All India Aakash Test Series for NEET - 2025

TEST - 1 (Code-A)

For Code-B Sol. Click here

Test Date : 28/07/2024

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION-A

1. Answer (3)

Hint & Sol.: Net force on q_2 will change but force between the q_1 and q_2 will remain same.

2. Answer (1)

Hint: Quantization of charge

Sol.: $q = ne$

$$n = \frac{80\times10^{-6}}{1.6\times10^{-19}}$$

$n = 5 \times 10^{14}$

3. Answer (3)

Hint: Electrostatic force between two point charged particles separated by distance r is

$$\vec{F} = \frac{q_1q_2}{4\pi\varepsilon_0 r^2}\hat{r}$$

Sol.: $\vec{r} = -(2\hat{i} + 2\hat{j} + \hat{k})$

$$r = \sqrt{4+4+1} = 3$$

$$\vec{F} = \frac{-q_1q_2}{4\pi\varepsilon_0 3^3}(2\hat{i} + 2\hat{j} + \hat{k})$$

$$\vec{F} = \frac{-q_1q_2}{108\pi\varepsilon_0}(2\hat{i} + 2\hat{j} + \hat{k})$$

4. Answer (2)

Hint: Electrostatic force between two point charged particles separated by distance r is

$$F = \frac{q_1q_2}{4\pi\varepsilon_0 r^2}$$

Sol.: $F = \frac{k32}{r^2}$

$$F_1 = \frac{36}{r^2}$$

$$\frac{F}{F_1} = \frac{32}{36}$$

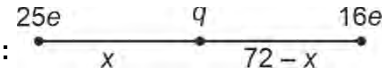
$$F_1 = \left(\frac{9F}{8}\right)$$

5. Answer (3)

Hint: Electrostatic force between two point charged particles separated by distance r is

$$F = \frac{kq_1q_2}{r^2}$$

Sol.:



$$\frac{k25eq}{x^2} = \frac{k16eq}{(72-x)^2}$$

$$\frac{5}{x} = \frac{4}{72-x}$$

$72 \times 5 - 5x = 4x$

$x = 40$ cm

6. Answer (2)

Hint: Electrostatic potential due to a dipole at a distance r making an angle θ with dipole axis is

$$V = \frac{kp\cos\theta}{r^2}$$

Sol.: $V = \frac{9\times10^9\times4\times10^{-8}}{\left(\frac{3}{2}\right)^2}\times\frac{1}{2} = 80$

7. Answer (2)

Hint: $dV = -\vec{E}\cdot\overrightarrow{dx}$

Sol.: $\int dV = -\int\vec{E}\cdot\overrightarrow{dx}$

$$\Delta V = \int_5^{10} 20x\,dx$$

$$= 20\left[\frac{x^2}{2}\right]_5^{10}$$

$= 10[100 - 25] = 750$ V

8. Answer (4)

Hint: $\Delta U = QV$

Sol.: $\Delta U = \frac{1}{2}mv^2$

$$QV = \frac{1}{2}mv^2$$

$$v = \sqrt{\frac{2QV}{m}}$$

9. Answer (1)

Hint: Use $V = \frac{kq}{r}$

Sol.: $N\times\frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$

$R = r\,N^{1/3}$

$V_b = 16V_s$

$\frac{Nkq}{rN^{1/3}} = 16\frac{kq}{r}$

$N^{2/3} = 16$

$N = 64$

10. Answer (4)

Hint: Use $W = q\Delta V$

Sol.: $V_A = V_B = V_C = V_E = V_D$

$W = q \times 0 = 0$

11. Answer (2)

Hint: $E = \frac{\lambda}{2\pi\varepsilon_0 R}$

Sol.: $E = \frac{2\lambda}{4\pi\varepsilon_0 R}$

$= 2 \times 2 \times 10^{-9} \times 9 \times 10^9 = 36$ V/m

12. Answer (2)

Hint: Electric field due to uniformly charged sphere at its surface, $E = \frac{kq}{r^2}$

Sol.: $E = \frac{4kq}{d^2}$

$6 \times 10^6 = \frac{4 \times 9 \times 10^9 q}{16}$

$\frac{24}{9} \times 10^{-3} = q$

$q = \frac{8}{3} \times 10^{-3}$ C

13. Answer (1)

Hint: Electrostatic potential due to a uniformly charged sphere at its surface, $V = \frac{\sigma R}{\varepsilon_0}$

Sol.: For same potential,

$\sigma \propto \frac{1}{R}$

$\frac{\sigma_1}{\sigma_2} = \frac{R_2}{R_1} = 2 : 1$

14. Answer (3)

Hint & Sol.: Electric flux is given by $\phi = \vec{E} \cdot \vec{A}$

$= \frac{V}{d} \cdot A$

= volt m

15. Answer (3)

Hint: Force of attraction between the plates is given by $F = \frac{q^2}{2\varepsilon_0 A}$ or $F \propto q^2$.

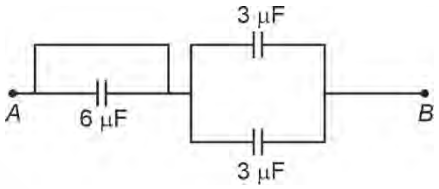
Sol.: When separation between the plates is halved, capacitance becomes two times. So charge stored in capacitor is doubled.

$\frac{F}{F_1} = \frac{q^2}{4q^2}$

$F_1 = 4F$

16. Answer (2)

Hint & Sol.:



C_{AB} = 3 μF + 3 μF = 6 μF

17. Answer (3)

Hint & Sol.: $q = CV$

$E = \frac{20}{2} = 10$ V

18. Answer (1)

Hint: Energy stored across capacitor is $U = \frac{1}{2}C_{eff}V^2$

Sol.: C_{eff} = 3 μF + 3 μF = 6 μF

$U = \frac{1}{2} \times 6 \times (10)^2$

= 0.3 mJ

Work done by battery, $W = 2U$

= 0.6 mJ

19. Answer (2)

Hint & Sol.: Electric force on a charged particle is $F = qE$

Electron moves from lower potential to higher potential.

20. Answer (2)

Hint: When capacitor is connected to battery, its potential remains same.

Sol.: Capacitance $C = \frac{A\varepsilon_0}{d}$

As d increases, then C decreases.

$\Rightarrow$ $Q = CV$

$\therefore$ Q decreases

$\Rightarrow$ $Q = CV$; $\frac{Q}{V} = C$ = decreases

$\Rightarrow$ Energy stored $U = \frac{1}{2}CV^2$

$\because$ C decreases

$\therefore$ U also decreases

21. Answer (4)

Hint: Electric potential due to a point charge at a distance r is, $V = \frac{kq}{r}$

Sol.: $V = \frac{kq}{r} + \frac{-kq}{r} + \frac{kq}{r} - \frac{kq}{r} = 0$

22. Answer (3)

Hint: Inside the spherical shell, electric potential will be constant.

Sol.: $V = \frac{kq}{10}$

$V_1 = \frac{kq}{20}$

$V_1 = \frac{V}{2}$

23. Answer (1)

Hint & Sol.: Unit of electrostatic pressure = $\frac{\sigma^2}{\varepsilon_0} \rightarrow \frac{\text{J}}{\text{m}^3}$

$F = \frac{q^2}{4\pi\varepsilon_0 r^2}$

$\Rightarrow$ $\varepsilon_0 \rightarrow \frac{q^2}{(F \times r)r}$

$\varepsilon_0 \rightarrow \frac{\text{C}^2}{\text{J m}}$

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

$\frac{A\varepsilon_0}{d} \rightarrow$ farad

$E = -\frac{dV}{dr}$

$\frac{V}{E} \rightarrow$ metre

24. Answer (3)

Hint: Electric flux is given by $\phi = \vec{E} \cdot \vec{A}$

Sol.: $\vec{A} = (50\hat{i})$ m^2

$\phi = (4\hat{i} + 2\hat{j} + 3\hat{k}) \cdot 50\hat{i}$

ϕ = 200 Vm

25. Answer (1)

Hint: Relation between electric field and electrostatic potential is $\vec{E} = -\frac{dV}{dx}\hat{i}$

Sol.: $\vec{E} = -\frac{d}{dx}(4x^2 - 8x - 4)\hat{i}$

$\vec{E} = (-8x + 8)\hat{i}$

$\vec{E}_{x=2} = -8\hat{i}$ V/m

26. Answer (3)

Hint & Sol.: $W = q\Delta V$

$= -e(-20 + 60) = -40$ eV

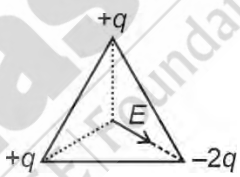
27. Answer (2)

Hint: Use principle of superposition

Sol.: For potential:

$V = \frac{kq}{r} + \frac{kq}{r} - \frac{2qk}{r} = 0$

For electric field:



28. Answer (4)

Hint: Force between two charges in a medium $= \frac{q_1 q_2}{4\pi\varepsilon_0 r^2 K}$, where K is dielectric constant

Sol.: $F_{\text{medium}} = 2F_{\text{air}}$

$\frac{q_1 q_2}{4\pi\varepsilon_0 \times 8 \times R^2} = \frac{2q_1 q_2}{4\pi\varepsilon_0 r^2}$

$R^2 = \frac{r^2}{16}$

$R = \frac{r}{4}$

29. Answer (4)

Hint & Sol.: If an electric dipole is kept in uniform electric field, then it will experience zero force and torque may or may not be zero.

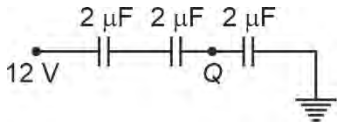
30. Answer (3)

Hint & Sol.: A negatively charged body has extra electrons. So, mass of the body increases and charges are additive in nature.

31. Answer (2)

Hint: Use $V = \frac{q}{C}$

Sol.:



$12 = \frac{q}{2} + \frac{q}{2} + \frac{q}{2}$

q = 8 μC

$12 - V_Q = \frac{8}{2} + \frac{8}{2}$

V_Q = 12 – 8 = 4 V

32. Answer (3)

Hint: Use relation between electrostatic field and electrostatic potential, $\Delta V = -\int E dx$ [Area under E versus x curve]

Sol.: $\int_0^V dV = -\int_0^4 E dx$ = – Area of trapezium

V = –30 V

33. Answer (2)

Hint & Sol.: Capacitance of isolated spherical conductor, $C = 4\pi\varepsilon_0\left(\frac{R}{2}\right)$

$= 2\pi\varepsilon_0 R$

34. Answer (1)

Hint: Use $C_{eq} = \frac{A\varepsilon_0}{\frac{t_1}{k_1} + \frac{t_2}{k_2}}$

Sol.: $C_{eq} = \frac{A\varepsilon_0}{\frac{d/3}{2} + \frac{2d/3}{1}}$

$= \frac{A\varepsilon_0}{\frac{d}{6} + \frac{2d}{3}} = \frac{6A\varepsilon_0}{5d}$

35. Answer (2)

Hint: Use $F = \frac{kq_1q_2}{r^2}$

Sol.: $F_1 = \frac{3q^2k}{r^2}$

$F_2 = \frac{kQq}{\left(\frac{r}{2}\right)^2}$

$\vec{F}_1 + \vec{F}_2 = 0$

$4Q + 3q = 0$

$Q = \frac{-3q}{4}$

SECTION-B

36. Answer (3)

Hint: Use relation between electrostatic field and electrostatic potential, $\vec{E} = -\frac{\partial V}{\partial x}\hat{i} - \frac{\partial V}{\partial y}\hat{j} - \frac{\partial V}{\partial z}\hat{k}$

Sol.: $E_x = -\frac{\partial}{\partial x}(-4x + 3y) = 4$

$E_y = -\frac{\partial}{\partial y}(-4x + 3y) = -3$

$\vec{E} = 4\hat{i} - 3\hat{j}$

$\left|\vec{E}\right| = \sqrt{4^2 + 3^2} = 5$

37. Answer (3)

Hint & Sol.: In a uniform electric field $\overrightarrow{\Delta V} = -\vec{E} \cdot \overrightarrow{\Delta r}$

Hence $V_A > V_C = V_B > V_D$

38. Answer (2)

Hint & Sol.:

Case-I: For $r < R$

$E \propto r$

Case-II: For $r \geq R$

$E \propto \frac{1}{r^2}$

39. Answer (2)

Hint & Sol.: Energy stored in the capacitor will be half of the work done by the battery.

40. Answer (3)

Hint: When a charged capacitor is connected with uncharged capacitor, then charge will flow until potential difference is same across both capacitors.

Sol.: By charge conservation,

$Q_i = Q_f$

$\Rightarrow$ 20 × 100 = (20 + C)40

C = 50 – 20 = 30 μF

41. Answer (4)

Hint: Dipole moment is given by $P = ql$

Sol.: $P = \sqrt{P_1^2 + P_2^2 + 2P_1P_2\cos\theta}$ and $\theta = 90°$

$P = \sqrt{P_1^2 + P_2^2}$

$= \sqrt{(2qa)^2 + (aq)^2} = \sqrt{5}qa$

42. Answer (2)

Hint: When two conductors are connected through a wire, then charge flows until they attain common potential.

Sol.: Let q_1 charge flows from smaller to bigger sphere: $\frac{q-q_1}{4\pi\varepsilon_0 R}=\frac{q+q_1}{4\pi\varepsilon_0(2R)}$

$2q - 2q_1 = q + q_1$

$q_1=\frac{q}{3}$

$V_{common}=\frac{q-q_1}{4\pi\varepsilon_0 R}$

$=\frac{2q}{3\times 4\pi\varepsilon_0 R}$

$=\frac{q}{6\pi\varepsilon_0 R}$

43. Answer (1)

Hint & Sol.: In order to protect from lightning we prefer to remain in car, because electrostatic shielding will be done by conductor.

