



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-4

Time : 3 Hrs. 20 Min.

Answers

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



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Answers & Solutions

PHYSICS

SECTION-A

1. Answer (1)

$$V = \sqrt{\frac{T}{\mu}}$$

$$\frac{\Delta V}{V} \times 100 = \frac{1}{2} \frac{\Delta T}{T} \times 100 \\ = 0.5\%$$

2. Answer (2)

$$y = 10 \sin\left(2\pi t + \frac{\pi}{6}\right)$$

$$t = 0$$

$$y = 10 \sin\left(\frac{\pi}{6}\right) = 10 \times \frac{1}{2} = 5 \text{ m}$$

3. Answer (4)

The dielectric constant k of a conductor is ∞

4. Answer (3)

$$W = q\Delta V$$

$$\frac{4}{10} = \Delta V$$

$$\Delta V = 0.4 \text{ volt}$$

5. Answer (2)

Weight = Thrust (in floating condition)

$$mg = \rho_{\text{air}} \times V_{\text{in}} \times g$$

$$= 1000 \times [5 \times 4 \times 0.003]$$

$$m = 60 \text{ kg}$$

6. Answer (2)

$$\text{As } \frac{\Delta L}{L} = 0.20\% = 0.002$$

$$\text{And } \Delta T = 100^\circ\text{C}, \frac{\Delta L}{L} = \alpha \Delta T$$

$$\alpha = \frac{0.002}{100} = 2 \times 10^{-5}/^\circ\text{C}$$

$$\gamma = 3\alpha = 6 \times 10^{-5}/^\circ\text{C}$$

$$\frac{\Delta V}{V} = \gamma \Delta T$$

$$= 6 \times 10^{-5} \times 100$$

$$= 6 \times 10^{-3}$$

$$= 0.6\%$$

7. Answer (4)

Molecules of a diatomic gas (like H₂, N₂ O₂, etc.) possess 5 degrees of freedom 3 translational and 2 rotational.

8. Answer (1)

$$PV = nRT$$

$$PV = \frac{m}{M} RT$$

$$\frac{m}{V} = \rho = \frac{PM}{RT}$$

$$\rho = \frac{PM}{RT}$$

$$\boxed{\rho \propto \frac{1}{T}}$$

9. Answer (3)

$$K = 10^3$$

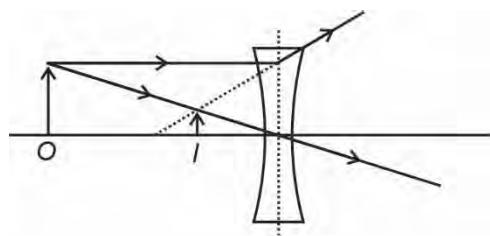
$$\Rightarrow \frac{2\pi}{\lambda} = 10^3$$

$$\Rightarrow \lambda = \frac{2\pi}{10^3}$$

$$\Rightarrow \lambda = 6.28 \times 10^{-3} \\ = 0.63 \text{ cm}$$

10. Answer (4)

The condition mentioned in the question is only possible for concave lens as shown below



11. Answer (3)

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

$$\text{Now, } \beta' = \frac{\lambda'D'}{d'} = \frac{2\lambda D}{\left(\frac{d}{2}\right)} = \frac{4\lambda D}{d} = 4\beta$$

12. Answer (3)

Use $v = f\lambda$

$$\mu = \frac{c}{v} = \frac{\lambda_1}{\lambda_2} = \frac{4000}{2000}$$

$$\Rightarrow \sin c = \frac{1}{\mu} = \frac{1}{2}$$

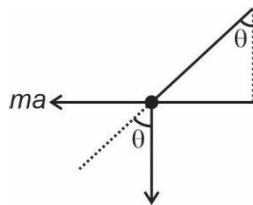
$$C = 30^\circ$$

13. Answer (1)

$$P = \frac{mgh}{t} = \frac{200 \times 10 \times 60}{5 \times 60} = 400 \text{ W}$$

14. Answer (3)

Equilibrium angle:



$$\tan \theta = \frac{ma}{mg} = \frac{1}{2}$$

$$\theta = \tan^{-1}\left(\frac{1}{2}\right)$$

Maximum angle:

$$\theta_m = 2\theta = 2\tan^{-1}\left(\frac{1}{2}\right)$$

15. Answer (2)

As current is decreasing in A, then magnetic flux through B will also decrease so to oppose the change, the loop B will move towards A.

16. Answer (4)

Current in capacitor leads the voltage by $\frac{\pi}{2}$ and

current in inductor lags behind the voltage by $\frac{\pi}{2}$.

$$\text{Total phase difference} = \frac{\pi}{2} + \frac{\pi}{2} = \pi \text{ radian} = 180^\circ$$

17. Answer (2)

$$\vec{p}_i = m\sqrt{2gH}(-\hat{j}) \text{ and } \vec{p}_f = m\sqrt{\frac{2gH}{2}}(\hat{j})$$

$$\vec{\Delta p} = m \times \sqrt{2g} \left[\sqrt{\frac{H}{2}} + \sqrt{H} \right] \hat{j}$$

$$|\vec{\Delta p}| = m\sqrt{2gH} \left[\frac{\sqrt{2}+1}{\sqrt{2}} \right] = (\sqrt{2}+1)m\sqrt{gH}$$

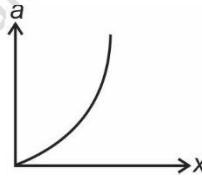
18. Answer (4)

At the highest point, only the horizontal component of the initial velocity will exist.

$$\Rightarrow u_x = 30\cos 60^\circ = 15 \text{ m s}^{-1}$$

19. Answer (2)

$a = 2x^2$ represents parabolic variation and the parabolic variation will be symmetric about acceleration axis.



20. Answer (3)

$$\text{We know that, } S_n = u + \frac{1}{2}a(2n-1)$$

$$\Rightarrow S_n = \frac{a}{2}(2n-1) \text{ as } u = 0$$

$$(S_n)_{\text{at } t=4} = \frac{3}{10} \times 7 = 2.1 \text{ m}$$

21. Answer (2)

$$\text{We know that, } K = \frac{3}{2}PV \Rightarrow \frac{K}{V} = \frac{3P}{2} \Rightarrow \frac{K}{V} \propto P$$

As pressure of gas is tripled, hence kinetic energy per unit volume of gas will also be tripled.

