

**AIM - 720***(Advanced INTENSIVE Mastery for 720)*

MM : 720

CST-8

Time : 3 Hrs. 20 Min.

Answers

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

15/04/2024

CODE-A



Aakash

Medical | IIT-JEE | Foundations

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

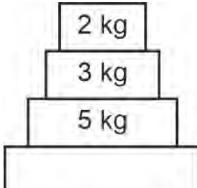
**AIM - 720***(Advanced INTENSIVE Mastery for 720)***CST-8**

Time : 3 Hrs. 20 Min.

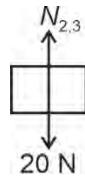
MM : 720

Answers & Solutions**PHYSICS****SECTION-A**

1. Answer (2)



Drawing FBD of 2 kg block



$$\Rightarrow N_{2,3} = 20 \text{ N}$$

2. Answer (2)

$$v = \frac{dx}{dt} = 16t - 4, v_{\text{at } t=1} = 12 \text{ m s}^{-1}$$

3. Answer (3)

Distance travelled in 3 seconds = 36 m

Distance travelled in 2 seconds = 20 m

⇒ Distance travelled in third second = 16 m

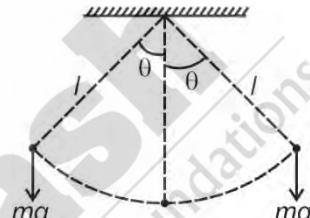
4. Answer (3)

Since the particle is moving with constant speed the angle between instantaneous velocity and instantaneous acceleration is always 90°.

5. Answer (1)

$$C_v = f \times \frac{R}{2} \Rightarrow C_v = \frac{3R}{2}$$
 as degree of freedom for monoatomic gas is 3.

6. Answer (3)



$$\text{Here } \tau = mg/\sin\theta$$

$$\vec{\tau} \perp \vec{l}$$

Here direction of \vec{l} changes but magnitude remains same.

7. Answer (3)

We know, $\omega = \omega_0 + \alpha t$

$$0 = 1800 \times \left(\frac{2\pi}{60} \right) + \alpha(120)$$

$$\alpha = -\frac{1800 \times 2\pi}{60 \times 120}$$

$$\alpha = -\frac{\pi}{2} \text{ rad/s}^2$$

8. Answer (4)

For escaping to infinity, the total energy of satellite should either be zero or some positive value.

9. Answer (4)

We know,

$$B = -V \frac{dp}{dV}$$

$$B = 1000[\hbar pg] \left[\frac{dV}{V} = \frac{0.1}{100} = \frac{1}{1000} \right]$$

$$B = (10^3)(200)(10^3)(10)$$

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

10. Answer (4)

- [Pressure] = [Young's modulus] = [Stress] = $[ML^{-1}T^{-2}]$
- [EMF] = [Potential difference] = [Electric potential] = $[ML^2T^{-3}A^{-1}]$
- [Heat] = [Work] = [Torque] = $[ML^2T^{-2}]$
- [Dipole moment] = [LTA]
[Electric field] = $[MLA^{-1}T^{-3}]$
[Electric flux] = $[ML^3A^{-1}T^{-3}]$

11. Answer (4)

$$a_c = \frac{v^2}{R} = 4t^2$$

$$v^2 = R \cdot 4t^2$$

$$v^2 = 16t^2$$

$$v = 4t$$

$$\frac{dv}{dt} = 4$$

$$F_t = \frac{mdv}{dt} = 8 \text{ N}$$

$$P = F_t \cdot v = 8 \times 4t = 32t$$

$$P = (32 \times 2) \text{ W} = 64 \text{ W}$$

12. Answer (4)

$$16 \text{ J} = \frac{1}{2}K(1 \text{ mm})^2$$

$$U_f = \frac{1}{2}K(3 \text{ mm})^2$$

$$U_f = 9 \times \frac{1}{2}K(1 \text{ mm})^2$$

$$U_f = 144 \text{ J}$$

$$\Delta W = U_f - U_i$$

$$= 144 \text{ J} - 16 \text{ J} = 128 \text{ J}$$

13. Answer (1)

$$U = \frac{1}{2\mu_0}B^2$$

$$B = \mu_0 n \cdot I$$

$$U = \frac{1}{2}\mu_0 n^2 I^2$$

$$= \frac{1}{2} \times 4\pi \times 10^{-7} \times 10^6 \times 1$$

$$U = 2\pi \times 10^{-1} \text{ J/m}^3$$

$$= 0.2\pi \text{ J/m}^3$$

14. Answer (2)

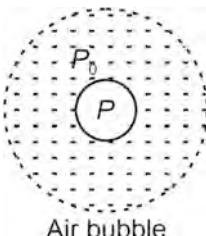
$$I = \frac{V}{X_c} = \frac{220}{\frac{1}{\omega C}}$$

$$= 220 \cdot \omega C$$

$$= 220 \times 100 \times 10 \times 10^{-6}$$

$$= 220 \text{ mA}$$

15. Answer (1)



Excess pressure inside an air bubble in liquid

$$= \frac{2T}{r}.$$

16. Answer (2)

Amount of energy required to increase the temperature by 1°C of 1 g water is one calorie.

17. Answer (1)

$$W = Q_H - Q_L$$

$$= (3000 - 1500) \text{ J} = 1500 \text{ J}$$

18. Answer (2)

Curve represents compression

\therefore W.D = negative

19. Answer (4)

$$E = E_0 \sin(\omega t - kx)$$

$$B = B_0 \sin(\omega t - kx)$$

Both E & B have average value equal to zero.