44. Answer (2)

Hint: Potential energy of system of two charges separated by distance 'r' is $U=\frac{kq_1q_2}{r}$

Sol.: $U=\frac{3kq^2}{r}+\frac{kxq^2}{r}+\frac{3kxq^2}{r}$

$U=\frac{3kq^2}{r}+\frac{4kxq^2}{r}$

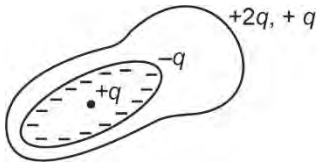
$U = 0$

$\frac{3kq^2}{r}+\frac{4kxq^2}{r}=0$

$x=-\frac{3}{4}$

45. Answer (4)

Hint & Sol.:



Charge on outer surface = $2q + q = 3q$

46. Answer (1)

Hint: Electric field at a point which lies outside the charged spherical conductor is given by $E=\frac{kq}{r^2}$

Sol.: Potential difference: $\frac{kq}{r}-\frac{kq}{2r}=V$

$kq = (2rV)$

Electric field at distance $2r$:

$E=\frac{kq}{(2r)^2}=\frac{V}{2r}$

47. Answer (4)

Hint & Sol.: Potential energy of an electric dipole placed in uniform electric field is given by $U=-\vec{P}\cdot\vec{E}$

$U = 0$

$\cos\theta = 0$

$\theta = 90°$

48. Answer (1)

Hint: $\frac{1}{C_S}=\frac{1}{C_1}+\frac{1}{C_2}$

$C_P = C_1 + C_2$

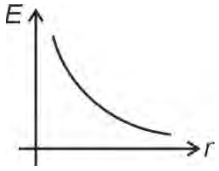
Sol.:

$C_{AB} = C + 2C = 3C$

49. Answer (2)

Hint: Electric field due to uniformly charged infinite wire is given by $E=\frac{\lambda}{2\pi\varepsilon_0 r}$

Sol.: $E\propto\frac{1}{r}$



50. Answer (3)

Hint & Sol.: When two concentric conducting shells are joined by a conducting wire, then all the charge of inner surface flows to the outer surface.

[CHEMISTRY]

SECTION-A

51. Answer (3)

Hint: Molality $=\frac{\text{Mole of solute}\times 1000}{\text{Mass of solvent (in g)}}$

Sol.: Mole of urea = 0.04

Mole of water = (1 – 0.04) = 0.96

Molality $=\frac{0.04\times 1000}{0.96\times 18}=2.3$ m

52. Answer (4)

Hint: In case of positive deviation from Raoult's law, A-B interactions are weaker than those between A-A or B-B interactions.

Sol.: Solutions which show positive deviations are

(a) Ethanol and acetone

(b) Carbon disulphide and acetone

- Mixture of bromoethane and chloroethane behaves as ideal solution.
- Mixture of phenol and aniline shows negative deviation from Raoult's law.

53. Answer (2)

Hint: Mole of $HNO_3 = 500 \times 4 \times 10^{-3}$

Sol.: Mass of $HNO_3 = 500 \times 4 \times 10^{-3} \times 63$

$= 126$ g

Let mass of concentrated HNO_3 solution be x g.

$$\frac{126}{x} \times 100 = 70$$

$$\Rightarrow \quad x = \frac{126 \times 100}{70} = 180 \text{ g}$$

Mass of HNO_3 solution = 180 g

54. Answer (2)

Hint: $\Delta_r G^\circ = -nFE^\circ_{cell}$

Sol.: $E^\circ_{cell} = E^\circ_{Ag^+/Ag} - E^\circ_{Ni^{2+}/Ni}$

$= 0.80 + 0.25 = 1.05$ V

$\Delta_r G^\circ = -2 \times 96500 \times 1.05$

$= -202.65$ kJ mol^{-1}

55. Answer (3)

Hint: Charge = Current × time

Sol.: $Q = 3.86 \times 100 \times 60 = 23160$

Number of faraday passed $= \frac{23160}{96500} = 0.24$

Mass of copper deposited $= 0.24 \times \frac{63.5}{2} = 7.62$ g

56. Answer (2)

Hint: • H^+ ion has exceptionally high conductivity in water.

• For other ions more is the charge more is the conductivity.

Sol.: For ions having similar charge, smaller is the ion, more is the solvation, lesser is the conductivity.

Ions	λ° (S cm^2 mol^{-1})
H^+	349.6
K^+	73.5
Ca^{2+}	119.0
Mg^{2+}	106.0

57. Answer (2)

Hint: For ideal solutions, intermolecular attractive forces between A-A and B-B are nearly, equal to those between A-B.

Sol.: For ideal solution;

$\Delta_{mix}H = 0$, $\Delta_{mix}V = 0$

$\Delta_{mix}G < 0$, $\Delta_{mix}S > 0$

58. Answer (2)

Hint: 24 g of methanol is present in 100 g of solution.

Sol.: Mass of $H_2O = 100 - 24 = 76$ g

$$\text{Molality} = \frac{\text{Mole of methanol} \times 1000}{\text{Mass of water (in g)}}$$

$$= \frac{24 \times 1000}{32 \times 76}$$

Molality = 9.87 m

59. Answer (1)

Hint: $\pi = iCRT$

Sol.:

	$BaCl_2$	$\rightleftharpoons$	Ba^{2+}	+	$2Cl^-$
Initial:	n mol		0		0
Final:	$(n - n\alpha)$ mol		$n\alpha$ mol		$2n\alpha$ mol

Total mol $= n - n\alpha + 2n\alpha + n\alpha$

$= n(1 + 2\alpha)$

$$i = \frac{n(1+2\alpha)}{n} = 1 + 2\alpha = 1 + 2 \times 0.9 = 2.8$$

$\pi = 2.8 \times 0.05 \times 0.083 \times 300 = 3.5$ bar

60. Answer (2)

Hint: $\Lambda^\circ_{m(CH_3CH_2COOH)} = \Lambda^\circ_{m(CH_3CH_2COOK)} + \Lambda^\circ_{m(HBr)} - \Lambda^\circ_{m(KBr)}$

Sol.: $\Lambda^\circ_{m(CH_3CH_2COOH)} = (z + y - x)$ S cm^2 mol^{-1}

61. Answer (2)

Hint & Sol.: In mercury cell, the electrolyte used is a paste of KOH and ZnO. Cathode used in mercury cell is paste of HgO and carbon.

62. Answer (1)

Hint: $\Delta T_f = K_f m$

Sol.: $\Delta T_f = \frac{9 \times 1000}{180 \times 250} \times 1.86 = 0.372$

Freezing point = –0.372°C

63. Answer (1)

Hint: $\Lambda_m = \frac{1000 \times k}{C}$

Sol.: $\Lambda_m = \frac{1000 \times 2.6 \times 10^{-2}}{0.25} = 104 \text{ S cm}^2 \text{ mol}^{-1}$

64. Answer (2)

Hint: $2H^+(aq) + 2e^- \rightarrow H_2(g)$

$E_{H^+/H_2} = 0 - \frac{0.0591}{2} \log \frac{p_{H_2}}{[H^+]^2}$

Sol.: pH = 8

$[H^+] = 10^{-8}$

$E_{H^+/H_2} = 0 - \frac{0.0591}{2} \log \frac{1}{(10^{-8})^2}$

$= -\frac{0.0591}{2} \times 16 = -0.473 \text{ V}$

65. Answer (2)

Hint: $Sn(s) + Cu^{2+}(aq) \rightarrow Sn^{2+}(aq) + Cu(s)$

$E^\circ_{cell} = E^\circ_R - E^\circ_L$

Sol.: $E^\circ_{cell} = 0.34 + 0.14 = 0.48 \text{ V}$

66. Answer (3)

Hint: Reaction at anode:

$2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-$

Sol.: 4 F electricity liberates 1 mole of O_2

10 F electricity liberates $\frac{1}{4} \times 10 = 2.5$ mole of O_2

Volume of O_2 liberated at STP = 2.5 × 22.4 = 56 L

67. Answer (3)

Hint: $M_1V_1 = M_2V_2$

Sol.: Volume of conc. $H_2SO_4 = \frac{100}{1.8}$ mL

Molarity of conc. H_2SO_4 (M_1) = $\frac{98 \times 1000 \times 1.8}{98 \times 100} = 18$

$M_1V_1 = M_2V_2$

or, $V_1 = \frac{M_2V_2}{M_1} = \frac{2 \times 250}{18}$

or, V_1 = 27.78 mL

68. Answer (2)

Hint: The concentration term which contains volume component is temperature dependent.

Sol.: As the temperature changes, volume also changes hence concentration of the solution varies.

Molarity and (w/V)% are temperature dependent concentration terms.

69. Answer (2)

Hint: More is the number of solute particles in the solution, lesser is the freezing point.

Sol.: Urea will not dissociate hence the number of solute particles will be least for urea solution. hence its freezing point will be maximum.

70. Answer (2)

Hint: Conductivity of CuO is 1×10^{-7} S m^{-1}

Sol.:

Material	Conductivity (S m^{-1})
Copper	5.9×10^3
Iron	1.0×10^3
CuO	1×10^{-7}

71. Answer (3)

Hint: $P_{Total} = \chi_A p^\circ_A + \chi_B p^\circ_B$

Sol.: $\chi_A = \frac{\frac{43}{86}}{\frac{43}{86} + \frac{25}{100}} = \frac{2}{3}$

$\chi_B = \frac{\frac{25}{100}}{\frac{43}{86} + \frac{25}{100}} = \frac{1}{3}$

$P_{Total} = \frac{2}{3} \times 360 + \frac{1}{3} \times 210 = 240 + 70 = 310 \text{ mm Hg}$

72. Answer (2)

Hint & Sol.: (K_b) is independent of the molality of the solution.

73. Answer (4)

Hint: If the concentration of the solutions is same at constant temperature then the solutions are said to be isotonic.

Sol.: $\frac{3}{60} = \frac{8 \times 1000}{100 \times M}$

$M = \frac{8 \times 1000 \times 60}{100 \times 3} = 1600 \text{ u}$

74. Answer (3)

Hint: Solubility of CO_2 is more than argon in water at a particular temperature.

Sol.: Lesser is the solubility of gas, more is the value of Henry's law constant.

Gas	K_H (k bar) at 298 K
Argon	40.3
CO_2	1.67

75. Answer (2)

Hint: $k = \frac{\text{Cell constant}}{R}$

Sol.: Cell constant = kR

$= 1.21 \times 90$

$= 108.9\ m^{-1}$

$= 1.09\ cm^{-1}$

76. Answer (1)

Hint & Sol.: With dilution, number of ions in the solution per unit volume decreases hence conductivity decreases.

77. Answer (1)

Hint: Q = Current (I) × time (s)

Sol.: Q = 4 × 5 × 60 = 1200 C

Charge of one electron = 1.6×10^{-19} C

Number of electrons at cathode $= \frac{1200}{1.6 \times 10^{-19}}$

$= 7.5 \times 10^{21}$

78. Answer (2)

Hint: Electrolysis of water takes place in a solution of dilute sulphuric acid.

Sol.: Reaction at anode:

$2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-$

Reaction at cathode:

$H_2O(l) + e^- \rightarrow \frac{1}{2}H_2(g) + OH^-$

79. Answer (3)

Hint: If E°_{cell} is positive the cell reaction will be spontaneous and disproportionation reaction will take place

Sol.:

- $\overset{+1}{I}O^- \rightarrow \overset{+5}{I}O_3^-$; E° = –0.14 V

  $\overset{+1}{I}O^- \rightarrow I_2^0$; E° = 0.45 V

$E^\circ_{cell} = (0.45 - 0.14)\ V = 0.31\ V$

- $\frac{1}{2}I_2^0 \rightarrow \overset{+1}{I}O^-$; E° = –0.45 V
- $\frac{1}{2}I_2^0 \rightarrow I^-$; E° = 0.54 V

$E^\circ_{cell} = 0.54 - 0.45 = 0.09\ V$

Both IO^- and I_2 will undergo disproportionation reaction.

80. Answer (2)

Hint: $\Delta G = \Delta G^\circ + RT\ln Q$

At equilibrium,

$\Delta G = 0$, $Q = K_C$

$\Delta G^\circ = -RT\ln K_C$

Sol.: $E^\circ_{cell} = \frac{2.303\ RT}{F}\log K_C$

$\Rightarrow\ 0.295 = 0.059\ \log K_C$

$\Rightarrow\ \log K_C = \frac{0.295}{0.059} = 5$

$K_C = 10^5$

81. Answer (2)

Hint: van't Hoff factor (i) = $\frac{\text{Total number of moles of particles after dissociation}}{\text{Number of moles of particles before dissociation}}$

Sol.: • $KBr \rightarrow K^+ + Br^-$

For 100% dissociation, i = 2

- $MgBr_2 \rightarrow Mg^{2+} + 2Br^-$

  Initial: 1, 0, 0

  Final: $1 - 0.75 = 0.25$, 0.75, $0.75 \times 2 = 1.5$

i = 0.25 + 0.75 + 1.5 = 2.5

- $Na_2SO_4 \rightarrow 2Na^+ + SO_4^{2-}$

  Initial: 1, 0, 0

  Final: $(1 - 0.8) = 0.2$, $0.8 \times 2 = 1.6$, 0.8

i = 0.2 + 1.6 + 0.8 = 2.6

- $AlCl_3 \rightarrow Al^{3+} + 3Cl^-$

  Initial: 1, 0, 0

  Final: $(1 - 0.6) = 0.4$, 0.6, $0.6 \times 3 = 1.8$

i = 0.4 + 0.6 + 1.8 = 2.8

82. Answer (3)

Hint: $\frac{\Delta p_1}{p_1^\circ} = x_2$

Sol.: $\frac{\Delta p_1}{p_1^\circ} = \frac{n_2}{n_1 + n_2}$

or, $\frac{10}{100}=\frac{\frac{12}{M}}{\frac{100}{100}+\frac{12}{M}}$

or, $\frac{1}{10}=\frac{\frac{12}{M}}{1+\frac{12}{M}}=\frac{12}{M}\times\frac{M}{(M+12)}$

or, M + 12 = 120

M = 120 – 12 = 108

83. Answer (3)

Hint: ΔG° is additive property while E° is not.

Sol.: $Fe^{2+} + 2e^- \rightarrow Fe$

$\Delta G_1^\circ = -nFE_1^\circ = -2F\times(-0.44) = 0.88\ F$ ...(i)

$Fe^{3+} + e^- \rightarrow Fe^{2+}$

$\Delta G_2^\circ = -F\times(0.77) = -0.77\ F$ ...(ii)

(i) + (ii) will give

$Fe^{3+} + 3e^- \rightarrow Fe\ (\Delta G_1^\circ + \Delta G_2^\circ) = 0.11\ F$

$-3\ F \times E_3 = 0.11\ F$

$E_3 = -0.037\ V$

84. Answer (2)

Hint: Electrolysis of aqueous NaCl gives Cl_2 gas at anode.

Sol.: Electrolysis of aqueous NaCl

Reaction at cathode:

$$H_2O(l) + e^- \rightarrow \frac{1}{2}H_2(g) + OH^-(aq)$$

Reaction at anode:

$$Cl^-(aq) \rightarrow \frac{1}{2}Cl_2(g) + e^-$$

85. Answer (3)

Hint: For strong electrolytes, Λ_m increases with dilution.