22. Answer (2)

$$n = \frac{P}{E} = \frac{P}{h\nu} = \frac{5 \times 10^{-3}}{6.6 \times 10^{-34} \times 8 \times 10^{15}}$$

$$n = \frac{5}{52.8} \times 10^{16} = 9.5 \times 10^{14}$$

23. Answer (4)

$$R = R_0(A)^{1/3}$$

$$4.8 = (1.2)(A)^{1/3}$$

$$(A)^{1/3} = 4$$

$$A = (4)^3 = 64$$

24. Answer (1)

$$\sigma = e(n_e\mu_e + n_h\mu_h)$$

$$= en_i(\mu_e + \mu_h)$$

$$= 1.6 \times 10^{-19} \times 5.4 \times 10^{19} \times (0.72 + 0.24)$$

$$= 8.3 \text{ S m}^{-1}$$

25. Answer (3)

A diode is said to be forward biased if *p*-type semiconductor of *p-n* junction is at high potential with respect to *n*-type semiconductor of *p-n* junction

26. Answer (1)

We know,

$$\omega = \omega_0 + \alpha t$$

$$\omega = 10 + 2(4)$$

$$\omega = 18 \text{ rad/s}$$

27. Answer (4)

$$\text{K.E. for escape } K = \frac{1}{2}mv_e^2 = \frac{1}{2}m(2gR)$$

$$K = mgR$$

28. Answer (3)

$$Y = \frac{F\ell}{Ax}$$

$$Y = \frac{(1000)(40)}{2 \times 10^{-4} \times 10 \times 10^{-2}}$$

$$Y = 2 \times 10^9 \text{ N/m}^2 = 2 \text{ GPa}$$

29. Answer (3)

Angular momentum of a particle about a point is given by

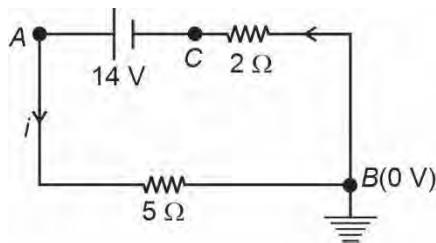
$$L = mr_{\perp}v$$

Hence for a particle moving with constant velocity, angular momentum remains constant. Also, angular momentum depends on the point of observation.

30. Answer (2)

With increase in temperature the relaxation time in conductors decrease.

31. Answer (2)



$$i = \frac{V}{R} = \frac{14}{5+2} = 2 \text{ A}$$

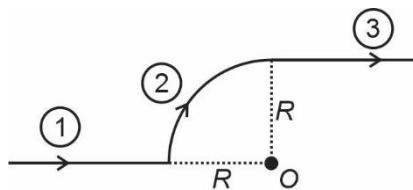
$$V_B - V_C = iR \Rightarrow 0 - V_C = 2 \times 2$$

$$V_C = -4 \text{ V}$$

32. Answer (4)

Wb/m^2 is the unit of magnetic field and hence it is equal to tesla.

33. Answer (3)



$$B_1 = 0, B_2 = \frac{\mu_0 i}{2R} \times \frac{1}{4} \otimes, B_3 = \frac{\mu_0 i}{2\pi R} \times \frac{1}{2} \otimes$$

$$\therefore B_{\text{net}} = \frac{\mu_0 i}{8R} + \frac{\mu_0 i}{4\pi R} = \frac{\mu_0 i}{4R} \left(\frac{1}{2} + \frac{1}{\pi} \right)$$

34. Answer (1)

A superconductor exhibits perfect diamagnetism.

35. Answer (4)

If a number contains decimal point, then all zeros after any non-zero digit are taken as significant.

SECTION-B

36. Answer (4)

Jump to first orbit leads to Lyman series. When an electron jumps from 3rd orbit to 1st orbit, it will give rise to second line of Lyman series.

37. Answer (3)

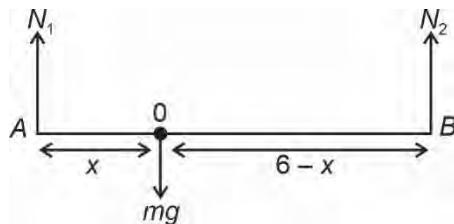
Speed of light in vacuum is given by

$$c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$$

$$\therefore \sqrt{\mu_0 \epsilon_0} = \frac{1}{c}$$

$$\text{Hence, } [\sqrt{\mu_0 \epsilon_0}] = [L^{-1} T]$$

38. Answer (3)



From the FBD of plank,

Taking torques about mg :

$$x(N_1) = (6 - x)N_2$$

$$x(3N) = (6 - x)N \quad [:: N_2 = 3N_1]$$

$$3x = 6 - x$$

$$4x = 6$$

$$\therefore x = 1.5 \text{ m}$$

Or, 4.5 m from knife 2

39. Answer (1)

We know,

$$(P.E. + K.E.)_i = (P.E. + K.E.)_f$$

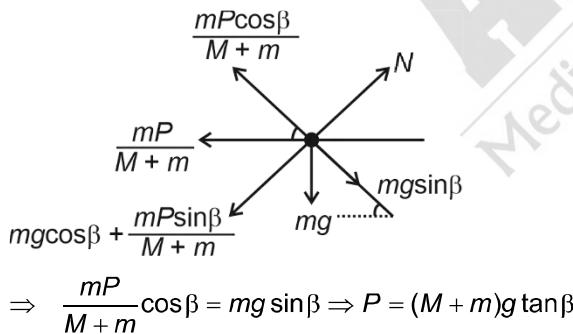
$$\frac{G(4)(6)}{100} + 0 = -\frac{G(4)(6)}{10} + \frac{1}{2}(4)v^2$$

$$\frac{24G}{100} + \frac{240}{100}G = 2v^2$$

$$v = \sqrt{\frac{108}{100}G} = \frac{3\sqrt{3}G}{5}$$

40. Answer (4)

Observing the block of mass m w.r.t. to frame of wedge:



$$\Rightarrow \frac{mP}{M+m}\cos\beta = mg\sin\beta \Rightarrow P = (M+m)g\tan\beta$$