20. Answer (3)

For minima

$$\Delta\phi = (2n - 1)\pi$$

21. Answer (4)

$$V = f\lambda$$

$$\Rightarrow V = 5 \times 10^{14} \times 2 \times 10^{-7}$$

$$= 10 \times 10^7$$

$$V = 10^8 \text{ m/s}$$

$$\Rightarrow V = \frac{C}{\mu} \Rightarrow \mu = \frac{3 \times 10^8}{10^8}$$

$$\mu = 3$$

22. Answer (2)

$$m = -\frac{v}{u}$$

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u}$$

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

$$\Rightarrow m = -\frac{uf}{(u-f)u} = \frac{f}{f-u}$$

$$\Rightarrow m = \frac{-30}{-30+20} = \frac{-30}{-10} = +3$$

$$h_i = 3 \times 4 = 12 \text{ cm}$$

23. Answer (2)

$$K_1 = \frac{hc}{\lambda_1} - \phi_0 \quad \dots(1)$$

$$K_2 = \frac{hc}{\lambda_2} - \phi_0 \quad \dots(2)$$

$$(1) - (2)$$

$$K_1 - K_2 = hc \left(\frac{1}{\lambda_1} - \frac{1}{\lambda_2} \right)$$

$$= hc \left(\frac{1}{4\lambda_2} - \frac{1}{\lambda_2} \right)$$

$$K_1 - K_2 = \frac{-3hc}{4\lambda_2}$$

$$K_1 - K_2 = -\frac{3}{4}(K_2 + \phi_0)$$

$$K_1 = \frac{K_2}{4} - \frac{3}{4}\phi_0$$

$$K_1 < \frac{K_2}{4}$$

24. Answer (3)

Let n is number of fissions per second

Energy released per second = $n \times 250$ MeV

$$= n \times 250 \times 1.6 \times 10^{-13} \text{ J}$$

Energy required per second = Power \times Time

$$= 2 \text{ kW} \times 1 \text{ s} = 2000 \text{ J}$$

$$n \times 250 \times 1.6 \times 10^{-13} = 2000$$

$$n = \frac{2000}{400 \times 10^{-13}} = 5 \times 10^{13}$$

25. Answer (3)

D_1 is forward biased and D_2 is reverse biased, no current flows through D_2

$$i = \frac{20}{6+4} = \frac{20}{10} = 2 \text{ A}$$

26. Answer (4)

Output of first AND gate = $A \cdot B$

Output of second AND gate = $A \cdot C$

Output of OR gate = $A \cdot B + A \cdot C$

27. Answer (1)

$$y = A \sin \omega t + B$$

$$y - B = A \sin \omega t$$

$$y_1 = A \sin \omega t$$

Amplitude = A

28. Answer (3)

$$\frac{I_{\max}}{I_{\min}} = \frac{(\sqrt{I_1} + \sqrt{I_2})^2}{(\sqrt{I_1} - \sqrt{I_2})^2}$$

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

$$= 9 : 1$$

29. Answer (1)

$$U = -PE \cos \theta$$

For unstable equilibrium $U = U_{\max}$, $\cos \theta = -1$

$$\theta = \pi$$

30. Answer (2)

For $V \leq R$

$$V = \frac{kq}{R}$$

$$= 50 \text{ V}$$

31. Answer (2)

$$r = R \left(\frac{I_1}{I_2} - 1 \right)$$

$$r = 5 \left(\frac{60}{40} - 1 \right)$$

$$= \frac{5}{2} \Omega$$

32. Answer (3)

$$R = R_0(1 + \alpha \Delta T)$$

Assuming $T_0 = 0^\circ\text{C}$ as reference temperature

$$8 = R_0[1 + \alpha(20 - 0)]$$

$$8 = R_0(1 + 20\alpha) \quad \dots(i)$$

$$12 = R_0(1 + 80\alpha) \quad \dots(ii)$$

$$\frac{8}{12} = \frac{R_0(1+20\alpha)}{R_0(1+80\alpha)} \Rightarrow \frac{2}{3} = \frac{1+20\alpha}{1+80\alpha}$$

$$2 + 160\alpha = 3 + 60\alpha \Rightarrow 100\alpha = 1$$

$$\alpha = 0.01^\circ\text{C}^{-1}$$

33. Answer (3)

A stationary charge can only produce electric field, that is why statement (B) is wrong.

34. Answer (3)

Magnetic field due to an infinite wire

$$B = \frac{\mu_0 i}{2\pi r}$$

$$B = \frac{4\pi \times 10^{-7} \times 80}{2\pi \times 2} = 8 \text{ }\mu\text{T}$$

Using right hand thumb rule, the direction of magnetic field comes out to be from west to east.

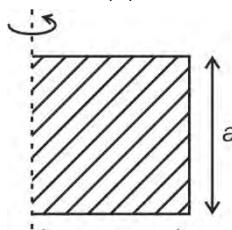
35. Answer (4)

Magnetic field on axis of a short bar magnet is given by

$$B = \frac{\mu_0 M}{2\pi r^3}$$

SECTION - B

36. Answer (1)



$$I = \frac{ma^2}{3}$$

37. Answer (4)

$$\text{We know, Orbital velocity, } v_o = \sqrt{\frac{GM}{R+h}}$$

$$\text{And, Escape velocity, } v_e = \sqrt{\frac{2GM}{R+h}}$$

$$\text{Also, Time period, } T = 2\pi \sqrt{\frac{(R+h)^3}{GM}}$$

38. Answer (2)

All zeros between two non-zero digits are always significant.

Hence, option (2) has no significant zeros.

39. Answer (3)

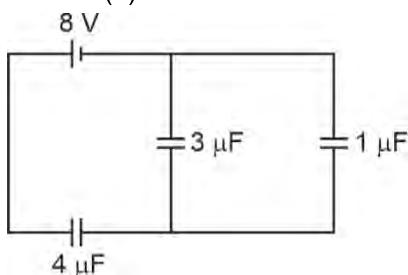
We know that impulse equals change in momentum.

$$\Rightarrow 6\hat{j} = \vec{P}_f - (2\hat{i} + \hat{j})$$

$$\Rightarrow \vec{P}_f = 2\hat{i} + 7\hat{j} = m\vec{v}$$

$$\vec{v} = 2\hat{i} + 7\hat{j}$$

40. Answer (4)



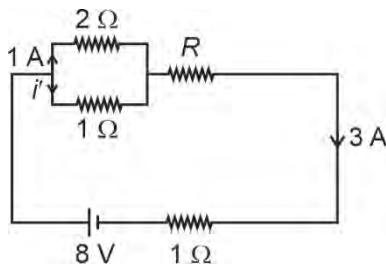
$$\text{Voltage across } 3 \mu\text{F} \text{ capacitor } \frac{V}{2} = 4 \text{ V}$$

$$\begin{aligned} q &= CV \\ &= 3 \times 4 = 12 \mu\text{C} \end{aligned}$$

41. Answer (2)

Electric field inside the cavity of uniformly charged sphere is uniform.

