All India Aakash Test Series for NEET - 2023

TEST - 1 (Code-A)

Test Date : 14/08/2022

ANSWERS

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

CLICK HERE TO JOIN CHANNEL

HINTS & SOLUTIONS

[PHYSICS]

SECTION-A

1. Answer (4)

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

Sol.: $\vec{r} = \vec{r}_2 - \vec{r}_1$

$= \left(3\hat{i} + 4\hat{j} + 4\hat{k}\right) - \left(2\hat{i} + 2\hat{j} + 2\hat{k}\right)$

$= \left(\hat{i} + 2\hat{j} + 2\hat{k}\right)$

$|\vec{r}| = \sqrt{2^2 + 2^2 + 1^2}$

= 3 m

$F = \frac{9\times10^9 \times 6\times10^{-6} \times 6\times10^{-6}}{3^2}$

$= 36\times10^{-3}\text{N} = 36 \text{ mN}$

2. Answer (3)

Hint: For maximum value of F, $\frac{dF}{dq} = 0$

Sol.: $F = \frac{k\left(\frac{2Q}{3} - q\right)q}{d^2}$

$\frac{dF}{dq} = \frac{k}{d^2}\left(-2q + \frac{2Q}{3}\right)$

$\frac{dF}{dq} = 0$

$-2q + \frac{2Q}{3} = 0$

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

3. Answer (3)

Hint and Sol.: If a point charge is brought in an electric field, then electric field at a nearby point may increase or decrease.

4. Answer (2)

Hint: $\vec{\tau} = \vec{p}\times\vec{E}$

Sol.: $\vec{\tau} = pE\sin\theta\hat{n}$

at $\theta = 0°, 180°$

$\tau = 0$

at $\theta = 90°$

$\tau = +pE$

5. Answer (1)

Hint: Use Gauss's law

Sol.: $\oint\vec{E}\cdot d\vec{A} = \frac{q_{enc}}{\varepsilon_0}$

Inside the conductor $E = 0$

$\frac{q_{enc}}{\varepsilon_0} = 0 \Rightarrow q_{enc} = 0$

6. Answer (2)

Hint: Electric force in a medium $F = \frac{q_1q_2}{4\pi\varepsilon_0 k r^2}$

Sol.: $F = \frac{q_1q_2}{4\pi\varepsilon_0 d^2}$

$F_1 = \frac{q_1q_2}{4\pi\varepsilon_0\, 4d_1^2}$

$F_1 = F$

$4d_1^2 = d^2$

$d_1 = d/2$

7. Answer (4)

Hint and Sol.: Electric lines of force does not exist in real it is an imaginary curve.

8. Answer (1)

Hint: $\oint\vec{E}\cdot d\vec{A} = \frac{q_{enc}}{\varepsilon_0}$

Sol.: $\oint_{S_1}\vec{E}\cdot d\vec{A} = \frac{q_1 + q_2}{\varepsilon_0}$

$= \frac{1\times10^{-6} + 2\times10^{-6}}{\varepsilon_0} = \frac{3\times10^{-6}}{\varepsilon_0}$

$\oint_{S_2}\vec{E}\cdot d\vec{A} = \frac{q_2 + q_3}{\varepsilon_0}$

$= \frac{2\times10^{-6} - 3\times10^{-6}}{\varepsilon_0}$

$= \frac{-1\times10^{-6}}{\varepsilon_0}$

$\oint_{S_3}\vec{E}\cdot d\vec{A} = \frac{q_1 + q_2 + q_3}{\varepsilon_0}$

$= \frac{1\times10^{-6} + 2\times10^{-6} - 3\times10^{-6}}{\varepsilon_0} = 0$

Flux is maximum for S_1

9. Answer (1)

Hint: $dV = -\vec{E}\cdot d\vec{r}$

Sol.: $dV = -\vec{E}\cdot d\vec{r}$

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

Along the electric field θ is 0°, hence $\frac{dV}{dr}$ is maximum, so the magnitude of variation of potential is maximum along the electric field.

10. Answer (2)

Hint: $W_E = q(V_A - V_B)$

Sol.: $W_E = q(V_A - V_B)$

$100\times10^{-6} = 4\times10^{-6}(V_A - V_B)$

$V_A - V_B = 25\,\text{V}$, point A is at higher potential

11. Answer (3)

Hint: $C_{eq} = \left(\frac{\varepsilon_0 A}{\frac{d}{k_1}+\frac{d}{k_2}+\frac{d}{k_3}}\right)$

Sol.: Here $k_1 = k_3 = 1, k_2 = \frac{\varepsilon}{\varepsilon_0}$

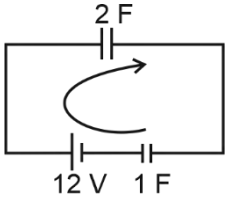
$$C_{eq} = \frac{\varepsilon_0 A}{d + \frac{d}{\left(\frac{\varepsilon}{\varepsilon_0}\right)} + d}$$

$$= \frac{\varepsilon_0 A}{2d + \frac{\varepsilon_0 d}{\varepsilon}} = \frac{\varepsilon_0 \varepsilon A}{(2\varepsilon + \varepsilon_0)d}$$

12. Answer (1)

Hint: $V_c = \frac{q}{C}$

Sol.:



$12 - \frac{q}{1} - \frac{q}{2} = 0$

$\frac{3q}{2} = 12$

$q = 8\ \mu\text{C}$

$V = \frac{q}{C} = \frac{8}{1}$

$= 8\,\text{V}$

13. Answer (3)

Hint and Sol.: Capacitance of spherical capacitor

$C = \frac{4\pi\varepsilon_0 ab}{b-a}$

$= \frac{4\pi\varepsilon_0 a\times 2a}{2a-a} = 8\pi\varepsilon_0 a$

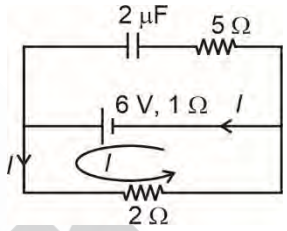
14. Answer (2)

Hint and Sol.: Dielectric strength, it is maximum electric field which a material can bear.

15. Answer (2)

Hint: In steady state no current will flow through capacitor.

Sol.:



$I = \frac{6}{1+2}$

$= 2\,\text{A}$

$V = \frac{q}{C} = 6 - 2\times1 = 4$

$q = 2\times4$

$= 8\,\mu\text{C}$

16. Answer (3)

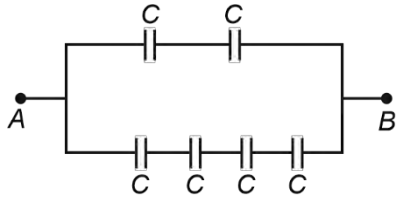
Hint: In series combination

$\frac{1}{C_{eff}} = \frac{1}{C_1}+\frac{1}{C_2}+\frac{1}{C_3}+...$

In parallel combination

$C_{eff} = C_1 + C_2 + C_3 + ...$

Sol.:



$C_{AB} = \frac{C}{4}+\frac{C}{2}$

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

17. Answer (1)

Hint: $V_c = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$

Sol.: $C_1 = C,\ C_2 = Ck, \qquad V_1 = 50\,\text{V}$

$V_c = 10\,\text{V}$

$$10 = \frac{50\times C + Ck\times 0}{C + kC}$$

$$10 = \frac{50C}{C(1+k)}$$

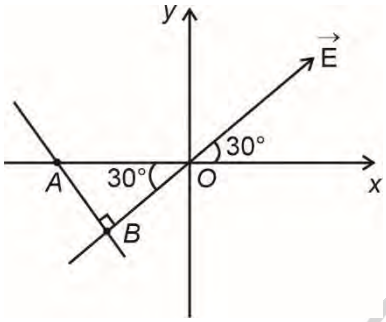
$10 + 10k = 50$

$k = 4$

18. Answer (2)

Hint: $dV = -\vec{E}\cdot d\vec{r}$

Sol.:



$OB = AO\cos 30^\circ$

$$= 3\times\frac{\sqrt{3}}{2}\text{m}$$

$V_A = V_B$

$V_B - V_O = E(OB)$

$$= 60\times\frac{3\sqrt{3}}{2}$$

$= 90\sqrt{3}$ V

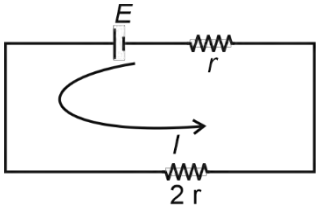
$V_A - V_O = 90\sqrt{3}$ V

$\therefore\ V_O - V_A = -90\sqrt{3}$ V

19. Answer (2)

Hint: Use KVL

Sol.:



$+E - ir - 2ir = 0$

$$i = \frac{E}{3r}$$

$V = i\times 2r$

$$= \frac{2E}{3}$$

20. Answer (3)

Hint and Sol.: Metals have positive thermal coefficient of resistance.