Sol.: $\Lambda_m = \Lambda_m^\circ - AC^{1/2}$

SECTION-B

86. Answer (3)

Hint: Lower is the value of standard reduction potential, higher is the reducing power of metal.

Sol.: Reduction potential of Mg^{2+}/Mg couple is –2.36 V which is lowest among the given couples hence reducing power of Mg is maximum.

Correct order of reducing power

Mg > Fe > Ni > Au

87. Answer (2)

Hint: $\Delta G^\circ = -nFE_{cell}^\circ$

Sol.: If $\Delta G^\circ < 0$ then $E_{cell}^\circ > 0$

Again $E_{cell}^\circ = \frac{2.303\ RT}{nF}\log K_C$

For $E_{cell}^\circ > 0$

$K_C > 1$

88. Answer (4)

Hint: Lead storage battery consists of a lead anode and a grid of lead packed with lead oxide as cathode.

Sol.: A 38% solution of H_2SO_4 is used as an electrolyte.

89. Answer (3)

Hint: $p = K_H\chi$

Sol.: $0.2\times4 = 4\times10^4\times\frac{n_{O_2}}{n_{O_2}+15}$

or, $0.8 = 4\times10^4\times\frac{n_{O_2}}{15}$ [$\because$ n_{O_2} is very small]

or, $\frac{0.8\times15}{4\times10^4} = n_{O_2}$

or, $n_{O_2} = 3\times10^{-4}$

90. Answer (4)

Hint: Mixture of ethanol-water form minimum boiling azeotrope.

Sol.: The solutions which show a large positive deviation from Raoult's form minimum boiling azeotrope.

91. Answer (2)

Hint: $\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$

Sol.: $\Lambda_m^\circ = 350 + 50 = 400\ S\ cm^2\ mol^{-1}$

$\alpha = \frac{12}{400} = 3\times10^{-2}$

$K_a = C\alpha^2 = 0.05 \times (3\times10^{-2})^2$

$K_a = 0.45\times10^{-4} = 4.5\times10^{-5}$

92. Answer (4)

Hint: In leclanche cell, cathode used is carbon (graphite) rod

Sol.:

Cell		Cathode used
Leclanche cell	-	Graphite rod
Mercury cell	-	Paste of HgO and carbon
Daniell cell	-	Copper rod
Lead storage battery	-	Grid of lead packed with PbO_2

93. Answer (2)

Hint: $R = \frac{\rho l}{A}$

Sol.: $\frac{1}{\rho} = k = \frac{l}{RA}$

or, $A = \pi r^2 = 3.14 \times 1^2 = 3.14\ cm^2$

or, $A = 3.14 \times 10^{-4}\ m^2$

$l = 20\ cm = 0.2\ m$

$k = \frac{0.2}{4 \times 10^3 \times 3.14 \times 10^{-4}} = 0.16\ S\ m^{-1}$

94. Answer (4)

Hint: $\overset{+6}{Cr}_2 O_7^{2-} + 6e^- \rightarrow 2Cr^{3+}$

Sol.: Number of faradays of electricity required

$= 1.5 \times 6 = 9$

95. Answer (3)

Hint: $E^\circ_{cell} = E^\circ_{Ag^+/Ag} - E^\circ_{Zn^{2+}/Zn}$

Sol.: $E^\circ_{cell} = 0.80 + 0.76 = 1.56\ V$

$Zn(s) + 2Ag^+(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$

$E_{cell} = E^\circ_{cell} - \frac{0.059}{2} \log \frac{[Zn^{2+}]}{[Ag^+]^2}$

$= 1.56 - \frac{0.059}{2} \log \frac{(10^{-6})}{(10^{-1})^2}$

$= 1.56 + \frac{0.059}{2} \times 4$

$= 1.56 + 0.118 = 1.678\ V$

96. Answer (3)

Hint: One faraday charge will liberate one equivalent of substance.

Sol.: Mole of Ag, Mg, Au obtained at electrodes are 1, $\frac{1}{2}$ and $\frac{1}{3}$

Mole ratio : : Ag : Mg : Au = $1 : \frac{1}{2} : \frac{1}{3} = 6 : 3 : 2$

97. Answer (2)

Hint & Sol: Two solutions having same osmotic pressure at a given temperature are called isotonic solutions.

98. Answer (4)

Hint: $\Delta T_b = K_b m$

Sol.: $\Delta T_b = 0.52 \times \frac{6.84 \times 1000}{342 \times 100}$

$\Delta T_b = 0.104$

Boiling point (T_b) = 100.1°C

99. Answer (2)

Hint: $M_1V_1 + M_2V_2 = M_3V_3$

Sol.: $M_3 \times (800 + 800) = 800 \times 4 + 800 \times 1$

or, $M_3 = \frac{4000}{1600} = 2.5$

100. Answer (2)

Hint: For a solution undergoing negative deviation from Raoult's law, the intermolecular attractive forces between A-A and B-B are weaker than those between A-B hence $\Delta H_{mix} < 0$.

Sol.: For a solution showing negative deviation from Raoult's law,

$\Delta H_{mix} < 0$, $\Delta G_{mix} < 0$ and $\Delta S_{mix} > 0$.

[BOTANY]

SECTION-A

101. Answer (4)

Hint: Nucellus forms the body of ovule and it gives rise to megaspore mother cell.

Sol.: Funicle helps in the attachment of ovule to the placenta. Cells of nucellus have abundant reserve food material. Nucellus can form apomictic embryo in *Citrus*.

102. Answer (3)

Hint: Meiosis is a reductional division.

Sol.: In over 60 percent of angiosperms, pollen grains are shed at 2-celled stage, which is the result of asymmetric mitosis.

103. Answer (2)

Hint: Pollen mother cell (PMC) undergoes meiosis to form microspores.

Sol.: In pollen grain, generative cell divides mitotically to give rise to the two male gametes. 1 meiotic and 2 mitotic divisions occur for the formation of two male gametes from pollen mother cell (PMC).

104. Answer (4)

Hint: Remains of nucellus are found in perispermic seeds.

Sol.: Black pepper and beet are perispermic seeds.

105. Answer (1)

Hint: *Eichhornia* is entomophilous flower.

Sol.: Not all aquatic plants are pollinated by water.

Pollination in water hyacinth and water lily occur by insects or wind.

106. Answer (2)

Hint: Filament is long and slender stalk.

Sol.: The proximal end of the filament is attached to the thalamus or the petal of the flower.

107. Answer (4)

Hint: Anther is the terminal bilobed structure of stamen.

Sol.: A typical angiosperm anther is bilobed, dithecous and tetrasporangiate. The connective of the anther is made up of vasculated sterile tissue.

108. Answer (2)

Hint: Apocarpous gynoecium is found in *Michelia*.

Sol.: In *Michelia*, gynoecium have more than one pistil, which are free from each other.

109. Answer (2)

Hint: Majority of flowering plants use biotic agents for pollination.

Sol.: In unisexual female flowers, emasculation is not required. Endosperm development precedes embryo development. Continuous self-pollination results in inbreeding depression.

110. Answer (2)

Hint: Pollination does not guarantee the transfer of the right type of pollen to the stigma.

Sol.: Pollination by wind is more common amongst abiotic pollinations. Wind pollination is quite common in grasses.

111. Answer (3)

Hint: Generative cell floats in the cytoplasm of vegetative cell.

Sol.: Generative cell is small, spindle shaped with dense cytoplasm and a nucleus.

112. Answer (4)

Hint: Self-incompatibility is a genetically controlled mechanism.

Sol.: Outbreeding device like self-incompatibility promotes cross-pollination. All others are going to promote self-pollination.

113. Answer (2)

Hint: Maize is pollinated by wind.

Sol.: Wind-pollinated flowers possess single ovule in each ovary. The pollen grains of wind-pollinated flowers are light and non-sticky.

Nectaries are present in insect pollinated flowers.

114. Answer (3)

Hint: Cleistogamy is a condition in which flowers do not open at all.

Sol.: Xenogamy brings genetically different types of pollen grains to stigma. Geitonogamy is genetically similar to autogamy. Some plants like *Viola* (common pansy), produce both types of flowers, *i.e.*, cleistogamous and chasmogamous.

115. Answer (3)

Hint: Megaspore mother cell (MMC) undergoes reductional division during megasporogenesis.

Sol.: The MMC undergoes meiosis and forms a linear tetrad of four haploid megaspores. Out of which, one remains functional (chalazal end) and three degenerate (micropylar end).

116. Answer (2)

Hint: Pollenkitt is the sticky covering found on the surface of pollen grain.

Sol.: Pollen grains are well-preserved as fossils because of the presence of sporopollenin.

117. Answer (1)

Hint: Endosperm in angiosperm is formed by triple fusion.

Sol.: Endosperm in angiosperm is formed by fusion of one male gamete with two polar nuclei.

Male plant (4n) Female plant (2n)

↓ ↓

gamete (2n) gamete (n)

Endosperm = 2n + n + n = 4n → Tetraploid

118. Answer (1)

Hint: Papaya is a dioecious plant.

Sol.: In dioecious plant, autogamy as well as geitonogamy are prevented.

119. Answer (3)

Hint: Microsporogenesis occurs in sporogenous tissue of anther.

Sol.: The formation of haploid microspores from diploid microspore mother cells inside pollen sac by meiotic division is called microsporogenesis.

120. Answer (3)

Hint: Some entomophilous flower produce foul odour to attract insects.

Sol: Mammals, tree dwelling rodents and some reptiles are reported as pollinators for different plant species.

121. Answer (2)

Hint: Both wind and water pollinated flowers are not very colourful and do not produce nectar.

Sol.: In most of the water-pollinated species, pollen grains are protected from wetting by a mucilaginous covering.

122. Answer (3)

Hint: False fruit is found in strawberry.

Sol.: Parthenocarpic fruit develops without the process of fertilization. False fruit is developed from other floral parts and thalamus along with the development of ovary wall, *e.g.*, Apple, Strawberry, Cashewnut.

123. Answer (4)

Hint: In embryo sac, the egg cell shows cytoplasmic polarity opposite to synergids.

Sol.: Synergids generally possess a micropylar nucleus and a chalazal vacuole. They also lack a cell wall on their chalazal side at maturity.

124. Answer (1)

Hint: Number of generations (n) of mitosis for producing 'x' cells is $x = 2^n$.

Sol.: Formation of female gametophyte from single megaspore involves 1 meiotic division and 3 mitotic generations.

125. Answer (4)

Hint: Double fertilisation involves syngamy and triple fusion.

Sol.: To ensure that only the desired pollen fall on the stigma in artificial hybridisation process emasculated flowers are to be bagged immediately after cross pollination.

126. Answer (2)

Hint: The oldest *Lupinus arcticus* excavated from Arctic Tundra.

Sol.: During an archaeological excavation at King Herod's Palace near the Dead Sea, a 2000 years old viable seed of date palm, *Phoenix dactylifera* was found.

127. Answer (4)

Hint: Seeds have better adaptive strategies for dispersal to new habitats.

Sol.: Seed forms the basis of agriculture is an advantage to humans not to angiosperms.

128. Answer (4)

Hint: In monocot, a single cotyledon called as scutellum is present.

Sol.: Remains of second cotyledon in monocots is called epiblast.

Coleoptile is the hollow foliar structure enclosing shoot apex and few leaf primordia.

Coleorhiza is an undifferentiated sheath enclosing radicle and root cap.

129. Answer (2)

Hint: The mass of cells called nucellus is enclosed within the integuments.

Sol.: Ovules generally differentiate a single megaspore mother cell (MMC) in the micropylar region of the nucellus.

130. Answer (4)

Hint: Pollen grain or microspore divides mitotically to form vegetative and generative cell.

Sol.: Generative cell of pollen grain is haploid and rest are diploid in nature.

131. Answer (1)

Hint: The portion of embryonal axis above the level of cotyledons terminates with the plumule.

Sol.: Hypocotyl is the portion of embryonal axis below the level of cotyledon.

132. Answer (2)

Hint: Ovule is also known as megasporangium

Sol.: Embryo sac is also called female gametophyte.

133. Answer (2)

Hint: Inner layer of seed coat is tegmen.

Sol.: Outer layer of seed coat is testa.

134. Answer (4)

Hint: Aleurone layer is triploid.

Sol.: Aleurone layer represents the outer covering of endosperm. The number of chromosomes will be $\frac{20}{2} \times 3 = 30$.

135. Answer (2)

Hint: Ovule is known as megasporangium

Sol.: Sporoderm is the cell wall of pollen grain.

SECTION - B

136. Answer (1)

Hint: Antipodals are known as vegetative cells of embryo sac.

Sol.: Polar nuclei are situated below the egg in large central cell of embryo sac.

137. Answer (3)

Hint: The hard outer layer of pollen grain called exine is made up of sporopollenin.

Sol.: Intine is the inner wall of the pollen grain and made up of cellulose and pectin.

138. Answer (3)

Hint: Root cap enclosed in an undifferentiated sheath called coleorhiza.

Sol.: B represents endosperm which is a triploid nutritive tissue.

139. Answer (3)

Hint: Protandrous condition is observed in cotton.

Sol.: Bisexual flowers are not always protogynous.

140. Answer (3)

Hint: Fertilisation is a key event of sexual reproduction.

Sol.: Apomixis involve seed formation without fertilisation.

141. Answer (4)

Hint: Exine has prominent apertures called germ pores.

Sol.: Exine is hard outer layer made up of sporopollenin, one of the most resistant organic materials known.

142. Answer (2)

Hint: Production of seed without fertilisation is called apomixis.

Sol.: If hybrids are made into apomicts, there is no segregation of characters in the hybrid progeny.

143. Answer (3)

Hint: A typical angiospermic embryo sac, at maturity is 7 celled and 8-nucleate.

Sol.: In embryo sac, the egg apparatus is 3-celled and 3-nucleate.

144. Answer (1)

Hint: Not all aquatic plants use water for pollination.

Sol.: In a majority of aquatic plants such as water hyacinth and water lily, the flowers emerge above the level of water and are pollinated by insects or wind.

145. Answer (2)

Hint: In majority of angiosperms, one of the megaspores is functional while the other three degenerate.

Sol.: The MMC undergoes meiosis and forms a linear tetrad of four haploid megaspores out of which three degenerate.

For the formation of 6 embryo sac, 6 megaspore mother cells are required.

146. Answer (3)

Hint: Cleistogamy ensures seed formation even in the absence of any pollinating agent.

