



Aakash

Medical | IIT-JEE | Foundations

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

(Advanced INTENSIVE Mastery for 720)

MM : 720

CST-18

Time : 3 Hrs. 20 Min.

Answers

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

02/05/2024

CODE-A

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Answers & Solutions**BOTANY****SECTION-A**

1. Answer (3)
Allelic sequence variation is described as a DNA polymorphism if more than one variant at a locus occurs in human population with a frequency greater than 0.01.
2. Answer (2)
HGP has aimed to determine the sequence of 3 billion chemical base pairs that make up human DNA.
3. Answer (3)
In prokaryotes, 23S rRNA act as ribozyme and serve the catalytic role during translation.
4. Answer (1)
Francis Crick postulated the presence of an adaptor molecule that would bind to specific amino acids and read the code simultaneously.
5. Answer (4)
Water stress causes the stomata to close hence reducing the CO₂ availability.
6. Answer (3)
Chloroplast, mitochondria and peroxisomes are involved in photorespiration.
7. Answer (2)
For frugivorous birds and mammals in the tropical forest of different continents the slope is found to be 1.15.
8. Answer (4)
The Evil Quartet, describe biodiversity losses does not include co-evolution.
9. Answer (3)
For one glucose molecule, two turns of TCA cycle are required. For sucrose molecules, four turns of TCA cycle is required for its complete oxidation.
10. Answer (1)
In sickle cell anaemia disorder, the mutant haemoglobin molecules undergoes polymerisation under low oxygen tension causing the change in the shape of the RBC from biconcave disc to elongated sickle like structure.
11. Answer (3)
Variation is the degree by which progeny differs from their parents.
12. Answer (1)
In *Drosophila* recombination frequency between genes *w* and *m* is 37.2%
Distance between *w* and *m* is 37.2 cM.
13. Answer (1)
Punnett square was developed by a British geneticist Reginald C. Punnett.
14. Answer (4)
For plants, scientific names are based on agreed principles and criteria, which are provided in the International Code for Botanical Nomenclature (ICBN).
15. Answer (4)
Asexual spores are generally not found in members of basidiomycetes.
16. Answer (3)
Bacteriophage viruses that infect the bacteria contain dsDNA as their genetic material.

17. Answer (2)
Tap roots of turnip and adventitious roots of sweet potato get swollen and store food.
The stems of maize and sugarcane have supporting roots coming out of the lower nodes of the stem which are called stilt roots.
18. Answer (3)
The fleshy leaves of onion and garlic stores food.
19. Answer (2)
Moong, *Sesbania*, *Trifolium*, Sweet pea, Sun hemp, and *Indigofera* are members of family Fabaceae, which has papilionaceous corolla.
20. Answer (2)
Pteridophytes are seedless vascular plants.
The leaves may be small (microphylls) as in *Selaginella* or large (macrophylls) as in ferns.
21. Answer (4)
Sargassum is the example of brown algae and in brown algae stored food is in form of laminarin or mannitol.
22. Answer (3)
Citric acid is produced by fungus *Aspergillus niger*.
Citric acid is used in flavouring and preservation of food.
23. Answer (2)
- | | Interaction | Species A | Species B |
|-------|--------------|-----------|-----------|
| (i) | Mutualism | (+) | (+) |
| (ii) | Predation | (+) | (-) |
| (iii) | Commensalism | (+) | (0) |
| (iv) | Parasitism | (+) | (-) |
24. Answer (2)
Net primary productivity is the rate of organic matter build up or stored by producers in excess of respiratory utilization per unit time and area.
NPP of whole biosphere is approximately 170 billion tons (dry weight) of organic matter.
25. Answer (1)
Presence of vessels is a characteristic feature of angiosperms. Gymnosperms lack vessels in their xylem.
26. Answer (4)
In the given figure of T.S. of Dicot stem, Label 'A' is parenchyma, Label 'B' is pericycle and Label 'C' is medullary rays.
27. Answer (3)
Cytokinins promote nutrient mobilisation which helps in delaying of leaf senescence.
28. Answer (3)
When fruits develop without the process of fertilization. It is called parthenocarpic fruit.

29. Answer (4)
- Floral rewards are required for entomophily.
 - Insect pollinated flowers have sticky pollen grains.
 - Outbreeding devices encourage cross-pollination and discourage self-pollination.
30. Answer (1)
Materials to be packaged in the form of vesicles from the ER fuse with the cis face of the golgi apparatus and move towards the maturing face. This explains, why the golgi apparatus remains in close association with ER.
31. Answer (3)
Mitochondria produce cellular energy in the form of ATP, hence they are called 'power house' of the cell.
32. Answer (4)
The golgi apparatus principally performs the function of packaging materials, to be delivered either to the intra-cellular targets or secreted outside the cell.
33. Answer (2)
The interphase, though called the resting phase, is the time during which the cell is preparing for division by undergoing both cell growth and DNA replication. Hence cell in this phase is metabolic active.
34. Answer (1)
During cell cycle, G₂ phase involve semi-autonomous organelle duplication.
35. Answer (3)
Number of meiotic division required to make x number of seeds/grains/fruit is

$$x + \frac{x}{4} = 20 + \frac{20}{4} = 25.$$

SECTION-B

36. Answer (1)
The sequence of chromosome 1 was completed only in May 2006.
37. Answer (2)
 $\phi \times 174$ bacteriophage has 5386 nucleotides.
38. Answer (3)
The correct sequence of steps involved in glycolysis is as follows:
 Glucose → Glucose 6-phosphate → Fructose 6-phosphate → Fructose 1,6-bisphosphate → glyceraldehyde-3-phosphate → 1, 3-bisphosphoglyceric acid → 3-phosphoglyceric acid → 2-phosphoglycerate → Phosphoenolpyruvate → Pyruvic acid.

