1)
17. (3)	57. (1)	97. (2)	137. (3)	177. (4)
18. (1)	58. (2)	98. (3)	138. (4)	178. (3)
19. (3)	59. (1)	99. (3)	139. (3)	179. (1)
20. (1)	60. (1)	100. (2)	140. (3)	180. (3)
21. (3)	61. (3)	101. (1)	141. (2)	181. (1)
22. (2)	62. (3)	102. (2)	142. (2)	182. (2)
23. (4)	63. (3)	103. (3)	143. (4)	183. (2)
24. (4)	64. (1)	104. (3)	144. (2)	184. (3)
25. (3)	65. (1)	105. (2)	145. (1)	185. (1)
26. (2)	66. (1)	106. (3)	146. (2)	186. (3)
27. (2)	67. (3)	107. (2)	147. (1)	187. (1)
28. (1)	68. (2)	108. (4)	148. (1)	188. (4)
29. (3)	69. (2)	109. (4)	149. (3)	189. (3)
30. (2)	70. (3)	110. (2)	150. (1)	190. (3)
31. (1)	71. (1)	111. (4)	151. (1)	191. (4)
32. (2)	72. (4)	112. (2)	152. (2)	192. (2)
33. (4)	73. (2)	113. (4)	153. (2)	193. (3)
34. (2)	74. (3)	114. (1)	154. (2)	194. (4)
35. (2)	75. (2)	115. (4)	155. (2)	195. (3)
36. (2)	76. (2)	116. (1)	156. (4)	196. (2)
37. (3)	77. (3)	117. (3)	157. (4)	197. (2)
38. (2)	78. (3)	118. (3)	158. (4)	198. (4)
39. (2)	79. (2)	119. (1)	159. (4)	199. (3)
40. (3)	80. (4)	120. (3)	160. (4)	200. (4)

20/04/2024



CODE-A



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Time : 3 Hrs. 20 Min.

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### Answers & Solutions

#### BOTANY

##### SECTION-A

1. Answer (4)

Systematics include characterisation identification, nomenclature and classification along with phylogeny.

2. Answer (2)

Kingdom Protista includes

(1) Auto-trophic/photosynthetic organisms (Dinoflagellates, Diatoms, Euglenoids)

(2) Consumer-decomposer organisms (Cellular slime moulds, Acellular slime moulds)

(3) Protozoans (flagellated protozoans, amoeboids, sporozoans, ciliates)

3. Answer (3)

Blue-green algae (BGA) have chlorophyll a similar to green plants and are photosynthetic autotrophs.

4. Answer (1)

Given floral formula belongs to Brassicaceae

$\oplus \text{♀} K_{2+2} C_{\times 4} A_{2+4} G_{(2)}$

Gynoecium is bicarpellary, syncarpous, superior ovary and have parietal placentation.

5. Answer (2)

When a stamen is attached to the petal, then it is called epipetalous e.g., brinjal, when stamens are united in a single bundle, then it is called monoadelphous, as in China rose. When stamens are united in two bundles, then it is called diadelphous as in pea. When stamens are united into more than two bundles it is called polyadelphous e.g., Citrus.

6. Answer (4)

Actinomorphic (radial symmetry) flowers are mustard, *datura*, chilli etc.

7. Answer (3)

In pteridophytes, the dominant phase is represented by the sporophyte which is diploid.

8. Answer (3)

Gymnosperms are heterosporous and produce smaller microspore and larger megasporangia.

9. Answer (1)

Cyanobacteria are also found inside vegetative part of *Cycas*. *Pinus* has fungal association in its roots.

10. Answer (3)

Interaction	Species A	Species B
Commensalism	(+)	(0)

11. Answer (3)

According to 10% law of Lindeman only 10% energy is transferred from one trophic level to next trophic level

Grass – Grasshopper – Frog – Snake

T<sub>1</sub> → T<sub>2</sub> → T<sub>3</sub> → T<sub>4</sub>

1000 J 100 J 10 J – 1 J

12. Answer (1)

Arrangement called radial when xylem and phloem within a vascular bundle are arranged in an alternate manner along different radii. Such vascular bundles are found in the roots of dicots and monocots.

13. Answer (4)
  - Peripheral region of secondary xylem is lighter in colour and is known as sapwood.
  - Sapwood is actively involved in the conduction of water.
14. Answer (1)
A typical sigmoid or S shaped curve is a characteristic of living organisms growing in a natural environment.
15. Answer (2)
Enclosed within the integuments is a mass of cells called the nucellus.
16. Answer (4)
  - As the anther develops, the cells of sporogenous tissue undergo meiotic divisions to form microspore tetrads.
  - Innermost wall layer of anther is tapetum, it nourishes the developing pollen grains.
  - Pollen grains represent the male gametophytes.
17. Answer (3)
Cell wall protects the plant cell from the attacks of pathogens like viruses, fungi etc. Cytoskeleton in a cell are involved in many functions such as mechanical support, motility, maintenance of the shape of the cell.
18. Answer (1)
Cilia and flagella are hair-like outgrowths of the cell membrane. Prokaryotic flagella is structurally different from that of eukaryotic flagella.
19. Answer (3)
The core of cilium and flagellum called axoneme. It possesses a number of microtubules running parallel to long axis. The axoneme usually has nine doublets of radially arranged peripheral microtubule and a pair of centrally located microtubules.
20. Answer (1)
 $G_1$  phase corresponds to the interval between mitosis and initiation of DNA replication.
21. Answer (3)
Meiosis involves segregation of homologous chromosome pairs. Cytokinesis occurs by separate mechanisms in plants and in animals.
22. Answer (2)
During metaphase, chromosomes are the thickest and shortest and hence, it is easy to study their morphology.
23. Answer (4)
If *i* gene becomes non-functional, there will be no longer the synthesis of repressor protein. This results in constitutive expression of all the structural genes.
24. Answer (4)
Replication