Sol.: Disadvantage of cleistogamy is that produced offsprings have limited genetic diversity.

147. Answer (1)

Hint: There is no correlation between the chromosome number of species and its pollen viability.

Sol.: It is possible to increase pollen viability periods by storing pollen grains for years in liquid nitrogen (–196°C).

148. Answer (4)

Hint: *Commelina* produce both types of flowers, open and closed flowers.

Sol.: Autogamy, geitonogamy and xenogamy can be observed in *Commelina*.

149. Answer (3)

Hint: In adventive embryony, embryo arises from diploid sporophytic cells.

Sol.: Embryo arises from diploid sporophytic cell such as nucellus or integuments in *Citrus,* Mango.

150. Answer (3)

Hint: Transfer of pollen grains to the stigma of a pistil is termed as pollination.

Sol.: All these events-from pollen deposition on the stigma until pollen tubes enter the ovule-are together referred to as pollen- pistil interaction.

[ZOOLOGY]

SECTION-A

151. Answer (1)

Hint: It leads to the formation of haploid cells.

Sol.: In human females, gametogenesis is called oogenesis which initiates during embryonic development. Fusion of male and female gametes is called fertilization. Attachment of blastocyst to the uterine wall is called implantation and embryonic development is known as gestation.

152. Answer (1)

Hint: It is a pre-fertilization event.

Sol.: Transfer of sperms in female reproductive tract is called insemination. There are remarkable differences between the reproductive events that occur in the male and in the female, *e.g.*, sperm formation continues even in the old men but formation of ovum ceases in women around the age of fifty years.

153. Answer (4)

Hint: Sperms are of two different types based on the sex chromosomes present in them.

Sol.: Autosomes are not responsible for determining the sex of the embryo. The presence of either X or Y chromosome in the sperm determines the sex of the embryo. As all ova have X chromosomes so, female sex chromosome is not responsible for sex determination.

154. Answer (2)

Hint: Milk is produced towards the end of the pregnancy.

Sol.: Mammary glands differentiate during pregnancy and secrete milk after child-birth.

155. Answer (3)

Hint: Primary and secondary sex organs in human males are located in the pelvis region.

Sol.: In adult human males, primary and secondary sex organs are located in the pelvis region. Scrotum helps in maintaining temperature lower than the normal internal body temperature, necessary for spermatogenesis.

156. Answer (2)

Hint: Each testis has about 250 compartments.

Sol.: In a human male, each testis has about 250 compartments called testicular lobules. So, there are about 500 lobules in testes.

157. Answer (1)

Hint: These cells provide nutrition to the male germ cells.

Sol.: Each seminiferous tubule is lined on its inside by two types of cells called male germ cells and Sertoli cells. The interstitial cells or Leydig cells and immunologically competent cells are present in the regions outside the seminiferous tubules called interstitial spaces.

158. Answer (3)

Hint: Urine is carried downwards from ureters to this structure.

Sol.: The epididymis leads to vas deferens that ascends to the abdomen and loops over the urinary bladder. It receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.

159. Answer (4)

Hint: Interstitial cells are present outside the seminiferous tubules.

Sol.: After spermiogenesis, sperm heads become embedded in the Sertoli cells, and are finally released from the seminiferous tubules by the process called spermiation.

160. Answer (3)

Hint: Maximum number is equal to the number of total digits present in all the limbs of a human.

Sol.: The glandular tissue of each breast is divided into 15-20 mammary lobes containing clusters of cells called alveoli. The mammary tubules of each lobe join to form a mammary duct. So, number of mammary lobes in a breast is equal to the number of mammary ducts.

161. Answer (1)

Hint: Structure with germinal epithelium

Sol.: Seminiferous tubules are present in human testis which is considered as a primary sex organ. The male sex accessory ducts include rete testis, vasa efferentia, epididymis and vas deferens.

162. Answer (3)

Hint: Present around urethra

Sol.: Vas deferens, seminal vesicles and bulbourethral glands are paired structures of male reproductive system whereas prostate gland is an unpaired structure.

163. Answer (4)

Hint: Fructose is present in semen.

Sol.: Penis is made up of special tissue that helps in its erection to facilitate insemination in vagina. Seminal plasma is rich in fructose, calcium and certain enzymes.

164. Answer (2)

Hint: Interstitial space is present outside the seminiferous tubules.

Sol.: Leydig cells are present in interstitium of the testis, outside the seminiferous tubules. Sertoli cells provide nutrition to the male germ cells. Granulosa cells are present around oocytes in growing follicles. Primary spermatocytes periodically undergo meiosis to form secondary spermatocytes.

165. Answer (4)

Hint: Secondary oocyte arrested in meiosis II is called ovum.

Sol.: In human females, ovum is the female gamete produced within the primary sex organ (ovary) before completion of meiosis because completion of meiosis II occurs after the entry of sperms within ovum. Ootid is formed within the secondary sex organ, *i.e.*, fallopian tube after the completion of meiosis.

166. Answer (2)

Hint: Male sex hormones

Sol.: The functions of male sex accessory ducts and glands are maintained by the testicular hormones called androgens.

167. Answer (4)

Hint: Ovulation usually takes place 14 days before menstruation.

Sol.: Menstrual cycle in human females consists of ovarian cycle and uterine cycle of equal duration. The luteal phase of ovarian cycle is of a fixed duration *i.e.*, of 14 days. So, ovulation takes place at 14^{th} day of a regular normal menstrual cycle of 28 days.

168. Answer (3)

Hint: Structure present between isthmus and infundibulum

Sol.: In human females, fertilization usually occurs in the ampullary region of oviducts when both sperms and ovum reach this region simultaneously.

169. Answer (1)

Hint: Female copulatory organ

Sol.: The female external genitalia includes mons pubis, labia majora, labia minora, clitoris and hymen. Vagina is a female accessory duct.

170. Answer (2)

Hint: Male sex accessory glands are present outside the testis.

Sol.: The male accessory glands include paired seminal vesicles, a prostate and paired bulbourethral glands.

Secretions of the epididymis, seminal vesicles and prostate gland are essential for the maturation and motility of sperms.

171. Answer (2)

Hint: Uterus opens into vagina through it.

Sol.: Uterus, cervix and vagina are unpaired structures whereas ovary, oviduct and mammary glands are paired structures in reproductive system of human females.

172. Answer (3)

Hint: Part of oviduct closest to the ovary.

Sol.: The edges of infundibulum possess finger-like projections called fimbriae, which help in collection of the ovum after ovulation. Ampulla is the widest and isthmus is the narrowest part of the fallopian tube.

173. Answer (2)

Hint: Ovaries are present in the pelvic cavity.

Sol.: The ovaries are located one on each side of the lower abdomen (pelvic cavity). Each ovary is about 2 to 4 cm in length and is connected to the pelvic wall and uterus by ligaments.

In the later phase of pregnancy, relaxin, a polypeptide hormone is produced from the ovary.

174. Answer (4)

Hint: A gonadotropin

Sol.: Levels of FSH and LH decrease during pregnancy because GnRH from hypothalamus remains inhibited due to increased plasma levels of estrogen and progesterone.

During pregnancy, function of gonadotropins is performed by hCG (Human Chorionic Gonadotropin).

175. Answer (4)

Hint: First menstruation is called menarche.

Sol.: All the events of menstrual cycle stops during pregnancy due to the increase in the levels of oestrogen, progestins and prolactin which inhibit GnRH and thus inhibits gonadotropins. The menstrual phase is followed by follicular phase. The first menstruation begins at puberty which is called menarche.

176. Answer (4)

Hint: It is a part of female external genitalia.

Sol.: Fallopian tubes/oviducts, uterus/womb and vagina are female accessory ducts. Hymen is a part of external genitalia in human females.

177. Answer (3)

Hint: Epididymis leads to vas deferens.

Sol.: Correct pathway of passage of sperms in human males is

Seminiferous tubules $\rightarrow$ Rete testis $\rightarrow$ Vasa efferentia $\rightarrow$ Epididymis $\rightarrow$ Vas deferens $\rightarrow$ Ejaculatory duct $\rightarrow$ Urethra

178. Answer (3)

Hint: LH maintains corpus luteum during luteal phase of a menstrual cycle.

Sol.: If pregnancy occurs, corpus luteum persists throughout the pregnancy and secretes progesterone. In the absence of fertilization, corpus luteum degenerates four days before next menstruation.

179. Answer (2)

Hint: Hormone secreted from growing follicles

Sol.: High concentration of estrogen causes feedback stimulation of LH from pituitary gland and GnRH from hypothalamus that leads to LH surge, responsible for ovulation.

180. Answer (4)

Hint: Gestation period in humans is of 9 months.

Sol.:

Gestation period	–	Duration of pregnancy
During 5th month of gestation	–	The first movement of foetus is observed.
By the end of 2nd trimester	–	Body is covered with fine hair.
By the end of 3rd trimester	–	Foetus is fully developed.

181. Answer (4)

Hint: FSH stimulates secretion of certain factors necessary for spermiogenesis.

Sol.: Complete development and function of seminiferous tubules require FSH and androgens.

182. Answer (3)

Hint: Conception and implantation prevent menstruation.

Sol.: After fertilisation, corpus luteum does not degenerate but secretes a large amount of progesterone which maintains the endometrium of uterus. As a result, endometrium does not disintegrate leading to amenorrhoea.

183. Answer (2)

Hint: Ovulatory phase represents the day of ovulation.

Sol.:

Menstrual phase → 3-5 days	For 28 days menstrual cycle
Ovulatory phase → One day	
Secretory phase → 14 days	
Proliferative phase → 8-11 days	

184. Answer (3)

Hint: Levels of both estrogen and progesterone increase during the luteal phase of menstrual cycle.

Sol.: Both estrogen and progesterone promote thickening of the endometrium of uterus. Estrogen inhibits milk secretion whereas prolactin and progesterone promote milk secretion. FSH promotes ovarian follicles to grow. Both estrogen and progesterone inhibits secretion of GnRH from hypothalamus.

185. Answer (4)

Hint: Implantation takes place within the glandular layer of uterus.

Sol.: In humans, embryo enters within uterus in morula stage but implantation takes place in blastocyst stage within the endometrium of uterus. Trophoblast gets attached within the endometrium of uterus and inner cell mass differentiates into the ectoderm and endoderm.

SECTION-B

186. Answer (2)

Hint: Sertoli cells are responsible for nourishment of sperms.

Sol.: Sertoli cells provide nourishment to developing germ cells and secrete certain factors which help in the process of spermiogenesis.

187. Answer (3)

Hint: Hormones act only after binding to their receptors.

Sol.: In males, FSH acts on Sertoli cells after binding to the membrane bound receptors and stimulates secretion of some factors which help in the process of spermiogenesis.

188. Answer (2)

Hint: Myometrium is made up of smooth muscles.

Sol.: Uterus is an inverted pear-shaped structure which is connected with the last part of the oviduct called isthmus. Myometrium of uterus is formed of involuntary smooth muscles which contracts during parturition and abortion.

189. Answer (2)

Hint: Hormone secreted from hypothalamus

Sol.: Oxytocin is secreted from hypothalamus and released from posterior lobe of the pituitary gland. It is responsible for milk ejection reflex as well as for foetal ejection reflex.

190. Answer (1)

Hint: Milk is ejected out through lactiferous ducts.

Sol.: The correct order of different parts of mammary gland in human females is-

Alveoli → Mammary tubules → Mammary ducts → Mammary ampulla → Lactiferous ducts → Outside

191. Answer (3)

Hint: It acts as a temporary endocrine gland.

Sol.: The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between the developing embryo (foetus) and maternal body called placenta.

192. Answer (4)

Hint: GnRH acts as 'switch on hormone' for puberty.

Sol.: Puberty does not hit humans before the age of 8 years because before that age the hypothalamus fails to secrete GnRH in a pulsatile manner. Spermatogenesis in human males starts at the age of puberty due to significant increase in the secretion of GnRH.

193. Answer (2)

Hint: Uterine contractions cause feedback stimulation of hypothalamus.

Sol.: Parturition is induced by a neuroendocrine mechanism. The signals for parturition originate from fully developed foetus and placenta which induce mild uterine contractions called foetal ejection reflex. This triggers release of oxytocin from maternal pituitary.

194. Answer (1)

Hint: Fraternal twins and monozygotic twins

Sol.: When zygote undergoes cleavage and embryo gets separated into two parts, each part can grow into two identical twins because cleavage in humans is of indeterminate type. When two eggs are released in a menstrual cycle and are fertilised by two separate sperms, they grow into non-identical twins. Hence, their cleavage and implantation occur separately.

195. Answer (2)

Hint: Acrosome covers the anterior portion of haploid nucleus.

Sol.: The sperm head contains a haploid nucleus, the anterior portion of which is covered by a cap-like structure, acrosome. The acrosome is filled with enzymes that help in the fertilization of the ovum. The middle piece of sperm possesses numerous mitochondria that produce energy for the movement of tail which in turn facilitate sperm motility essential for fertilization.

196. Answer (3)

Hint: Exclude outer layer of blastocyst

Sol.: The blastomeres in the blastocyst are arranged into an outer layer called trophoblast and an inner cell mass contains certain stem cells which have the potency to give rise to all the tissues and organs. Yolk sac is the extra-embryonic foetal membrane.

Amnion is an extra-embryonic membrane.

197. Answer (1)

Hint: % is equal to the total number of ribs in humans

Sol.: For normal fertility, at least 60% sperms in an ejaculate must have normal shape and size and at least 40% of them must show vigorous motility. So, the per cent of sperms having normal shape, size and vigorous motility is

$$=\frac{60}{100}\times\frac{40}{100}=\frac{24}{100}\times 100=24\%$$

198. Answer (3)

Hint: Meiosis-I in primary oocyte remains arrested upto puberty.

Sol.: Primary oocytes start meiosis during embryonic development and get temporarily arrested in prophase I. The primary oocyte within the tertiary follicle grows in size and completes the first meiotic division to produce secondary oocyte and first polar body. The secondary oocyte (ovum) completes its meiosis II during fertilization.

199. Answer (3)

Hint: Occurs in primary sex organ of male

Sol.: Insemination occurs in vagina. All changes that take place in sperms within female reproductive tract after insemination is called capacitation which potentiate sperms for fertilization. Release of sperms from the seminiferous tubules is called spermiation.

200. Answer (4)

Hint: Progesterone is commonly known as pregnancy hormone.