21. Answer (3)

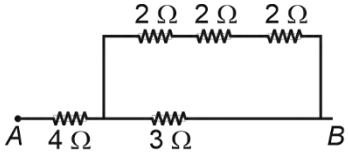
Hint: For series combination

$R_{eff} = R_1 + R_2 + ...R_n$

for parallel combination

$$\frac{1}{R_{eff}} = \frac{1}{R_1} + \frac{1}{R_2} + ...\frac{1}{R_n}$$

Sol.:



$$R = \frac{6\times 3}{6+3} + 4$$

$= 2 + 4$

$= 6\ \Omega$

22. Answer (2)

Hint: In parallel combination of cell

$$E = \frac{\frac{E_1}{r_1} + \frac{E_2}{r_2} + \frac{E_3}{r_3}}{\frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}}$$

Sol.: $E_1 = E_2 = E_3 = 9\,\text{V}$

$r_1 = r_2 = r_3 = 3\,\Omega$

$$E = \frac{\frac{9}{3} + \frac{9}{3} + \frac{9}{3}}{\frac{1}{3} + \frac{1}{3} + \frac{1}{3}}$$

$= 3 + 3 + 3$

$= 9$ V

23. Answer (4)

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

Sol.: $l_1 = \frac{l}{n}$

$A_1 = nA$

$$R_1 = \rho\frac{l_1}{A_1}$$

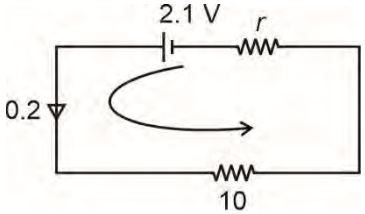
$$R_1 = \rho\frac{l}{An^2}$$

$$= \frac{R}{n^2}$$

24. Answer (2)

Hint: Power dissipated = $I^2 R$

Sol.:



$2.1 - 0.2r - 10 \times 0.2 = 0$

$2.1 - 0.2r - 2 = 0$

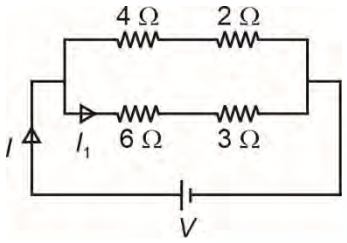
$r = \frac{1}{2}\ \Omega$

Power dissipated = $\left(\frac{1}{5}\right)^2 \times \frac{1}{2} = \frac{1}{50}$ W

25. Answer (3)

Hint: Use the concept of balance wheatstone bridge.

Sol.:



$V = V_1 + V_2$

$V = 6I_1 + 3I_1$

$I_1 = \frac{V}{9}$

$V_{6\Omega} = \frac{6 \times V}{9}$

$= \frac{2V}{3}$

26. Answer (1)

Hint: In series combination

$R_{eff} = R_1 + R_2$

Sol.: $R = \left(\frac{l}{\sigma A}\right)$

$\frac{2l}{\sigma_{eff} A} = \frac{l}{\sigma A} + \frac{l}{2\sigma A}$

$\frac{2}{\sigma_{eff}} = \frac{1}{\sigma} + \frac{1}{2\sigma}$

$\frac{2}{\sigma_{eff}} = \frac{2+1}{2\sigma}$

$\sigma_{eff} = \frac{4\sigma}{3}$

27. Answer (2)

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

Sol.: $V = IR$

$4 = 2\rho \left[\frac{100 \times 10^{-2}}{2 \times 10^{-6}}\right]$

$\rho = 4 \times 10^{-6}\ \Omega$ m

28. Answer (2)

Hint: emf $\propto$ balancing length

Sol.: $V \propto l$

$\frac{V}{V_1} = \frac{l}{4 \times l_1}$

$\frac{V}{\left(\frac{4V}{3}\right)} = \frac{l}{4l_1}$

$l_1 = \frac{l}{3}$

29. Answer (3)

Hint: Use concept of balanced wheatstone bridge

Sol.: $\frac{R_1}{40} = \frac{R_2}{60}$

$3R_1 = 2R_2$

$R_1 < R_2$

After connecting resistance of 20 Ω in series

$\frac{R_1 + 20}{50} = \frac{R_2}{50}$

$R_1 + 20 = \frac{3R_1}{2}$

$\frac{R_1}{2} = 20$

$R_1 = 40\,\Omega$

30. Answer (1)

Hint and Sol.: From the colour coding of carbon resistor, Violet – 7, Green – 5, Grey – 8, Orange – 3

31. Answer (4)

Hint and Sol.: Nichrome (which is an alloy of nickel, iron and chromium) exhibits a very weak dependence of resistivity with temperature.

32. Answer (2)

Hint: Use KCL

Sol.: $\frac{10 - V_O}{2} + \frac{4 - V_O}{2} + \frac{6 - V_O}{4} = 0$

$20 - 2V_O + 8 - 2V_O + 6 - V_O = 0$

$V_O = \left(\frac{34}{5}\right)$ V

33. Answer (2)

Hint and Sol.: The amount of charge flowing per unit time per unit area normal to flow is called current density.

34. Answer (1)

Hint: $I_{avg} = \left(\frac{\Delta Q}{\Delta t}\right)$

Sol.: $\frac{dQ}{dt} = I$

$$\int dQ = \int_0^2 \left(3t^2 + 2t + 5\right) dt$$

$$\Delta Q = \left[t^3 + t^2 + 5t\right]_0^2$$

$$= 8 + 4 + 10 = 22$$

$$I_{avg} = \frac{22}{2} = 11 \text{ A}$$

35. Answer (3)

Hint: $I = neAv_d$

Sol.: $v_d = \frac{I}{neA}$

$$= \frac{3.2}{10^{26} \times 1.6 \times 10^{-19} \times 2 \times 10^{-6}} = 0.1 \text{ m/s}$$

SECTION-B

36. Answer (3)

Hint: $|\vec{p}| = ql$ (Here q is magnitude of charge and l is distance between two charges).

Sol.: $\vec{p} = qa\hat{i} - qa\hat{i} + 2qa\hat{j}$

$$= 2qa\hat{j}$$

37. Answer (3)

Hint: $U = \frac{kq_1q_2}{r}$

Sol.:

$$U = -\frac{2qQk}{a} + \frac{2q^2k}{2a} - \frac{kQq}{a}$$

$$U = -\frac{3kqQ}{a} + \frac{q^2k}{a}$$

$U = 0$

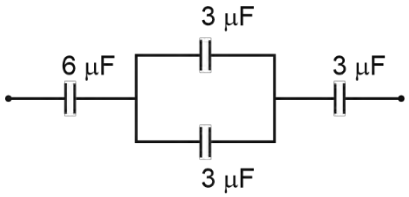
$$-\frac{3kqQ}{a} + \frac{q^2k}{a} = 0$$

$$\frac{Q}{q} = \frac{1}{3}$$

38. Answer (3)

Hint: Charge on the capacitors will be same in series combination

Sol.:



$$\frac{q}{6} + \frac{q}{6} + \frac{q}{3} = 80$$

$$\frac{4q}{6} = 80$$

$q = 120$ μC

$$V = \frac{q}{C} = \frac{120}{6} = 20 \text{ V}$$

39. Answer (2)

Hint: $C = \frac{A\varepsilon_0 k}{d}$

Sol.: On removing dielectric capacitance will decrease.

Also, $E = \frac{Q}{A\varepsilon_0 k}$

$$U = \frac{Q^2}{2C}$$

40. Answer (2)

Hint: $dV = -\vec{E} \cdot d\vec{r}$

Sol.: $\int_{V_Q}^{V_R} dV = -\int_0^{d/\sqrt{2}} Edr\cos 0^\circ \Rightarrow V_R - V_Q = \frac{-Ed}{\sqrt{2}}$

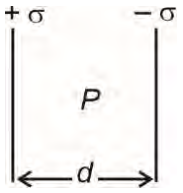
$V_Q = V_P$

$$\therefore\ V_R - V_P = \frac{-Ed}{\sqrt{2}}$$

41. Answer (1)

Hint: $|\Delta V| = Ed$

Sol.:



$$E_P = \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$$

$$\Delta V = \frac{\sigma d}{\varepsilon_0}$$

42. Answer (2)

Hint: $\mu = \frac{e\tau_e}{m_e}$

Sol.: $\mu = \frac{e\tau_e}{m_e}$

$\mu \propto \tau_e$

43. Answer (4)

Hint: $P = VI$

Sol.: $I = \frac{P}{V} = \frac{40}{10} = 4\,A$

Let resistance R be connected in series with bulb so that it glows with full intensity.

$10 + 4R = 20$

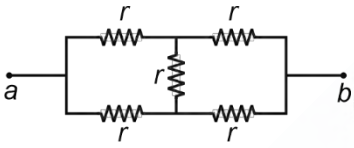
$4R = 10$

$R = 2.5\ \Omega$

44. Answer (3)

Hint: Use concept of balanced wheatstone bridge

Sol.:



$R_{ab} = \frac{2r \times 2r}{2r + 2r} = r$

45. Answer (1)

Hint and Sol.: Kirchhoff's junction law is based on the law of conservation of charge. While Kirchhoff's voltage law is based on the law of conservation of energy.

46. Answer (2)

Hint and Sol.: Given circuit is balanced wheat stone bridge, it does not depend on diagonal resistance, therefore current flowing through the battery remains same.

47. Answer (1)

Hint: Potential gradient is potential drop across wire per unit length

Sol.: $V = IR$

$V = I\rho\frac{\ell}{A}$

$\frac{V}{\ell} = \frac{I\rho}{A}$

$= \frac{0.4 \times 20 \times 10^{-8}}{4 \times 10^{-6}} = 2 \times 10^{-2}$ V/m

48. Answer (3)

Hint: Potential difference across parallel resistance will be same.