42. Answer (3)



Since 2Ω and 1Ω are in parallel combination, therefore the potential difference across them will be same.

$$\Delta V = iR$$

$$\therefore 2 \times 1 = i' \times 1 \Rightarrow i' = 2 \text{ A}$$

Current through 1Ω resistor is 2 A

$$\text{Total current} = 1 + 2 = 3 \text{ A}$$

$$\text{Terminal voltage: } V = \epsilon - ir$$

$$V = 8 - 3 \times 1 = 5 \text{ V}$$

43. Answer (3)

$$\frac{1}{\lambda_0} = R \left(\frac{1}{(1)^2} - \frac{1}{n^2} \right)$$

$$\frac{1}{\lambda_0} = R \left(1 - \frac{1}{n^2} \right)$$

$$\frac{1}{n^2} = 1 - \frac{1}{\lambda_0 R} \Rightarrow \frac{1}{n^2} = \frac{\lambda_0 R - 1}{\lambda_0 R}$$

$$n = \sqrt{\frac{\lambda_0 R}{\lambda_0 R - 1}}$$

44. Answer (1)

Number of pulses per second in output is same as number of pulses per second in input.

45. Answer (3)

For concave mirror distance between real object and real image is zero.

46. Answer (4)

On using white light in the YDSE, light of different colours will form their own interference pattern and bright fringes will form of different colour.

47. Answer (3)

$$I = \frac{h}{\cos \alpha}$$

$$\Rightarrow h = I \cos \alpha$$

$$= 5 \times \frac{4}{5} = 4 \text{ cm}$$

48. Answer (3)

Let $\theta^\circ\text{C}$ be the temperature at 50 cm from hot end.

$$\frac{dQ}{dt} = kA \frac{\Delta T}{\Delta x} \Rightarrow \frac{\Delta T}{\Delta x} = \frac{dQ}{dt} \times \frac{1}{kA}$$

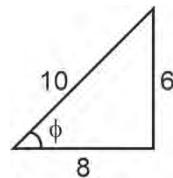
$$\therefore \frac{\Delta T}{\Delta x} = \text{constant}$$

$$\therefore \frac{\theta - 100}{0.5} = \frac{20 - 100}{4}$$

$$\theta - 100 = -10$$

$$\theta = 90^\circ\text{C}$$

49. Answer (2)



$$\tan \phi = \frac{X_L - X_c}{R} = \frac{6}{8}$$

$$\frac{10}{R} = \frac{6}{8}$$

$$R = \frac{80}{6} = \frac{40}{3} \Omega$$

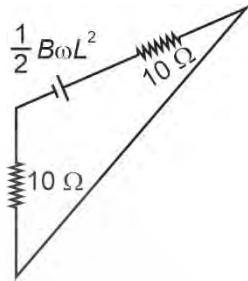
$$Z = \sqrt{R^2 + (X_L - X_c)^2}$$

$$= \sqrt{\frac{1600}{9} + 100}$$

$$= \sqrt{\frac{2500}{9}} = \frac{50}{3} \Omega$$

$$\text{Power} = \frac{200 \times 200 \times 3}{50} \times \frac{8}{10} = 1920 \text{ W}$$

50. Answer (3)



$$\varepsilon = 1/2 B \omega L^2$$

$$I = \frac{1}{2} \frac{B \omega L^2}{20}$$

$$= \frac{1}{40} \times 0.1 \times 10 \times \frac{1}{4} = \frac{1}{160} \text{ A}$$

BOTANY

SECTION - A

51. Answer (4)

Fucus is a brown algae, it shows diplobiontic life cycle. *Volvox*, *Spirogyra* and *Chlamydomonas* show haplobiontic life cycle.

52. Answer (4)

Coralloid roots are associated with N₂-fixing cyanobacteria.

53. Answer (4)

Statins are obtained from *Monascus purpureus*.

54. Answer (4)

Conformers cannot maintain a constant internal environment.

Majority of animals and nearly all plants are conformers.

55. Answer (1)

Mineralisation is the release of inorganic substances from organic matter.

56. Answer (4)

Phylum chordata comprises animals based on the common features like presence of notochord and dorsal hollow neural systems. Chordata and Hominidae, both are taxa of man.

57. Answer (1)

Kingdom Monera includes unicellular, colonial or filamentous, prokaryotic organisms without nuclear membrane.

Cell wall is made up of peptidoglycan. Membrane bound cell organelles are absent. Nucleoid or incipient nucleus is present which is composed of naked DNA, RNA and non-histone proteins.

58. Answer (4)

Archaeabacteria differ from other bacteria in having a different cell wall structure which is responsible for their survival in extreme conditions. They are divided into three groups; methanogens (e.g.: *Methanobacterium*), halophiles (e.g.: *Halococcus*) and thermoacidophiles (e.g.: *Thermoplasma* and *Thermoproteus*).

59. Answer (3)

Corolla is composed of petals. Petals are usually brightly coloured to attract insects for pollination.

60. Answer (3)

When the ovules are borne on central axis and septa are absent, as in *Dianthus* and *Primrose*, the placentation is called free central.

Argemone shows parietal placentation.