41. Answer (4)

In purely inductive circuit, voltage leads current by

$$\frac{\pi}{2}.$$

42. Answer (2)

For t_1 to t_2

$$E_0 = -A\sqrt{3}$$

For t_2 to t_3

$$E'_0 = \frac{A}{\sqrt{3}} = \frac{E_0}{3}$$

43. Answer (4)

$$m_T = m_0 \times m_e$$

$$m_T = m_0 \times \left(1 + \frac{D}{f_e}\right)$$

$$\Rightarrow 120 = 20 \times \left(1 + \frac{D}{f_e}\right)$$

$$\Rightarrow 6 = 1 + \frac{25}{f_e} \Rightarrow 5 = \frac{25}{f_e}$$

$$\Rightarrow f_e = 5 \text{ cm}$$

44. Answer (2)

$$d\sin\theta = n\lambda$$

For 1st minima, $n = 1$

$$\sin\theta = \frac{\lambda}{d}$$

$$\Rightarrow \frac{1}{2} = \frac{5 \times 10^{-7}}{d}$$

$$\Rightarrow d = 10^{-6}$$

$$d = 1 \mu\text{m}$$

45. Answer (1)

$$\Delta P = \frac{Mg}{A} = \frac{8 \times 10^5}{400}$$

$$= 0.02 \times 10^5$$

$$= 2 \times 10^3 \text{ Pa}$$

$$= 2 \text{ kPa}$$

46. Answer (2)

$$n_1 C_{V_1} \Delta T_1 = n_2 C_{V_2} \Delta T_2$$

$$\frac{28}{28} \times \frac{5R}{2} \times (\theta - 27) = \frac{32}{32} \times \frac{5R}{2} \times (57 - \theta)$$

$$2\theta = 57 + 27$$

$$\theta = \frac{84}{2} = 42^\circ\text{C}$$

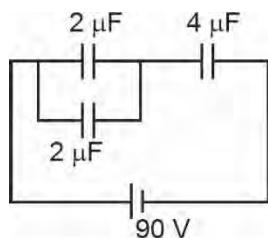
47. Answer (3)

$$\phi = \vec{E} \cdot \vec{A}$$

$$= (2\hat{i} + 3\hat{j} + \hat{k}) \cdot \pi R^2 \hat{i}$$

$$= 2\pi R^2$$

48. Answer (1)



$$q = C_{eq} \times V$$

$$= 180 \mu\text{C}$$

$$U = \frac{1}{2} \frac{q^2}{C}$$

$$= \frac{1}{2} \times \frac{180 \times 180}{4} = 45 \times 90$$

$$= 4050 \mu\text{J}$$

49. Answer (3)

According to maximum power transfer theorem
internal resistance = load resistance

$$\therefore \frac{\left(R + \frac{3}{2}\right) \times 5}{\left(R + \frac{3}{2}\right) + 5} = 4 \Rightarrow 5R + \frac{15}{2} = 4R + \frac{13}{2} \times 4$$

$$R = 26 - \frac{15}{2} = \frac{37}{2} \Omega$$

50. Answer (3)

Suppose an electron enters the depletion layer with speed v_1 and p -region with speed v_2

By energy conservation

$$\frac{1}{2}mv_2^2 + eV = \frac{1}{2}mv_1^2$$

$$\frac{1}{2}mv_2^2 = \frac{1}{2}mv_1^2 - eV$$

$$\frac{1}{2}mv_2^2 = \frac{1}{2} \times 9.1 \times 10^{-31} \times (8 \times 10^5)^2 - 1.6 \times 10^{-19} \times 0.6 \\ = (2.91 - 0.96) \times 10^{-19} = 1.95 \times 10^{-19}$$

$$v_2^2 = \frac{2 \times 1.95 \times 10^{-19}}{9.1 \times 10^{-31}} = 42.86 \times 10^{10}$$

$$v_2 = 6.5 \times 10^5 \text{ m/s}$$

BOTANY

SECTION-A

51. Answer (2)

The average rate of polymerization in *E.coli* is 2000 bp per second. For long DNA molecules, since the two strands of DNA cannot be separated in its entire length (due to very high energy requirement) the replication occur within a small opening of the DNA helix. DNA polymerase on their own cannot initiate the process of replication. Deoxyribonucleoside triphosphates provide energy for polymerisation reaction.

52. Answer (4)

Sequence annotation is the blind approach of simply sequencing the whole set of genome that contained all the coding and non-coding sequence, and later assigning different regions in the sequence with functions.

53. Answer (4)

Cistron is a segment of DNA coding for a polypeptide.

54. Answer (1)

The negatively charged DNA is wrapped around the positively charged histone octamer to form a structure called nucleosome. The nucleosomes in chromatin are seen as 'beads-on-string' structure. Nucleosomes constitute the repeating unit of a structure in nucleus called chromatin.

55. Answer (1)

RuBisCO is a bifunctional enzyme as it shows both carboxylase and oxygenase activity.

56. Answer (2)

Calvin pathway occurs in all photosynthetic plants.

57. Answer (2)

In grasses, some cells at the adaxial epidermis along the veins modify themselves into large, empty and colourless cells called bulliform cells.

58. Answer (1)

Cork cambium (phellogen) is a couple of layer thick secondary meristematic tissue. Phellogen cuts off cells on both sides. The outer cells differentiate into phellem (cork) while the inner, cells differentiate into secondary cortex or phelloderm.

59. Answer (3)

Auxins were first isolated from human urine.

60. Answer (3)

Vallisneria, *Hydrilla* and *Zostera* are some examples of water pollinated plants.

61. Answer (1)

Aleurone layer is triploid, nucellus is diploid, antipodal cells are haploid and tapetal cells are polyploid.

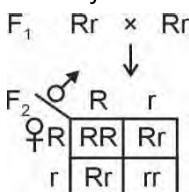
62. Answer (3)

Robert May scientifically estimate the global species diversity at about 7 million.

According to IUCN, the total number of plant and animal species described so far is slightly more than 1.5 million.

63. Answer (2)

Monohybrid cross in *Antirrhinum*



Progenies with genotype Rr and rr have at least one recessive allele so the probability will be $\frac{3}{4}$.

64. Answer (4)

Down's syndrome is developed due to trisomy of chromosome number 21. Trisomic condition arises due to formation of n + 1 male or female gamete by non-disjunction.

65. Answer (2)

Dominance is not an autonomous feature of a gene or the product that it has information for.

Dominant genes do not stop the activity of mutant genes.

66. Answer (1)

Wildlife sanctuaries are *in-situ* conservation strategy of organisms.

67. Answer (3)

Pyruvate enters mitochondrial matrix undergoes oxidative decarboxylation by a complex set of reactions catalysed by pyruvate dehydrogenase.

68. Answer (2)

Flower shape was not considered by Mendel in Pea plant for his experiment.

69. Answer (4)

Endoplasmic reticulum plays a role in the origin of plasmodesmata.

70. Answer (2)

Acidic conditions are maintained inside the lysosomes by pumping of H⁺ ions into them.