Sol.: $P = VI$

$I = \frac{40}{20} = 2\,A$

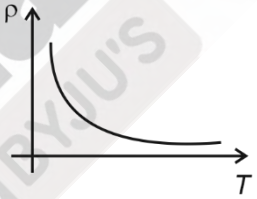
Now, $\frac{R \times 2 \times 2}{R + 2} = 2$

$4R = 2R + 4$

$R = 2\ \Omega$

49. Answer (2)

Hint and Sol.: For semiconductor, resistivity decreases with increase in temperature.



50. Answer (4)

Hint and Sol.: Ohm's law fails in transistor, photodiode and diode because V-I characteristics of all these devices are non-linear.

[CHEMISTRY]

SECTION-A

51. Answer (3)

Hint: Total charge on cations must be equal to total charge on anions.

Sol.: Let the number of Ni^{3+} ions = x

Then, number of Ni^{2+} ions = 0.94 – x

(0.94 – x) × 2 + x × 3 = 2

1.88 – 2x + 3x = 2

x = 2 – 1.88 = 0.12

Fraction of $Ni^{3+} = \frac{x}{0.94} = \frac{0.12}{0.94} = \frac{6}{47}$

52. Answer (2)

Hint: $d = \frac{ZM}{N_A a^3}$

Sol.: $d_{sc} = \frac{1 \times M}{N_A (2r)^3}$ $\left[\because \text{for simple cubic, } a = 2r\right]$

$d_{fcc} = \frac{4 \times M}{N_A \left(2\sqrt{2}r\right)^3}$ $\left[\because \text{for fcc, } a = 2\sqrt{2}r\right]$

$\frac{d_{fcc}}{d_{sc}} = \left(\frac{2}{2\sqrt{2}}\right)^3 \times \frac{4}{1} = \frac{\sqrt{2}}{1}$

53. Answer (2)

Hint: No. of closed packed atoms : octahedral voids : Tetrahedral voids : : 1 : 1 : 2

Sol.: Since fcc unit cell contains 4 atom per unit cell therefore number of tetrahedral and octahedral voids are 8 and 4 respectively so total voids are 12.

54. Answer (1)

Hint: In end-centred unit cell, one constituent particle is present at the centre of any two opposite faces beside the ones present at its corners.

Sol.: Orthorhombic and monoclinic crystal system contain end-centred variations.

55. Answer (4)

Hint: $d = \dfrac{zM}{N_A a^3}$

Sol.: $d = \dfrac{4 \times 50}{\left(6 \times 10^{23}\right) \times \left(200 \times 10^{-10}\right)^3} = 41.67\,g\,cm^{-3}$

56. Answer (4)

Hint: F-centres are anionic sites occupied by unpaired electrons which is called Farbenzenter for colour centre.

Sol.: In metal excess defect, due to anionic vacancies formation of F-centres take place.

57. Answer (3)

Hint: Diamagnetic substance are weakly repelled by magnetic field.

Sol.: Ferrimagnetic substance looses ferrimagnetic property and becomes paramagnetic on heating.

58. Answer (1)

Hint: There are eight tetrahedral voids per unit cell of fcc lattice.

Sol.: No. of X atoms per unit cell

$= \dfrac{1}{8} \times 8 + \dfrac{1}{2} \times 6 = 4$

No. of Y atoms per unit cell $= \dfrac{1}{2} \times 8 = 4$

Formula of the compound Y_4X_4 or YX.

59. Answer (1)

Hint: $\Delta T_f = ik_f m$

Sol.: For P_1 solution, $im = \dfrac{10}{60} \times \dfrac{1000}{250} = \dfrac{2}{3}$

$\left(\Delta T_f\right)_1 = \dfrac{2}{3} K_f = 0.66\ K_f$

$(T_f)_1 = -\dfrac{2}{3} K_f = -0.66 K_f$

For P_2 solution, $im = \dfrac{2 \times 10}{58.5} \times \dfrac{1000}{250} = 1.36$ m

$\left(\Delta T_f\right)_2 = 1.36\ K_f$

$\left(T_f\right)_2 = -1.36\ K_f$

For P_3 solution, $im = \dfrac{10}{180} \times \dfrac{1000}{250} = 0.22$ m

$\left(\Delta T_f\right)_3 = 0.22\ K_f$

$\left(T_f\right)_3 = -0.22\ K_f$

Order of freezing point: $P_3 > P_1 > P_2$

60. Answer (4)

Hint: $y_A = \dfrac{P_A^\circ x_A}{P_A^\circ x_A + P_B^\circ x_B}$

Sol.: $P_A = P_A^\circ x_A = 200$

$x_A = \dfrac{200}{P_A^\circ} = \dfrac{200}{400} = 0.5, \quad x_B = 1 - x_A = 0.5$

$y_A = \dfrac{P_A^\circ x_A}{P_A^\circ x_A + P_B^\circ x_B} = \dfrac{200}{200 + 100 \times 0.5} = \dfrac{4}{5}, y_B = \dfrac{1}{5}$

Molar ratio = $\dfrac{y_A}{y_B} = \dfrac{4/5}{1/5} = 4:1$

61. Answer (3)

Hint: For negative deviation from Raoult's law, the interactions between A---A, B----B should be weaker than A----B.

Sol.: Due to intermolecular hydrogen bonding, the solution of acetone and chloroform shows negative deviation from Raoult's Law.

62. Answer (2)

Hint: Volume changes with change in temperature.

Sol.: Molarity, normality and $\left(\dfrac{w}{V}\right)\%$ all contains volume terms therefore depend on temperature.

Molality does not contain volume term therefore it is temperature independent.

63. Answer (2)

Hint: $K_4\left[Fe(CN)_6\right] \rightarrow 4K^+ + \left[Fe(CN)_6\right]^{4-}$

van't Hoff factor = 5

Sol.:

Species	van't Hoff factor
$CaSO_4$	i = 2
$Al_2(SO_4)_3$	i = 5
$CaCl_2$	i = 3
$AlCl_3$	i = 4

64. Answer (4)

Hint & Sol.: ΔH_{mix} and ΔV_{mix} = 0 for ideal solutions.

65. Answer (1)

Hint: Dissolved oxygen is more in cold water than warm water.

Sol.: Due to greater oxygen content in cold water, aquatic species are more comfortable in cold water than warm water.

Solubility of gases in liquid increases with decrease in temperature.

66. Answer (3)

Hint: $P = K_H x$

Sol.: 0.2 molal means 0.2 mol H_2S in 1 kg water.

$$x = \frac{n_{H_2S}}{n_{H_2S} + n_{H_2O}} = \frac{0.2}{0.2 + \left(\frac{1000}{18}\right)} = 3.6 \times 10^{-3}$$

$$K_H = \frac{P}{x} = \frac{1}{3.6 \times 10^{-3}} \simeq 278 \text{ atm}$$

67. Answer (4)

Hint & Sol.: Ebullioscopic constant depends on nature of solvent only therefore for all aqueous solution value of K_b is same.

68. Answer (2)

Hint: For aluminium, $Z = \frac{27}{3F}$

Sol.: Using Faraday 1st law

$W = ZQ$

$$2.7 = \frac{27}{3F} \times Q \Rightarrow Q = 0.3F$$

69. Answer (2)

Hint: Oxidation potential of Ag is greater than NO_3^- as well as H_2O.

Sol.: At anode

- $Ag(s) \rightarrow Ag^+(aq) + 1e^-$

At cathode

- $Ag^+(aq) + 1e^- \rightarrow Ag(s)$

70. Answer (3)

Hint & Sol.: In fuel cell, combustion energy of a fuel is directly used to convert into electrical energy e.g. H_2-O_2 fuel cell.

71. Answer (2)

Hint:

$$\Lambda_m^\circ CH_3COOH = \frac{1}{2}\Lambda_m^\circ\left[(CH_3COO)_2Mg\right] + \frac{1}{2}\Lambda_m^\circ(H_2SO_4) - \frac{1}{2}\Lambda_m^\circ(MgSO_4)$$

Sol.: Using Kohlrausch's Law

$$\Lambda_m^\circ CH_3COOH = \frac{z}{2} + \frac{x}{2} - \frac{y}{2}$$

72. Answer (4)

Hint: Greater is the reduction potential, lesser is the reducing power.

Sol.: Order of reduction potential: Au > Cu > Pb > Zn

Order of reducing power: Au < Cu < Pb < Zn

73. Answer (1)

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

Sol.: For the reaction

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

n=2

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

$$= -202.65 \text{ kJmol}^{-1}$$

74. Answer (4)

Hint: $E_{cell}^\circ = \frac{RT}{nF}\ln K = \frac{2.303RT}{nF}\log K$

Sol.: $E_{cell}^\circ = \frac{2.303RT}{2 \times F}\log K$

$$0.5 = \frac{0.05}{2}\log K$$

$$K = 10^{20}$$

75. Answer (2)

Hint: For the species undergoing disproportionation

$E_C^\circ - E_A^\circ = E_{cell}^\circ > 0$

Sol.: For the reactions

$$AO^{2+} \rightarrow A^{3+} + AO_2^+$$

$$E_{cell}^\circ = E_{AO^{2+}/A^{3+}} - E_{AO_2^{2+}/AO^{2+}}$$

$$= 0.34 - (-1.0)$$

$$= 1.34\,V = +ve$$

$\therefore$ Disproportionation of AO^{2+} will take place

76. Answer (3)

Hint: Ionic mobilities increases on dilution.

Sol.:

- For strong electrolyte Λ_m increases on dilution as the ionic mobilities increases.
- Conductivity decreases on dilution as the number of ions per unit volume decreases.