61. Answer (1)
Fabaceae was earlier called as Papilionoideae. The plants belonging to this family are *Indigofera*, groundnut, arhar, moong, muliathi, sunhemp.
62. Answer (1)
Some mature cells like erythrocytes of many mammals and sieve tube cells of vascular plants lack nucleus.
63. Answer (1)
SER is involved in detoxification of drugs. Lysosomes are known as suicidal bags. Nucleus contains highly extended and elaborate nucleoprotein fibres called chromatin. Nucleoid is present in prokaryotes.
64. Answer (4)
The cell wall determines the shape of the cell and provides a strong structural support and prevents the bacterium from bursting or collapsing.
65. Answer (4)
1 microspore mother cell after meiotic division resulting in formation of tetrad of cells i.e., four haploid daughter cells. Hence 4 microspore mother cells after meiotic division will form 4 microspore tetrad i.e., 16 haploid daughter cells.
66. Answer (1)
In Anaphase I separation of homologous chromosomes leads to reduction in number of chromosomes per daughter cells.
67. Answer (2)
The interphase lasts more than 95% of the duration of cell cycle.
68. Answer (2)
Companion cells are specialised parenchymatous cells which are closely associated with sieve tube elements. Sieve tube elements and companion cells are connected by pit fields between their common longitudinal walls which enable easy transfer of materials between them.
69. Answer (3)
Greater part of secondary xylem called heartwood is dark brown due to deposition of organic compounds like resins, tannins, gums and essential oils. It is located in the central or inner most layers of stem. These substances make it hard, durable and, this region comprised of dead elements with highly lignified walls.
70. Answer (1)
Ability of plants to follow different pathways in response to environment is called plasticity. For example, heterophyly in cotton, coriander and larkspur.
71. Answer (2)
Inner wall of pollen grain is called intine, which is made up of cellulose and pectin.
72. Answer (4)
If the female parent bears bisexual flowers, removal of anthers from the flower bud before the anther dehisces using a pair of forceps is necessary.
Emasculated flowers have to be covered with a bag of suitable size, generally made up of butter paper to prevent contamination of its stigma with unwanted pollen.
If female parent produces unisexual flowers, there is no need for emasculation.
73. Answer (1)
Maurice Wilkins produced the X-ray diffraction data of DNA. Taylor's experiment proved that the DNA in chromosomes also replicate semiconservatively. Marshall Nirenberg devised the cell-free system for protein synthesis. The technique of DNA fingerprinting was developed by Alec Jeffreys.
74. Answer (4)
Histone proteins are rich in basic amino acids, such as lysine and arginine.
75. Answer (4)
Split gene arrangement is characteristic of eukaryotes. The template strand in a transcription unit is copied to mRNA.
76. Answer (1)
DNA 3'-ATGCATGCATGCATG-5'
mRNA 5'-UACGUACGUACGUAC-3'
77. Answer (4)
 C_4 plants have Kranz anatomy and in them decarboxylation occurs in bundle sheath cells.
78. Answer (1)
 H_2O is the external electron donor used during non-cyclic photophosphorylation.
79. Answer (4)
In the Mendelian monohybrid cross, law of dominance is used to explain the expression of only one of the parental traits in the F_1 and the expression of both in the F_2 generation. It also explains the proportion of 3 : 1 phenotypes obtained in F_2 generation.
80. Answer (2)
In humans, chromosome complement 44 + XXY results in Klinefelter's syndrome.
81. Answer (4)
Mendel selected 14 true breeding pea plant varieties, as pairs which were similar except for one character with contrasting traits.
82. Answer (2)
Monosomy refers to $2n - 1$ conditions, nullisomy refers to $2n - 2$ condition, trisomy refers to $2n + 1$ condition and tetrasomy refers to $2n + 2$ condition.

83. Answer (4)
Oxidative decarboxylation is catalysed by pyruvate dehydrogenase and takes place in mitochondrial matrix. It involves release of CO₂.
84. Answer (3)
Cutting and clearing of Amazon rain forest for soyabean cultivation exemplifies habitat loss and fragmentation.
85. Answer (1)
Western ghats and Sri Lanka, Indo-Burma and Himalayas are biodiversity hotspots in India.
Hotspots are *in-situ* conservation strategy.
- SECTION - B**
86. Answer (3)
Algin and carrageen are hydrocolloids obtained from brown and red algae respectively.
87. Answer (1)
The technology of biogas production was developed in India by Indian Agricultural Research Institute (IARI) and Khadi and Village Industries Commission (KVIC).
88. Answer (2)
Mycorrhiza is a mutualistic relationship between fungi and roots of higher plants.
89. Answer (2)
In deep marine habitats, two main limiting factors are
 1. Light
 2. Nutrients (nitrogen is most limiting nutrient)
90. Answer (4)
Most of the dinoflagellates have two flagella, one lies longitudinally and the other transversely in a furrow between the wall plates.
Very often, red dinoflagellates (e.g.: *Gonyaulax*) undergo such rapid multiplication that they make the sea appear red (red tides).
91. Answer (3)
A few millimeters above the root cap is the region of meristematic activity. The cells of this region are very small, thin walled and with dense protoplasm which divides repeatedly.
92. Answer (3)
Middle lamella holds the neighbouring cells together. In ripening fruits, the pectate compounds solubilize to a jelly-like material making the fruits soft.

93. Answer (2)
The cell cycle is divided into two basic phases: Interphase and M phase.
94. Answer (3)
In monocot stem, vascular bundles are conjoint and closed.
Peripheral vascular bundles are generally smaller than the centrally located ones.
Water containing cavities are present within the vascular bundles. Pith is absent.
Large number of scattered vascular bundles, each surrounded by a sclerenchymatous bundle sheath, and a large, conspicuous parenchymatous ground tissue.
95. Answer (4)
Short day plants flower when they are exposed to a photoperiod shorter than a critical period. Soyabean is a short day plant.
96. Answer (4)
Megaspore mother cell undergoes meiosis and forms a linear tetrad of four haploid megaspores.
Megaspore mother cell is a large cell which contains prominent nucleus and dense cytoplasm.
Ovules generally differentiate a single megaspore mother cell (MMC) in the micropylar region of nucellus.
97. Answer (2)
DNA fingerprinting employs techniques like PCR, Southern blotting and autoradiography.
98. Answer (4)
The experiment conducted by Matthew Meselson and Franklin Stahl by taking heavy nitrogen in *E. coli* suggests that DNA in chromosomes replicate semi-conservatively.
99. Answer (3)
RRY_Y, rrY_y, RrYY and Rryy plants are homozygous for only one trait. In F₂ generation, they are produced in the $\frac{8}{16}$ proportion. i.e. $\frac{1}{2}$.
100. Answer (2)
FMN-FeS are the components of complex I of ETS of mitochondria.

ZOOLOGY

SECTION - A

101. Answer (2)

Naming of enzyme EcoRI

E → 1st letter (Genus name) → *Escherichia*

co → 2nd two letters (Species name) → *coli*

R → Strain of bacteria

I → Roman number (Order of isolation)

102. Answer (3)

Restriction enzymes are called molecular scissors.