71. Answer (4)

Mesophyll cells are round and oval in shape.

72. Answer (3)

In S-phase DNA duplication occurs but the number of chromosomes remains the same. So, 40 will be the chromosome number and 40 pg will be the amount of DNA in G₂ Phase.

73. Answer (4)

Interphase is also called resting phase. Interphase is a phase between two successive M phases.

74. Answer (3)

In the 24 hour average duration of cell cycle of a human cell, cell division proper lasts for only about an hour.

75. Answer (3)

Cytotaxonomy is based on cytological information. Chemotaxonomy uses chemical constituents of the plant for classification.

76. Answer (4)

Fusion between one large, non-motile (static) female gamete and a smaller, motile male gamete is termed oogamous, e.g., *Volvox*, *Fucus*.

77. Answer (4)

Lactobacillus produces lactic acid during curd formation. Curd is more nutritious than milk as it contains a number of vitamins especially B₁₂.

78. Answer (3)

Euryhaline are organisms which tolerate a wide range of salinities. e.g. salmon.

79. Answer (1)

Only 10% of the total energy is actually available to the next trophic level. It is called 10% law of energy transfer. This law was given by Lindeman in 1942.

80. Answer (3)

Families have a group of related genera and this grouping is on the basis of both vegetative and reproductive features of plant species. With increase in taxonomic hierarchy i.e., from species to kingdom the number of common characteristics decreases.

81. Answer (4)

Two kingdom classification system does not distinguish between—(i) Unicellular and multicellular organisms, (ii) Eukaryotes and prokaryotes and (iii) Photosynthetic and non-photosynthetic organisms.

82. Answer (3)

Chlorobium is photolithotroph that uses H₂S as electron and proton donor.

83. Answer (3)

Stilt roots and prop roots both are modified adventitious roots which provide mechanical support to the plant.

84. Answer (4)

In maize seed, aleurone layer is a proteinaceous layer that covers the endosperm and separates the embryo from endosperm.

85. Answer (2)

The floral formula $\oplus \text{♀} K_{(5)} C_{(5)} A_5 G_{(2)}$ is of Solanaceae. This family includes tomato, potato, brinjal etc.

SECTION-B

86. Answer (2)

During DNA replication, the discontinuously synthesized fragments of DNA strands are later joined by the enzyme DNA ligase.

87. Answer (1)

Genetic codes are unambiguous, degenerate, non-overlapping and nearly universal.

88. Answer (3)

- Trichomes may be multicellular or unicellular but usually multicellular.
- Guard cells regulate the opening and closing of stomata.
- Walls of guard cells away from the stomatal pore are thin and walls towards the stomatal pore are highly thickened.

89. Answer (2)

Auxin shows apical dominance by inhibiting the growth of lateral buds. Cytokinin inhibits apical dominance, showing antagonistic effect.

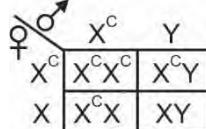
90. Answer (1)

Central cell becomes primary endosperm cell after triple fusion which develops into endosperm.

In double fertilisation, one male gamete fuses with egg cell and other male gamete moves towards the two polar nuclei present in the central cell and fuses with them.

91. Answer (2)

According to the question, the cross can be represented as follows:



$X^c X^c$ – Affected female

$X^c X$ – Carrier female

$X^c Y$ – Affected male

XY – Normal male

Therefore, probability of their children to be affected with this disorder is 50%.

92. Answer (4)

In one Krebs cycle, two decarboxylation reactions will occur.

93. Answer (2)

Peroxisomes are quite common in photosynthetic cells where these perform photorespiration. For this, they are associated with chloroplast and mitochondria.

94. Answer (3)

When the cell prepares itself for division it grows and duplicates its genetic material.

95. Answer (4)

Floridean starch is the stored food of red algae and *Porphyra* is a red alga.

96. Answer (4)

Equation $\frac{dN}{dt} = rN$ describes geometric growth resulting in a J-shaped curve. Logistic growth is represented by a sigmoid curve.

97. Answer (3)

The entire sequence of communities that successively change in a given area are called sere.

Xerarch succession takes place in dry areas and saline conditions.

98. Answer (4)

Secondary treatment is also called biological treatment because it involves microbial digestion of the organic matter.

99. Answer (2)

There are four major groups of protozoans:

Amoeboid – There is presence of silica shells in some forms.

Flagellated – *Trypanosoma* causes sleeping sickness.

Ciliated – Freshwater or marine, few parasites.

Sporozoans – *Plasmodium* (malaria parasite).

100. Answer (3)

In some plants such as bean, gram and pea, the endosperm is not present in mature seeds and such seeds are called non-endospermic seeds.

ZOOLOGY

SECTION-A

101. Answer (4)

Crocodilus belongs to the class Reptilia and is a poikilothermic animal. *Ornithorhynchus* belongs to the class Mammalia and is a homeothermic animal.

102. Answer (3)

The bone, blood and cartilage are the types of specialised connective tissue. Cartilage is present in the tip of nose and the intercellular material of cartilage is solid and pliable and resists compression.

103. Answer (4)

A rapid decline in death rate, maternal mortality rate and infant mortality rate as well as an increase in number of people in reproducible age are probable reasons for increased growth rate of population.

104. Answer (2)

DNA ligases are called molecular glue because they act on cut DNA molecules and join their ends.

105. Answer (3)

- Computed tomography uses X-rays to generate a three dimensional image of the internals of an object which is useful in detection of cancers.
- The malignant tumors are mass of proliferating cells called neoplastic or tumor cells. As these cells actively divide and grow, they also starve the normal cells by competing for vital nutrients.
- The chemical carcinogens present in tobacco smoke have been identified as a major cause of lung cancer.
- Several genes called cellular oncogenes (*c-onc*) or protooncogenes have been identified in normal cells which when activated under certain conditions, could lead to oncogenic transformation of the cells.

106. Answer (1)

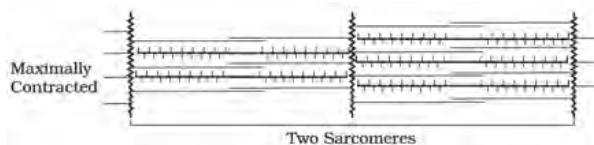
- | | |
|------------------------|---|
| Arachidonic acid | - 20 carbon fatty acid |
| RuBisCO | - Most abundant protein in whole of the biosphere |
| N-acetyl galactosamine | - Amino sugar |
| Cellulose | - Homopolymer of glucose |

107. Answer (2)

- The exaggerated response of the immune system to certain antigens present in the environment is called allergy.
- Lymphoid tissue located within the lining of the major tracts (respiratory, digestive and urogenital tracts) is called Mucosa-Associated Lymphoid Tissue (MALT). It constitutes about 50 per cent of the lymphoid tissue in human body.
- AIDS is caused by the Human Immuno Deficiency Virus (HIV), a member of a group of viruses called retrovirus, which have an envelope enclosing the RNA genome.
- Bone marrow and thymus are primary lymphoid organs.