77. Answer (3)

Hint and Sol.: For the galvanization of iron, zinc is used.

78. Answer (4)

Hint: $t = \frac{2.303}{k}\log\frac{[A]_o}{[A]_t}$ for first order reaction.

Sol.: $t = \frac{2.303}{2.303\times10^{-3}}\log\frac{(4)}{(0.4)}$

= 1000 s

79. Answer (4)

Hint: $t_{1/2} \propto a^{1-n}$

Sol.: For first order reaction

$t_{1/2} \propto a^{1-1} \propto a^{\circ}$

Means half life of first order reaction is independent of initial concentration of reactant.

80. Answer (2)

Hint: Slowest step is the rate determining step

Sol.: (1) $O_3 \rightleftharpoons O_2 + O$

$K_{eq} = \frac{[O_2][O]}{[O_3]}$

$[O] = K_{eq}\frac{[O_3]}{[O_2]}$ _____(i)

(2) $O_3 + O \xrightarrow{slow} 2O_2$

$r = k[O_3][O]$

$= k[O_3]K_{eq}\frac{[O_3]}{[O_2]} = k'[O_3]^2[O_2]^{-1}$

Overall order = (2) + (–1) = 1

81. Answer (1)

Hint: Rate = k $[A]^x$ $[B]^y$ where x and y are the order w.r.t A and B.

Sol.: $r = k[A]^x[B]^y$ _____(i)

$2r = k[2A]^x[B]^y$ _____(ii)

$4r = k[2A]^x[2B]^y$ _____(iii)

Using equation (i), (ii) and (iii), we get

x = 1, y = 1

$\therefore$ Rate = $k[A]^1[B]^1$

82. Answer (2)

Hint:

$r = \frac{-d[BrO_3^-]}{dt} = \frac{-1}{5}\frac{d[Br^-]}{dt} = -\frac{1}{6}\frac{d[H^+]}{dt} = \frac{1}{3}\frac{d[Br_2]}{dt} = \frac{1}{3}\frac{d[H_2O]}{dt}$

Sol.: $\frac{\text{Rate of appearance of } Br_2}{\text{Rate of disappearance of } Br^-} = \frac{3r}{5r} = \frac{3}{5}$

83. Answer (4)

Hint: Unit of rate constant = $\left(\text{mol L}^{-1}\right)^{1-n}\text{s}^{-1}$

Sol.:

Order of reaction (n)	Unit of rate constant
0^{th} order	mol L^{-1} s^{-1}
1^{st} order	s^{-1}
2^{nd} order	mol^{-1} L s^{-1}
3^{rd} order	mol^{-2} L^2 s^{-1}

84. Answer (2)

Hint & Sol.: Order of reaction is applicable to elementary as well as complex reactions.

85. Answer (3)

Hint: $t = \frac{2.303}{k}\log\frac{[A]_o}{[A]_t}$

Sol.: $t = \frac{2.303}{k}\log\frac{100}{100-99.9} = \frac{3\times2.303}{k}$

SECTION-B

86. Answer (3)

Hint:

Close packing of spheres in one dimension

Sol.: In one dimensional close packed arrangement, the coordination number is 2.

87. Answer (3)

Hint: Triclinic crystal system is the most unsymmetrical system.

Sol.: For triclinic crystal system, $\alpha \neq \beta \neq \gamma \neq 90°$ and $a \neq b \neq c$.

88. Answer (4)

Hint: Packing efficiency of fcc unit cell is 74%.

Sol.: In ccp lattice, tetrahedral voids are present at body diagonal of unit cell.

89. Answer (4)

Hint & Sol.: Osmotic pressure method is widely used to determine molar masses of proteins and polymers as the pressure measurement is around the room temperature and molarity is used instead of molality.

90. Answer (3)

Hint: Azeotropes are constant boiling mixtures.

Sol.:

- Large positive deviation from Raoult's law form minimum boiling azeotrope at a specific composition.
- Azeotropes have same composition in liquid and vapour phase therefore it is not possible to separate the components by fractional distillation.

91. Answer (2)

Hint: $i = 1 - \alpha + \frac{\alpha}{n}$

Sol.: van't Hoff factor $(i) = 1 - 0.4 + \frac{0.4}{3}$

(i) = 0.73

92. Answer (3)

Hint: Relative lowering in vapour pressure = mole fraction of solute.

Sol.: $\because \frac{\Delta P}{P_A^o} \times 100 = 50 \therefore x_B = 0.5$

$$x_B = \frac{n_B}{n_A + n_B} = \frac{w/50}{\frac{171}{114} + \frac{w}{50}} = 0.5$$

$w = 75\,g$

93. Answer (2)

Hint: $E_{cell} = E^\circ_{cell} - \frac{0.059}{n}\log Q$

Sol.: $Mg(s) + Cu^{2+}(aq) \rightleftharpoons Cu(s) + Mg^{2+}(aq)$

$$Q = \frac{[Cu]\left[Mg^{2+}\right]}{[Mg]\left[Cu^{2+}\right]} = \frac{(0.001)}{(0.01)} = 0.1$$

$E^\circ_{cell} = E^\circ_C - E^\circ_A = 0.34 - (-2.37) = 2.71V$

$E_{cell} = 2.71 - \frac{0.059}{2}\log(0.1) = 2.74\,V$

94. Answer (1)

Hint & Sol.: Graphite is a conductor while CuO, Si and Ge are semiconductors.

95. Answer (1)

Hint & Sol.:

Ions	H^+	Na^+	K^+	Ca^{2+}
($S\,cm^2\,mol^{-1}$)	349.6	50.1	73.5	119

96. Answer (1)

Hint & Sol.: In lead storage batteries, 38% aqueous sulphuric acid is used as an electrolyte.

97. Answer (1)

Hint: Cell constant = $\frac{l}{A}$

Sol.: Cell constant $G^* = \kappa \times R$

98. Answer (4)

Hint: $k = Ae^{-E_a/RT}$

Sol.: $\ln k = \ln A - \frac{E_a}{R}\left(\frac{1}{T}\right)$

Or $\log k = \log A - \frac{E_a}{2.303R}\left(\frac{1}{T}\right)$

On comparing with y = mx + C

slope $(m) = \frac{-E_a}{2.303R}$

99. Answer (3)

Hint: $\frac{r_{t+\Delta t}}{r_t} = (2)^{\frac{\Delta t}{10}}$

Sol.: $\frac{r_{55^\circ}}{r_{25^\circ}} = (2)^{\frac{55-25}{10}} = 8$

100. Answer (1)

Hint & Sol.: Decomposition of gaseous ammonia on a hot platinum surface at high pressure is an example of zero order reaction.

$$2NH_3(g) \xrightarrow[\text{Pt catalyst}]{1130\ K} N_2(g) + 3H_2(g)$$

[BOTANY]

SECTION-A

101. Answer (2)

Hint: Some algae produce isogametes.

Sol.: *Cladophora* forms isogametes while *Chara*, *Volvox* and *Fucus* form heterogametes.

102. Answer (1)

Hint: Polycarpic plants flower repeatedly at intervals in their life.

Sol.: Interflowering phase is seen in polycarpic plants and they do not show clear-cut distinction of the three phases.

103. Answer (4)

Hint: Annual plants have life span of less than a year.

Sol.: Life span of rice – 3-4 months

Life span of rose – 5-7 years

Life span of mango – 200 years

Life span of banana – 25 years

104. Answer (2)

Hint: Algae mainly reproduce by zoospores.

Sol.: *Amoeba* – Binary fission

Penicillium – Conidia

Chalmydomonas – Zoospores

Yeast—Budding

105. Answer (3)

Hint: Leaves of several plants have adventitious buds that help in vegetative propagation.

Sol.: *Bryophyllum* vegetatively propagates via leaf buds.

106. Answer (4)

Hint: Interflowering period is seen in polycarpic plants.

Sol.: Interflowering period is part of mature phase in polycarpic plants.

107. Answer (4)

Hint: Coconut is a monoecious plant.

Sol.: In coconut, staminate and pistillate flowers are produced on same plant.

108. Answer (3)

Hint: Zygote is produced by fusion of gametes.

Sol.: Zygotes are always diploid as they are produced by fusion of haploid gametes.

109. Answer (2)

Hint: Monocarpic plants flower once in their life.

Sol.: Neelakuranji is a perennial plant and flower once in its lifetime.

110. Answer (4)

Hint: Variations are seen in offsprings produced by sexual reproduction.

Sol.: *Chara* sexually reproduces by fusion of heterogametes, sperm/antherozoids and egg.

111. Answer (2)

Hint: Algae and bryophytes produce motile male gametes that swim in water to reach the female gamete.

Sol.: In algae and bryophytes large number of male gametes are produced to compensate the loss of gametes which occur during their transfer to female gametes.

112. Answer (2)

Hint: This structure is always diploid.

Sol.: Zygote is the vital link that ensures continuity of species between two successive generations.

113. Answer (3)

Hint: Tapetum is the innermost layer of anther wall.

Sol.: Anther wall is four layered. The outer three layers provide protection and help in dehiscence of anther.

114. Answer (3)

Hint: Pollen grain is considered as male gametophyte while embryo sac is considered as female gametophyte of typical angiospermic plants.

Sol.: Pollen grains are two/three celled while embryo sac is seven celled structure. They are products of meiosis and contain gametes. A pollen grain has two male gametes whereas an embryo sac has only one egg, *i.e.,* female gamete.

115. Answer (3)

Hint: A mature pollen grain is generally two celled.