39. Answer (2)
Law of Dominance is not universally applicable.
Law of segregation is universally applicable.
40. Answer (3)
The cell membrane of archaebacteria contain branched chain lipids. The branched chain of archaebacteria helps prevent cell membranes from leaking at high temperature.
41. Answer (4)
Tetradynamous and sometimes didynamous condition of stamens is found in the members of family Brassicaceae.
42. Answer (4)
The functional megaspore divides mitotically forming 2-nucleate embryo sac. Two more sequential mitotic nuclear divisions results in the formation of the 4-nucleate and ultimately 8 nucleate stage leading to the organisation of 7 celled and 8-nucleate embryo sac.
43. Answer (1)
Lipases are obtained from *Candida lipolytica* and lipases are used in removing oily stains.
44. Answer (3)
Amensalism is an interaction between two organism of different species in which one species inhibits the growth of other species by secreting certain chemicals.
45. Answer (1)
Succession on rocks is called lithosere.
46. Answer (2)
 - Companion cells are specialised parenchymatous cells.

- A tissue is a group of cells having common origin and usually performing a common function.
- Maize is a monocot plant and it has scattered vascular bundles, each surrounded by sclerenchymatous bundle sheath.

47. Answer (3)

Influences of ethylene on plants include horizontal growth of seedlings, swelling of the axis and apical hook formation in dicot seedlings.

Both ethylene and ABA are showing synergistic effects in promoting shedding of leaves, fruits and flowers.

48. Answer (3)

- Sporopollenin can withstand high temperatures, strong acids and alkali. No enzyme that degrades sporopollenin is so far known.
- Pollen grains can be fossilized because of the presence of sporopollenin.

49. Answer (3)

Cells that do not divide further exit G_1 phase to enter an inactive stage called (G_0) stage of cell cycle. Cells in this stage remain metabolically active but no longer proliferate unless called on to do so.

50. Answer (2)

Prokaryotic cells lack a membrane-bound nucleus. Bacteria and cyanobacteria are prokaryotes which have nuclear matter without envelope.

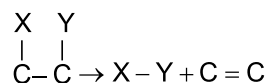
ZOOLOGY

SECTION-A

51. Answer (2)
In mammals, including humans, insulin is synthesized as a pro-hormone which contains an extra stretch called the C peptide. This C peptide is not present in the mature insulin and is removed during maturation into insulin.
52. Answer (2)
Biolistics or gene gun and micro-injection are direct methods of gene transfer.
53. Answer (4)
Unless we cut the vector and the source DNA with the same restriction enzyme, the recombinant DNA molecule cannot be created.
When cut by the same restriction enzyme, the resultant DNA fragments have the same kind of 'sticky-ends' and these can be joined together (end-to-end) using DNA ligases.

54. Answer (4)

Lyases: Enzymes that catalyse removal of groups from substrates by mechanisms other than hydrolysis leaving double bonds.



Lyases belong to class IV of enzymes.

55. Answer (4)

The SAN generates an action potential which stimulates the atria to undergo a simultaneous contraction – the atrial systole. SAN is also called the pacemaker of heart as it generates the maximum number of action potentials *i.e.*, (70-75 per min) and is responsible for initiating and maintaining the rhythmic contractile activity of the heart.

56. Answer (2)
In cockroaches, the head is connected with thorax by a short extension of the prothorax known as the neck.
57. Answer (2)
During coagulation of blood, a clot or coagulum is formed mainly of a network of threads called fibrins in which dead and damaged formed elements of blood are trapped. Fibrins are formed by the conversion of inactive fibrinogens in the plasma by the enzyme thrombin. Thrombins, in turn, are formed from another inactive substances present in the plasma called prothrombin. Calcium ions play a very important role in blood clotting.
58. Answer (3)
After completion of the biosynthetic stage, the product has to be subjected through a series of processes before it is ready for marketing as a finished product.
The processes include separation and purification which are collectively referred to as downstream processing.
59. Answer (2)
 2^n copies of DNA are obtained after (n) number of PCR cycles.
 $\therefore (2)^8 = 256$ DNA molecules
 $\therefore n = 8$ PCR cycles
60. Answer (2)
Annelids and arthropods show metamerism.
Nereis (Annelid) and prawn (Arthropod) are aquatic invertebrates.
61. Answer (3)
Sponges are generally asymmetrical.
Coelenterates are radially symmetrical.
Ciliated comb plates are present in ctenophores.
62. Answer (3)
Ethmoid and sphenoid are unpaired cranial bones.
Mandible is the unpaired facial bone.
63. Answer (1)
The sum of total number of tibia and fibula in both the hind limbs of man is 4 and the total number of floating ribs is also 4.
The number of lumbar vertebrae and sacral vertebra in adult human is 5 and 1 respectively.
64. Answer (2)
Mendel had talked of inheritable 'factors' influencing phenotype. Darwin either ignored his observations or kept silence.
- Lamarck proposed the theory of inheritance of acquired characters.
Oparin and Haldane proposed the theory of chemical evolution.
65. Answer (3)
The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation.
66. Answer (1)
ADH facilitates water reabsorption from latter parts of the tubule, thereby preventing diuresis.
Mammals have the ability to produce concentrated urine.
The Henle's loop and vasa recta play a significant role in this.
67. Answer (2)
Each kidney has nearly one million complex tubular structures called nephrons, which are its functional units.
68. Answer (3)
Coca alkaloid has a potent stimulating action on the central nervous system, producing a sense of euphoria and increased energy.
69. Answer (3)
The scrotum helps in maintaining the low temperature of testes (about 2-2.5°C lower than the normal internal body temperature) necessary for spermatogenesis.
70. Answer (2)
About 65 mya, the dinosaurs suddenly disappeared from the Earth.
71. Answer (2)
To avoid possible pregnancy due to casual unprotected intercourse, administration of progestogens or progestogen-estrogen combinations or IUDs within 72 hours of coitus have been found to be very effective as emergency contraceptives.
72. Answer (4)
As chances of fertilisation are very high from the day 10 to 17 of the 28 days menstrual cycle, it is called the fertile period.
73. Answer (2)
RCH stands for Reproductive and Child Health Care.
74. Answer (1)
Each primary oocyte is surrounded by a layer of granulosa cells and is called the primary follicle. Large number of these follicles degenerate during the phase from birth to puberty.