RNase cleaves the RNA molecules.

DNA ligase is also called molecular glue.

103. Answer (2)

In humans, each testis has about 250 compartments called testicular lobules. So, number of testicular lobules in both testes are about 500.

104. Answer (3)

In Green Revolution, increased yields have partly been due to the use of improved crop varieties, but mainly due to the use of better management practices and use of agrochemicals.

105. Answer (1)

The electrical potential difference across the resting membrane is called the resting potential. Potential difference across a depolarised plasma membrane is called action potential which is also termed as nerve impulse.

106. Answer (4)

Endoskeleton is fully ossified (Bony) and the long bones are hollow with air cavities (Pneumatic) in the organisms of class Aves. *Pavo* (Peacock) is a member of class Aves. *Salpa* belongs to the subphylum Urochordata.

Myxine (Hag fish) is a member of Cyclostomata.

Calotes (Garden lizard) is a reptile.

107. Answer (2)

Hydrolases: Enzymes catalysing hydrolysis of ester, ether, peptide, glycosidic, C–C, C–halide or P–N bonds.

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

108. Answer (3)

Purines = [A] + [G]

Pyrimidines = [C] + [T]

[A] = [T] = 20%

[C] = [G] = 30%

∴ Purines = 50%

Pyrimidines = 50%

109. Answer (4)

70-80 per cent of electrolytes and water are reabsorbed by PCT.

About 40-50 per cent of the body weight of a human adult is contributed by muscles.

There are about 1 to 2 million islets of Langerhans in a normal human pancreas representing only 1 to 2 per cent of the pancreatic tissue. Lymphocytes contribute 20-25 per cent of the total WBCs.

110. Answer (4)

Balanoglossus is a hemichordate. They have a rudimentary structure in the collar region called stomochord.

Excretory organ is proboscis gland.

Kidneys for excretion are present in chordates.

111. Answer (3)

Three critical research areas of biotechnology are:

- (i) Providing the best catalyst in the form of improved organism usually a microbe or pure enzyme.
- (ii) Creating optimal conditions through engineering for a catalyst to act.
- (iii) Downstream processing technologies to purify the protein/organic compound

112. Answer (2)

Ciliated epithelium is mainly present in the inner surface of hollow organs like bronchioles and fallopian tubes.

113. Answer (2)

	Circulatory system	Respiratory system
Arthropoda	+	+
Annelida	+	-
Coelenterata	-	-
Porifera	-	-

114. Answer (3)

Progestasert – Phagocytosis of sperms

Saheli – Once a week pill

Implants – Alter the quality of cervical mucus

Sterilisation – Terminal method of contraception

115. Answer (1)

A specialised centre in the medulla region of the brain called respiratory rhythm centre is primarily responsible for the regulation of respiration.

Pneumotaxic centre present in the pons region of the brain moderate the functions of respiratory rhythm centre.

116. Answer (2)

Periodic abstinence, coitus interruptus and lactational amenorrhea are natural methods of contraception. As no medicines or devices are used in these methods, side effects are almost nil but the chances of failure are also high.

117. Answer (3)

DNA is a negatively charged molecule. When an electric current is applied to the gel, DNA migrate towards the positively charged electrode.

The DNA fragments separate according to their size through sieving effect provided by agarose gel.

118. Answer (3)

The brain of frog is divided into fore-brain, mid-brain and hind-brain. Forebrain includes olfactory lobes, paired cerebral hemispheres and unpaired diencephalon.

119. Answer (1)

Water – 70-90%

Lipids – 2%

Nucleic acids – 5-7%

Ions – 1%

120. Answer (2)

Diaphragm, cervical caps and vaults are barriers made of rubber that are inserted into the female reproductive tract to cover the cervix during coitus. They are reusable. Spermicidal creams, jellies and foams are usually used along with these barriers to increase their contraceptive efficiency.

121. Answer (4)

	Column I		Column II
a.	Exclusively marine phylum	(iv)	Echinodermata
b.	Phylum of insects	(ii)	Arthropoda
c.	Second largest phylum	(i)	Mollusca
d.	Phylum of sea walnuts	(iii)	Ctenophora

122. Answer (3)

A unique vascular connection exists between the digestive tract and liver called hepatic portal system. The hepatic portal vein carries blood from intestine to the liver before it is delivered to the systemic circulation.

123. Answer (1)

Insulin is a proteinaceous hormone and easily gets digested into the alimentary canal by protein degrading enzymes.

124. Answer (2)

The use of vaccines and immunisation programmes have enabled us to completely eradicate a deadly disease like small pox.

125. Answer (2)

Starch forms helical secondary structures. In fact, starch can hold I_2 molecules in the helical portion. The starch- I_2 is blue in colour. Cellulose does not contain complex helices and hence cannot hold I_2 .

Adenine and Guanine are substituted purines.

126. Answer (1)

The first clinical gene therapy was given in 1990 to a 4-year-old girl with ADA deficiency.

127. Answer (4)

Name of bones	Number in humans
Ear ossicles	6
Girdle bones	6
Vertebrochondral ribs (False ribs)	6
Lumbar vertebrae	5

128. Answer (1)

Thecodonts are ancestors of crocodiles, dinosaurs and birds.

129. Answer (3)

T-lymphocytes mediate cell-mediated immune response and CMI is primarily responsible for the graft rejection.

130. Answer (4)

Hormones that are polypeptide, peptide or protein in nature usually interact with membrane bound receptors. They do not enter the target cell, but generate second messengers which in turn regulate cellular metabolism.

131. Answer (1)

A thin, muscular wall called the inter-atrial septum separates the right and the left atria, whereas a thick-walled, inter-ventricular septum separates the left and the right ventricles.

132. Answer (4)

- Bt toxins are endotoxins and digested in human's gut. Insects ingest Bt toxins in inactive form which is activated in alkaline medium of insect's gut.

133. Answer (4)

GFR is glomerular filtration rate. It is the amount of the filtrate formed from the kidneys per minute i.e., 125 mL/min in humans.