Sol.: The vegetative cell is bigger and generative cell is smaller. Pollen grains have prominent germ pores.

116. Answer (4)

Hint: A megasporangium may have more than one embryo sacs.

Sol.: The food storing tissue of megasporangium is called nucellus. Endosperm is formed after triple fusion.

117. Answer (4)

Hint: Secondary nucleus is formed after fusion of two polar nuclei.

Sol.: Secondary nucleus is '2n' or diploid whereas antipodals, synergids and egg are haploid.

118. Answer (1)

Hint: Nectar and pollen are usual floral rewards for animal pollinators.

Sol.: Insect pollinated flowers are usually large, if small, they are clustered into inflorescence. They are fragrant. Night bloomers are usually white coloured.

119. Answer (1)

Hint: *Zostera* and *Hydrilla* both show hydrophily.

Sol.: *Zostera* is marine plant while *Hydrilla* is a fresh water plant showing hydrophily.

120. Answer (3)

Hint: Some primates, rodents and reptiles also act as pollinators.

Sol.: Large animals such as lemurs, lizards etc. also acts as pollinating agents.

121. Answer (2)

Hint: Monosporic embryo sac development is the most common type.

Sol.: Monosporic embryo sac is 7 celled, 8 nucleate and has 3 celled egg apparatus. It arises from single functional megaspore formed after 1 meiosis in megaspore mother cell and 3 sequential mitosis in megaspore.

122. Answer (3)

Hint: Such flowers are found in *Oxalis* and *Commelina*.

Sol.: Flowers which do not open at all are termed as cleistogamous flowers, *e.g.*, *Oxalis* and *Commelina*.

123. Answer (4)

Hint: In dioecious plants both autogamy as well as geitonogamy are prevented.

Sol.: Castor and maize show geitonogamy. China rose shows autogamy while papaya shows xenogamy.

124. Answer (3)

Hint: Homogamy promotes self pollination.

Sol.: Synchronised pollen release and stigma receptivity refers to homogamy. Homogamy is not an outbreeding device.

125. Answer (4)

Hint: Central cell is binucleate.

Sol.: Central cell contains two polar nuclei. Filiform apparatus is found in synergids.

126. Answer (1)

Hint: Unisexual flowers does not require emasculation.

Sol.: Removal of anther or emasculation is required in unisexual flowers. It is not required in maize as it has unisexual flowers.

127. Answer (4)

Hint: Double fertilisation includes two types of fusions.

Sol.: Syngamy and triple fusion (fusion of male gamete with secondary nucleus) refers to double fertilisation.

128. Answer (3)

Hint: The coconut water from tender coconut and its white kernel are food storing tissues.

Sol.: The coconut water is formed by free nuclear endosperm development while white kernel is formed by cellular mode of endosperm development.

129. Answer (4)

Hint: Leguminous seeds are non-endospermous.

Sol.: Mature bean seeds lack endosperm whereas castor, maize and wheat have endosperm.

130. Answer (3)

Hint: Epiblast represents the remains of second cotyledon.

Sol.: Epiblast and coleorhiza are absent in dicot embryos. Root cap is seen in both dicot and monocot embryos.

131. Answer (4)

Hint: Perisperm arise from persistent, residual nucellus.

Sol.: Perisperm is diploid tissue.

132. Answer (1)

Hint: There is record of some old yet viable seeds.

Sol.: A large number of seeds can remain alive for several years. Some seeds can live for hundreds of years.

133. Answer (3)

Hint: Banana is a seedless fruit.

Sol.: In banana, seeds are absent as fruits develop without fertilisation. True fruits arise only from the ovary.

134. Answer (2)

Hint: Both *Citrus* and mango have apomictic seeds.

Sol.: They have multiple embryos in their seeds. They have zygotic embryo too.

135. Answer (2)

Hint: In 60% of angiosperms, pollens are shed at two celled stage.

Sol.: Anther is bilobed with each lobe having two theca. Synergids have filiform apparatus.

SECTION-B

136. Answer (2)

Hint: Life span is specific trait of each organism.

Sol.: Life span is not related with size or complexity of organisms, so crow and parrot have difference in their life spans.

137. Answer (3)

Hint: Multicellular organisms reproduce by fragmentation.

Sol.: *Chlamydomonas* is a unicellular alga. It asexually reproduces by zoospores.

138. Answer (3)

Hint: Sexual reproduction produces variations.

Sol.: Sexual reproduction is a slow, elaborate and complex process.

139. Answer (4)

Hint: Embryogenesis is formation of embryo from zygote.

Sol.: Embryogenesis is a post-fertilisation event. Rest all are pre-fertilisation events.

140. Answer (2)

Hint: A stamen can be attached to a thalamus or a petal.

Sol.: Filament of a stamen is long and slender stalk that can get attached to thalamus.

141. Answer (4)

Hint: Exine is the outermost layer of pollen grain.

Sol.: Sporopollenin is found in exine. Intine is made of pectin and cellulose.

142. Answer (2)

Hint: Members of Solanaceae have pollen viability for several months.

Sol.: Pollen grains of tomato plant may remain viable for several months.

143. Answer (2)

Hint: Nectar acts as reward for animal pollinators.

Sol.: Insect pollinated flowers produce nectar or fragrance to attract insects, and these are absent in wind pollinated flowers.

144. Answer (4)

Hint: Orange show apomixis or adventive embryony.

Sol.: Apomictic embryos of orange seeds arise from nucellar cells. These embryos are diploid and are genetically identical except the one which arise from zygote.

145. Answer (2)

Hint: Endosperm develops from PEN (Primary endosperm nucleus).

Sol.: Endosperm is triploid tissue. It develops prior to embryo formation.

146. Answer (4)

Sol.: Pollen-pistil interaction refers to the events that occur from pollen deposition on the stigma until pollen tube entry in ovule.

147. Answer (2)

Hint: All aquatic plants are not pollinated by water current.

Sol.: Water lily gets pollinated by insects.

148. Answer (4)

Hint: *Vallisneria* is a water pollinated plant.

Sol.: *Vallisneria* shows epihydrophily.

149. Answer (4)

Hint: Pollinators are not required, if flowers do not open.

Sol.: Pollinators are not required in cleistogamy.

150. Answer (4)

Sol.: *Michelia* has multicarpellary apocarpous ovary. *Papaver* and lily have multicarpellary syncarpous ovary. Pea has monocarpellary ovary.

[ZOOLOGY]

SECTION-A

151. Answer (4)

Hint: Identify an ovarian event

Sol.: Menstrual cycle comprises uterine events and ovarian events. The phases in uterine events are proliferative phase, secretory phase and menstruation. The phases in ovarian events are follicular phase, ovulatory phase and luteal phase.

152. Answer (3)

Hint: Bony fishes exhibit external fertilisation.

Sol.: Organisms exhibiting external fertilisation show great synchrony between the sexes and release a large number of gametes into the surrounding medium (water) in order to enhance the chances of syngamy. This happens in the bony fishes and frogs, when a large number of offsprings are produced. A major disadvantage is that the offsprings are extremely vulnerable to predators, threatening their survival upto adulthood.

153. Answer (3)

Hint: Seminiferous tubules are less than 4 in number, in each lobule.

Sol.: Each testis has about 250 compartments called testicular lobules. Each lobule contains 1 to 3 highly coiled seminiferous tubules in which sperms are produced.

154. Answer (4)

Hint: Identify a haploid cell

Sol.:

Spermatogonia, primary spermatocytes	–	Diploid
Oogonia, primary oocytes	–	Diploid
Secondary spermatocytes, sperms	–	Haploid
Secondary oocytes, ovum (ootid)	–	Haploid

155. Answer (3)

Hint: Duration of luteal phase is always fixed.

Sol.: Cyclic menstruation is an indicator of normal reproductive phase and extends between menarche and menopause.

156. Answer (2)

Hint: Inner group of cells in blastocyst.

Sol.: Inner cell mass contains certain cells called stem cells which have the potency to give rise to all the tissues and organs of developing embryo.

Trophoblast forms the extra-embryonic membranes.

157. Answer (2)

Hint: *Pheretima* is hermaphrodite.

Sol.: The most vital event of sexual reproduction is the fusion of gametes (fertilisation).

In rotifers, honeybees and even some lizards and birds (turkey), the female gamete undergoes development to form new organisms without fertilisation. This phenomenon is called parthenogenesis.

158. Answer (1)

Hint: During spermiogenesis, much of the cytoplasm is lost.

Sol.: Transformation of spermatid into sperm (spermatozoa) is termed as spermiogenesis.

A spermatid is non-motile and heavy. The weight of gamete is reduced along with the development of locomotory structures. Both spermatids and sperms are haploid.

159. Answer (4)

Hint: Surrounds the vaginal opening

Sol.: 'A' is labia majora.

'B' is labia minora.

The clitoris is a tiny finger-like structure lies at the upper junction of two labia minora. Mons pubis is a cushion of fatty tissue covered by skin and pubic hair.

160. Answer (3)

Hint: Normal reproductive phase extends between menarche to menopause.

Sol.: Sperm formation continue even in old men, but formation of ova ceases in women around the age of 50 years. For normal fertility, at least 60% sperms must have normal shape and size and at least 40% of them must show vigorous motility.