75. Answer (3)

- (1) Common cold – Virus
- (2) Elephantiasis – Helminth
- (3) Amoebiasis – Protozoan
- (4) Pneumonia – Bacteria

76. Answer (1)

When CO₂ concentration in blood increases, then breathing becomes faster than the normal breathing. Regulation of respiration is under the control of the central nervous system.

77. Answer (4)

Humans have two lungs which are covered by a double layered pleura, with pleural fluid between them.

78. Answer (3)

The dorsal portion of midbrain consists mainly of four round swellings (lobes) called corpora quadrigemina.

79. Answer (3)

The ear is the structure responsible for hearing as well as maintaining balance (equilibrium) in frogs.

80. Answer (2)

Cytidine – Cytosine with a pentose sugar

Serine – Amino acid

Palmitic acid – 16 carbon fatty acid

81. Answer (4)

The new potential developed in the post-synaptic neurons may be excitatory or inhibitory based on the type of neurotransmitters released from the synaptic vesicles of the pre-synaptic neuron.

82. Answer (1)

Cellulose does not contain complex helices and hence cannot hold I₂.

83. Answer (3)

Thyroxine is an iodothyronine and like steroid hormones, it also regulates the gene expression or chromosome function by interacting with intracellular receptors.

84. Answer (4)

Exocrine glands secrete mucus, saliva, earwax, oil, milk, digestive enzymes and other cell products. These products are released through ducts or tubes. In contrast, endocrine glands do not have ducts. Their products called hormones are secreted directly into the fluid bathing the gland.

85. Answer (3)

Transgenic animals that produce useful biological products can be created by the introduction of the portion of DNA (or genes) which codes for a particular product such as human protein, α -1-antitrypsin *i.e.*, is used to treat emphysema. Similar attempts are being made for treatment of phenylketonuria (PKU) and cystic fibrosis.

SECTION-B

86. Answer (2)

Cardiac muscle fibres are involuntary in nature and have striations with a centrally located nucleus.

87. Answer (1)

Glucagon is a peptide hormone and it plays an important role in maintaining the normal blood glucose levels.

88. Answer (4)

Ventricular systole increases the ventricular pressure causing the closure of tricuspid and bicuspid valves due to attempted backflow of blood into the atria.

89. Answer (2)

Several nematodes parasitise a wide variety of plants and animals including human beings. A nematode *Meloidogyne incognita* infects the roots of tobacco plants and causes a great reduction in yield. A novel strategy was adopted to prevent this infestation which was based on the process of RNA interference (RNAi).

90. Answer (1)

Amniocentesis can lead to female foeticide as it detects the sex of the foetus. To legally check the increasing menace of female foeticides, the Government of India put a ban on amniocentesis for sex determination.

91. Answer (2)

Pons consists of tracts of nerve fibres which interconnect different regions of the brain. Neurosecretory cells of hypothalamus secrete hypothalamic hormones for both anterior and posterior lobes of the pituitary gland.

92. Answer (3)

Salivary glands are absent in frogs. Their brain is enclosed in a bony structure called the brain box (cranium).

93. Answer (1)

The PNS is divided into two divisions called somatic neural system and autonomic neural system. The somatic neural system relays impulses from CNS to skeletal muscles. The CNS includes brain and spinal cord.

94. Answer (2)

The word 'restriction' in 'restriction enzyme' refers to prevention of the multiplication of bacteriophages in bacteria.

95. Answer (3)

After getting into the body of the person, the AIDS virus enters into macrophages where the RNA genome of the virus replicates to form the viral DNA with the help of the enzyme reverse transcriptase.

96. Answer (4)

Natural selection is the process of selection of advantageous variations by nature. Both industrial melanism and Darwin's finches are examples of natural selection.

97. Answer (1)

Muscular dystrophy causes progressive degeneration of the skeletal muscles. Tetany is caused due to low Ca^{2+} in body fluids.

98. Answer (1)

Blood is the medium of transport for O_2 and CO_2 . It is a specialized connective tissue consisting of fluid matrix, plasma and formed elements. Lymph is a colourless fluid containing specialized lymphocytes which are responsible for the immune responses of the body. Urine is a light yellow-coloured watery fluid which is slightly acidic and is formed by the kidneys.

99. Answer (1)

Petromyzon – Lamprey
Balaenoptera – Blue whale
Struthio – Ostrich
Hippocampus – Sea horse

100. Answer (4)

Prosthetic groups are organic compounds and are distinguished from other co-factors in that they are tightly bound to the apoenzyme. Co-enzymes are also organic compounds but their association with the apoenzyme is only transient, usually occurring during the course of catalysis.