134. Answer (4)

- AIDS is caused by the Human Immuno deficiency Virus (HIV)
- Gonorrhoea is a sexually transmitted disease caused by bacteria *Neisseria gonorrhoeae*.
- Bacteria like *Streptococcus pneumoniae* and *Haemophilus influenzae* are responsible for pneumonia.

135. Answer (3)

Taq polymerase is a heat resistant enzyme isolated from the bacterium *Thermus aquaticus* (can survive temperatures upto 95°C).

During primer extension step, the sample is heated to 72°C for some time, during which the DNA polymerase adds nucleotides to the primer.

SECTION - B

136. Answer (2)

- Tibia and fibula – Appendicular skeleton
 Sternum and occipital condyle – Axial skeleton
 Clavicle and scapula – Pectoral girdle
 Pubis and ischium – Coxal bones

137. Answer (1)

Morphine and codeine are alkaloids.

138. Answer (2)

Hypothalamus is the basal part of diencephalon. The pituitary gland is located in a bony cavity called sella turcica and is attached to hypothalamus by a stalk.

139. Answer (3)

Thoracic vertebrae, ribs and sternum together form the rib cage in humans.

140. Answer (1)

Australian marsupials exhibit divergent evolution. Darwin's finches as well as placental mammals of Australia exhibit adaptive radiation.

141. Answer (3)

The pulmonary circulation starts by the pumping of deoxygenated blood by the right ventricle which is carried to the lungs where it is oxygenated and returned to the left atrium.

142. Answer (4)

Sertoli cells are present inside the seminiferous tubules. Interstitial or Leydig cells and immunologically competent cells are present outside seminiferous tubules in interstitial spaces.

143. Answer (3)

On each side, vas deferens receives a duct from seminal vesicle and opens into urethra as ejaculatory duct.

144. Answer (4)

Variation in gene frequencies within populations can occur by chance rather than by natural selection. This is referred to as genetic drift.

145. Answer (3)

A chemical synapse consists of 3 parts:

- Pre-synaptic membrane
- Synaptic cleft
- Post-synaptic membrane

146. Answer (2)

In some children, ADA deficiency can be cured by bone marrow transplantation; in others it can be treated by enzyme replacement therapy.

147. Answer (2)

Recombinants will be tetracycline sensitive. They have gene for β-galactosidase which will give blue colour in the presence of a chromogenic substrate.

148. Answer (4)

In *Adamsia* only polyp phase is observed that reproduce asexually.

Obelia exhibits metagenesis.

149. Answer (1)

Cuboidal epithelium is composed of single layer of cube like cells. Commonly found in ducts of gland and tubular parts of nephrons.

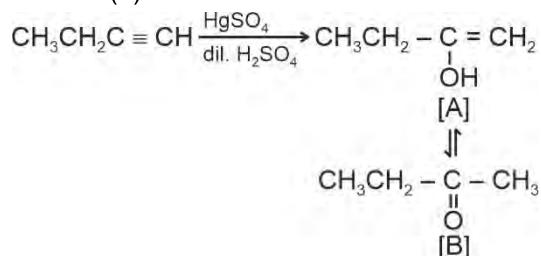
150. Answer (4)

The ventral surface of their body is distinguished by the presence of genital openings.

CHEMISTRY

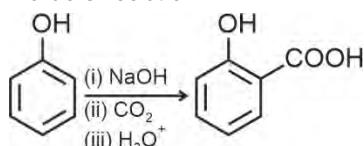
SECTION - A

151. Answer (2)

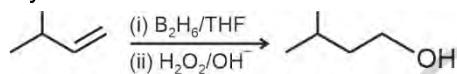


152. Answer (2)

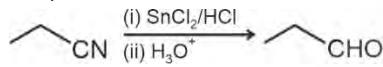
- Kolbe's reaction



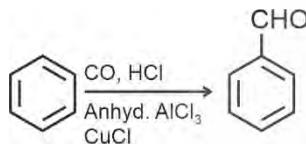
- Hydroboration-oxidation



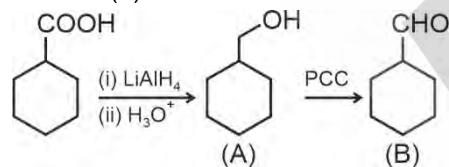
- Stephen reaction



- Gatterman-Koch reaction



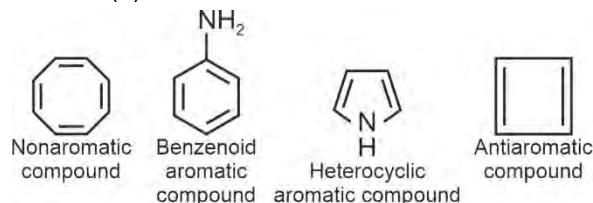
153. Answer (3)



154. Answer (3)

Myosin is an example of fibrous protein.

155. Answer (4)



156. Answer (4)

From slow step

$$r = K[D][C]$$

From (i)

$$K_{eq} = \frac{[D]}{[A][B]}$$

$$[D] = K_{eq}[A][B]$$

Hence,

$$r = K K_{eq}[A][B][C]$$

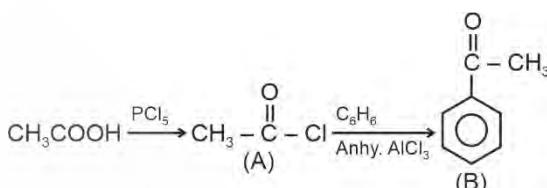
$$r = K'[A][B][C]$$

157. Answer (1)

Aldehydes are more reactive than ketones for nucleophilic addition reactions.

HCHO is most reactive aldehyde due to less steric repulsion and less +I effect.

158. Answer (4)



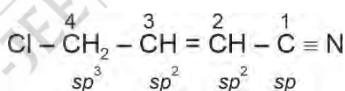
159. Answer (1)

Methyl orange shows different colour below pH 3.1 and above pH 4.5 hence its working pH range is 3.1 to 4.5.

160. Answer (1)



161. Answer (2)



162. Answer (4)

Hydrogen atoms at bridgehead α -carbon or sp^2 hybridised α -carbon do not get involved in hyperconjugation.