161. Answer (2)

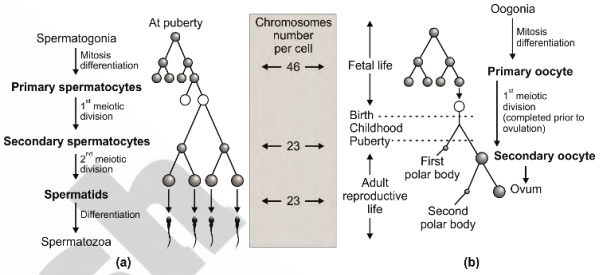
Hint: It undergoes cyclical changes during menstrual cycle.

Sol.: Blastocyst becomes embedded in the endometrium of uterus. The wall of uterus has 3 layers of tissue. The external thin membranous perimetrium, middle thick layer of smooth muscles, myometrium and inner glandular layer called endometrium that lines the uterine cavity. After attachment, the uterine cells divide rapidly and covers the blastocyst.

162. Answer (2)

Hint: A tiny first polar body is formed after first meiotic division.

Sol.:



163. Answer (2)

Hint: Leydig cells synthesise and secrete androgens.

Sol.: Each seminiferous tubule is lined on its inside by male germ cells (spermatogonia) and Sertoli cells. Fertilisation can only occur if the ovum and sperms are transported simultaneously to the ampullary region. This is the reason why not all copulations lead to fertilisation and pregnancy. The sex of the baby is determined by the father and not by the mother.

164. Answer (4)

Hint: Identify the hormone which softens pubic symphysis.

Sol.: Hormones hCG, hPL and relaxin are produced in women only during pregnancy. In the later phase of pregnancy, a hormone called relaxin is secreted by ovary.

165. Answer (3)

Hint: High estrogen and progesterone inhibit the release of gonadotropins.

Sol.: Luteal phase (secretory phase) is the most constant phase of menstrual cycle, that is of 14 days. During this, the remaining part of the Graafian follicle transforms into corpus luteum. The corpus luteum secretes large amount of progesterone which is essential for the maintenance of endometrium.

166. Answer (1)

Hint: First sign of growing foetus may be noticed by listening to the heart sound through stethoscope.

Sol.:

Formation of heart	–	After 1st month
First movements of foetus	–	During 5th month
Eyelids separate, Body covered with fine hair	–	By the end of 24 weeks (second trimester)

167. Answer (2)

Hint: Foetal ejection reflex triggers the release of oxytocin from the maternal pituitary

Sol.: Oxytocin released from maternal pituitary, acts on the uterine muscle and causes stronger uterine contractions which in turn stimulates further secretion of oxytocin. The stimulatory reflex between the uterine contractions and oxytocin secretion continues resulting in stronger and stronger contractions. The signals for parturition originate from the fully developed foetus and the placenta which induce foetal ejection reflex.

168. Answer (3)

Hint: Cells surrounding primary oocyte.

Sol.: In males, inhibin is secreted by Sertoli cells, which suppress FSH synthesis.

In females, granulosa cells of ovary secrete inhibin.

169. Answer (3)

Hint: Milk secreting glands in females.

Sol.:

Ampulla is the best site for fertilisation.

Cervix and vagina forms the birth canal.

Uterine fundus is the normal site for implantation.

170. Answer (2)

Hint: The mammary tubules of each lobe join to form a mammary duct.

Sol.: The glandular tissue of each breast is divided into 15-20 mammary lobes containing cluster of cells called alveoli. The cells of alveoli secrete milk, which is stored in the cavities of alveoli. The alveoli open into mammary tubules. The tubules of each lobule join to form a mammary duct. Several mammary ducts join to form a wider mammary ampulla which is connected to lactiferous duct through which milk is sucked out.

171. Answer (3)

Hint: Related to the part of male gamete that contains hydrolytic enzymes.

Sol.: When a sperm comes in contact with egg membrane, the acrosome starts releasing its hydrolytic enzymes or sperm lysins which help in dissolving various layers of ovum. This is known as acrosomal reaction.

The middle piece possesses numerous mitochondria that produce energy for the movement of tail that facilitates motility.

172. Answer (2)

Hint: Degeneration of corpus luteum leads to menstruation.

Sol.: Blood flowing in umbilical cord of mammalian embryo is 100% foetal and connects maternal endometrium with embryo.

The corpus luteum secretes large amount of progesterone required for maintenance of endometrium. The menstrual phase is followed by follicular phase.

173. Answer (2)

Hint: Carbon dioxide is exhaled out during breathing.

Sol.: Placenta acts as an endocrine tissue and produces several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogen, progestogens, etc. Detection of hCG in the urine is the basis of pregnancy/Gravindex test. The placenta facilitates the supply of oxygen and nutrients to the embryo and also removal of carbon dioxide and excretory/waste materials produced by the embryo.

174. Answer (1)

Hint: Insemination is transfer of sperm into the female genital tract.

Sol.: The reproductive events in human include formation of gametes (gametogenesis), i.e., sperms in male and ovum in females, transfer of sperms into the female genital tract (insemination) and fusion of male and female gametes (fertilisation) leading to formation of zygote. This is followed by formation and development of blastocyst (blastulation) and its attachment to uterine wall (implantation), embryonic development (gestation) and delivery of the baby (parturition).

175. Answer (3)

Hint: Fertilised eggs are covered by hard calcareous shell.

Sol.: Majority of mammals including human beings are viviparous animals while animals like reptiles and birds are oviparous.

Because of proper embryonic care and protection, the chances of survival of young ones is greater in viviparous animals.

176. Answer (4)

Hint: Oxytocin means quick birth.

Sol.: An important role is played by release of prostaglandins for initiation of uterine contractions during parturition in humans. Increase in estrogen facilitates increase in receptors for oxytocin which leads to stronger and stronger uterine contractions.

177. Answer (3)

Hint: Identify the hormone responsible for ovulation.

Sol.: LH hormone causes the cells of the ruptured follicle to form corpus luteum. It also stimulates the corpus luteum to secrete estrogen and progesterone. With the rise in estrogen and progesterone, the levels of FSH and LH drop. Low levels of LH cause degeneration of corpus luteum.

178. Answer (3)

Hint: Origin of axial filament

Sol.: The sperm head contains an elongated nucleus, the anterior portion of which is covered by a cap-like structure, acrosome. Middle piece possesses numerous mitochondria which produce energy for the movement of tail which facilitates sperm motility, essential for fertilisation. Neck contains two centriole–proximal and distal.

179. Answer (2)

Hint: It is also found in mucous secretions of human body.

Sol.: The milk produced during the initial few days of lactation is called colostrum. It is slightly yellow in colour, rich in calories and antibodies (IgA). This antibody provides passive immunity to the child. IgG is the only antibody that can cross the placenta and confer immunity to the foetus.

180. Answer (1)

Hint: 'A' is a solid ball of cells

Sol.: The embryo with 8 to 16 blastomeres is called morula. The morula continues to divide and transforms into blastocyst as it moves further into the uterus. The blastula of humans is called blastocyst.

181. Answer (1)

Hint: Chromosome number in meiocyte of cat is 38.

Sol.: Chromosome number in gamete of cat is 19.

Chromosome number in gamete of dog is 39.

Chromosome number in gamete of rat is 21.

Chromosome number in gamete of humans is 23.

182. Answer (2)

Hint: Rete testis is intra-testicular duct.

Sol.: Path of sperm through the male body:

Seminiferous tubules → Rete testis → Vasa efferentia ↓ Epididymis ↓ Vas deferens ↓ Ejaculatory duct → Urethra

183. Answer (2)

Hint: Characterized by the presence of pseudopodia.

Sol.: In sponges (*Spongilla*), the parent individual releases a specialised mass of cells enclosed in a common opaque envelope called gemmule. Gemmules are thought to be internal buds formed by endogenous budding during unfavourable conditions.

In *Hydra*, if the body breaks into distinct pieces, each fragment grows into an adult capable of producing offsprings.

184. Answer (2)

Hint: FSH acts on the nurse cells.

Sol.: LH acts on the Leydig cells and stimulates synthesis and secretion of androgens. FSH acts on the Sertoli cells and stimulates secretion of some factors which help in spermiogenesis. FSH stimulates growth and development of the ovarian follicles in females.

185. Answer (2)

Hint: Related to the juvenile phase.

Sol.: Life spans of organisms are not necessarily correlated with their sizes.

In animals, the juvenile phase is followed by morphological and physiological changes prior to active reproductive behaviour.

SECTION-B

186. Answer (2)

Hint: Life span of parrot is greater than that of crocodile and dog.

Sol.: Life span of parrot = 140 yrs = A

Life span of crocodile = 60 yrs = B

Life span of dog = 20 yrs = C

187. Answer (2)

Hint: Sexual reproduction is biparental.

Sol.: When two parents (opposite sex) participate in the reproductive process and also involve fusion of male and female gametes, it is called sexual reproduction. Sexual mode of reproduction enables creation of new variants, so that survival advantage is enhanced.

188. Answer (3)

Hint: More than one oocyte may be ovulated.

Sol.: Sometimes, two or more follicles reach maturity in one month or cycle, so more than one oocyte may be ovulated. This is the commonest cause of multiple births. In such cases the siblings are fraternal, not identical.

Due to pressure of growing blastocyst, a slit is produced in zona pellucida through which it squeezes out. The growing blastocyst comes out of this slit. At times, it gets broken into two parts which then gives rise to identical twins or monozygotic twins.

189. Answer (2)

Hint: Vasa efferentia leaves the testis and open into epididymis.

Sol.: Epididymis leads to vas deferens that ascends to abdomen and loops over the urinary bladder. Vas deferens receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct. These ducts store and transport the sperms from the testis to the outside through urethra. Urethral meatus is external opening of urethra.