Sol.: Progesterone maintains endometrium of uterus for implantation of embryo and its further development. During 1st trimester of pregnancy, corpus luteum is the main endocrine gland which secretes progesterone. After first trimester, placenta is the main gland for secretion of progesterone. So, pregnancy will be continued if oophorectomy is performed after first trimester of gestation.

❑ ❑ ❑

All India Aakash Test Series for NEET - 2025

TEST - 1 (Code-B)

For Code-A Sol.
Click here

Test Date : 28/07/2024

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION-A

1. Answer (2)

Hint: Use $F = \frac{kq_1q_2}{r^2}$

Sol.: $F_1 = \frac{3q^2k}{r^2}$

$F_2 = \frac{kQq}{\left(\frac{r}{2}\right)^2}$

$\vec{F}_1 + \vec{F}_2 = 0$

$4Q + 3q = 0$

$Q = \frac{-3q}{4}$

2. Answer (1)

Hint: Use $C_{eq} = \frac{A\varepsilon_0}{\frac{t_1}{k_1} + \frac{t_2}{k_2}}$

Sol.: $C_{eq} = \frac{A\varepsilon_0}{\frac{d/3}{2} + \frac{2d/3}{1}}$

$= \frac{A\varepsilon_0}{\frac{d}{6} + \frac{2d}{3}} = \frac{6A\varepsilon_0}{5d}$

3. Answer (2)

Hint & Sol.: Capacitance of isolated spherical conductor, $C = 4\pi\varepsilon_0\left(\frac{R}{2}\right)$

$= 2\pi\varepsilon_0 R$

4. Answer (3)

Hint: Use relation between electrostatic field and electrostatic potential, $\Delta V = -\int E dx$ [Area under E versus x curve]

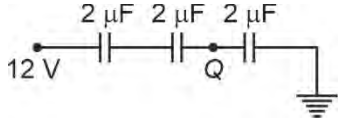
Sol.: $\int_0^V dV = -\int_0^4 E dx$ = – Area of trapezium

$V = -30$ V

5. Answer (2)

Hint: Use $V = \frac{q}{C}$

Sol.:



$12 = \frac{q}{2} + \frac{q}{2} + \frac{q}{2}$

$q = 8\ \mu C$

$12 - V_Q = \frac{8}{2} + \frac{8}{2}$

$V_Q = 12 - 8 = 4$ V

6. Answer (3)

Hint & Sol.: A negatively charged body has extra electrons. So, mass of the body increases and charges are additive in nature.

7. Answer (4)

Hint & Sol.: If an electric dipole is kept in uniform electric field, then it will experience zero force and torque may or may not be zero.

8. Answer (4)

Hint: Force between two charges in a medium $= \frac{q_1q_2}{4\pi\varepsilon_0 r^2 K}$, where K is dielectric constant

Sol.: $F_{medium} = 2F_{air}$

$\frac{q_1q_2}{4\pi\varepsilon_0 \times 8 \times R^2} = \frac{2q_1q_2}{4\pi\varepsilon_0 r^2}$

$R^2 = \frac{r^2}{16}$

$R = \frac{r}{4}$

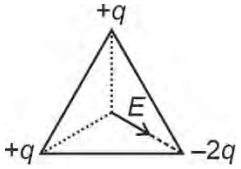
9. Answer (2)

Hint: Use principle of superposition

Sol.: For potential:

$V = \frac{kq}{r} + \frac{kq}{r} - \frac{2qk}{r} = 0$

For electric field:



10. Answer (3)

Hint & Sol.: $W = q\Delta V$

$= -e(-20 + 60) = -40$ eV

11. Answer (1)

Hint: Relation between electric field and electrostatic potential is $\vec{E} = -\frac{dV}{dx}\hat{i}$

Sol.: $\vec{E} = -\frac{d}{dx}(4x^2 - 8x - 4)\hat{i}$

$\vec{E} = (-8x + 8)\hat{i}$

$\vec{E}_{x=2} = -8\hat{i}$ V/m

12. Answer (3)

Hint: Electric flux is given by $\phi = \vec{E} \cdot \vec{A}$

Sol.: $\vec{A} = (50\hat{i})$ m^2

$\phi = (4\hat{i} + 2\hat{j} + 3\hat{k}) \cdot 50\hat{i}$

ϕ = 200 Vm

13. Answer (1)

Hint & Sol.: Unit of electrostatic pressure = $\frac{\sigma^2}{\varepsilon_0} \rightarrow \frac{\text{J}}{\text{m}^3}$

$F = \frac{q^2}{4\pi\varepsilon_0 r^2}$

$\Rightarrow \quad \varepsilon_0 \rightarrow \frac{q^2}{(F \times r)r}$

$\varepsilon_0 \rightarrow \frac{\text{C}^2}{\text{J m}}$

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

$\frac{A\varepsilon_0}{d} \rightarrow$ farad

$E = -\frac{dV}{dr}$

$\frac{V}{E} \rightarrow$ metre

14. Answer (3)

Hint: Inside the spherical shell, electric potential will be constant.

Sol.: $V = \frac{kq}{10}$

$V_1 = \frac{kq}{20}$

$V_1 = \frac{V}{2}$

15. Answer (4)

Hint: Electric potential due to a point charge at a distance r is, $V = \frac{kq}{r}$

Sol.: $V = \frac{kq}{r} + \frac{-kq}{r} + \frac{kq}{r} - \frac{kq}{r} = 0$

16. Answer (2)

Hint: When capacitor is connected to battery, its potential remains same.

Sol.: Capacitance $C = \frac{A\varepsilon_0}{d}$

As d increases, then C decreases.

$\Rightarrow$ $Q = CV$

$\therefore$ Q decreases

$\Rightarrow$ $Q = CV$; $\frac{Q}{V} = C$ = decreases

$\Rightarrow$ Energy stored $U = \frac{1}{2}CV^2$

$\because$ C decreases

$\therefore$ U also decreases

17. Answer (2)

Hint & Sol.: Electric force on a charged particle is $F = qE$

Electron moves from lower potential to higher potential.

18. Answer (1)

Hint: Energy stored across capacitor is $U = \frac{1}{2}C_{\text{eff}}V^2$

Sol.: C_{eff} = 3 μF + 3 μF = 6 μF

$U = \frac{1}{2} \times 6 \times (10)^2$

= 0.3 mJ

Work done by battery, $W = 2U$

= 0.6 mJ

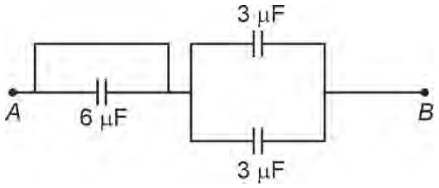
19. Answer (3)

Hint & Sol.: $q = CV$

$E = \frac{20}{2} = 10$ V

20. Answer (2)

Hint & Sol.:



C_{AB} = 3 μF + 3 μF = 6 μF

21. Answer (3)

Hint: Force of attraction between the plates is given by $F = \frac{q^2}{2\varepsilon_0 A}$ or $F \propto q^2$.

Sol.: When separation between the plates is halved, capacitance becomes two times. So charge stored in capacitor is doubled.

$\frac{F}{F_1} = \frac{q^2}{4q^2}$

$F_1 = 4F$

22. Answer (3)

Hint & Sol.: Electric flux is given by $\phi = \vec{E} \cdot \vec{A}$

$= \frac{V}{d} \cdot A$

= volt m

23. Answer (1)

Hint: Electrostatic potential due to a uniformly charged sphere at its surface, $V = \frac{\sigma R}{\varepsilon_0}$

Sol.: For same potential,

$\sigma \propto \frac{1}{R}$

$\frac{\sigma_1}{\sigma_2} = \frac{R_2}{R_1} = 2 : 1$

24. Answer (2)

Hint: Electric field due to uniformly charged sphere at its surface, $E = \frac{kq}{r^2}$

Sol.: $E = \frac{4kq}{d^2}$

$6 \times 10^6 = \frac{4 \times 9 \times 10^9 q}{16}$

$\frac{24}{9} \times 10^{-3} = q$

$q = \frac{8}{3} \times 10^{-3}$ C

25. Answer (2)

Hint: $E = \frac{\lambda}{2\pi\varepsilon_0 R}$

Sol.: $E = \frac{2\lambda}{4\pi\varepsilon_0 R}$

= 2 × 2 × 10^{-9} × 9 × 10^9 = 36 V/m

26. Answer (4)

Hint: Use $W = q\Delta V$

Sol.: $V_A = V_B = V_C = V_E = V_D$

$W = q \times 0 = 0$

27. Answer (1)

Hint: Use $V = \frac{kq}{r}$

Sol.: $N \times \frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$

$R = r N^{1/3}$

$V_b = 16 V_s$

$\frac{Nkq}{rN^{1/3}} = 16\frac{kq}{r}$

$N^{2/3} = 16$

$N = 64$

28. Answer (4)

Hint: $\Delta U = QV$

Sol.: $\Delta U = \frac{1}{2}mv^2$

$QV = \frac{1}{2}mv^2$

$v = \sqrt{\frac{2QV}{m}}$

29. Answer (2)

Hint: $dV = -\vec{E} \cdot \overrightarrow{dx}$

Sol.: $\int dV = -\int \vec{E} \cdot \overrightarrow{dx}$

$\Delta V = \int_5^{10} 20x\,dx$

$= 20\left[\frac{x^2}{2}\right]_5^{10}$

= 10[100 – 25] = 750 V

30. Answer (2)

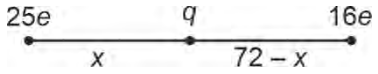
Hint: Electrostatic potential due to a dipole at a distance r making an angle θ with dipole axis is $V = \frac{kp\cos\theta}{r^2}$

Sol.: $V = \frac{9 \times 10^9 \times 4 \times 10^{-8}}{\left(\frac{3}{2}\right)^2} \times \frac{1}{2} = 80$

31. Answer (3)

Hint: Electrostatic force between two point charged particles separated by distance r is $F = \frac{kq_1q_2}{r^2}$

Sol.:



$\frac{k25eq}{x^2} = \frac{k16eq}{(72-x)^2}$

$\frac{5}{x} = \frac{4}{72-x}$

$72 \times 5 - 5x = 4x$

$x = 40$ cm

32. Answer (2)

Hint: Electrostatic force between two point charged particles separated by distance r is $F = \frac{q_1q_2}{4\pi\varepsilon_0 r^2}$

Sol.: $F = \frac{k32}{r^2}$

$F_1 = \frac{36}{r^2}$

$\frac{F}{F_1} = \frac{32}{36}$

$F_1 = \left(\frac{9F}{8}\right)$

33. Answer (3)

Hint: Electrostatic force between two point charged particles separated by distance r is $\vec{F} = \frac{q_1q_2}{4\pi\varepsilon_0 r^2}\hat{r}$

Sol.: $\vec{r} = -(2\hat{i} + 2\hat{j} + \hat{k})$

$r = \sqrt{4+4+1} = 3$

$\vec{F} = \frac{-q_1q_2}{4\pi\varepsilon_0 3^3}(2\hat{i} + 2\hat{j} + \hat{k})$

$\vec{F} = \frac{-q_1q_2}{108\pi\varepsilon_0}(2\hat{i} + 2\hat{j} + \hat{k})$

34. Answer (1)

Hint: Quantization of charge

Sol.: $q = ne$

$n = \frac{80 \times 10^{-6}}{1.6 \times 10^{-19}}$

$n = 5 \times 10^{14}$

35. Answer (3)

Hint & Sol.: Net force on q_2 will change but force between the q_1 and q_2 will remain same.

SECTION-B

36. Answer (3)

Hint & Sol.: When two concentric conducting shells are joined by a conducting wire, then all the charge of inner surface flows to the outer surface.

37. Answer (2)

Hint: Electric field due to uniformly charged infinite wire is given by $E = \frac{\lambda}{2\pi\varepsilon_0 r}$

Sol.: $E \propto \frac{1}{r}$

38. Answer (1)

Hint: $\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2}$

$C_P = C_1 + C_2$

Sol.:

$C_{AB} = C + 2C = 3C$

39. Answer (4)

Hint & Sol.: Potential energy of an electric dipole placed in uniform electric field is given by $U = -\vec{P} \cdot \vec{E}$

$U = 0$

$\cos\theta = 0$

$\theta = 90°$

40. Answer (1)

Hint: Electric field at a point which lies outside the charged spherical conductor is given by $E = \frac{kq}{r^2}$

Sol.: Potential difference: $\frac{kq}{r} - \frac{kq}{2r} = V$

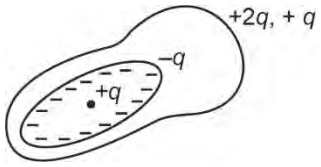
$kq = (2rV)$

Electric field at distance $2r$:

$E = \frac{kq}{(2r)^2} = \frac{V}{2r}$

41. Answer (4)

Hint & Sol.:



Charge on outer surface = $2q + q = 3q$

42. Answer (2)

Hint: Potential energy of system of two charges separated by distance 'r' is $U = \frac{kq_1q_2}{r}$

Sol.: $U = \frac{3kq^2}{r} + \frac{kxq^2}{r} + \frac{3kxq^2}{r}$

$U = \frac{3kq^2}{r} + \frac{4kxq^2}{r}$

$U = 0$

$\frac{3kq^2}{r} + \frac{4kxq^2}{r} = 0$

$x = -\frac{3}{4}$

43. Answer (1)

Hint & Sol.: In order to protect from lightning we prefer to remain in car, because electrostatic shielding will be done by conductor.

44. Answer (2)

Hint: When two conductors are connected through a wire, then charge flows until they attain common potential.

Sol.: Let q_1 charge flows from smaller to bigger sphere: $\frac{q-q_1}{4\pi\varepsilon_0 R} = \frac{q+q_1}{4\pi\varepsilon_0(2R)}$

$2q - 2q_1 = q + q_1$

$q_1 = \frac{q}{3}$

$V_{common} = \frac{q-q_1}{4\pi\varepsilon_0 R}$

$= \frac{2q}{3\times 4\pi\varepsilon_0 R}$

$= \frac{q}{6\pi\varepsilon_0 R}$

45. Answer (4)

Hint: Dipole moment is given by $P = ql$

Sol.: $P = \sqrt{P_1^2 + P_2^2 + 2P_1P_2\cos\theta}$ and $\theta = 90°$

$P = \sqrt{P_1^2 + P_2^2}$

$= \sqrt{(2qa)^2 + (aq)^2} = \sqrt{5}qa$

46. Answer (3)

Hint: When a charged capacitor is connected with uncharged capacitor, then charge will flow until potential difference is same across both capacitors.