108. Answer (2)

During muscle contraction, the 'Z' lines attached to actins are pulled inwards, the 'T' bands get reduced, whereas the 'A' bands retain the length.



109. Answer (1)

Neurons are excitable cells because their membranes are in a polarised state.

110. Answer (1)

The secondary structure of B-DNA was explained by Watson and Crick. Each strand appears like a helical staircase. Each step of ascent is represented by a pair of bases. At each step of ascent, the strand turns 36°. The pitch would be 34 Å. The rise per base pair would be 3.4 Å.

111. Answer (2)

DNA polymerases are essential for DNA replication. *Taq* polymerase is used in PCR technique.

112. Answer (4)

Origin of replication is responsible for controlling the copy number of linked DNA. A *tet^R* gene in pBR322 contains the restriction sites for *Bam*H I and *Sa*I.

rop codes for the proteins involved in replication of the plasmid.

113. Answer (2)

Presence of glucose (glycosuria) and ketone bodies (ketonuria) in urine are indicative of diabetes mellitus.

114. Answer (2)

On the basis of their chemical nature, hormones can be divided into groups.

- Peptide, polypeptide, protein hormones (eg., insulin, glucagon, pituitary hormones, hypothalamic hormones etc.)
- Steroids (eg., cortisol, testosterone, estradiol and progesterone)
- Iodothyronines (eg., thyroxine)
- Amino acid derivatives (eg., epinephrine)

115. Answer (1)

The work of Thomas Malthus on populations influenced Darwin. According to him, every population has an inherent capacity to increase its number exponentially if every individual of that population reproduced maximally.

116. Answer (4)

Androgens have anabolic (synthetic) effects on proteins and carbohydrate metabolism. Androgens play a major regulatory role in the process of spermatogenesis (formation of spermatozoa). Androgens act on the central neural system and influence the male sexual behaviour (libido).

117. Answer (3)
Emphysema is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased. One of the major cause of this is cigarette smoking.

118. Answer (3)
The penis is the male external genitalia. It is made up of specialised tissue that helps in erection of the penis to facilitate insemination. Spermiation is release of sperms from the seminiferous tubules.

119. Answer (2)
Planaria is a fresh water, free-living flatworm. Roundworms (eg. *Ascaris*) are pseudocoelomates. *Hirudinaria* shows exoparasitism and is a coelomate.

120. Answer (3)
The vasa efferentia leave the testis and open into epididymis located along the posterior surface of each testis.

121. Answer (4)
The flower tops, leaves and the resin of *Cannabis* plant are used in various combinations to produce marijuana, hashish, charas and ganja.
Generally taken by inhalation and oral ingestion, these are known for their effects on cardiovascular system of the body. Roots of *Cannabis* are not used.

122. Answer (2)
In the blood vascular system of frog, the ventricle opens into a sac-like conus arteriosus on the ventral side of the heart. The blood from the heart is carried to all parts of the body by the arterial system.

123. Answer (4)
Condoms are effective in preventing users from contracting STIs.

124. Answer (1)
In 1997, an American company got patent rights on Basmati rice through the US Patent and Trademark Office.

125. Answer (3)
The correct pathway of gases during expiration is Alveoli → Bronchioles → Bronchi → Larynx → Pharynx

126. Answer (4)
Each spermatogonium is diploid and contains 46 chromosomes. Some of the spermatogonia called primary spermatocytes periodically undergo meiosis. A primary spermatocyte completes the first meiotic division leading to formation of two equal, haploid cells called secondary spermatocytes.

127. Answer (2)
Non-protein constituents called co-factors are bound to the enzyme to make enzyme catalytically active. Three kinds of co-factors can be identified: prosthetic groups, co-enzymes and metal ions. In peroxidase and catalase, which catalyze the breakdown of hydrogen peroxide to water and oxygen, haem is the prosthetic group and it is the part of the active site of the enzyme.

128. Answer (4)
Whales, bats, cheetah and human (all mammals) share similarities in the pattern of bones of forelimbs. Though these forelimbs perform different functions in these animals, they have similar anatomical structure. All of them have humerus, radius, ulna, carpal, metacarpals and phalanges in their forelimbs. Hence, in these animals, the same structure developed along different directions due to adaptations to different needs. This is divergent evolution and these structures are homologous.

129. Answer (4)
Presence of ventral heart is the characteristic feature of all vertebrates without any exception. Cyclostomes do not have paired appendages. Internal and external fertilisation both can be present in chordates. In male chondrichthys, pelvic fins bear claspers.

130. Answer (2)

Hominids	Cranial capacity
<i>Homo habilis</i>	– 650-800 cc
<i>Homo erectus</i>	– 900 cc
Neanderthal man	– 1400 cc

131. Answer (2)
Basmati rice is distinct for its unique aroma and flavour and 27 documented varieties of Basmati are grown in India.

132. Answer (3)
Laccifer and *Locusta* belong to the phylum Arthropoda, *Locusta* is a gregarious pest. *Cucumaria* and *Chaetopleura* belong to the phylum Echinodermata and Mollusca respectively.

133. Answer (3)
For a circular DNA, the number of fragments obtained after restriction enzyme digestion is equal to the number of restriction sites.
As the plasmid has two sites for *EcoRI*, then the number of fragments will be two.

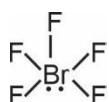
134. Answer (3)
Low temperature preserves the enzyme in a temporarily inactive state whereas high temperature destroys enzymatic activity because proteins are denatured by heat.

135. Answer (4)
Total number of carpals in one limb = 8
Total number of tarsals in one limb = 7

CHEMISTRY

SECTION-A

151. Answer (2)

Hybridisation \rightarrow sp^3d^2 Shape \rightarrow Square pyramidal

152. Answer (3)

Stability \propto bond order $N_2 \rightarrow$ Bond order = 3 $N_2^+ \rightarrow$ Bond order = 2.5 $N_2^- \rightarrow$ Bond order = 2.5 $N_2^{2-} \rightarrow$ Bond order = 2

N_2^+ is more stable than N_2^- because of presence of more antibonding electron in N_2^-

153. Answer (4)

NaCl dissociates into ions, so number of particles in the solution increases so boiling point of 1 molal NaCl is greater than 1 molal urea solution.