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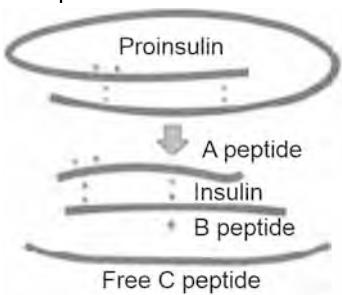
graph LR
    DNA((DNA)) -- Transcription --> mRNA((mRNA))
    mRNA -- Translation --> Protein[protein]
    
```
25. Answer (3)
Sugar phosphate backbone is found in both DNA and RNA.
26. Answer (2)
Griffith concluded that the R-strain bacteria had somehow been transformed by the heat killed S- strain of bacteria.
27. Answer (2)
Shield pigments like carotenoids protect plant from excessive heat and prevent photo-oxidation of chlorophyll a pigments.
28. Answer (1)
 $4H_2O \rightarrow 8H^+ + 8e^- + 2O_2$
29. Answer (3)
In ATP synthase, the  $F_1$  headpiece is a peripheral membrane protein complex and contains the site for synthesis of ATP from ADP and inorganic phosphate.  $F_0$  is an integral membrane protein complex that forms the channel through which proton cross the inner membrane.
30. Answer (2)
Crustaceans represent the minimum biodiversity among the invertebrates.
31. Answer (1)
A stable community with species rich diversity should not show too much variation in productivity from year to year.
32. Answer (2)
Three scientists independently rediscovered the principles of heredity already work out by Mendel. They were Hugo de Vries, Carl Correns and Von Tschermak.
33. Answer (4)
Butterfly show female heterogametic condition. Grasshopper, humans and *Drosophila* show male heterogametic condition.
34. Answer (2)
Colour blindness is a X-linked recessive trait and it shows criss-cross inheritance i.e., a male transmits his traits to his grandson through daughter; while a female transmits the traits to her granddaughter through her son.
35. Answer (2)
Mendel worked for seven years on a pea plant to explain the laws of heredity.

**SECTION-B**

36. Answer (2)  
W.M. Stanley showed that viruses could be crystallised and crystals consist largely of proteins.
- D.J. Ivanowsky recognised certain microbes as causal organism of the mosaic disease of tobacco. These were found to be smaller than bacteria because they passed through bacteria proof filters.
37. Answer (3)  
 $C_{1+2+(2)}$  condition depicts presence of vexillary aestivation of petals.
38. Answer (2)  
Red color of red algae is due to the predominance of the red pigment, phycoerythrin.
39. Answer (2)  
The first antibiotic was discovered by Alexander Fleming.  
Penicillin was produced from fungi *Penicillium notatum*.
40. Answer (3)  
Temperature plays an important role in both latitudinal and altitudinal distribution of organism.  
e.g. Mango, a tropical and subtropical tree plant is not found in temperate countries.
41. Answer (3)  
Small amount of phosphate is always added to soil solution through weathering of rocks.  
Many animal need large quantities of this element to make shells, bones and teeth.
42. Answer (2)  
• The guard cells possess chloroplasts.  
• Epidermis is usually single-layered.  
• Cuticle is absent in roots.
43. Answer (1)  
Growth, differentiation and development are very closely related events in the life of a plant.
44. Answer (2)  
Ploidy of megasporangium mother cell is '2n' and for antipodal cells, it is 'n'.
45. Answer (3)  
The largest isolated single cell is the egg of an Ostrich.
46. Answer (1)  
In plant cells, the cytokinesis is achieved by the formation of a cell plate.
47. Answer (3)  
The pitch of the DNA is 3.4 nm.
48. Answer (3)  
Hershey and Chase gave the unequivocal proof that DNA is the genetic material.
49. Answer (4)  
In ETS, succinate dehydrogenase is a complex II.
50. Answer (4)  
Pleiotropy - Phenylketonuria  
Polygenic inheritance – human height  
Incomplete dominance – Gene for starch grain size in pea  
Co-dominance – Human blood group AB

**ZOOLOGY****SECTION-A**

51. Answer (2)  
Direct methods of gene transfer involve gene gun/biolistics and micro-injection.
52. Answer (3)  
Each restriction endonuclease functions by 'inspecting' the length of the DNA sequence.  
Once it finds its specific recognition sequence, it will bind to the DNA and cut each of the two strands of the double helix at specific points in their sugar-phosphate-sugar backbones.
53. Answer (3)  
Steps of PCR include – Denaturation, annealing, and extension.  
*Taq* polymerase is used in the extension step of PCR.
54. Answer (3)
- 
55. Answer (4)  
Cnidoblasts are used for anchorage, defense and capture of the prey.
56. Answer (4)  