PHYSICS

SECTION-A

101. Answer (1)

According to conservation of energy

$$(\text{K.E} + \text{P.E})_{\infty} = (\text{K.E} + \text{P.E})_{\text{surface}}$$

$$0 + 0 = \frac{1}{2}mv^2 - \frac{GMm}{R}$$

$$v = \sqrt{2gR} = 11.2 \text{ km/s}$$

102. Answer (2)

$$F - T = 2a \text{ and } T = 1(a) = a$$

$$\therefore a = \frac{F}{3} = \frac{10}{3} \text{ m/s}^2$$

$$\text{and } T = \frac{10}{3} \text{ N}$$

$$\text{Stress} = \frac{T}{\pi r^2} = \frac{6.25}{3\pi} \times 10^9$$

$$r = 4 \times 10^{-5} \text{ m}$$

103. Answer (1)

We know,

$$\vec{\tau} = \frac{d\vec{L}}{dt}$$

Since, angular momentum of the particle is decreasing hence torque is acting opposite to its angular momentum.

104. Answer (4)

We know,

$$L = mvr$$

$$v = \frac{L}{mr}$$

Centripetal force

$$F = \frac{mv^2}{r} = \frac{m}{r} \left(\frac{L^2}{m^2 r^2} \right)$$

$$\therefore F = \frac{L^2}{mr^3}$$

105. Answer (2)

$$\varepsilon = BLv$$

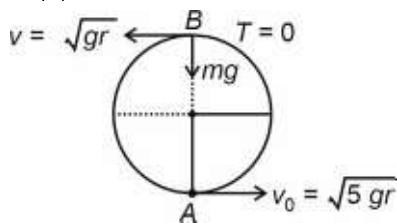
$$= 10^{-3} \times 1 \times 10^2 = 0.1 \text{ V}$$

The positive charge will collect at Q.

106. Answer (1)

$$\tan 45^\circ = \frac{X_L}{R} = \frac{X_C}{R}$$

107. Answer (1)



The given condition is the critical condition for the vertical circle. At highest point tension will be zero.

108. Answer (4)

$$\frac{dU}{dx} = 2x - 2$$

For minimum PE:

$$2x - 2 = 0$$

$$x = 1 \text{ m}$$

T.E is conserved:

$$KE + PE = 8$$

$$\frac{1}{2}mv^2 + [1 - 2] = 8$$

$$\frac{1}{2}2v^2 - 1 = 8$$

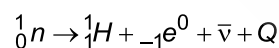
$$v^2 = 9$$

$$v = 3 \text{ m s}^{-1}$$

109. Answer (3)

Work function is the property of the metallic surface only.

110. Answer (4)



The mass defect

$$\Delta m = m_n - m_H - m_e$$

$$= 1.675 \times 10^{-27} - (1.672 \times 10^{-27} + 9 \times 10^{-31}) \text{ kg}$$

$$\Delta m = 2.1 \times 10^{-30} \text{ kg}$$

Since, combined mass of products is less than the mass of reactant, hence energy will be released.

111. Answer (3)

Initially conduction will start by Ge diode

$$V_{01} = 15 - 0.3 = 14.7 \text{ V}$$

When Ge diode reversed, conduction will happen through Si diode

$$V_{02} = 15 - 0.7 = 14.3 \text{ V}$$

$$\text{Change } V_{01} - V_{02} = 14.7 - 14.3 = 0.4 \text{ V}$$

112. Answer (4)

An intrinsic semiconductor doped with trivalent impurities gives a p-type semiconductor.

113. Answer (3)

$$\text{Volumetric expansion} = \beta_1 + 2\beta_2$$

114. Answer (4)

Compression work \rightarrow -ve (Work on system)

Volume of a gas decreases

115. Answer (3)

Internal energy depends on initial and final state as it is a state function.

116. Answer (2)

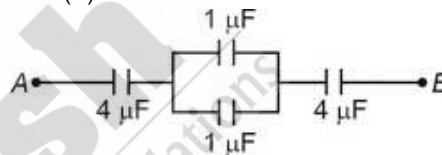
$$(\text{R.D.})_{\text{metal}} = \frac{W_A}{W_A - W_W} = \frac{300}{300 - 270} = 10$$

117. Answer (3)

$$\text{Pitch} = \frac{4}{8} = 0.5 \text{ mm}$$

$$\begin{aligned} \text{Now, least count} &= \frac{\text{Pitch}}{\text{CSD}} = \frac{0.5}{50} \\ &= \frac{1}{100} \text{ mm} = 0.01 \text{ mm} \\ &= 0.001 \text{ cm} \end{aligned}$$

118. Answer (3)



$$C_{AB} = 1 \mu\text{F}$$

119. Answer (2)

$$\vec{F} = q\vec{E}$$

$$\text{And, } a = \frac{F}{m}$$

120. Answer (2)

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$T_1 = 2\pi\sqrt{\frac{4l}{5g}}$$

$$= \frac{4}{\sqrt{5}} \text{ s}$$

121. Answer (1)

$$f = \frac{(2n-1)v}{4l}$$

$$f_1 = \frac{v}{4l} \quad [n = 1]$$

For first overtone $n = 2$

$$f_2 = \frac{3v}{4l}$$

$$\begin{aligned} f_2 &= 3 \times 100 \\ &= 300 \text{ Hz} \end{aligned}$$

122. Answer (3)

$$u = -30 \text{ cm}$$

$$f = -10 \text{ cm}$$

$$v = \frac{uf}{u-f}$$

$$= \frac{(-30)(-10)}{-30+10}$$

$$= \frac{(-30)(-10)}{-20}$$

$$= -15 \text{ cm}$$

It means image is real.

$$m = \frac{-v}{u} = \frac{-(-15)}{-30}$$

$$m = \frac{-1}{2}$$

It means image is diminished and inverted.