190. Answer (2)

Hint: By this time, most of the major organ system are formed.

Sol.: By the end of 12 weeks, most of the organs are formed, for example, the limbs and external genitalia are well developed. After 1 month of pregnancy, the embryo's heart is formed. By the end of 2nd month of pregnancy, the foetus develops limbs and digits.

191. Answer (4)

Hint: During cleavage, nucleus to cytoplasm ratio increases.

Sol.: The second meiotic division of secondary oocyte is not completed until the ovum has been penetrated by a sperm. Human sperm is viable for upto 48 hours. The secondary oocyte forms a membrane called zona pellucida.

192. Answer (4)

Hint: Tertiary follicle is characterised by a fluid filled cavity called antrum.

Sol.: During embryonic development stage, oogenesis is initiated and oogonia starts division and enter into prophase-I of the meiotic division and get temporarily arrested at that stage. Primary oocyte within the tertiary follicle grows in size and completes its first meiotic division prior to ovulation. It is an unequal division resulting in the formation of a large haploid secondary oocyte and a tiny first polar body.

193. Answer (3)

Hint: It helps in the lubrication of penis.

Sol.: Secretions of epididymis, vas deferens, seminal vesicle and prostate gland are essential for the maturation and motility of sperms. Bulbourethral glands or Cowper's glands secrete a viscous mucus which acts as a lubricant.

194. Answer (4)

Hint: It opposes the functioning of RAAS.

Sol.: During pregnancy, the levels of hormones like estrogen, progestogen, cortisol (secreted by zona fasciculata of adrenal cortex), prolactin (secreted by hypophysis and stimulate milk formation in mammary glands), thyroxine (secreted by follicular cells of thyroid gland) etc. are increased several folds in the maternal blood.

195. Answer (2)

Hint: When favourable conditions return, *Amoeba* produce many minute amoebae.

Sol.: Under unfavourable conditions, the *Amoeba* withdraws its pseudopodia and secretes a three-layered hard covering or cyst around itself. This phenomenon is termed as encystation. When favourable conditions return, the encysted *Amoeba* divides by multiple fission and produces many minute amoebae or pseudopodiospores; the cyst wall bursts out and the spores are liberated in surrounding medium to grow up into many amoebae.

196. Answer (4)

Hint: Primary sex organs are involved in gametogenesis.

Sol.: Seminiferous tubules are highly coiled tubules that produce sperms. Sertoli or sustentacular or nurse cells provide nourishment to developing spermatozoa and regulate spermatogenesis. Leydig cells are interstitial cells which secrete androgens.

197. Answer (3)

Hint: Second meiotic division occurs in fallopian tube.

Sol.: During oogenesis, after Ist meiotic division primary oocyte results in formation of secondary oocyte and first polar body. First polar body is released into perivitelline space. After second meiotic division, secondary oocyte forms ovum and second polar body. Second polar body is released in perivitelline space.

198. Answer (1)

Hint: Mammary glands produce milk for the new born.

Sol.: The female reproductive system consists of a pair of ovaries along with a pair of oviducts, uterus, cervix, vagina and the external genitalia located in pelvic region. These parts of the system along with a pair of the mammary glands are integrated structurally and functionally to support the process of ovulation, fertilisation, pregnancy, birth and child care.

199. Answer (2)

Hint: It is surrounded by more layers of granulosa cells and a new theca.

Sol.: Receptors for binding of sperm (male gamete) in female mammals are present on zona pellucida. It is secreted by secondary oocyte.

200. Answer (3)

Hint: During embryogenesis, cells of zygote become more specialised to form embryo.

Sol.: Cell division (mitosis) increases the number of cells in the developing embryo; cell differentiation and cell modification help group of cells to undergo certain modifications to form specialised tissues and organs to form an organism.

❑ ❑ ❑

All India Aakash Test Series for NEET - 2023

TEST - I (Code-B)

Test Date : 14/08/2022

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION-A

1. Answer (3)

Hint: $I = neAv_d$

Sol.: $v_d = \dfrac{I}{neA}$

$$= \frac{3.2}{10^{26} \times 1.6 \times 10^{-19} \times 2 \times 10^{-6}} = 0.1\,\text{m/s}$$

2. Answer (1)

Hint: $I_{avg} = \left(\dfrac{\Delta Q}{\Delta t}\right)$

Sol.: $\dfrac{dQ}{dt} = I$

$$\int dQ = \int_0^2 \left(3t^2 + 2t + 5\right) dt$$

$$\Delta Q = \left[t^3 + t^2 + 5t\right]_0^2$$

$$= 8 + 4 + 10 = 22$$

$$I_{avg} = \frac{22}{2} = 11\ \text{A}$$

3. Answer (2)

Hint and Sol.: The amount of charge flowing per unit time per unit area normal to flow is called current density.

4. Answer (2)

Hint: Use KCL

Sol.: $\dfrac{10 - V_O}{2} + \dfrac{4 - V_O}{2} + \dfrac{6 - V_O}{4} = 0$

$$20 - 2V_O + 8 - 2V_O + 6 - V_O = 0$$

$$V_O = \left(\frac{34}{5}\right) \text{V}$$

5. Answer (4)

Hint and Sol.: Nichrome (which is an alloy of nickel, iron and chromium) exhibits a very weak dependence of resistivity with temperature.

6. Answer (1)

Hint and Sol.: From the colour coding of carbon resistor, Violet – 7, Green – 5, Grey – 8, Orange – 3

7. Answer (3)

Hint: Use concept of balanced wheatstone bridge

Sol.: $\dfrac{R_1}{40} = \dfrac{R_2}{60}$

$$3R_1 = 2R_2$$

$$R_1 < R_2$$

After connecting resistance of 20 Ω in series

$$\frac{R_1 + 20}{50} = \frac{R_2}{50}$$

$$R_1 + 20 = \frac{3R_1}{2}$$

$$\frac{R_1}{2} = 20$$

$$R_1 = 40\,\Omega$$

8. Answer (2)

Hint: emf $\propto$ balancing length

Sol.: $V \propto l$

$$\frac{V}{V_1} = \frac{l}{4 \times l_1}$$

$$\frac{V}{\left(\frac{4V}{3}\right)} = \frac{l}{4l_1}$$

$$l_1 = \frac{l}{3}$$

9. Answer (2)

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

Sol.: $V = IR$

$$4 = 2\rho \left[\frac{100 \times 10^{-2}}{2 \times 10^{-6}}\right]$$

$$\rho = 4 \times 10^{-6}\ \Omega\,\text{m}$$

10. Answer (1)

Hint: In series combination

$$R_{eff} = R_1 + R_2$$

Sol.: $R = \left(\frac{l}{\sigma A}\right)$

$$\frac{2l}{\sigma_{eff} A} = \frac{l}{\sigma A} + \frac{l}{2\sigma A}$$

$$\frac{2}{\sigma_{eff}} = \frac{1}{\sigma} + \frac{1}{2\sigma}$$

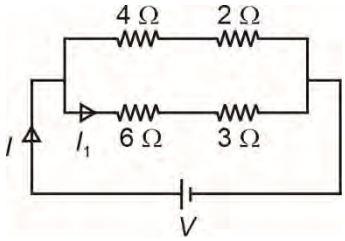
$$\frac{2}{\sigma_{eff}} = \frac{2+1}{2\sigma}$$

$$\sigma_{eff} = \frac{4\sigma}{3}$$

11. Answer (3)

Hint: Use the concept of balance wheatstone bridge.

Sol.:



$$V = V_1 + V_2$$

$$V = 6I_1 + 3I_1$$

$$I_1 = \frac{V}{9}$$

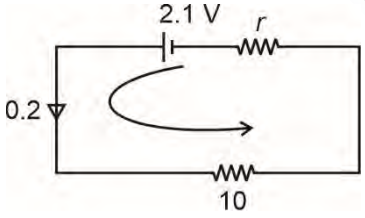
$$V_{6\Omega} = \frac{6 \times V}{9}$$

$$= \frac{2V}{3}$$

12. Answer (2)

Hint: Power dissipated = $I^2 R$

Sol.:



$$2.1 - 0.2r - 10 \times 0.2 = 0$$

$$2.1 - 0.2r - 2 = 0$$

$$r = \frac{1}{2}\ \Omega$$

Power dissipated = $\left(\frac{1}{5}\right)^2 \times \frac{1}{2} = \frac{1}{50}$ W

13. Answer (4)

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

Sol.: $I_1 = \frac{I}{n}$

$$A_1 = nA$$

$$R_1 = \rho \frac{l_1}{A_1}$$

$$R_1 = \rho \frac{l}{An^2}$$

$$= \frac{R}{n^2}$$

14. Answer (2)

Hint: In parallel combination of cell

$$E = \frac{\frac{E_1}{r_1} + \frac{E_2}{r_2} + \frac{E_3}{r_3}}{\frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}}$$

Sol.: $E_1 = E_2 = E_3 = 9\,\text{V}$

$$r_1 = r_2 = r_3 = 3\,\Omega$$

$$E = \frac{\frac{9}{3} + \frac{9}{3} + \frac{9}{3}}{\frac{1}{3} + \frac{1}{3} + \frac{1}{3}}$$

$$= 3 + 3 + 3$$

= 9 V

15. Answer (3)

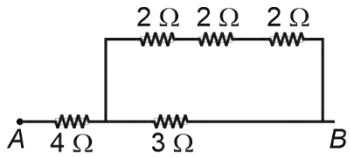
Hint: For series combination

$$R_{eff} = R_1 + R_2 + ...R_n$$

for parallel combination

$$\frac{1}{R_{eff}} = \frac{1}{R_1} + \frac{1}{R_2} + ... \frac{1}{R_n}$$

Sol.:



$$R = \frac{6 \times 3}{6 + 3} + 4$$

$$= 2 + 4$$

= 6 Ω

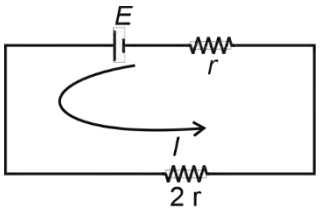
16. Answer (3)

Hint and Sol.: Metals have positive thermal coefficient of resistance.