Ligament is a dense regular connective tissue that contains compactly packed fibres and fibroblasts. The collagen fibres are present in rows between many parallel bundles of fibres.

57. Answer (1)  
Communication/gap junctions are present in the intercalated discs of cardiac muscles.
58. Answer (2)  
There are an estimated 200,000 varieties of rice grown in India.
59. Answer (1)  
Insulin contains two interchain disulphide bonds between the A and B chains and one intra – chain disulphide bond in the A chain.
- 
60. Answer (1)  
Adenine and guanine are substituted purines while cytosine, thymine and uracil are substituted pyrimidines.
61. Answer (3)
- |                    |   |
|--------------------|---|
| Addison's disease  | → Hyposecretion of hormones of adrenal cortex |
| Diabetes insipidus | → Hyposecretion of ADH                        |
| Cretinism          | → Hypothyroidism                              |
| Acromegaly         | → Hypersecretion of growth hormone            |
62. Answer (3)  
The acid-insoluble fraction has polysaccharides like cellulose. Cellulose is composed of only one type of monosaccharide (glucose). It is a homopolymer. Cellulose does not contain complex helices and hence cannot hold I<sub>2</sub>.
63. Answer (3)  
Metabolic pathways which lead to a more complex structure from a simpler structure are called anabolic pathway or biosynthetic pathway.  
Assembly of a protein from amino acids is an example of anabolic process and requires energy.
64. Answer (1)  
The ion channels present in the axonal membrane are selectively permeable to different ions. When a stimulus is applied at a site on the polarised membrane, the membrane at the site becomes freely permeable to Na<sup>+</sup>.
65. Answer (1)  
Neurotransmitters are not involved in the transmission of impulses across electrical synapse. Physiological junction between two

- neurons is called the synapse. Synaptic vesicles are present in synaptic knob. In the myelinated neurons, gaps between adjacent myelin sheaths are called nodes of Ranvier.
66. Answer (1)  
The male sex accessory ducts include rete testis, epididymis and vasa efferentia which are placed within the testes inside the scrotum, whereas, vas deferens ascends upwards to the abdomen and loops over the urinary bladder.
67. Answer (3)  
In humans, vas deferens receives a duct from seminal vesicle of same side to form the ejaculatory duct. Ejaculatory ducts of both sides open into the urethra.
68. Answer (2)  
The reproductive cycle of female primates is called menstrual cycle which starts only after attaining sexual maturity (puberty).
69. Answer (2)
- |                       |  |
|-----------------------|--|
| Pavo (Parrot)         | – Crop and gizzard – additional chambers for digestion |
| Vipera (Viper)        | – No external ear openings                             |
| Pteropus (Flying fox) | – Mammary glands                                       |
| Clarias (Magur)       | – Operculum present                                    |
70. Answer (3)  
In humans, the part starting with the external nostrils up to the terminal bronchioles constitute the conducting part, whereas, the alveoli and their ducts form the respiratory or exchange part of the respiratory system.
71. Answer (1)  
Pressure contributed by an individual gas in a mixture of gases is known as the partial pressure.
72. Answer (4)  
Substances like glucose, amino acids, Na<sup>+</sup>, etc., in the filtrate are reabsorbed actively whereas the nitrogenous wastes are absorbed by passive transport.
73. Answer (2)  
Heart is a mesodermally derived organ. It is protected by a double walled membranous bag called pericardium, enclosing the pericardial fluid. Human heart has 4 chambers, two relatively small upper chambers called atria and two larger lower chambers called ventricles. Inter-atrial septum is a thin, muscular wall which separates the right and left atria, whereas, a thick wall called the interventricular septum separates the left and right ventricles.

- The atrium and ventricle of the same side are also separated by a thick fibrous tissue called the atrio-ventricular septum.
74. Answer (3)  
Rubber is a secondary metabolite.  
Adenine is the nitrogenous base.
75. Answer (2)  
The widespread use of various contraceptive methods have a significant role in checking uncontrolled growth of population. However, their possible ill-effects like nausea, abdominal pain breakthrough bleeding, irregular menstrual cycle or even breast cancer, though not very significant, should not be totally ignored.