Sol.: By charge conservation,

$Q_i = Q_f$

$\Rightarrow$ $20 \times 100 = (20 + C)40$

$C = 50 - 20 = 30\ \mu F$

47. Answer (2)

Hint & Sol.: Energy stored in the capacitor will be half of the work done by the battery.

48. Answer (2)

Hint & Sol.:

Case-I: For $r < R$

$E \propto r$

Case-II: For $r \geq R$

$E \propto \frac{1}{r^2}$

49. Answer (3)

Hint & Sol.: In a uniform electric field $\overrightarrow{\Delta V} = -\vec{E}\cdot\overrightarrow{\Delta r}$

Hence $V_A > V_C = V_B > V_D$

50. Answer (3)

Hint: Use relation between electrostatic field and electrostatic potential, $\vec{E} = -\frac{\partial V}{\partial x}\hat{i} - \frac{\partial V}{\partial y}\hat{j} - \frac{\partial V}{\partial z}\hat{k}$

Sol.: $E_x = -\frac{\partial}{\partial x}(-4x + 3y) = 4$

$E_y = -\frac{\partial}{\partial y}(-4x + 3y) = -3$

$\vec{E} = 4\hat{i} - 3\hat{j}$

$|\vec{E}| = \sqrt{4^2 + 3^2} = 5$

[CHEMISTRY]

SECTION-A

51. Answer (3)

Hint: For strong electrolytes, Λ_m increases with dilution.

Sol.: $\Lambda_m = \Lambda_m^\circ - AC^{1/2}$

52. Answer (2)

Hint: Electrolysis of aqueous NaCl gives Cl_2 gas at anode.

Sol.: Electrolysis of aqueous NaCl

Reaction at cathode:

$$H_2O(l) + e^- \rightarrow \frac{1}{2}H_2(g) + OH^-(aq)$$

Reaction at anode:

$$Cl^-(aq) \rightarrow \frac{1}{2}Cl_2(g) + e^-$$

53. Answer (3)

Hint: ΔG° is additive property while E° is not.

Sol.: $Fe^{2+} + 2e^- \rightarrow Fe$

$\Delta G_1^\circ = -nFE_1^\circ = -2F \times (-0.44) = 0.88\ F$ ...(i)

$Fe^{3+} + e^- \rightarrow Fe^{2+}$

$\Delta G_2^\circ = -F \times (0.77) = -0.77\ F$ ...(ii)

(i) + (ii) will give

$Fe^{3+} + 3e^- \rightarrow Fe$ $(\Delta G_1^\circ + \Delta G_2^\circ) = 0.11\ F$

$-3\ F \times E_3 = 0.11\ F$

$E_3 = -0.037\ V$

54. Answer (3)

Hint: $\frac{\Delta p_1}{p_1^\circ} = x_2$

Sol.: $\frac{\Delta p_1}{p_1^\circ} = \frac{n_2}{n_1 + n_2}$

or, $\frac{10}{100} = \frac{\frac{12}{M}}{\frac{100}{100} + \frac{12}{M}}$

or, $\frac{1}{10} = \frac{\frac{12}{M}}{1 + \frac{12}{M}} = \frac{12}{M} \times \frac{M}{(M+12)}$

or, $M + 12 = 120$

$M = 120 - 12 = 108$

55. Answer (2)

Hint: van't Hoff factor (i) = $\frac{\text{Total number of moles of particles after dissociation}}{\text{Number of moles of particles before dissociation}}$

Sol.: • $KBr \rightarrow K^+ + Br^-$

For 100% dissociation, i = 2

	$MgBr_2$	$\rightarrow Mg^{2+}$	$+ 2Br^-$
• Initial:	1	0	0
Final:	$1 - 0.75 = 0.25$	0.75	$0.75 \times 2 = 1.5$

i = 0.25 + 0.75 + 1.5 = 2.5

	Na_2SO_4	$\rightarrow 2Na^+$	$+ SO_4^{2-}$
• Initial:	1	0	0
Final:	$(1 - 0.8) = 0.2$	$0.8 \times 2 = 1.6$	0.8

i = 0.2 + 1.6 + 0.8 = 2.6

	$AlCl_3$	$\rightarrow Al^{3+}$	$+ 3Cl^-$
• Initial:	1	0	0
Final:	$(1 - 0.6) = 0.4$	0.6	$0.6 \times 3 = 1.8$

i = 0.4 + 0.6 + 1.8 = 2.8

56. Answer (2)

Hint: $\Delta G = \Delta G^\circ + RT\ln Q$

At equilibrium,

$\Delta G = 0$, $Q = K_C$

$\Delta G^\circ = -RT\ln K_C$

Sol.: $E_{cell}^\circ = \frac{2.303\ RT}{F} \log K_C$

$\Rightarrow$ $0.295 = 0.059 \log K_C$

$\Rightarrow$ $\log K_C = \frac{0.295}{0.059} = 5$

$K_C = 10^5$

57. Answer (3)

Hint: If E_{cell}° is positive the cell reaction will be spontaneous and disproportionation reaction will take place

Sol.:

• $\overset{+1}{I}O^- \rightarrow \overset{+5}{I}O_3^-$; $E^\circ = -0.14\ V$

$\overset{+1}{I}O^- \rightarrow I_2^0$; $E^\circ = 0.45\ V$

$E^\circ_{cell} = (0.45 - 0.14)\ V = 0.31\ V$

- $\frac{1}{2}I_2^0 \rightarrow \overset{+1}{I}O^-$; $E^\circ = -0.45$ V
- $\frac{1}{2}I_2^0 \rightarrow I^-$; $E^\circ = 0.54$ V

$E^\circ_{cell} = 0.54 - 0.45 = 0.09\ V$

Both IO^- and I_2 will undergo disproportionation reaction.

58. Answer (2)

Hint: Electrolysis of water takes place in a solution of dilute sulphuric acid.

Sol.: Reaction at anode:

$2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-$

Reaction at cathode:

$$H_2O(l) + e^- \rightarrow \frac{1}{2}H_2(g) + OH^-$$

59. Answer (1)

Hint: Q = Current (I) × time (s)

Sol.: Q = 4 × 5 × 60 = 1200 C

Charge of one electron = 1.6×10^{-19} C

Number of electrons at cathode $= \frac{1200}{1.6 \times 10^{-19}}$

$= 7.5 \times 10^{21}$

60. Answer (1)

Hint & Sol.: With dilution, number of ions in the solution per unit volume decreases hence conductivity decreases.

61. Answer (2)

Hint: $k = \frac{\text{Cell constant}}{R}$

Sol.: Cell constant = kR

$= 1.21 \times 90$

$= 108.9\ m^{-1}$

$= 1.09\ cm^{-1}$

62. Answer (3)

Hint: Solubility of CO_2 is more than argon in water at a particular temperature.

Sol.: Lesser is the solubility of gas, more is the value of Henry's law constant.

Gas	K_H (k bar) at 298 K
Argon	40.3
CO_2	1.67

63. Answer (4)

Hint: If the concentration of the solutions is same at constant temperature then the solutions are said to be isotonic.

Sol.: $\frac{3}{60} = \frac{8 \times 1000}{100 \times M}$

$M = \frac{8 \times 1000 \times 60}{100 \times 3} = 1600$ u

64. Answer (2)

Hint & Sol.: (K_b) is independent of the molality of the solution.

65. Answer (3)

Hint: $P_{Total} = \chi_A p^\circ_A + \chi_B p^\circ_B$

Sol.: $\chi_A = \frac{\frac{43}{86}}{\frac{43}{86} + \frac{25}{100}} = \frac{2}{3}$

$\chi_B = \frac{\frac{25}{100}}{\frac{43}{86} + \frac{25}{100}} = \frac{1}{3}$

$P_{Total} = \frac{2}{3} \times 360 + \frac{1}{3} \times 210 = 240 + 70 = 310$ mm Hg

66. Answer (2)

Hint: Conductivity of CuO is 1×10^{-7} S m^{-1}

Sol.:

Material	Conductivity (S m^{-1})
Copper	5.9×10^3
Iron	1.0×10^3
CuO	1×10^{-7}

67. Answer (2)

Hint: More is the number of solute particles in the solution, lesser is the freezing point.

Sol.: Urea will not dissociate hence the number of solute particles will be least for urea solution. hence its freezing point will be maximum.

68. Answer (2)

Hint: The concentration term which contains volume component is temperature dependent.

Sol.: As the temperature changes, volume also changes hence concentration of the solution varies.

Molarity and (w/V)% are temperature dependent concentration terms.

69. Answer (3)

Hint: $M_1V_1 = M_2V_2$

Sol.: Volume of conc. $H_2SO_4 = \frac{100}{1.8}$ mL

Molarity of conc. H_2SO_4 (M_1) = $\frac{98\times1000\times1.8}{98\times100} = 18$

$M_1V_1 = M_2V_2$

or, $V_1 = \frac{M_2V_2}{M_1} = \frac{2\times250}{18}$

or, $V_1 = 27.78$ mL

70. Answer (3)

Hint: Reaction at anode:

$2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-$

Sol.: 4 F electricity liberates 1 mole of O_2

10 F electricity liberates $\frac{1}{4}\times10 = 2.5$ mole of O_2

Volume of O_2 liberated at STP = 2.5 × 22.4 = 56 L

71. Answer (2)

Hint: $Sn(s) + Cu^{2+}(aq) \rightarrow Sn^{2+}(aq) + Cu(s)$

$E^\circ_{cell} = E^\circ_R - E^\circ_L$

Sol.: $E^\circ_{cell} = 0.34 + 0.14 = 0.48$ V

72. Answer (2)

Hint: $2H^+(aq) + 2e^- \rightarrow H_2(g)$

$E_{H^+/H_2} = 0 - \frac{0.0591}{2}\log\frac{p_{H_2}}{[H^+]^2}$

Sol.: pH = 8

$[H^+] = 10^{-8}$

$E_{H^+/H_2} = 0 - \frac{0.0591}{2}\log\frac{1}{(10^{-8})^2}$

$= -\frac{0.0591}{2}\times16 = -0.473$ V

73. Answer (1)

Hint: $\Lambda_m = \frac{1000\times k}{C}$

Sol.: $\Lambda_m = \frac{1000\times2.6\times10^{-2}}{0.25} = 104$ S cm^2 mol^{-1}

74. Answer (1)

Hint: $\Delta T_f = K_f m$

Sol.: $\Delta T_f = \frac{9\times1000}{180\times250}\times1.86 = 0.372$

Freezing point = –0.372°C

75. Answer (2)

Hint & Sol.: In mercury cell, the electrolyte used is a paste of KOH and ZnO. Cathode used in mercury cell is paste of HgO and carbon.

76. Answer (2)

Hint: $\Lambda^\circ_{m(CH_3CH_2COOH)} = \Lambda^\circ_{m(CH_3CH_2COOK)} + \Lambda^\circ_{m(HBr)} - \Lambda^\circ_{m(KBr)}$

Sol.: $\Lambda^\circ_{m(CH_3CH_2COOH)} = (z + y - x)$ S cm^2 mol^{-1}

77. Answer (1)

Hint: $\pi = iCRT$

Sol.:

	$BaCl_2$	$\rightleftharpoons$	Ba^{2+}	+	$2Cl^-$
Initial:	n mol		0		0
Final:	$(n - n\alpha)$ mol		$n\alpha$ mol		$2n\alpha$ mol

Total mol = $n - n\alpha + 2n\alpha + n\alpha$

$= n(1 + 2\alpha)$

$i = \frac{n(1+2\alpha)}{n} = 1 + 2\alpha = 1 + 2\times0.9 = 2.8$

$\pi = 2.8 \times 0.05 \times 0.083 \times 300 = 3.5$ bar

78. Answer (2)

Hint: 24 g of methanol is present in 100 g of solution.

Sol.: Mass of $H_2O = 100 - 24 = 76$ g

$\text{Molality} = \frac{\text{Mole of methanol}\times1000}{\text{Mass of water (in g)}}$

$= \frac{24\times1000}{32\times76}$

Molality = 9.87 m

79. Answer (2)

Hint: For ideal solutions, intermolecular attractive forces between A-A and B-B are nearly, equal to those between A-B.

Sol.: For ideal solution;

$\Delta_{mix}H = 0$, $\Delta_{mix}V = 0$

$\Delta_{mix}G < 0$, $\Delta_{mix}S > 0$

80. Answer (2)

Hint: • H^+ ion has exceptionally high conductivity in water.

• For other ions more is the charge more is the conductivity.

Sol.: For ions having similar charge, smaller is the ion, more is the solvation, lesser is the conductivity.

Ions	λ° (S cm^2 mol^{-1})
H^+	349.6
K^+	73.5
Ca^{2+}	119.0
Mg^{2+}	106.0

81. Answer (3)

Hint: Charge = Current × time

Sol.: Q = 3.86 × 100 × 60 = 23160

Number of faraday passed = $\frac{23160}{96500} = 0.24$

Mass of copper deposited = $0.24 \times \frac{63.5}{2} = 7.62$ g

82. Answer (2)

Hint: $\Delta_r G^\circ = -nFE^\circ_{cell}$

Sol.: $E^\circ_{cell} = E^\circ_{Ag^+/Ag} - E^\circ_{Ni^{2+}/Ni}$

$= 0.80 + 0.25 = 1.05$ V

$\Delta_r G^\circ = -2 \times 96500 \times 1.05$

$= -202.65$ kJ mol^{-1}

83. Answer (2)

Hint: Mole of $HNO_3 = 500 \times 4 \times 10^{-3}$

Sol.: Mass of $HNO_3 = 500 \times 4 \times 10^{-3} \times 63$

$= 126$ g

Let mass of concentrated HNO_3 solution be x g.

$\frac{126}{x} \times 100 = 70$

$\Rightarrow \quad x = \frac{126 \times 100}{70} = 180$ g

Mass of HNO_3 solution = 180 g

84. Answer (4)

Hint: In case of positive deviation from Raoult's law, A-B interactions are weaker than those between A-A or B-B interactions.

Sol.: Solutions which show positive deviations are

(a) Ethanol and acetone

(b) Carbon disulphide and acetone

- Mixture of bromoethane and chloroethane behaves as ideal solution.
- Mixture of phenol and aniline shows negative deviation from Raoult's law.