154. Answer (2)

$$P^\circ_A = 400 \text{ mm Hg}$$

$$P^\circ_B = 600 \text{ mm Hg}$$

$$P_{\text{total}} = 450 \text{ mm Hg}$$

$$P_{\text{total}} = X_A P^\circ_A + X_B P^\circ_B$$

$$P_{\text{total}} = X_A P^\circ_A + (1 - X_A) P^\circ_B$$

$$450 = X_A \times 400 + (1 - X_A) 600$$

$$450 = 400 X_A + 600 - 600 X_A$$

$$-150 = -200 X_A$$

$$X_A = \frac{150}{200} = \frac{3}{4} = 0.75$$

$$X_B = 1 - 0.75 = 0.25$$

155. Answer (1)

$$Z = 37$$

Electronic configuration = [Kr]5s¹ so it belongs to s-block

156. Answer (1)

 $SO_2 \rightarrow$ Bent shape

 $XeF_4 \rightarrow$ Square planar shape

 $ClF_3 \rightarrow$ T-shape

 $PF_5 \rightarrow$ Trigonal bipyramidal shape

157. Answer (1)

$$\lambda^\circ_{CH_3COOH} = \lambda^\circ_{CH_3COO^-} + \lambda^\circ_{H^+}$$

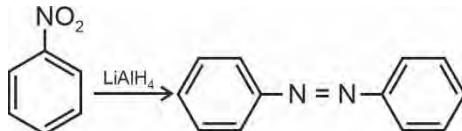
$$= 349.6 + 40.9$$

$$= 390.5 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$$

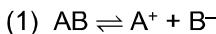
$$\alpha = \frac{\lambda_m^c}{\lambda_m^\circ}$$

$$= \frac{8.54}{390.5} \times 100 = 2.186\%$$

158. Answer (4)



159. Answer (2)



$$K_{sp} = (A^+) (B^-)$$

$$K_{sp} = (s) (s)$$

$$1 \times 10^{-12} = s^2$$

$$s = 1 \times 10^{-6}$$

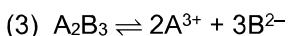


$$K_{sp} = (A^+) (2B^-)^2$$

$$K_{sp} = (s) (2s)^2$$

$$4 \times 10^{-9} = 4s^3$$

$$s = 1 \times 10^{-3}$$



$$K_{sp} = (2A^{3+})^2 (3B^{2-})^3$$

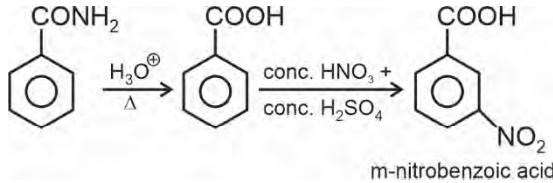
$$K_{sp} = (2s)^2 (3s^2)^3$$

$$1.08 \times 10^{-23} = 108s^5$$

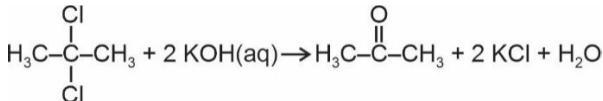
$$s = 1 \times 10^{-5}$$

Maximum solubility is of AB_2

160. Answer (3)



161. Answer (3)

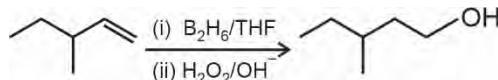


Acetone gives positive haloform test.

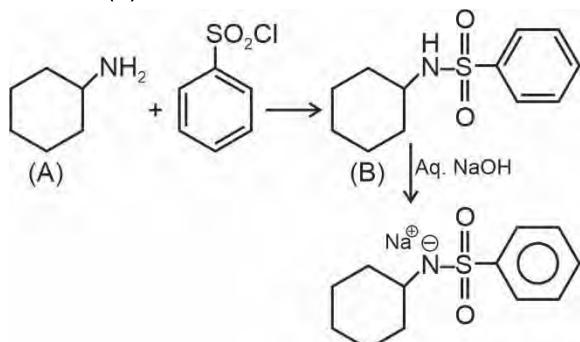
162. Answer (1)

Chemically amylose is a long unbranched chain polymer of α -D-(+)-glucose units.

163. Answer (4)



164. Answer (1)



Because of salt formation (B) is soluble in aqueous alkali.

165. Answer (3)

- cis-But-2-ene is a polar molecule while trans-but-2-ene is non-polar molecule.
- Because of polar nature, boiling point of cis-But-2-ene is more than trans-But-2-ene.

166. Answer (2)

$$50 \times 0.5 = 25 \text{ millimoles of HCl}$$

2 millimoles HCl requires 1 millimole of CaCO_3

25 millimoles HCl requires $\frac{1}{2} \times 25 = 12.5$ mmoles of CaCO_3

$$\text{mole of } \text{CaCO}_3 \text{ required} = \frac{12.5}{1000}$$

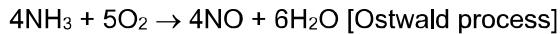
$$= 125 \times 10^{-4} \text{ mol}$$

$$\% \text{ Purity} = \frac{\text{Weight of pure } \text{CaCO}_3}{\text{Weight of impure sample}} \times 100$$

$$40 = \frac{125 \times 10^{-4}}{x} \times 100 \times 100$$

$$x = 3.125 \text{ g}$$

167. Answer (2)



4 moles of NO formed when 5 moles of O_2 is consumed

32 moles of NO requires $\frac{5}{4} \times 32 = 40$ mole O_2 molecule

168. Answer (4)

If addition of sodium nitroprusside in sodium fusion extract gives violet colour then compound contains sulphur.

169. Answer (2)

Alcoholic compounds on reaction with ceric ammonium nitrate gives red colour.