76. Answer (2)  
According to the MTP (Amendment) Act, 2017, a pregnancy may be terminated on certain considered grounds within the first 12 weeks of pregnancy on the opinion of one registered medical practitioner.
77. Answer (3)  
Coitus interruptus is a natural method of contraception. In this, insemination is avoided as the male partner withdraws his penis from the vagina just prior to ejaculation.
78. Answer (3)
- 
- (a) Longitudinal view of a sarcomere  
(b) Cross-section of a sarcomere
79. Answer (2)  
A complex protein, troponin is distributed at regular intervals on the tropomyosin. In the resting state, a subunit of troponin masks the active binding sites for myosin on the actin filaments.
80. Answer (4)  
Even before Darwin, a French naturalist Lamarck had said that evolution of life forms had occurred but driven by the use and disuse of organs. He gave the examples of Giraffe, who in an attempt to forage leaves on tall trees had to adapt by elongation of their necks.

81. Answer (3)  
Conventional religious literature tells us about the theory of special creation. This theory has three connotations. One, that all living organisms (species or types) that we see today were created as such. Two, that the diversity was always the same since creation and will be the same in future also. Three, that Earth is about 4000 years old.
82. Answer (3)  
In 1953, S.L. Miller, an American scientist created similar conditions prevailing in primitive Earth, on a laboratory scale. He created electric discharge in a closed flask containing  $\text{CH}_4$ ,  $\text{H}_2$ ,  $\text{NH}_3$  and water vapour at  $800^\circ\text{C}$ . He observed the formation of amino acids.
83. Answer (4)  
The mouthparts of cockroaches consist of a labrum, a pair of mandibles, a pair of maxillae and a labium.  
Phallic gland is a large club shaped gland present below the ejaculatory duct and reaching anteriorly up to the 5<sup>th</sup> abdominal segment.  
Collateral gland is a pair of branched accessory gland that secretes the hard egg case or ootheca.
84. Answer (4)  
Lipids are exception in the acid-insoluble fraction w.r.t molecular weight. The molecular weight of lipids do not exceed 800 Da but still is a part of the acid insoluble fraction as on disrupting the cell structure, the lipids form vesicles which are not water soluble. So, these vesicles get separated along with the acid-insoluble pool.
85. Answer (4)  
The exaggerated response of the immune system to certain antigens present in the environment is called allergy. Allergy is due to the release of chemicals like histamine and serotonin from the mast cells.
- ### SECTION-B
86. Answer (2)  
In the continuous culture system, the used medium is drained out from one side while the fresh medium is added from the other to maintain the cells in their physiologically most active log/exponential phase.
87. Answer (2)  
*Laccifer* (Lac insect), *Pinctada* (Pearl oyster), *Rana* (Frog) and *Apis* (Honeybee) are economically beneficial organisms.
88. Answer (4)  
In 1997, an American company got the patent rights on Basmati rice through the US Patent and Trademark Office.

## 89. Answer (3)

Androgens stimulate the muscular growth, growth of facial and axial hair, aggressiveness and low pitch of voice.

They play a major stimulatory role in the process of spermatogenesis.

These hormones produce an anabolic effect on protein and carbohydrate metabolism.

## 90. Answer (4)

The foetus receives some antibodies (IgG) from their mother, through the placenta during pregnancy. It provides passive immunity.

## 91. Answer (4)

Hypothalamus acts as the master clock because it regulates circadian (24-hour) rhythms of body, activities of several endocrine glands and human behaviour.

## 92. Answer (2)

In humans, the external opening of penis is called urethral meatus. Seminal vesicles, prostate gland and bulbourethral glands are male accessory glands. Ovaries are considered as the primary sex organs in females and uterus is commonly called womb.

## 93. Answer (1)

Analysis of urine helps in the clinical diagnosis of many metabolic disorders as well as malfunctioning of kidneys. Urine formed by the nephrons is ultimately carried to the urinary bladder where it is stored till a voluntary signal is given by the CNS.