85. Answer (3)

Hint: Molality $= \frac{\text{Mole of solute} \times 1000}{\text{Mass of solvent (in g)}}$

Sol.: Mole of urea = 0.04

Mole of water = (1 – 0.04) = 0.96

Molality $= \frac{0.04 \times 1000}{0.96 \times 18} = 2.3$ m

SECTION-B

86. Answer (2)

Hint: For a solution undergoing negative deviation from Raoult's law, the intermolecular attractive forces between A-A and B-B are weaker than those between A-B hence $\Delta H_{mix} < 0$.

Sol.: For a solution showing negative deviation from Raoult's law,

$\Delta H_{mix} < 0$, $\Delta G_{mix} < 0$ and $\Delta S_{mix} > 0$.

87. Answer (2)

Hint: $M_1V_1 + M_2V_2 = M_3V_3$

Sol.: $M_3 \times (800 + 800) = 800 \times 4 + 800 \times 1$

or, $M_3 = \frac{4000}{1600} = 2.5$

88. Answer (4)

Hint: $\Delta T_b = K_b m$

Sol.: $\Delta T_b = 0.52 \times \frac{6.84 \times 1000}{342 \times 100}$

$\Delta T_b = 0.104$

Boiling point (T_b) = 100.1°C

89. Answer (2)

Hint & Sol: Two solutions having same osmotic pressure at a given temperature are called isotonic solutions.

90. Answer (3)

Hint: One faraday charge will liberate one equivalent of substance.

Sol.: Mole of Ag, Mg, Au obtained at electrodes are 1, $\frac{1}{2}$ and $\frac{1}{3}$

Mole ratio : : Ag : Mg : Au = 1 : $\frac{1}{2}$: $\frac{1}{3}$ = 6 : 3 : 2

91. Answer (3)

Hint: $E^\circ_{cell} = E^\circ_{Ag^+/Ag} - E^\circ_{Zn^{2+}/Zn}$

Sol.: $E^\circ_{cell} = 0.80 + 0.76 = 1.56$ V

$Zn(s) + 2Ag^+(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$

$E_{cell} = E^\circ_{cell} - \frac{0.059}{2} \log \frac{[Zn^{2+}]}{[Ag^+]^2}$

$= 1.56 - \frac{0.059}{2} \log \frac{(10^{-6})}{(10^{-1})^2}$

$= 1.56 + \frac{0.059}{2} \times 4$

$= 1.56 + 0.118 = 1.678$ V

92. Answer (4)

Hint: $\overset{+6}{Cr}_2O_7^{2-} + 6e^- \rightarrow 2Cr^{3+}$

Sol.: Number of faradays of electricity required = 1.5 × 6 = 9

93. Answer (2)

Hint: $R = \frac{\rho l}{A}$

Sol.: $\frac{1}{\rho} = k = \frac{l}{RA}$

or, $A = \pi r^2 = 3.14 \times 1^2 = 3.14\ cm^2$

or, $A = 3.14 \times 10^{-4}\ m^2$

$l = 20\ cm = 0.2\ m$

$k = \frac{0.2}{4 \times 10^3 \times 3.14 \times 10^{-4}} = 0.16\ S\ m^{-1}$

94. Answer (4)

Hint: In leclanche cell, cathode used is carbon (graphite) rod

Sol.:

Cell		Cathode used
Leclanche cell	-	Graphite rod
Mercury cell	-	Paste of HgO and carbon
Daniell cell	-	Copper rod
Lead storage battery	-	Grid of lead packed with PbO_2

95. Answer (2)

Hint: $\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$

Sol.: $\Lambda_m^\circ = 350 + 50 = 400\ S\ cm^2\ mol^{-1}$

$\alpha = \frac{12}{400} = 3 \times 10^{-2}$

$K_a = C\alpha^2 = 0.05 \times (3 \times 10^{-2})^2$

$K_a = 0.45 \times 10^{-4} = 4.5 \times 10^{-5}$

96. Answer (4)

Hint: Mixture of ethanol-water form minimum boiling azeotrope.

Sol.: The solutions which show a large positive deviation from Raoult's form minimum boiling azeotrope.

97. Answer (3)

Hint: $p = K_H\chi$

Sol.: $0.2 \times 4 = 4 \times 10^4 \times \frac{n_{O_2}}{n_{O_2} + 15}$

or, $0.8 = 4 \times 10^4 \times \frac{n_{O_2}}{15}$ [$\because$ n_{O_2} is very small]

or, $\frac{0.8 \times 15}{4 \times 10^4} = n_{O_2}$

or, $n_{O_2} = 3 \times 10^{-4}$

98. Answer (4)

Hint: Lead storage battery consists of a lead anode and a grid of lead packed with lead oxide as cathode.

Sol.: A 38% solution of H_2SO_4 is used as an electrolyte.

99. Answer (2)

Hint: $\Delta G^\circ = -nFE_{cell}^\circ$

Sol.: If $\Delta G^\circ < 0$ then $E_{cell}^\circ > 0$

Again $E_{cell}^\circ = \frac{2.303\ RT}{nF} \log K_C$

For $E_{cell}^\circ > 0$

$K_C > 1$

100. Answer (3)

Hint: Lower is the value of standard reduction potential, higher is the reducing power of metal.

Sol.: Reduction potential of Mg^{2+}/Mg couple is –2.36 V which is lowest among the given couples hence reducing power of Mg is maximum.

Correct order of reducing power

Mg > Fe > Ni > Au

[BOTANY]

SECTION-A

101. Answer (4)

Hint: Nucellus forms the body of ovule and it gives rise to megaspore mother cell.

Sol.: Funicle helps in the attachment of ovule to the placenta. Cells of nucellus have abundant reserve food material. Nucellus can form apomictic embryo in *Citrus*.

102. Answer (3)

Hint: Meiosis is a reductional division.

Sol.: In over 60 percent of angiosperms, pollen grains are shed at 2-celled stage, which is the result of asymmetric mitosis.

103. Answer (2)

Hint: Pollen mother cell (PMC) undergoes meiosis to form microspores.

Sol.: In pollen grain, generative cell divides mitotically to give rise to the two male gametes. 1 meiotic and 2 mitotic divisions occur for the formation of two male gametes from pollen mother cell (PMC).

104. Answer (4)

Hint: Remains of nucellus are found in perispermic seeds.

Sol.: Black pepper and beet are perispermic seeds.

105. Answer (1)

Hint: *Eichhornia* is entomophilous flower.

Sol.: Not all aquatic plants are pollinated by water.

Pollination in water hyacinth and water lily occur by insects or wind.

106. Answer (2)

Hint: Filament is long and slender stalk.

Sol.: The proximal end of the filament is attached to the thalamus or the petal of the flower.

107. Answer (4)

Hint: Anther is the terminal bilobed structure of stamen.

Sol.: A typical angiosperm anther is bilobed, dithecous and tetrasporangiate. The connective of the anther is made up of vasculated sterile tissue.

108. Answer (2)

Hint: Apocarpous gynoecium is found in *Michelia*.

Sol.: In *Michelia*, gynoecium have more than one pistil, which are free from each other.

109. Answer (2)

Hint: Majority of flowering plants use biotic agents for pollination.

Sol.: In unisexual female flowers, emasculation is not required. Endosperm development precedes embryo development. Continuous self-pollination results in inbreeding depression.

110. Answer (2)

Hint: Pollination does not guarantee the transfer of the right type of pollen to the stigma.

Sol.: Pollination by wind is more common amongst abiotic pollinations. Wind pollination is quite common in grasses.

111. Answer (3)

Hint: Generative cell floats in the cytoplasm of vegetative cell.

Sol.: Generative cell is small, spindle shaped with dense cytoplasm and a nucleus.

112. Answer (4)

Hint: Self-incompatibility is a genetically controlled mechanism.

Sol.: Outbreeding device like self-incompatibility promotes cross-pollination. All others are going to promote self-pollination.

113. Answer (2)

Hint: Maize is pollinated by wind.

Sol.: Wind-pollinated flowers possess single ovule in each ovary. The pollen grains of wind-pollinated flowers are light and non-sticky.

Nectaries are present in insect pollinated flowers.

114. Answer (3)

Hint: Cleistogamy is a condition in which flowers do not open at all.

Sol.: Xenogamy brings genetically different types of pollen grains to stigma. Geitonogamy is genetically similar to autogamy. Some plants like *Viola* (common pansy), produce both types of flowers, *i.e.*, cleistogamous and chasmogamous.

115. Answer (3)

Hint: Megaspore mother cell (MMC) undergoes reductional division during megasporogenesis.

Sol.: The MMC undergoes meiosis and forms a linear tetrad of four haploid megaspores. Out of which, one remains functional (chalazal end) and three degenerate (micropylar end).

116. Answer (2)

Hint: Pollenkitt is the sticky covering found on the surface of pollen grain.

Sol.: Pollen grains are well-preserved as fossils because of the presence of sporopollenin.

117. Answer (1)

Hint: Endosperm in angiosperm is formed by triple fusion.

Sol.: Endosperm in angiosperm is formed by fusion of one male gamete with two polar nuclei.

Male plant (4n) Female plant (2n)

↓ ↓

gamete (2n) gamete (n)

Endosperm = 2n + n + n = 4n → Tetraploid

118. Answer (1)

Hint: Papaya is a dioecious plant.

Sol.: In dioecious plant, autogamy as well as geitonogamy are prevented.

119. Answer (3)

Hint: Microsporogenesis occurs in sporogenous tissue of anther.

Sol.: The formation of haploid microspores from diploid microspore mother cells inside pollen sac by meiotic division is called microsporogenesis.

120. Answer (3)

Hint: Some entomophilous flower produce foul odour to attract insects.

Sol: Mammals, tree dwelling rodents and some reptiles are reported as pollinators for different plant species.

121. Answer (2)

Hint: Ovule is known as megasporangium

Sol.: Sporoderm is the cell wall of pollen grain.

122. Answer (4)

Hint: Aleurone layer is triploid.

Sol.: Aleurone layer represents the outer covering of endosperm. The number of chromosomes will be $\frac{20}{2} \times 3 = 30$.

123. Answer (2)

Hint: Inner layer of seed coat is tegmen.

Sol.: Outer layer of seed coat is testa.

124. Answer (2)

Hint: Ovule is also known as megasporangium

Sol.: Embryo sac is also called female gametophyte.

125. Answer (1)

Hint: The portion of embryonal axis above the level of cotyledons terminates with the plumule.

Sol.: Hypocotyl is the portion of embryonal axis below the level of cotyledon.

126. Answer (4)

Hint: Pollen grain or microspore divides mitotically to form vegetative and generative cell.

Sol.: Generative cell of pollen grain is haploid and rest are diploid in nature.

127. Answer (2)

Hint: The mass of cells called nucellus is enclosed within the integuments.

Sol.: Ovules generally differentiate a single megaspore mother cell (MMC) in the micropylar region of the nucellus.

128. Answer (4)

Hint: In monocot, a single cotyledon called as scutellum is present.

Sol.: Remains of second cotyledon in monocots is called epiblast.

Coleoptile is the hollow foliar structure enclosing shoot apex and few leaf primordia.

Coleorhiza is an undifferentiated sheath enclosing radicle and root cap.

129. Answer (4)

Hint: Seeds have better adaptive strategies for dispersal to new habitats.

Sol.: Seed forms the basis of agriculture is an advantage to humans not to angiosperms.

130. Answer (2)

Hint: The oldest *Lupinus arcticus* excavated from Arctic Tundra.

Sol.: During an archaeological excavation at King Herod's Palace near the Dead Sea, a 2000 years old viable seed of date palm, *Phoenix dactylifera* was found.

131. Answer (4)

Hint: Double fertilisation involves syngamy and triple fusion.

Sol.: To ensure that only the desired pollen fall on the stigma in artificial hybridisation process emasculated flowers are to be bagged immediately after cross pollination.

132. Answer (1)

Hint: Number of generations (n) of mitosis for producing 'x' cells is $x = 2^n$.

Sol.: Formation of female gametophyte from single megaspore involves 1 meiotic division and 3 mitotic generations.

133. Answer (4)

Hint: In embryo sac, the egg cell shows cytoplasmic polarity opposite to synergids.

Sol.: Synergids generally possess a micropylar nucleus and a chalazal vacuole. They also lack a cell wall on their chalazal side at maturity.

134. Answer (3)

Hint: False fruit is found in strawberry.

Sol.: Parthenocarpic fruit develops without the process of fertilization. False fruit is developed from other floral parts and thalamus along with the development of ovary wall, *e.g.*, Apple, Strawberry, Cashewnut.

135. Answer (2)

Hint: Both wind and water pollinated flowers are not very colourful and do not produce nectar.

Sol.: In most of the water-pollinated species, pollen grains are protected from wetting by a mucilaginous covering.

SECTION - B

136. Answer (3)

Hint: Transfer of pollen grains to the stigma of a pistil is termed as pollination.

Sol.: All these events-from pollen deposition on the stigma until pollen tubes enter the ovule-are together referred to as pollen- pistil interaction.

137. Answer (3)

Hint: In adventive embryony, embryo arises from diploid sporophytic cells.

Sol.: Embryo arises from diploid sporophytic cell such as nucellus or integuments in *Citrus,* Mango.

138. Answer (4)

Hint: *Commelina* produce both types of flowers, open and closed flowers.

Sol.: Autogamy, geitonogamy and xenogamy can be observed in *Commelina*.

139. Answer (1)

Hint: There is no correlation between the chromosome number of species and its pollen viability.

Sol.: It is possible to increase pollen viability periods by storing pollen grains for years in liquid nitrogen (–196°C).

140. Answer (3)

Hint: Cleistogamy ensures seed formation even in the absence of any pollinating agent.

Sol.: Disadvantage of cleistogamy is that produced offsprings have limited genetic diversity.

141. Answer (2)

Hint: In majority of angiosperms, one of the megaspores is functional while the other three degenerate.

Sol.: The MMC undergoes meiosis and forms a linear tetrad of four haploid megaspores out of which three degenerate.

For the formation of 6 embryo sac, 6 megaspore mother cells are required.

142. Answer (1)

Hint: Not all aquatic plants use water for pollination.

Sol.: In a majority of aquatic plants such as water hyacinth and water lily, the flowers emerge above the level of water and are pollinated by insects or wind.

143. Answer (3)

Hint: A typical angiospermic embryo sac, at maturity is 7 celled and 8-nucleate.

Sol.: In embryo sac, the egg apparatus is 3-celled and 3-nucleate.

144. Answer (2)

Hint: Production of seed without fertilisation is called apomixis.

Sol.: If hybrids are made into apomicts, there is no segregation of characters in the hybrid progeny.

145. Answer (4)

Hint: Exine has prominent apertures called germ pores.