170. Answer (3)

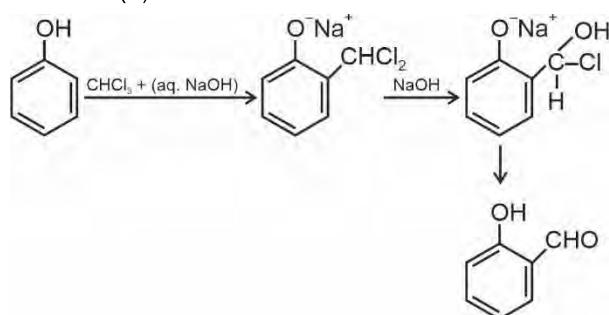


Experimental rate expression is given as

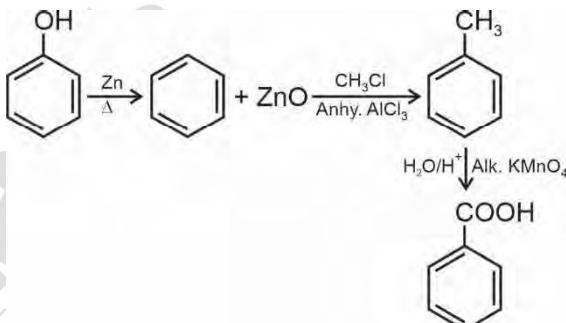
$$\text{Rate} = k[\text{C}_2\text{H}_4]$$

Overall order of reaction = 1

171. Answer (3)



172. Answer (4)



173. Answer (3)

	HF	HCl	HBr	HI
Melting point/K	190	159	185	222

Generally melting point increases down the group, but in the case of HF, it exhibits strong hydrogen bonding and therefore has a higher melting point HBr and HCl.

174. Answer (1)

$\text{H}_4\text{P}_2\text{O}_5 \rightarrow \begin{matrix} \text{HO} & \text{P} & \text{O} & \text{OH} \\ & & \backslash & / \\ \text{OH} & & \text{O} & \text{OH} \end{matrix}$	$4 + 2x - 10 = 0$ $2x = 5$ $x = 3$
$\text{H}_4\text{P}_2\text{O}_6 \rightarrow \begin{matrix} \text{O} & \text{O} \\ \parallel & \parallel \\ \text{HO} & \text{P} & \text{P} & \text{OH} \\ & & \\ \text{OH} & & \text{O} & \text{OH} \end{matrix}$	$4 + 2x - 12 = 0$ $2x = 8$ $x = 4$
$\text{H}_4\text{P}_2\text{O}_7 \rightarrow \begin{matrix} \text{O} & \text{O} \\ \parallel & \parallel \\ \text{HO} & \text{P} & \text{O} & \text{P} & \text{OH} \\ & & & & \\ \text{OH} & & \text{O} & & \text{OH} \end{matrix}$	$4 + 2x - 14 = 0$ $2x = 10$ $x = 5$

175. Answer (4)

188 g AgBr contains 80 g of bromine

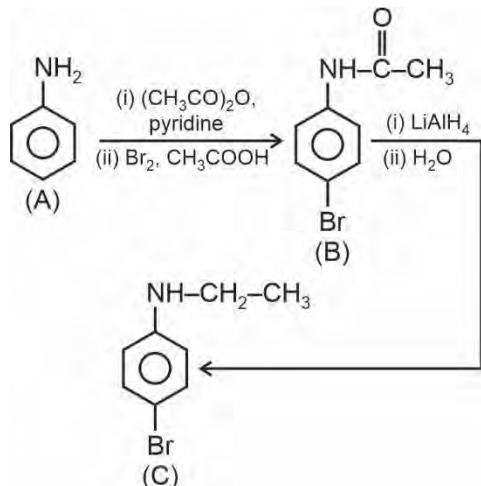
$$0.4 \text{ g AgBr contains } \frac{80 \times 0.4}{188} \text{ g of bromine}$$

$$\text{Percentage of bromine} = \frac{80 \times 0.4 \times 100}{188 \times 0.56} = 30.4\%$$

176. Answer (2)

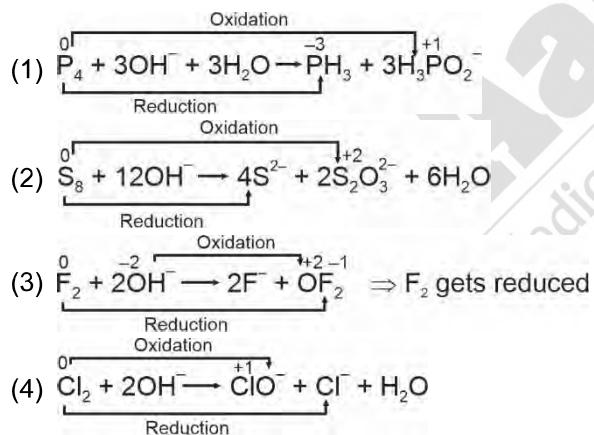
Thin layer chromatography is another type of adsorption chromatography.

177. Answer (1)



178. Answer (3)

In disproportionation reaction same element gets oxidised as well as reduced.



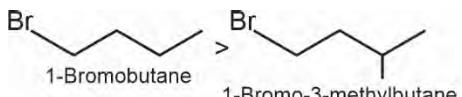
179. Answer (4)

Atomic radius of Ga is less than that of Al due to poor screening effect of 10 d-electrons for the outer electrons.

Element Atomic radius (pm)

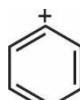
B	88
Al	143
Ga	135
In	167
Tl	170

180. Answer (4)

In S_N2 reaction, the incoming nucleophile attacks less hindered carbon atom easily.Hence, the correct order of S_N2 reaction is:

181. Answer (1)

Phenyl cation is highly unstable, the presence of electron withdrawing group at ortho and para-position increases the reactivity of haloarenes.

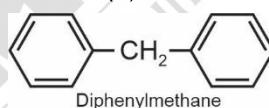


Phenyl cation is not stabilised by resonance.

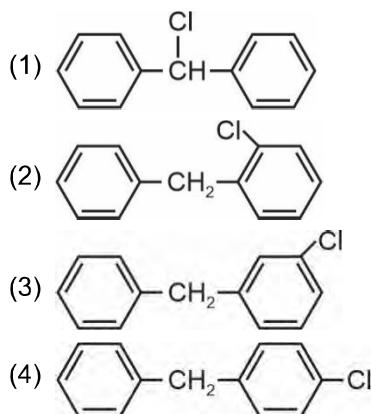
182. Answer (3)

[Co(CN)₆]³⁻, [Co(C₂O₄)₆]³⁻ and [Co(NH₃)₆]³⁺ are d²sp³ hybridised and diamagnetic in nature.While [CoF₆]³⁻ is sp³d² hybridised and paramagnetic in nature.

183. Answer (1)



In diphenylmethane, there are four non-equivalent hydrogen atoms are present. So, total number of structural isomers are 4.