## 94. Answer (3)

Residual volume cannot be measured by the spirometer. FRC and TLC also include residual volume, so they cannot be measured by spirometer.

## 95. Answer (3)

When a host is exposed to antigens, which may be in the form of living or dead microbes or other proteins, antibodies are produced in the host body. This type of immunity is called the active immunity. Active immunity is slow and takes time to give its full effective response.

## 96. Answer (2)

Male reproductive organs of frogs consist of a pair of yellowish ovoid testes. Vasa efferentia are 10-12 in number that arise from testes. They enter the kidneys on their side and open into the Bidder's canal. Finally, it communicates with the urinogenital duct that comes out of the kidneys and opens into the cloaca.

## 97. Answer (2)

Total number of MTPs performed in a year all over the world	-	45 to 50 million
Government of India legalised MTP	-	In 1971
'Family Planning Programme' initiated by the Government of India	-	In 1951
The Medical Termination of Pregnancy (Amendment) Act	-	2017

## 98. Answer (3)

Fishes pump deoxygenated blood by the ventricles. Amphibians and reptiles pump mixed blood by their ventricles and crocodile, birds and mammals pump oxygenated blood by the left ventricle and deoxygenated blood by the right ventricle.

## 99. Answer (3)

Total number of carpal bones in both forelimbs = 16

Total number of tarsal bones in both hindlimbs = 14

Total number of metacarpal bones in both forelimbs = 10

Total number of true ribs = 14

Total number of floating ribs = 4

## 100. Answer (2)

Hugo de Vries believed that mutations caused speciation. Mutations are random and directionless while Darwinian variations are small and directional.

**PHYSICS****SECTION-A**

## 101. Answer (1)

When elevator is moving with constant speed,

Force on floor by person = 600 N

When elevator accelerates upwards at  $3 \text{ m s}^{-2}$

then force on floor by person =  $600 \text{ N} + 180 \text{ N}$

$$= 780 \text{ N}$$

When elevator accelerates downward at  $3 \text{ m s}^{-2}$  then force on floor by person =  $600 - 180$   
 $= 420 \text{ N}$

## 102. Answer (2)

Since the particle moves with constant speed hence the direction of acceleration vector cannot be  $\vec{a}_3$  and  $\vec{a}_1$  it will be perpendicular to velocity which is  $\vec{a}_2$ .

103. Answer (3)

$$x = 7 + 7t^2$$

$$\Rightarrow v = 14t$$

$$\text{at } t = 1 \text{ s, } v = 14 \text{ m s}^{-1}$$

104. Answer (3)

Acceleration is given by slope of velocity-time graph.

105. Answer (2)

Both the gases will occupy volume equal to volume of container.

$$PV = nRT$$

$$\Rightarrow \frac{P_1}{P_2} = \frac{n_1}{n_2} = \frac{5}{3}$$

106. Answer (3)

$$\lambda \propto \frac{1}{P} \quad (\text{So, graph will be straight line})$$

107. Answer (2)

$$\begin{aligned} E &= \Delta mc^2 \\ &= 2.5 \times 10^{-3} \times (3 \times 10^8)^2 \\ E &= 22.5 \times 10^{13} \text{ J} \end{aligned}$$

108. Answer (4)

For forward biased *p*-side should be connected to higher potential and *n*-side should be connected to lower potential.

109. Answer (4)

$$\begin{aligned} Y &= \overline{AB} = \bar{A} + \bar{B} \\ A &= 0, B = 1 \Rightarrow Y = \bar{0} + \bar{1} = 1 + 0 = 1 \\ A &= 1, B = 0 \Rightarrow Y = \bar{1} + \bar{0} = 0 + 1 = 1 \end{aligned}$$

110. Answer (2)

When object is placed between pole and focus, then image formed is virtual, magnified and erect.

111. Answer (4)

$$\begin{aligned} M_T &= M_o \times M_e \\ \Rightarrow 96 &= 8 \times m_e \\ \Rightarrow m_e &= \frac{96}{8} \\ m_e &= 12 \end{aligned}$$

112. Answer (2)

$$\text{Critical angle } \sin\theta_c = 0.75 = \frac{3}{4}$$

$$\sin\theta_c = \frac{3}{4} = \frac{1}{\mu}$$

$$\Rightarrow \mu = \frac{4}{3} \text{ and}$$

$$\text{Polarising angle } \theta_p = \tan^{-1}(\mu)$$

$$\theta_p = \tan^{-1}\left(\frac{4}{3}\right)$$

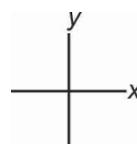
$$\theta_p = 53^\circ$$

113. Answer (4)

$\vec{v}$  is parallel to  $\vec{E} \times \vec{B}$

$$v \rightarrow \hat{i}$$

$$\vec{E} \rightarrow -\hat{j}$$



So, direction of  $B$  is along  $(-\hat{k})$  i.e.,  $-z$ -axis

114. Answer (1)

$$\Delta R = R_0 (\alpha \Delta T)$$

$$15 - 10 = 10 \times \alpha \times 200$$

$$5 = 10 \times \alpha \times 200$$

$$\Rightarrow \alpha = \frac{1}{400} \text{ } ^\circ\text{C}^{-1}$$

115. Answer (4)