Sol.: Exine is hard outer layer made up of sporopollenin, one of the most resistant organic materials known.

146. Answer (3)

Hint: Fertilisation is a key event of sexual reproduction.

Sol.: Apomixis involve seed formation without fertilisation.

147. Answer (3)

Hint: Protandrous condition is observed in cotton.

Sol.: Bisexual flowers are not always protogynous.

148. Answer (3)

Hint: Root cap enclosed in an undifferentiated sheath called coleorhiza.

Sol.: B represents endosperm which is a triploid nutritive tissue.

149. Answer (3)

Hint: The hard outer layer of pollen grain called exine is made up of sporopollenin.

Sol.: Intine is the inner wall of the pollen grain and made up of cellulose and pectin.

150. Answer (1)

Hint: Antipodals are known as vegetative cells of embryo sac.

Sol.: Polar nuclei are situated below the egg in large central cell of embryo sac.

[ZOOLOGY]

SECTION-A

151. Answer (4)

Hint: Implantation takes place within the glandular layer of uterus.

Sol.: In humans, embryo enters within uterus in morula stage but implantation takes place in blastocyst stage within the endometrium of uterus. Trophoblast gets attached within the endometrium of uterus and inner cell mass differentiates into the ectoderm and endoderm.

152. Answer (3)

Hint: Levels of both estrogen and progesterone increase during the luteal phase of menstrual cycle.

Sol.: Both estrogen and progesterone promote thickening of the endometrium of uterus. Estrogen

inhibits milk secretion whereas prolactin and progesterone promote milk secretion. FSH promotes ovarian follicles to grow. Both estrogen and progesterone inhibits secretion of GnRH from hypothalamus.

153. Answer (2)

Hint: Ovulatory phase represents the day of ovulation.

Sol.:

Menstrual phase → 3-5 days	For 28 days menstrual cycle
Ovulatory phase → One day	
Secretory phase → 14 days	
Proliferative phase → 8-11 days	

154. Answer (3)

Hint: Conception and implantation prevent menstruation.

Sol.: After fertilisation, corpus luteum does not degenerate but secretes a large amount of progesterone which maintains the endometrium of uterus. As a result, endometrium does not disintegrate leading to amenorrhoea.

155. Answer (4)

Hint: FSH stimulates secretion of certain factors necessary for spermiogenesis.

Sol.: Complete development and function of seminiferous tubules require FSH and androgens.

156. Answer (4)

Hint: Gestation period in humans is of 9 months.

Sol.:

Gestation period	–	Duration of pregnancy
During 5th month of gestation	–	The first movement of foetus is observed.
By the end of 2nd trimester	–	Body is covered with fine hair.
By the end of 3rd trimester	–	Foetus is fully developed.

157. Answer (2)

Hint: Hormone secreted from growing follicles

Sol.: High concentration of estrogen causes feedback stimulation of LH from pituitary gland and GnRH from hypothalamus that leads to LH surge, responsible for ovulation.

158. Answer (3)

Hint: LH maintains corpus luteum during luteal phase of a menstrual cycle.

Sol.: If pregnancy occurs, corpus luteum persists throughout the pregnancy and secretes progesterone. In the absence of fertilization, corpus luteum degenerates four days before next menstruation.

159. Answer (3)

Hint: Epididymis leads to vas deferens.

Sol.: Correct pathway of passage of sperms in human males is

Seminiferous tubules → Rete testis → Vasa efferentia → Epididymis → Vas deferens → Ejaculatory duct → Urethra

160. Answer (4)

Hint: It is a part of female external genitalia.

Sol.: Fallopian tubes/oviducts, uterus/womb and vagina are female accessory ducts. Hymen is a part of external genitalia in human females.

161. Answer (4)

Hint: First menstruation is called menarche.

Sol.: All the events of menstrual cycle stops during pregnancy due to the increase in the levels of oestrogen, progestins and prolactin which inhibit GnRH and thus inhibits gonadotropins. The menstrual phase is followed by follicular phase. The first menstruation begins at puberty which is called menarche.

162. Answer (4)

Hint: A gonadotropin

Sol.: Levels of FSH and LH decrease during pregnancy because GnRH from hypothalamus remains inhibited due to increased plasma levels of estrogen and progesterone.

During pregnancy, function of gonadotropins is performed by hCG (Human Chorionic Gonadotropin).

163. Answer (2)

Hint: Ovaries are present in the pelvic cavity.

Sol.: The ovaries are located one on each side of the lower abdomen (pelvic cavity). Each ovary is about 2 to 4 cm in length and is connected to the pelvic wall and uterus by ligaments.

In the later phase of pregnancy, relaxin, a polypeptide hormone is produced from the ovary.

164. Answer (3)

Hint: Part of oviduct closest to the ovary.

Sol.: The edges of infundibulum possess finger-like projections called fimbriae, which help in collection of the ovum after ovulation. Ampulla is the widest and isthmus is the narrowest part of the fallopian tube.

165. Answer (2)

Hint: Uterus opens into vagina through it.

Sol.: Uterus, cervix and vagina are unpaired structures whereas ovary, oviduct and mammary glands are paired structures in reproductive system of human females.

166. Answer (2)

Hint: Male sex accessory glands are present outside the testis.

Sol.: The male accessory glands include paired seminal vesicles, a prostate and paired bulbourethral glands.

Secretions of the epididymis, seminal vesicles and prostate gland are essential for the maturation and motility of sperms.

167. Answer (1)

Hint: Female copulatory organ

Sol.: The female external genitalia includes mons pubis, labia majora, labia minora, clitoris and hymen. Vagina is a female accessory duct.

168. Answer (3)

Hint: Structure present between isthmus and infundibulum

Sol.: In human females, fertilization usually occurs in the ampullary region of oviducts when both sperms and ovum reach this region simultaneously.

169. Answer (4)

Hint: Ovulation usually takes place 14 days before menstruation.

Sol.: Menstrual cycle in human females consists of ovarian cycle and uterine cycle of equal duration. The luteal phase of ovarian cycle is of a fixed duration *i.e.*, of 14 days. So, ovulation takes place at 14^{th} day of a regular normal menstrual cycle of 28 days.

170. Answer (2)

Hint: Male sex hormones

Sol.: The functions of male sex accessory ducts and glands are maintained by the testicular hormones called androgens.

171. Answer (4)

Hint: Secondary oocyte arrested in meiosis II is called ovum.

Sol.: In human females, ovum is the female gamete produced within the primary sex organ (ovary) before completion of meiosis because completion of meiosis II occurs after the entry of sperms within ovum. Ootid is formed within the secondary sex organ, *i.e.*, fallopian tube after the completion of meiosis.

172. Answer (2)

Hint: Interstitial space is present outside the seminiferous tubules.

Sol.: Leydig cells are present in interstitium of the testis, outside the seminiferous tubules. Sertoli cells provide nutrition to the male germ cells. Granulosa cells are present around oocytes in growing follicles. Primary spermatocytes periodically undergo meiosis to form secondary spermatocytes.

173. Answer (4)

Hint: Fructose is present in semen.

Sol.: Penis is made up of special tissue that helps in its erection to facilitate insemination in vagina. Seminal plasma is rich in fructose, calcium and certain enzymes.

174. Answer (3)

Hint: Present around urethra

Sol.: Vas deferens, seminal vesicles and bulbourethral glands are paired structures of male reproductive system whereas prostate gland is an unpaired structure.

175. Answer (1)

Hint: Structure with germinal epithelium

Sol.: Seminiferous tubules are present in human testis which is considered as a primary sex organ. The male sex accessory ducts include rete testis, vasa efferentia, epididymis and vas deferens.

176. Answer (3)

Hint: Maximum number is equal to the number of total digits present in all the limbs of a human.

Sol.: The glandular tissue of each breast is divided into 15-20 mammary lobes containing clusters of cells called alveoli. The mammary tubules of each lobe join to form a mammary duct. So, number of mammary lobes in a breast is equal to the number of mammary ducts.

177. Answer (4)

Hint: Interstitial cells are present outside the seminiferous tubules.

Sol.: After spermiogenesis, sperm heads become embedded in the Sertoli cells, and are finally released from the seminiferous tubules by the process called spermiation.

178. Answer (3)

Hint: Urine is carried downwards from ureters to this structure.

Sol.: The epididymis leads to vas deferens that ascends to the abdomen and loops over the urinary bladder. It receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.

179. Answer (1)

Hint: These cells provide nutrition to the male germ cells.

Sol.: Each seminiferous tubule is lined on its inside by two types of cells called male germ cells and Sertoli cells. The interstitial cells or Leydig cells and immunologically competent cells are present in the regions outside the seminiferous tubules called interstitial spaces.

180. Answer (2)

Hint: Each testis has about 250 compartments.

Sol.: In a human male, each testis has about 250 compartments called testicular lobules. So, there are about 500 lobules in testes.

181. Answer (3)

Hint: Primary and secondary sex organs in human males are located in the pelvis region.

Sol.: In adult human males, primary and secondary sex organs are located in the pelvis region. Scrotum helps in maintaining temperature lower than the normal internal body temperature, necessary for spermatogenesis.

182. Answer (2)

Hint: Milk is produced towards the end of the pregnancy.

Sol.: Mammary glands differentiate during pregnancy and secrete milk after child-birth.

183. Answer (4)

Hint: Sperms are of two different types based on the sex chromosomes present in them.

Sol.: Autosomes are not responsible for determining the sex of the embryo. The presence of either X or Y chromosome in the sperm determines the sex of the embryo. As all ova have X chromosomes so, female sex chromosome is not responsible for sex determination.

184. Answer (1)

Hint: It is a pre-fertilization event.

Sol.: Transfer of sperms in female reproductive tract is called insemination. There are remarkable differences between the reproductive events that occur in the male and in the female, *e.g.*, sperm formation continues even in the old men but formation of ovum ceases in women around the age of fifty years.

185. Answer (1)

Hint: It leads to the formation of haploid cells.

Sol.: In human females, gametogenesis is called oogenesis which initiates during embryonic development. Fusion of male and female gametes is called fertilization. Attachment of blastocyst to the uterine wall is called implantation and embryonic development is known as gestation.

SECTION-B

186. Answer (4)

Hint: Progesterone is commonly known as pregnancy hormone.

Sol.: Progesterone maintains endometrium of uterus for implantation of embryo and its further development. During 1st trimester of pregnancy, corpus luteum is the main endocrine gland which secretes progesterone. After first trimester, placenta is the main gland for secretion of progesterone. So, pregnancy will be continued if oophorectomy is performed after first trimester of gestation.

187. Answer (3)

Hint: Occurs in primary sex organ of male

Sol.: Insemination occurs in vagina. All changes that take place in sperms within female reproductive tract after insemination is called capacitation which potentiate sperms for fertilization. Release of sperms from the seminiferous tubules is called spermiation.

188. Answer (3)

Hint: Meiosis-I in primary oocyte remains arrested upto puberty.

Sol.: Primary oocytes start meiosis during embryonic development and get temporarily arrested in prophase I. The primary oocyte within the tertiary follicle grows in size and completes the first meiotic division to produce secondary oocyte and first polar body. The secondary oocyte (ovum) completes its meiosis II during fertilization.

189. Answer (1)

Hint: % is equal to the total number of ribs in humans

Sol.: For normal fertility, at least 60% sperms in an ejaculate must have normal shape and size and at least 40% of them must show vigorous motility. So, the per cent of sperms having normal shape, size and vigorous motility is

$$= \frac{60}{100} \times \frac{40}{100} = \frac{24}{100} \times 100 = 24\%$$

190. Answer (3)

Hint: Exclude outer layer of blastocyst

Sol.: The blastomeres in the blastocyst are arranged into an outer layer called trophoblast and an inner cell mass contains certain stem cells which have the potency to give rise to all the tissues and organs. Yolk sac is the extra-embryonic foetal membrane.

Amnion is an extra-embryonic membrane.

191. Answer (2)

Hint: Acrosome covers the anterior portion of haploid nucleus.

Sol.: The sperm head contains a haploid nucleus, the anterior portion of which is covered by a cap-like structure, acrosome. The acrosome is filled with enzymes that help in the fertilization of the ovum. The middle piece of sperm possesses numerous mitochondria that produce energy for the movement of tail which in turn facilitate sperm motility essential for fertilization.

192. Answer (1)

Hint: Fraternal twins and monozygotic twins

Sol.: When zygote undergoes cleavage and embryo gets separated into two parts, each part can grow into two identical twins because cleavage in humans is of indeterminate type. When two eggs are released in a menstrual cycle and are fertilised by two separate sperms, they grow into non-identical twins. Hence, their cleavage and implantation occur separately.

193. Answer (2)

Hint: Uterine contractions cause feedback stimulation of hypothalamus.

Sol.: Parturition is induced by a neuroendocrine mechanism. The signals for parturition originate from fully developed foetus and placenta which induce mild uterine contractions called foetal ejection reflex. This triggers release of oxytocin from maternal pituitary.

194. Answer (4)

Hint: GnRH acts as 'switch on hormone' for puberty.

Sol.: Puberty does not hit humans before the age of 8 years because before that age the hypothalamus fails to secrete GnRH in a pulsatile manner. Spermatogenesis in human males starts at the age of puberty due to significant increase in the secretion of GnRH.

195. Answer (3)

Hint: It acts as a temporary endocrine gland.

Sol.: The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between the developing embryo (foetus) and maternal body called placenta.

196. Answer (1)

Hint: Milk is ejected out through lactiferous ducts.

Sol.: The correct order of different parts of mammary gland in human females is-

Alveoli → Mammary tubules → Mammary ducts → Mammary ampulla → Lactiferous ducts → Outside

197. Answer (2)

Hint: Hormone secreted from hypothalamus

Sol.: Oxytocin is secreted from hypothalamus and released from posterior lobe of the pituitary gland. It is responsible for milk ejection reflex as well as for foetal ejection reflex.

198. Answer (2)

Hint: Myometrium is made up of smooth muscles.

Sol.: Uterus is an inverted pear-shaped structure which is connected with the last part of the oviduct called isthmus. Myometrium of uterus is formed of involuntary smooth muscles which contracts during parturition and abortion.

199. Answer (3)

Hint: Hormones act only after binding to their receptors.

Sol.: In males, FSH acts on Sertoli cells after binding to the membrane bound receptors and stimulates secretion of some factors which help in the process of spermiogenesis.

200. Answer (2)

Hint: Sertoli cells are responsible for nourishment of sperms.

Sol.: Sertoli cells provide nourishment to developing germ cells and secrete certain factors which help in the process of spermiogenesis.

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