123. Answer (2)

$$\frac{1}{f} = (\mu_L - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right) \quad \dots(i)$$

$$\frac{1}{f_m} = \left(\frac{\mu_L}{\mu_w} - 1 \right) \left(\frac{1}{R_1} - \frac{1}{R_2} \right) \quad \dots(ii)$$

Divide eq. (ii) by eq (i)

$$\frac{f}{f_m} = \frac{\left(\frac{\mu_L}{\mu_w} - 1 \right)}{(\mu_L - 1)} = \frac{\left(\frac{3 \times 3}{2 \times 4} - 1 \right)}{\left(\frac{3}{2} - 1 \right)} = \frac{\frac{1}{8}}{\frac{1}{2}} = \frac{1}{4}$$

$$f_m = 4f = 4 \times 20 = 80 \text{ cm}$$

It means image is real.

$$m = \frac{-v}{u} = \frac{-(-15)}{-30}$$

$$m = \frac{-1}{2}$$

It means image is diminished and inverted.

124. Answer (3)

$$\text{Width of central maximum } w = \frac{2\lambda D}{d}$$

$$w = \frac{2\lambda b}{a}$$

125. Answer (4)

Speed of all electromagnetic waves in vacuum is same.

126. Answer (1)

$$R = \rho \frac{l}{A} = \frac{\rho l}{\pi r^2}$$

$$R' = \rho \times \frac{2l}{\pi(2r)^2} = \frac{\rho l}{\pi r^2} \times \frac{1}{2}$$

$$\therefore R' = \frac{R}{2}$$

127. Answer (3)

All the three resistors are in parallel combination, hence

$$R_{eq} = \frac{R}{3}$$

128. Answer (3)

Magnetic field lines due to a straight current carrying conductor is in the form of concentric circles.

129. Answer (1)

Force due to magnetic field on a charged particle

$$\text{is } \vec{F} = q(\vec{v} \times \vec{B}) \text{ or } |\vec{F}| = qvB \sin \theta$$

$$\text{Also, } \vec{F}_{\max} = \left(\frac{d\vec{p}}{dt} \right)_{\max}$$

$$|\vec{F}|_{\max} = qvB(\sin \theta)_{\max} \Rightarrow \theta = 90^\circ$$

130. Answer (3)

$$\vec{\tau} = \vec{M} \times \vec{B} \Rightarrow \vec{\tau} = 25\hat{i} \times (2\hat{i} + 3\hat{j})$$

$$\vec{\tau} = 75\hat{k} \text{ N m}$$

$$\therefore |\vec{\tau}| = 75 \text{ N m}$$

131. Answer (1)

$$F = \frac{dp}{dt} \Rightarrow F = \frac{mdv}{dt} \Rightarrow mdv = Fdt$$

$$\Rightarrow mv = \frac{6t^3}{3} \Rightarrow v = \frac{6t^3}{3m} \Rightarrow v = \frac{6 \times 1}{3 \times 3} = \frac{6}{9} \text{ m s}^{-1}$$

$$= \frac{2}{3} \text{ m s}^{-1}$$

132. Answer (3)

In uniform circular motion, an object has constant speed but variable velocity. It is because velocity being a vector quantity can be changed by changing the direction only.

133. Answer (1)

$$h = \frac{1}{2}gt_1^2$$

$$\Rightarrow \frac{h}{2} = \frac{1}{2}gt^2$$

$$t = \sqrt{\frac{h}{g}}, t_1 = \sqrt{\frac{2h}{g}} \Rightarrow t_1 = \sqrt{2}t$$

$$\Rightarrow t = \frac{t_1}{\sqrt{2}}$$

134. Answer (3)

$$\vec{V}_{B,W} = \vec{V}_{B,g} - \vec{V}_{W,g} = 3\hat{i} + 4\hat{j} - (-3\hat{i} - 4\hat{j}) \\ = 6\hat{i} + 8\hat{j}$$

135. Answer (3)

$$PV = \frac{mRT}{M} \Rightarrow PM = \rho RT \\ \Rightarrow \frac{\rho_1}{\rho_2} = \frac{P_1}{P_2} \times \frac{M_1}{M_2} = \frac{5}{7} \times \frac{4}{3} \\ = 20 : 21$$

SECTION-B

136. Answer (2)

We know,

$$v_e = \sqrt{\frac{2GM}{R}} \Rightarrow v_e \propto \frac{1}{\sqrt{R}}$$

$$\therefore \frac{v_e}{v'_e} = \sqrt{\frac{R'}{R}} = \frac{1}{10}$$

$$R' = \frac{R}{100} = \frac{6400}{100} = 64 \text{ km}$$

137. Answer (1)

Here, according to conservation of angular momentum

$$L_i = L_f$$

$$I(20) = I'(10)$$

$$\therefore I' = 2I$$

138. Answer (2)

Mutual inductance is independent of current in the coils.

Mutual inductance can be increased by reducing the distance between the coils or by increasing the number of turns in the coils.

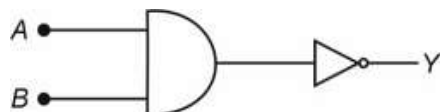
139. Answer (2)

$$i_{rms} = \frac{V_{rms}}{Z}$$

At resonance $z = R$

$$\therefore i_{rms} = \frac{200}{20} = 10 \text{ A}$$

140. Answer (2)



The resulting gate will be a NAND gate

141. Answer (2)

For first excited state $n = 2$

$$mvr = \frac{2h}{2\pi} = \frac{h}{\pi} \quad \dots(i)$$

$$mv = \frac{h}{\lambda} \quad \dots(ii)$$

$$\frac{(i)}{(ii)} \Rightarrow r = \frac{\lambda}{\pi}$$

$$\lambda = \pi r = 3.14 \times 2.12$$

$$\lambda = 6.66 \text{ \AA}$$

142. Answer (3)

When a copper ball is heated its size increases.

As volume $\propto (\text{radius})^3$ and area $\propto (\text{radius})^2$, so percentage increase will be largest in volume. Density will decrease with rise in temperature.