Material having low retentivity as well as low coercivity are preferred for electromagnets.

116. Answer (1)

Real battery has internal resistance and resistance generate heat when current flows through it.

117. Answer (3)

Radius of circular paths of charged particle in magnetic field is given by

$$R = \frac{mv}{qB}$$

$$\text{Given, } R_e = R_p$$

$$\therefore \frac{m_e v_e}{eB} = \frac{m_p v_p}{eB}$$

$$v_p = \frac{m_e \times v_e}{m_p}$$

$$= \frac{9 \times 10^{-31}}{1.7 \times 10^{-27}} \times 9 \times 10^5$$

$$v_p = 4.7 \times 10^2 \text{ m/s}$$

118. Answer (3)

$$B_{\text{end}} = \frac{B_{\text{centre}}}{2} = \frac{B}{2}$$

119. Answer (1)

$$x = (t - 1)^2 = t^2 + 1 - 2t$$

$$v = \frac{dx}{dt} = 2t - 2$$

$$v(1) = 2t - 2 = 0$$

$$v(2) = 2 \times 2 - 2 = 2 \text{ ms}^{-1}$$

Work done = Change in kinetic energy

$$\begin{aligned} &= \frac{1}{2} \times (1)(2)^2 \text{ J} \\ &= 2 \text{ J} \end{aligned}$$

120. Answer (3)

For identical balls, when there is elastic collision between two balls the velocities will interchange.

121. Answer (2)

Due to Lenz's law, the loop will try to decrease flux.

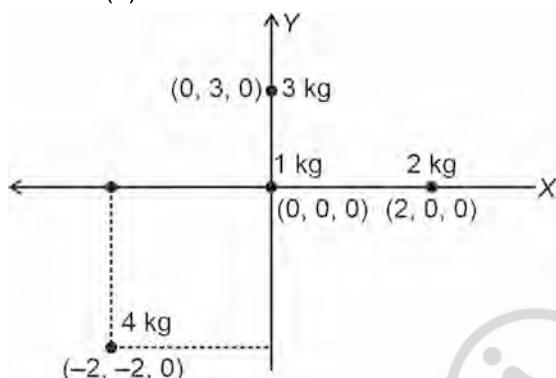
122. Answer (3)

$$P = V \cdot I \cos\phi$$

$$100 = 200 \times 4 \cos\phi$$

$$\cos\phi = \frac{1}{8}$$

123. Answer (1)



From the graph, (about X-axis)

$$I = 4(2)^2 + 3(3)^2$$

$$I = 16 + 27$$

$$I = 43 \text{ kg m}^2$$

124. Answer (1)

We know, the earth slows down at aphelion and moves faster at perihelion, this is due to the conservation of angular momentum as there is no net external torque on earth-sun system. Thus, areal velocity in elliptical path remains same.

125. Answer (4)

Inside the shell

$$I_g = 0$$

126. Answer (2)

In the given U-x curve B is the point of equilibrium.

Thus, at A repulsion will occur (region AB)

While at C attraction will occur (region BC)

127. Answer (1)

Percentage change in length due to temperature change

$$\%l = \frac{\Delta l}{l} \times 100 = \alpha \Delta T \times 100$$

$$= 2 \times 10^{-5} \times 100 \times 100 = 0.2\%$$

128. Answer (1)

$$Q = Av$$

$$A_1 v_1 = A_2 v_2$$

$$\frac{v_1}{v_2} = \frac{A_2}{A_1} = \frac{\frac{\pi}{4} d_2^2}{\frac{\pi}{4} d_1^2}$$

$$\frac{v_1}{v_2} = \frac{9}{4}$$

129. Answer (1)

Efficiency is given by useful work output divided by input heat.

$$\eta = \frac{W_{\text{output}}}{Q_{\text{input}}}$$

$$W = 0.4 \times 500 = 200 \text{ J}$$

130. Answer (3)

In an isothermal process, the temperature remains constant, leading to no change in internal energy.

131. Answer (3)

$$1 \text{ MSD} = \frac{1}{20} \text{ cm}$$

$$\therefore 10 \text{ VSD} = 9 \text{ MSD}$$

$$1 \text{ VSD} = \frac{9}{10} \text{ MSD} = \frac{9}{10} \times \frac{1}{20} \text{ cm} \\ = 0.45 \text{ mm}$$

$$\text{Now, LC} = 1 \text{ MSD} - 1 \text{ VSD} \\ = (0.5 - 0.45) \text{ mm} \\ = 0.05 \text{ mm}$$

132. Answer (1)

$$a = \omega^2 x$$

$$\omega = \sqrt{\frac{a}{x}} \\ = \sqrt{\frac{2}{2 \times 10^{-2}}} \\ = 10 \text{ rad/s}$$

133. Answer (3)

$$y = 0.5 \sin \frac{2\pi}{3.2} (64t - x)$$

$$\omega = \frac{2\pi \times 64}{3.2}$$

$$2\pi f = 2\pi \times 20$$

$$f = 20 \text{ Hz}$$

134. Answer (2)

Inside the inner shell potential will remain constant.

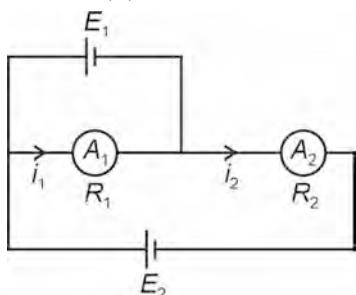
135. Answer (1)

Due to induction attraction between a charged body and a neutral body is possible.

$$\text{Electric field due to a point charge } E = \frac{q}{4\pi\epsilon_0 r^2}$$

## SECTION-B

136. Answer (2)



Applying KVL, we get

$$i_1 = \frac{E_1}{R_1} \text{ and } i_2 = \frac{E_2 - E_1}{R_2}$$

Now,  $i_1$  and  $i_2$  can be same if  $E_2 > E_1$  and  $R_1$  and  $R_2$  have values which satisfy the above equations. Also, for  $E_2 > E_1$ , the current direction in both the ammeters will be same.

137. Answer (3)

Before cutting the string  $T = 2 mg + Kx_0$  and  $Kx_0 = mg$

After cutting the string

$$2mg + Kx_0 = 2ma \text{ and } Kx_0 = mg$$

$$3mg = 2ma$$

$$\Rightarrow a = \frac{3g}{2}$$

138. Answer (4)

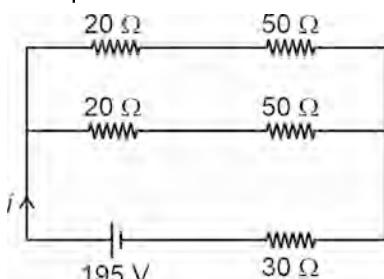
$$r \propto n^2$$

$$\frac{R_2}{R_1} = \left(\frac{5}{3}\right)^2 = \frac{25}{9}$$

139. Answer (3)

$D_1$  and  $D_2$  are forward biased and  $D_3$  is reverse biased.

So equivalent circuit is



$$R_{eq} = \frac{70 \times 70}{70 + 70} + 30$$

$$= 35 + 30 = 65$$

$$i = \frac{195}{65} = 3 \text{ A}$$

140. Answer (3)

$$\delta_{net} = 0$$

$$\delta_1 = \delta_2$$

$$\Rightarrow (\mu_1 - 1)A_1 = (\mu_2 - 1)A_2$$