I.	No hyperconjugation	
II.	Hyperconjugation occurs	
III.	No hyperconjugation	
IV.	Hyperconjugation occurs	

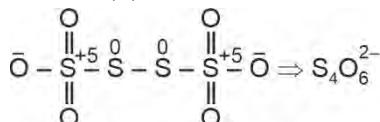
163. Answer (3)

On balancing the given redox reaction

3 mol of Cl_2 \equiv 1 mol of ClO_3^-

$$\therefore 2 \text{ mol of } \text{Cl}_2 \equiv \frac{2}{3} \text{ mol of } \text{ClO}_3^-$$

164. Answer (3)

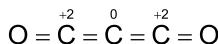


Tetraethionate ion

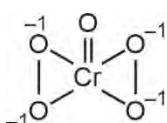
Average oxidation state

$$= 4x + 6(-2) = -2$$

$$x = \frac{10}{4} = 2.5$$



Carbon suboxide



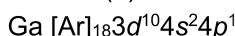
2 peroxide linkage

 Fe_3O_4 is a mixed oxide of FeO and Fe_2O_3 .

165. Answer (4)

Silicon dioxide (SiO_2) is non-reactive in its normal form due to the high bond enthalpy of Si – O bond, so assertion and reason both are correct and reason is explaining assertion.

166. Answer (3)

Valence electron is in $4p$ subshell of Gallium atom, so $n = 4$

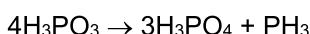
$$l = 1$$

$$m_l = 1, 0, -1$$

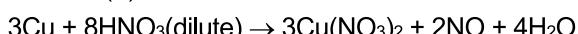
$$s = +\frac{1}{2} \text{ or } -\frac{1}{2}$$

167. Answer (2)

Phosphorous acid disproportionate to give phosphoric acid and phosphine



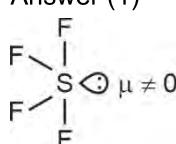
168. Answer (4)



169. Answer (3)

$$\text{O}_2^+, \text{ bond order} = \frac{1}{2}(\text{N}_b - \text{N}_a) = \frac{1}{2}(10 - 5) = 2.5$$

170. Answer (1)



171. Answer (2)

Solubility of gas \propto pressure

$$\text{Solubility of gas} \propto \frac{1}{\text{Temperature}}.$$

172. Answer (1)

$$\frac{P^0 - P_s}{P_s} = \frac{w_2 \times M_1}{M_2 \times w_1}$$

$$\frac{\frac{P^0 - \frac{9}{10}P^0}{9}}{\frac{9}{10}} = \frac{w \times 18}{60 \times 360}$$

$$\frac{1}{9} = \frac{w \times 18}{60 \times 360} \Rightarrow w = \frac{60 \times 360}{9 \times 18} = 133.33 \text{ g}$$

173. Answer (2)

$$\text{Number of O}_2 \text{ molecules in } 16 \text{ g of O}_2 = \frac{16}{32} \times N_A$$

$$= 0.5 N_A$$

$$\text{Number of N}_2 \text{ molecules in } 14 \text{ g of N}_2 = \frac{14}{28} \times N_A$$

$$= 0.5 N_A$$

174. Answer (1)

Average atomic mass of an element

$$= \frac{\sum (\% \text{ abundance of an isotope} \times \text{Atomic mass})}{100}$$

Average atomic mass of boron

$$= \frac{(19 \times 10) + (81 \times 11)}{100}$$

$$= \frac{190 + 891}{100} = 10.81 \text{ u}$$

175. Answer (2)

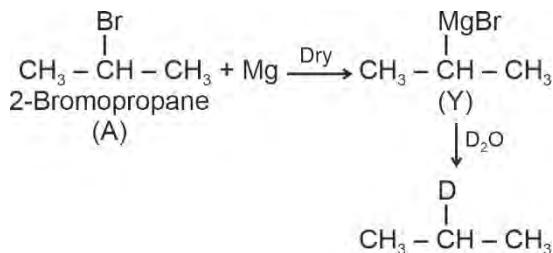
Coordination isomerism arises from the interchange of ligands between cationic and anionic entities of different metal ions present in a complex.

$\therefore [\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$ and $[\text{Co}(\text{CN})_6][\text{Cr}(\text{NH}_3)_6]$ are related as coordination isomers.

176. Answer (3)

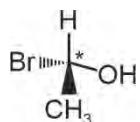
Aniline does not undergo Friedel-Crafts reaction (alkylation and acetylation) due to salt formation with AlCl_3 , the Lewis acid, which is used as a catalyst. Due to this, nitrogen of aniline acquires positive charge and hence acts as a strong deactivating group.

177. Answer (2)



178. Answer (1)

Molecule in which atleast one carbon atom is attached to four different group is called chiral molecule.



Chiral molecule

179. Answer (2)

When e^- is added to oxygen, the added electron goes to the smaller $n = 2$ quantum level and suffers significant repulsion from the other electrons present in this level.

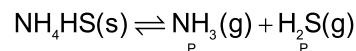
180. Answer (3)

As we move from lithium to fluorine, Z_{eff} increases. The effective nuclear charge experienced by a valence electron in an atom will be less than the actual charge on the nucleus because of shielding of the valence electron from the nucleus by intervening core electrons.

181. Answer (4)

When $E_{\text{ext}} > 1.1$ V then electron flows from Cu to Zn and current flows from Zn to Cu.

182. Answer (2)



$$K_P = P^2$$

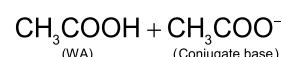
$$256 = P^2$$

$$P = 16 \text{ atm}$$

$$P_T = 16 + 16 = 32 \text{ atm}$$

183. Answer (1)

A mixture of weak acid and its conjugate base will form an acidic buffer.