143. Answer (2)

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

$$F_1 = 900 \times 10 \left[\frac{\pi(5)^2}{\pi(15)^2} \right] = 1000 \text{ N}$$

144. Answer (2)

Dimension of A \neq Dimension of C

Hence A - C will not be a meaningful quantity.

145. Answer (1)

$$q = CV$$

Capacitance increases and charge on the condenser increases, potential difference across the condenser remains same.

146. Answer (4)

The new force between q_1 and q_2 remains same but net force on q_4 and q_3 will change.

147. Answer (4)

$$\tan \theta_P = \mu$$

$$\Rightarrow \mu = \tan 53^\circ$$

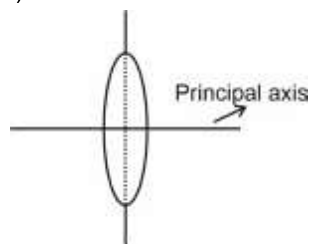
$$\mu = \frac{4}{3}$$

$$\text{and } v = \frac{c}{\mu}$$

$$= \frac{3 \times 10^8}{\frac{4}{3}}$$

$$= \frac{9}{4} \times 10^8 \text{ m/s}$$

148. Answer (3)



Focal length of both lens is $2f$
So, their ratio is 1 : 1.

149. Answer (3)

$$\Delta V = iR \Rightarrow E_2 = i_2 \times R_2 \Rightarrow i_2 = \frac{E_2}{R_2}$$

150. Answer (4)

$$F_{s \max} = \mu \times N = 0.3 \times 50 = 15 \text{ N}$$

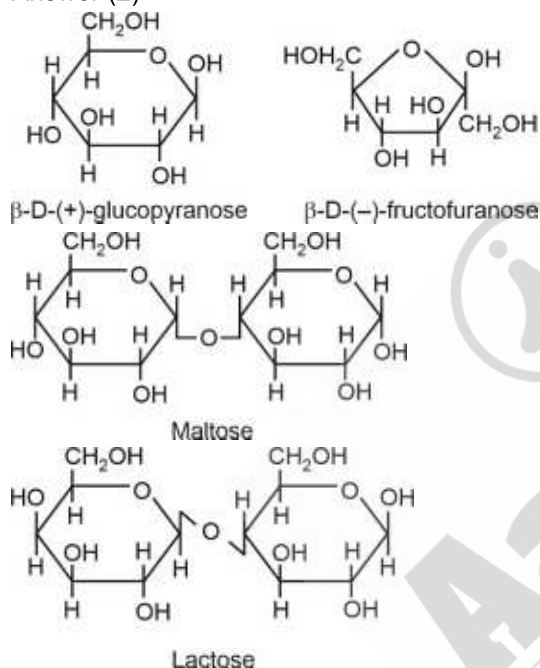
Since, applied force (10 N) is less than the $F_{s \max}$

Therefore $F_s = 10 \text{ N}$

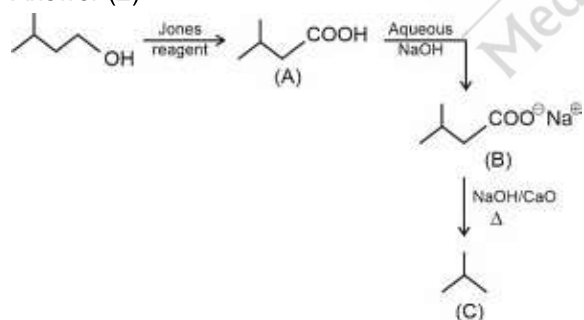
CHEMISTRY

SECTION-A

151. Answer (2)



152. Answer (2)



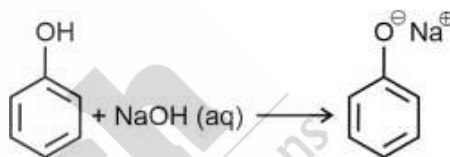
153. Answer (2)

With increase in number of branched chains, the molecule attains the shape of a sphere. This results in smaller area of contact and therefore weak intermolecular forces between spherical molecules, which are overcome at relatively lower temperatures.

154. Answer (4)

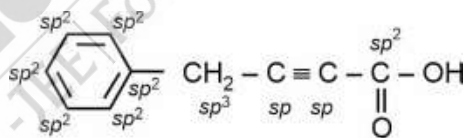
More stable is alkene, lesser is the energy released on hydrogenation.

155. Answer (2)

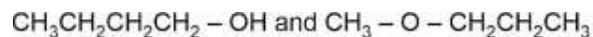
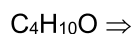


Sodium phenoxide is formed which is easily solvated in aqueous medium.

156. Answer (2)

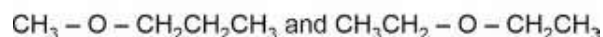


157. Answer (3)



Butanol Methoxy propane

Functional group isomers

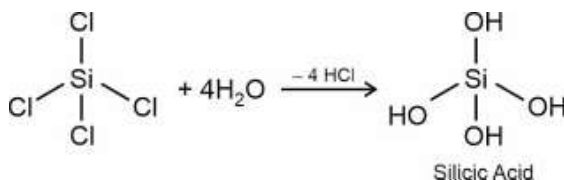


Methoxy propane Ethoxyethane

Metamers

158. Answer (2)

Halides of Ge are more stable in its +4 oxidation state. Hence, GeX_4 is more stable than GeX_2 .



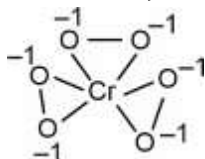
159. Answer (4)

Species in intermediate oxidation state can undergo disproportionation.