$$\Rightarrow (1.51 - 1)3 = (1.68 - 1)A_2$$

$$\Rightarrow A_2 = \frac{0.51 \times 3}{0.68}$$

$$= \frac{3}{4} \times 3$$

$$= 2.25^\circ$$

141. Answer (2)

Wavelength associated with moving electron is given by  $\lambda = \frac{h}{mv}$

if  $v$  decrease,  $\lambda$  increases

$$\text{and } \beta = \frac{\lambda D}{d}$$

$$\Rightarrow \beta \propto \lambda$$

142. Answer (2)

$$X_L = \omega L = 10 \times 5 = 50 \Omega$$

$$X_C = \frac{1}{\omega C} = \frac{1}{10 \times 2 \times 10^{-3}} = 50 \Omega$$

$$\therefore X_L = X_C \Rightarrow Z = R$$

$$Z = \frac{V}{I} = R \Rightarrow \frac{220}{2} = 110 \Omega$$

143. Answer (4)

At  $t = 0$ , no current will flow through inductor, hence potential difference across it will be 5 V.

$$\therefore L \frac{di}{dt} = \frac{10}{20} \times 10$$

$$\frac{di}{dt} = \frac{5}{L}$$

$$\frac{di}{dt} = \frac{5}{1} \text{ A/s}$$

144. Answer (2)

Using law of conservation of angular momentum

$$mv_0 R_0 = mv' \left( \frac{R_0}{2} \right)$$

$$\therefore v' = 2v_0$$

$$\text{Thus, K.E.} = \frac{1}{2} m (2v_0)^2$$

$$\text{K.E.} = 2mv_0^2$$

145. Answer (1)

We know, due to rotation of earth

$$g' = g - R\omega^2 \cos^2 \theta$$

At poles  $\theta = 90^\circ$  $\therefore g$  is maximum at poles.

146. Answer (2)

$P \propto \frac{1}{V}$  so, volume decreases. This is based on Boyle's Law.

147. Answer (1)

According to the principle of continuity, the velocity of fluid increases when the cross-sectional area decreases.

148. Answer (1)

$$\text{Let } v = \lambda^a g^b p^c$$

$$[M^0 L^1 T^{-1}] = [L]^a [L T^{-2}]^b [ML^{-3}]^c$$

On comparing

$$c = 0, a + b - 3c = 1$$

$$-2b = -1$$

$$\Rightarrow b = \frac{1}{2}$$

$$\text{Hence, } a = \frac{1}{2}$$

$$\therefore a = \frac{1}{2}, b = \frac{1}{2} \text{ and } c = 0$$

149. Answer (3)

$$F = \frac{KQ^2}{r^2}$$

$$F_1 = \frac{K \left( \frac{4Q}{5} \right)^2}{r^2}$$

$$= \frac{16F}{25}$$

150. Answer (1)

$$C = \frac{A\varepsilon_0 K}{d}$$

$$\frac{A\varepsilon_0}{d} = \frac{C}{K}$$

$$= \frac{C}{3}$$

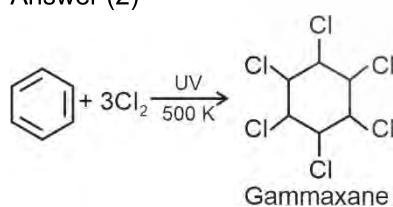
## CHEMISTRY

### SECTION-A

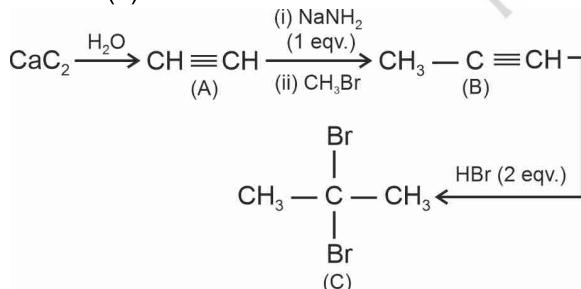
151. Answer (1)

Vitamin E is a fat-soluble vitamin, deficiency of it causes increased fragility of RBCs and muscular weakness.

152. Answer (2)



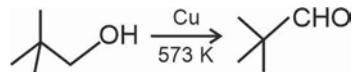
153. Answer (2)



154. Answer (2)

Aspirin possesses analgesic, anti-inflammatory and antipyretic properties.

155. Answer (2)



156. Answer (4)

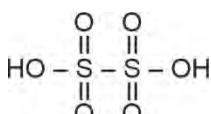
$$\vec{v} = R_H \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right] \quad \{n_1 = 1 \text{ and } n_2 = 4\}$$

$$\frac{1}{\lambda} = R_H \left[ \frac{1}{1} - \frac{1}{16} \right] = R_H \left[ \frac{15}{16} \right]$$

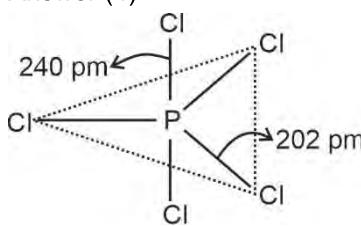
$$\lambda = \frac{16}{15 R_H}$$

157. Answer (4)

Structure of  $\text{H}_2\text{S}_2\text{O}_6$



158. Answer (4)

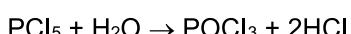


(1) It has trigonal bipyramidal structure in liquid and gaseous phases

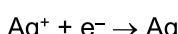
(2) Three equatorial P-Cl bonds are equivalent

(3) Two axial bonds are longer than equatorial bonds

(4) It hydrolyses with moist air to give  $\text{POCl}_3$  and finally phosphoric acid



159. Answer (4)



1F  $\rightarrow$  1 gram eq. of Ag

1 mol  $\text{e}^-$  will deposit 1 mol of Ag.

160. Answer (4)

Solubility of salts of weak acid like  $\text{PO}_4^{3-}$  etc. increases at higher concentration of  $\text{H}^+$  as at higher  $[\text{H}^+]$ , concentration of anion decreases due to protonation which in turn increases the solubility of the salt so that  $K_{sp} = Q_{sp}$ .

161. Answer (1)

- Exothermic reactions are favoured at low temperature.
- Equilibrium shifts towards lesser number of gaseous moles on increasing pressure.

162. Answer (3)

Atoms or ions which contain same number of electrons are isoelectronic species. Example,



All contains 10 electrons.

163. Answer (2)

$\text{Na}^+$  having noble gas configuration and high effective nuclear charge.

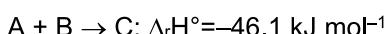
164. Answer (4)

Actinoids exhibit larger range of oxidation states because of the very small gap between 5f, 6d and 7s orbitals.

Thus, outermost electron get easily excited to higher energy levels, giving variable oxidation states.

165. Answer (1)

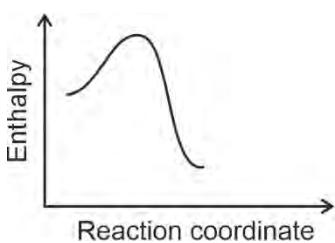
Since the reaction is an exothermic reaction,