184. Answer (2)

$\text{Mn}^{2+} > \text{Fe}^{2+}$ (Ionisation energy)

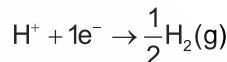
$(3d^5) \text{ Mn}^{2+} = \boxed{1 \ 1 \ 1 \ 1 \ 1}$ ($3d^5$) more stable configuration than Fe^{2+}

 $(3d^6) \text{ Fe}^{2+} = \boxed{1 \ 1 \ 1 \ 1 \ 1}$

Lesser energy required to remove 1 electron from $3d$ orbital to gain $3d^5$ electronic configuration

- Cr^{2+} is reducing as it's configuration changes from d^4 to d^3 , having half filled t_{2g} level. Whereas, Mn^{3+} changes to Mn^{2+} to achieve half-filled d^5 configuration.
 $\therefore \text{Mn}^{3+}$ is oxidising.
- Cu^{2+} is more stable than Cu^+ in aq. phase due to it's high hydration energy which compensates two ionisation energies.
- No unpaired electrons in Zn , therefore due to weak metallic bonding, enthalpy of atomisation is lowest in $3d$ series.

185. Answer (1)



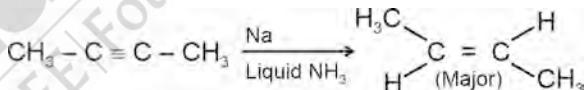
$$E_{(\text{H}^+/\text{H}_2)} = -0.0591 \text{ pH}$$

$$= -0.0591 \times 7$$

$$= -0.4137 \text{ V}$$

SECTION-B

186. Answer (3)



187. Answer (2)

Compound which is stronger acid than H_2CO_3 will liberate CO_2 on reaction with NaHCO_3 .

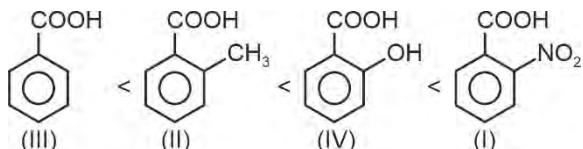
188. Answer (3)

More stable is the carbocation, faster is dehydration in acidic medium.

189. Answer (2)

Acidic strength of benzoic acid increases due to ortho effect.

Hence order of acidic strength



190. Answer (2)

This is first order reaction

Hence, $r = k[A]$

$$4 \times 10^{-4} = 10^{-3} [A]$$

$$[A] = 0.4 \text{ M}$$

191. Answer (2)

Volume of nitrogen at STP (V_2)

$$= \left(\frac{P \cdot V}{T} \right)_{\text{given}} \times \left(\frac{T}{P} \right)_{\text{STP}}$$

$$= \frac{700 \times 76}{300} \times \frac{273}{760} = 63.7 \text{ mL}$$

$$\text{Weight of nitrogen at STP} = \left(\frac{28}{22400} \times 63.7 \right) \text{ g}$$

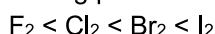
$$\therefore \text{Percentage of nitrogen} = \frac{28 \times 63.7 \times 100}{22400 \times 0.5} \\ \approx 16\%$$

192. Answer (2)

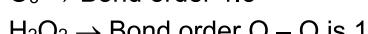
Energies of the orbitals in the same subshell decrease with increase in the atomic number as Z_{eff} increase with increase in atomic number.

193. Answer (3)

Boiling point follows the order



194. Answer (3)

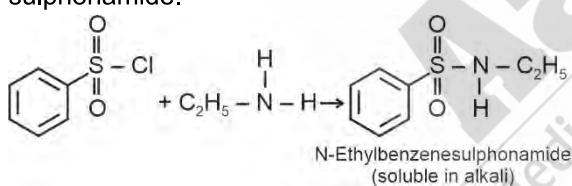


195. Answer (4)

Valence bond theory in coordination compounds does not give quantitative interpretation of magnetic data.

196. Answer (1)

The reaction of benzene sulphonyl chloride with Ethyl amine yields N-Ethylbenzene-sulphonamide.



197. Answer (2)

$$E_{\text{cell}}^{\circ} = 0.80 - 0.36 = 0.46 \text{ V}$$

$$E_{\text{cell}}^{\circ} = \frac{0.059}{2} \log(k)$$

$$0.46 = \frac{0.059}{2} \log(k)$$

$$\log(k) = \frac{0.46 \times 2}{0.059}$$

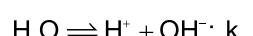
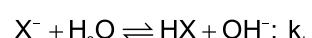
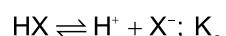
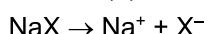
$$\log(k) = 15.6$$

$$k = 10^{15.6}$$

$$k = 10^{15} \times 10^{0.6}$$

$$k = 4 \times 10^{15}$$

198. Answer (4)



$$K_h = \frac{K_w}{K_a} = \frac{10^{-14}}{3 \times 10^{-9}}$$

$$K_h = 0.33 \times 10^{-5}$$

$$K_h = 3.3 \times 10^{-6}$$

199. Answer (4)

Magnetic moment for (1) [Kr] $4d^6 5s^1$ $n = \text{unpaired electron}$

$$n = 5$$

$$\text{Magnetic moment} = \sqrt{n(n+2)} = \sqrt{5(5+2)}$$

$$= \sqrt{35} \text{ BM}$$

$$(2) [\text{Kr}] 4d^2 5s^2$$

$$n = 2$$

$$\sqrt{n(n+2)} = \sqrt{2(2+2)} = \sqrt{2(4)} = \sqrt{8} \text{ BM}$$

$$(3) [\text{Kr}] 4d^7 5s^2$$

$$n = 3$$

$$\sqrt{n(n+2)} = \sqrt{3(3+2)} = \sqrt{15} \text{ BM}$$

$$(4) [\text{Kr}] 4d^5 5s^1$$

$$n = 6$$

$$\sqrt{n(n+2)} = \sqrt{6(8)} = \sqrt{48} \text{ BM}$$

200. Answer (2)

$$\Delta_r H^\circ = \sum \Delta_f H_{\text{Product}}^\circ - \sum \Delta_f H_{\text{Reactant}}^\circ$$

$$-21 = [3 \times \Delta_f H_{\text{H}_2\text{O(l)}}^\circ - \Delta_f H_{\text{Fe}_2\text{O}_3(\text{s})}^\circ]$$

$$\therefore \Delta_f H_{\text{H}_2(\text{g})}^\circ = 0$$

$$\therefore \Delta_f H_{\text{Fe(s)}}^\circ = 0$$

$$-21 = -841.5 - x$$

$$x = -841.5 + 21$$

$$= -820.5 \text{ kJ mol}^{-1}$$