160. Answer (4)

CrO_6 has 3 peroxide linkages



Oxidation state of Cr \Rightarrow +6

161. Answer (2)

$4l + 2$ gives us the maximum number of electrons in a subshell of an atom e.g. for $3d$ subshell, $l = 2$

Maximum number of electrons in $3d$ subshell

$$= 4l + 2$$

$$= 4 \times 2 + 2$$

$$= 10$$

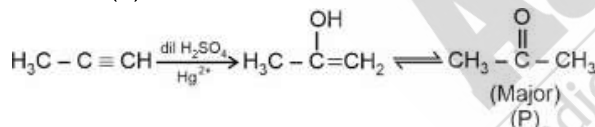
162. Answer (4)

When 3 parts of conc. HCl and 1 part of conc. HNO_3 are mixed, aqua regia is formed.

163. Answer (2)

Bleaching effect of chlorine is permanent, chlorine water on standing forms HCl and HOCl .

164. Answer (4)



165. Answer (4)

Cannizzaro reaction is an example of disproportionation redox reaction. During Cannizzaro reaction aldehyde converts to corresponding alcohol and carboxylic acid salt.

166. Answer (4)

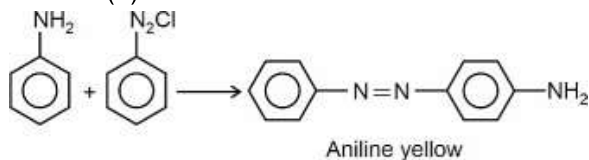
For elementary reaction

$$r \propto [\text{reactant}]^n$$

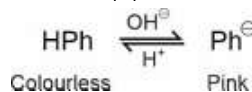
(where n is stoichiometric coefficient)

$$r = k[A][B]^2$$

167. Answer (2)



168. Answer (4)



169. Answer (1)

Colour absorbed in the visible region corresponds to the complementary colour of the light absorbed.

170. Answer (1)

When heat is added to the system, molecular motion increases.

\therefore Randomness of the system increases.

171. Answer (1)

$$\text{P} (Z = 15) \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^3$$

$$\text{As} (Z = 33) \rightarrow [\text{Ar}] 3d^{10} 4s^2 4p^3$$

$$\text{Group number} = 15^{\text{th}}$$

172. Answer (2)

Elements	Blocks
K(Z = 19)	s
Rh(Z = 45)	d
Nd(Z = 60)	f
Ge(Z = 32)	p

173. Answer (3)

Cations like K^+ , Na^+ , Ca^{2+} etc. and anions like

Cl^- , Br^- , NO_3^- etc. simply get hydrated not hydrolyse

\Rightarrow pH of salt of strong acid and strong base is equal to 7 at 298 K

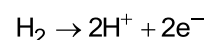
174. Answer (2)

pH of salt of weak acid with weak base, eg. $\text{CH}_3\text{COONH}_4$ is given as

$$\text{pH} = \frac{1}{2} [\text{p}K_w + \text{p}K_a - \text{p}K_b]$$

No concentration term is involved during hydrolysis of salt of weak acid with weak base, so pH does not depend on concentration.

175. Answer (2)



$$E_{\text{H}_2/\text{H}^+} = E_{\text{H}_2/\text{H}^+}^0 - \frac{0.0591}{2} \log \frac{[\text{H}^+]^2}{(\text{P}_{\text{H}_2})}$$

$$E_{\text{H}_2/\text{H}^+} = 0 - \frac{0.0591}{2} \log \frac{(10^{-1})^2}{10^{-2}}$$

$$E_{\text{H}_2/\text{H}^+} = 0$$

176. Answer (2)

Energy of resonance hybrid is less than canonical structures.

177. Answer (1)

$$\text{Bond order} = \frac{1}{2}(N_b - N_a) = \frac{1}{2}(8 - 4) = 2$$

178. Answer (3)

$$\pi = 2.5 \times 10^{-3} \text{ bar}$$

$$V = 250 \text{ cm}^3 = 0.25 \text{ L}$$

$$T = 300 \text{ K}$$

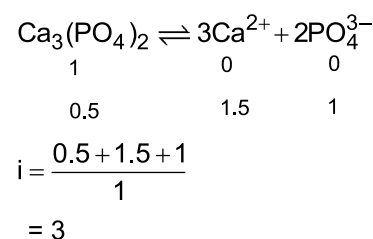
$$R = 0.083 \text{ L bar mol}^{-1} \text{ K}^{-1}$$

$$\pi = CRT$$

$$\pi = \frac{wRT}{MV}$$

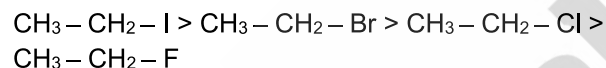
$$M = \frac{w \times RT}{\pi V} = \frac{1.5 \times 0.083 \times 300}{2.5 \times 0.25 \times 10^{-3}} = 59760 \text{ g mol}^{-1}$$

179. Answer (3)



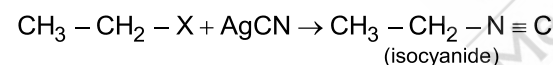
180. Answer (2)

The correct order of rate of reactivity for dehydrohalogenation is:

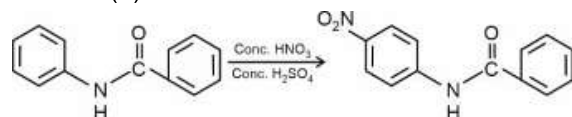


181. Answer (1)

KCN is ionic compound while AgCN is covalent compound.



182. Answer (2)



183. Answer (2)

$$\text{Let O.S. of Cr} = x$$

$$+1 + x + 2(-2) = 0$$

$$x = +3$$

$$\therefore \text{Primary valency of Cr} = 3$$

$$\text{C.N of Cr is 6, hence secondary valency is 6.}$$

184. Answer (3)

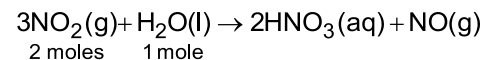
22.4 L of SO_2 at STP contains 6.023×10^{23} SO_2 molecules.