$\Delta H^\circ$  = negative

$\therefore \Delta rH^\circ$  = Exothermic

Enthalpy diagram for exothermic reaction is as follows:



166. Answer (2)

$$\text{Number of moles of } \text{CO}_2 = \frac{4.4}{44} = 0.1$$

At STP, 1 mole of  $\text{CO}_2$  at STP contains 22.4 L volume, 0.1 mole of  $\text{CO}_2$  at STP contains 2.24 L volume.

167. Answer (2)

$$M_1 = 0.1 \text{ M} \quad M_2 = 0.05 \text{ M}$$

$$V_1 = 100 \text{ cm}^3$$

$$V_2 = ?$$

For dilution

$$M_1 V_1 = M_2 V_2$$

$$0.1 \times 100 = 0.05 \times V_2$$

$$V_2 = 200 \text{ cm}^3$$

$$\therefore \text{Volume of water added} = 200 - 100 \\ = 100 \text{ cm}^3$$

168. Answer (1)

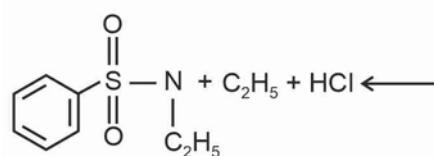
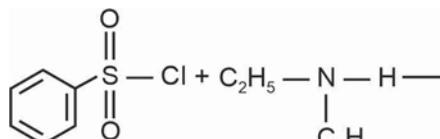
Molar conductivity depends on the number of free ions in aqueous solution.

Molar conductivity  $\propto$  number of free ions in solution.

Compound	No. of free ions in solution
$[\text{CO}(\text{NH}_3)_6]\text{Cl}_3$	4
$[\text{CO}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$	3
$[\text{CO}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$	2
$[\text{CO}(\text{NH}_3)_3\text{Cl}_3]$	1

169. Answer (4)

In the reaction with secondary amine, N,N-diethylbenzene sulphonamide is formed.

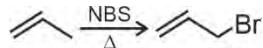


N, N-Diethylbenzenesulphonamide

N, N-diethylbenzene sulphonamide is not acidic hence insoluble in alkali.

170. Answer (1)

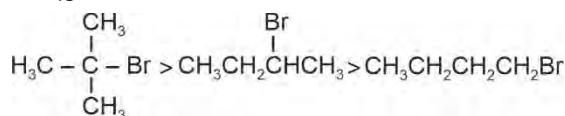
This is free radical allylic substitution reaction.



## 171. Answer (1)

The more stable carbocation proceeds with faster rate of S<sub>N</sub>1 reaction.

∴ The correct order of reactivity of S<sub>N</sub>1 reaction is



## 172. Answer (3)

Osmotic pressure is best method to determine molecular weight of polymers because it can be measured at room temperature and shows reasonable variation.

## 173. Answer (3)

K<sub>2</sub>SO<sub>4</sub> shows maximum value of i due to dissociation. Therefore it has maximum depression in freezing point and lowest freezing point.

## 174. Answer (3)

O<sub>2</sub> has bond order = 2

O<sub>2</sub><sup>+</sup> has bond order = 2.5

To convert O<sub>2</sub> to O<sub>2</sub><sup>+</sup> electron is removed from π\*2p<sub>x</sub>.

## 175. Answer (2)



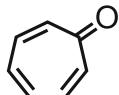
1 lone and 3 bonds so hybridisation of N is sp<sup>3</sup>.

## 176. Answer (1)

In order to avoid decomposition of liquid below its boiling point, distillation is done under reduced pressure. Glycerol is separated from spent lye using this technique.

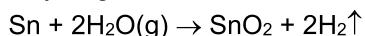
## 177. Answer (4)

In heterocyclic aromatic compounds contains heteroatom in aromatic ring. In tropone, oxygen atom is not the part of ring.



## 178. Answer (3)

Tin decomposes steam to form dioxide and dihydrogen.



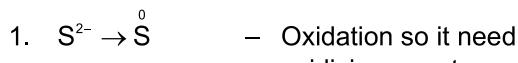
C, Si and Ge are not affected by water while Pb is unaffected by water probably because of a protective oxide film.

## 179. Answer (1)

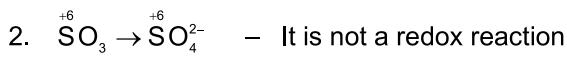
$$E_{\text{cell}}^{\circ} = E_{\text{cathode}}^{\circ} - E_{\text{anode}}^{\circ}$$

$$= 0.15 - (-0.74) = +0.89 \text{ V}$$

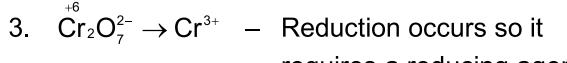
## 180. Answer (3)



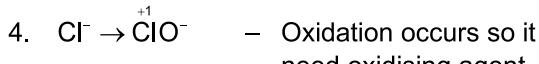
– Oxidation so it need oxidising agent



– It is not a redox reaction

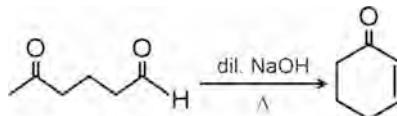


– Reduction occurs so it requires a reducing agent

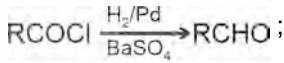


– Oxidation occurs so it need oxidising agent

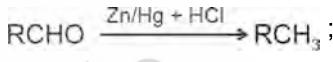
## 181. Answer (1)



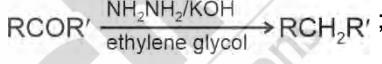
## 182. Answer (2)



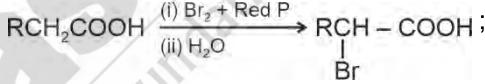
Rosenmund reaction



Clemmensen reduction



Wolff-Kishner reduction



HVZ reaction

## 183. Answer (2)

Since t<sub>87.5%</sub> = 3t<sub>1/2</sub>

This will be first order reaction.

## 184. Answer (3)

Sodium nitroprusside is Na<sub>2</sub>[Fe(CN)<sub>5</sub>NO].

## 185. Answer (1)

Group-I: Dilute HCl

Group-II: H<sub>2</sub>S gas in presence of dil. HCl

Group-III: NH<sub>4</sub>OH in presence of NH<sub>4</sub>Cl

Group-IV: H<sub>2</sub>S in presence of NH<sub>4</sub>OH

## SECTION-B

## 186. Answer (3)

For zero order reaction

$$A_t = a_0 - kt$$

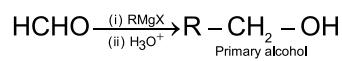
$$at = t_{100\%}$$

$$at = 0$$

$$0 = a_0 - kt_{100\%}$$

$$t_{100\%} = \frac{a_0}{k}$$

## 187. Answer (1)



Primary alcohol