184. Answer (4)

(n + l) value can be 3 and 4

For (n + l) = 3 (3s, 2p)

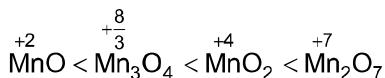
For (n + l) = 4 (4s, 3p)

$$\begin{aligned} \text{Total number of orbitals} &= 3s + 3(2p) + 4s + 3(3p) \\ &= 1 + 3 + 1 + 3 = 8 \end{aligned}$$

185. Answer (2)

When the metal is in its highest oxidation state, its oxide is acidic.

The correct order of acidic strength is:

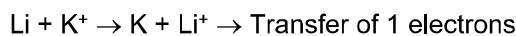
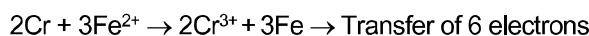
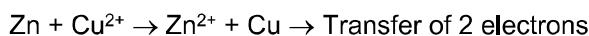


SECTION-B

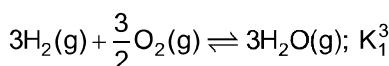
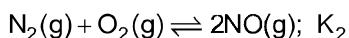
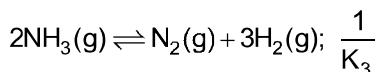
186. Answer (1)

There is no such equilibrium between the canonical forms and the canonical forms have no real existence.

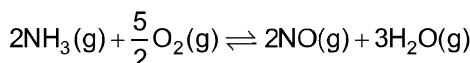
187. Answer (3)



188. Answer (2)

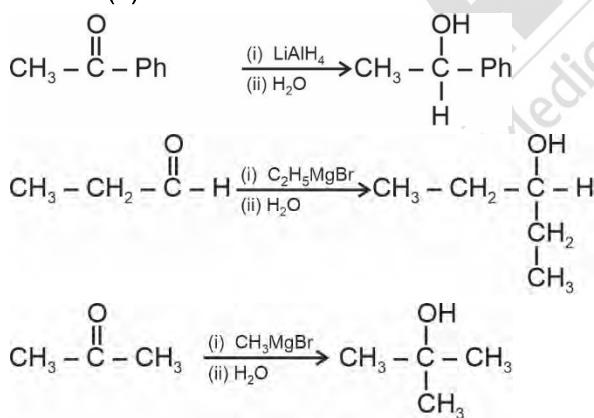


Adding (i), (ii) and (iii)

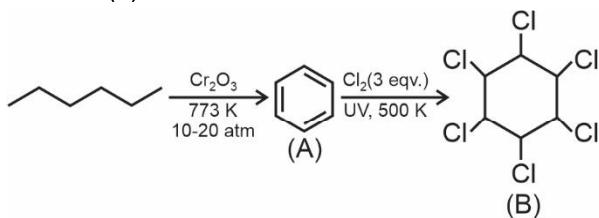


$$K = \frac{K_2 K_1^3}{K_3}$$

189. Answer (3)



190. Answer (3)



191. Answer (3)



Concentration of $\text{OH}^- = 0.5 \text{ M}$

$$\text{pOH} = -\log (\text{OH}^-)$$

$$\text{pOH} = -\log (0.5)$$

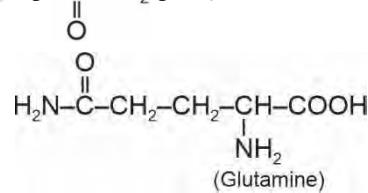
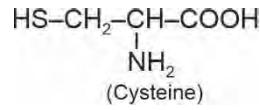
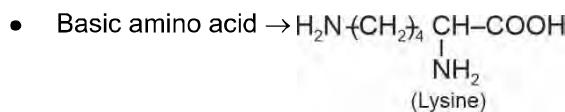
$$\text{pOH} = 0.3$$

$$\text{pH} + \text{pOH} = 14$$

$$\text{pH} = 14 - \text{pOH}$$

$$\text{pH} = 14 - 0.3 = 13.7$$

192. Answer (4)

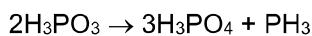


193. Answer (4)

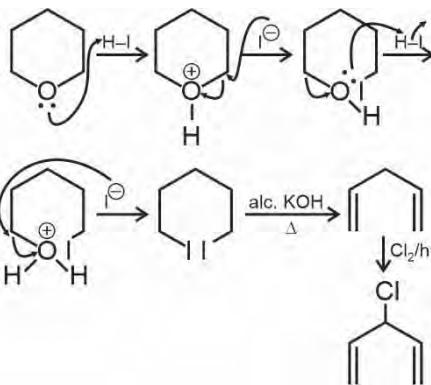
A catalyst catalyses the spontaneous reactions but does not catalyse non-spontaneous reaction.

194. Answer (3)

Orthophosphorous acid on heating disproportionates to give orthophosphoric acid and phosphine.



195. Answer (4)

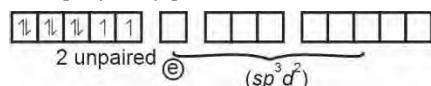


196. Answer (1)

Boiling point of propan-1-ol is higher than the acetone because in propan-1-ol intermolecular hydrogen bonding is present.

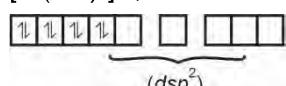
197. Answer (4)

$$\text{Ni}^{2+} [\text{Ni}(\text{H}_2\text{O})_6]^{2+} = 3d^8$$



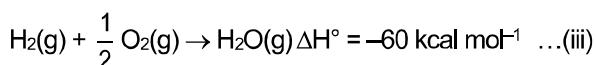
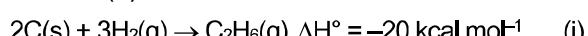
Due to presence of two unpaired electrons in $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$, it is green in colour.

$$[\text{Ni}(\text{CN})_4]^{2-}; \text{Ni}^{2+} = 3d^8$$

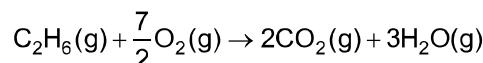


$[\text{Ni}(\text{CN})_4]^{2-}$ is colourless due to absence of unpaired electrons.

198. Answer (4)



ΔH° combustion for the equation \rightarrow



$$\Delta H^\circ = [- \text{equation (i)} + 2 \times \text{Equation (ii)}$$

$$+ 3 \times \text{Equation (iii)}]$$

$$= [+20 + 2(-80) + 3(-60)]$$

$$= 20 - 160 - 180 = -320 \text{ kcal mol}^{-1}$$

199. Answer (1)

Kinetic energy of the ejected electron is proportional to the frequency of the electromagnetic radiation and is independent of intensity of the light.

200. Answer (1)