5.6 L of SO_2 at STP contains $\frac{6.023 \times 10^{23}}{4}$ SO_2 molecules.

\therefore Total number of atoms

$$= \frac{6.023 \times 10^{23}}{4} \times 3 \cong 4.5 \times 10^{23}$$

185. Answer (4)



1 mole of H_2O requires 3 moles of NO_2 , which means NO_2 is a limiting reagent.

$$\begin{aligned} \text{Moles of } \text{H}_2\text{O}(\text{l}) \text{ left} &= 1 - 0.66 \\ &= 0.33 \end{aligned}$$

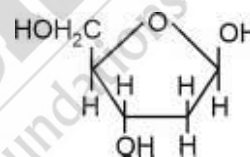
$$\text{Moles of } \text{HNO}_3 \text{ formed} = 1.33 \text{ moles}$$

$$\text{Moles of } \text{NO} \text{ formed} = 0.66 \text{ moles}$$

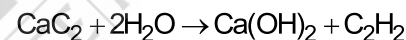
SECTION-B

186. Answer (1)

Sugar moiety present in DNA is β -D-2-deoxyribose.



187. Answer (4)



188. Answer (3)

Compounds

pK_a

	1.02
	3.43
	4.20

189. Answer (4)

$$2\pi r = n\lambda$$

$$\text{Number of waves} = \frac{2\pi r}{\lambda} \quad \dots(i)$$

$$\lambda = \frac{h}{mv} \quad \dots(ii)$$

$$\text{Number of waves} = \frac{2\pi r}{h} (mv) = \frac{2\pi r \cdot mv}{h}$$

Angular momentum of Bohr's 3rd orbit is

$$mvr = \frac{3h}{2\pi}$$

$$\text{Number of waves} = \frac{2\pi \times 3h}{h \times 2\pi} = 3$$

190. Answer (1)

Noble gases have weak dispersion forces and low boiling points.

Helium has the lowest boiling point (4.2 K) of any known substance.

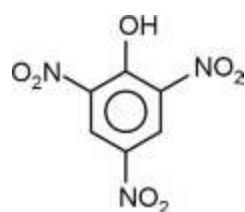
191. Answer (2)

$$t_{75\%} = 2t_{1/2}$$

$$t_{1/2} = \frac{30}{2} = 15 \text{ min}$$

$$t_{87.5\%} = 3t_{1/2} = 3 \times 15 = 45 \text{ min}$$

192. Answer (1)

Acids with acidic strength more than H_2CO_3 willgive CO_2 with NaHCO_3 .

are stronger acids than

 NaHCO_3 .

193. Answer (1)

Actinoid contraction is greater than lanthanoid contraction due to poor shielding of 5f orbitals than 4f orbitals.

194. Answer (3)

$$\Delta G = \Delta H - T\Delta S$$

$$\Delta H = ?$$

$$\Delta H = \Delta U + p\Delta V$$

$$= \Delta U + \Delta n_g RT$$

$$= 1.5 \text{ k cal} + (2)(2 \times 10^{-3})(300)$$

$$= 1.5 + 4 \times 10^{-3} \times 300$$

$$= 1.5 + 1200 \times 10^{-3}$$

$$= 1.5 + 1.2 = 2.7 \text{ kcal}$$

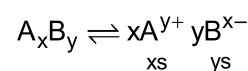
$$\Delta G = \Delta H - T\Delta S$$

$$= 2.7 - 300(18 \times 10^{-3})$$

$$= 2.7 - 5.4$$

$$\Delta G = -2.7 \text{ kcal}$$

195. Answer (3)

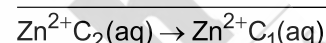
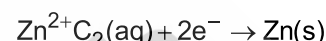
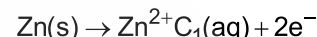


$$\therefore K_{sp} = [A^{y+}]^x [B^{x-}]^y$$

$$= (xs)^x (ys)^y$$

$$= x^x y^y s^{(x+y)}$$

196. Answer (2)



$$E_{\text{cell}} = 0 - \frac{0.0591}{2} \log \left(\frac{C_1}{C_2} \right)$$

$$E_{\text{cell}} = + \frac{0.0591}{2} \log \left(\frac{C_2}{C_1} \right)$$

$$E_{\text{cell}} = + \frac{0.0591}{2} \log \frac{0.1}{0.01}$$

$$= \frac{0.0591}{2} \log 10$$

$$E_{\text{cell}} = + \frac{0.0591}{2} = +ve$$

$$E_{\text{cell}} > 0, \text{ when } C_2 > C_1$$

197. Answer (1)

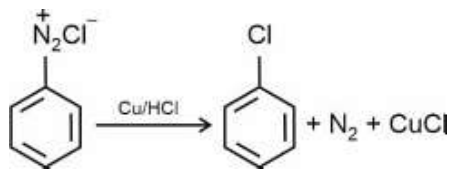
Formal charge helps in selection of lowest energy structure having the smallest formal charges on the atoms.

198. Answer (3)

Complex ion	Number of unpaired electrons
$[\text{CoF}_6]^{3-}$	4
$[\text{Ni}(\text{CO})_4]$	Zero
$[\text{FeF}_6]^{3-}$	5
$[\text{NiCl}_4]^{2-}$	2

199. Answer (3)

Gattermann reaction :



200. Answer (3)

Partition chromatography is based on continuous differential partitioning of components of a mixture between stationary and mobile phases. Paper chromatography is a type of partition chromatography.

☐ ☐ ☐


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