17. Answer (2)

Hint: Use KVL

Sol.:



$+E - ir - 2ir = 0$

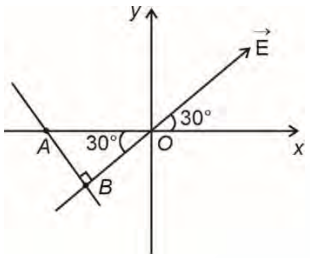
$i = \dfrac{E}{3r}$

$V = i \times 2r = \dfrac{2E}{3}$

18. Answer (2)

Hint: $dV = -\vec{E} \cdot d\vec{r}$

Sol.:



$OB = AO\cos 30^\circ$

$= 3 \times \dfrac{\sqrt{3}}{2}\text{m}$

$V_A = V_B$

$V_B - V_O = E(OB)$

$= 60 \times \dfrac{3\sqrt{3}}{2} = 90\sqrt{3}\ \text{V}$

$V_A - V_O = 90\sqrt{3}\ \text{V}$

$\therefore\ V_O - V_A = -90\sqrt{3}\ \text{V}$

19. Answer (1)

Hint: $V_c = \dfrac{C_1V_1 + C_2V_2}{C_1 + C_2}$

Sol.: $C_1 = C,\ C_2 = Ck, \qquad V_1 = 50\,\text{V}$

$V_c = 10\,\text{V}$

$10 = \dfrac{50 \times C + Ck \times 0}{C + kC}$

$10 = \dfrac{50C}{C(1+k)}$

$10 + 10k = 50$

$k = 4$

20. Answer (3)

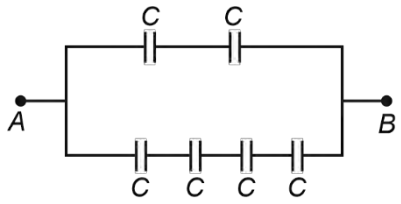
Hint: In series combination

$\dfrac{1}{C_{eff}} = \dfrac{1}{C_1} + \dfrac{1}{C_2} + \dfrac{1}{C_3} + \ldots$

In parallel combination

$C_{eff} = C_1 + C_2 + C_3 + \ldots$

Sol.:



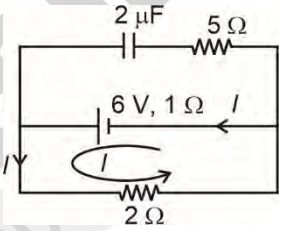
$C_{AB} = \dfrac{C}{4} + \dfrac{C}{2}$

$= \dfrac{3C}{4}$

21. Answer (2)

Hint: In steady state no current will flow through capacitor.

Sol.:



$I = \dfrac{6}{1+2}$

$= 2\,\text{A}$

$V = \dfrac{q}{C} = 6 - 2 \times 1 = 4$

$q = 2 \times 4$

$= 8\,\mu\text{C}$

22. Answer (2)

Hint and Sol.: Dielectric strength, it is maximum electric field which a material can bear.

23. Answer (3)

Hint and Sol.: Capacitance of spherical capacitor

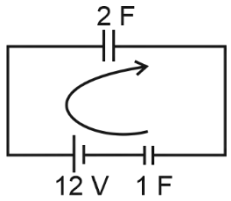
$C = \dfrac{4\pi\varepsilon_0 ab}{b-a}$

$= \dfrac{4\pi\varepsilon_0 a \times 2a}{2a - a} = 8\pi\varepsilon_0 a$

24. Answer (1)

Hint: $V_c = \dfrac{q}{C}$

Sol.:



$$12-\frac{q}{1}-\frac{q}{2}=0$$

$$\frac{3q}{2}=12$$

$$q=8\ \mu C$$

$$V=\frac{q}{C}=\frac{8}{1}$$

$$=8\,V$$

25. Answer (3)

Hint: $C_{eq}=\left(\frac{\varepsilon_0 A}{\frac{d}{k_1}+\frac{d}{k_2}+\frac{d}{k_3}}\right)$

Sol.: Here $k_1=k_3=1, k_2=\frac{\varepsilon}{\varepsilon_0}$

$$C_{eq}=\frac{\varepsilon_0 A}{d+\frac{d}{\left(\frac{\varepsilon}{\varepsilon_0}\right)}+d}$$

$$=\frac{\varepsilon_0 A}{2d+\frac{\varepsilon_0 d}{\varepsilon}}=\frac{\varepsilon_0\varepsilon A}{(2\varepsilon+\varepsilon_0)d}$$

26. Answer (2)

Hint: $W_E=q(V_A-V_B)$

Sol.: $W_E=q(V_A-V_B)$

$$100\times10^{-6}=4\times10^{-6}(V_A-V_B)$$

$V_A-V_B=25\,V$, point A is at higher potential

27. Answer (1)

Hint: $dV=-\vec{E}\cdot d\vec{r}$

Sol.: $dV=-\vec{E}\cdot d\vec{r}$

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

Along the electric field θ is 0°, hence $\frac{dV}{dr}$ is maximum, so the magnitude of variation of potential is maximum along the electric field.

28. Answer (1)

Hint: $\oint\vec{E}\cdot d\vec{A}=\frac{q_{enc}}{\varepsilon_0}$

Sol.: $\oint_{S_1}\vec{E}\cdot d\vec{A}=\frac{q_1+q_2}{\varepsilon_0}$

$$=\frac{1\times10^{-6}+2\times10^{-6}}{\varepsilon_0}=\frac{3\times10^{-6}}{\varepsilon_0}$$

$$\oint_{S_2}\vec{E}\cdot d\vec{A}=\frac{q_2+q_3}{\varepsilon_0}$$

$$=\frac{2\times10^{-6}-3\times10^{-6}}{\varepsilon_0}$$

$$=\frac{-1\times10^{-6}}{\varepsilon_0}$$

$$\oint_{S_3}\vec{E}\cdot d\vec{A}=\frac{q_1+q_2+q_3}{\varepsilon_0}$$

$$=\frac{1\times10^{-6}+2\times10^{-6}-3\times10^{-6}}{\varepsilon_0}=0$$

Flux is maximum for S_1

29. Answer (4)

Hint and Sol.: Electric lines of force does not exist in real it is an imaginary curve.

30. Answer (2)

Hint: Electric force in a medium $F=\frac{q_1q_2}{4\pi\varepsilon_0 k r^2}$

Sol.: $F=\frac{q_1q_2}{4\pi\varepsilon_0 d^2}$

$$F_1=\frac{q_1q_2}{4\pi\varepsilon_0\,4d_1^2}$$

$F_1=F$

$4d_1^2=d^2$

$d_1=d/2$

31. Answer (1)

Hint: Use Gauss's law

Sol.: $\oint\vec{E}\cdot d\vec{A}=\frac{q_{enc}}{\varepsilon_0}$

Inside the conductor $E=0$

$$\frac{q_{enc}}{\varepsilon_0}=0\Rightarrow q_{enc}=0$$

32. Answer (2)

Hint: $\vec{\tau}=\vec{p}\times\vec{E}$

Sol.: $\vec{\tau}=pE\sin\theta\hat{n}$

at $\theta=0°, 180°$

$\tau=0$

at $\theta=90°$

$\tau=+pE$

33. Answer (3)

Hint and Sol.: If a point charge is brought in an electric field, then electric field at a nearby point may increase or decrease.

34. Answer (3)

Hint: For maximum value of F, $\frac{dF}{dq}=0$

Sol.: $F=\frac{k\left(\frac{2Q}{3}-q\right)q}{d^2}$

$\frac{dF}{dq}=\frac{k}{d^2}\left(-2q+\frac{2Q}{3}\right)$

$\frac{dF}{dq}=0$

$-2q+\frac{2Q}{3}=0$

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

35. Answer (4)

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

Sol.: $\vec{r}=\vec{r}_2-\vec{r}_1$

$=\left(3\hat{i}+4\hat{j}+4\hat{k}\right)-\left(2\hat{i}+2\hat{j}+2\hat{k}\right)$

$=\left(\hat{i}+2\hat{j}+2\hat{k}\right)$

$|\vec{r}|=\sqrt{2^2+2^2+1^2}$

= 3 m

$F=\frac{9\times10^9\times6\times10^{-6}\times6\times10^{-6}}{3^2}$

$=36\times10^{-3}\text{N}=36\ \text{mN}$

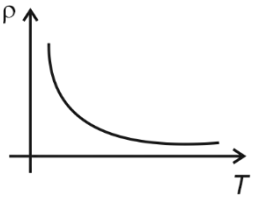
SECTION-B

36. Answer (4)

Hint and Sol.: Ohm's law fails in transistor, photodiode and diode because *V-I* characteristics of all these devices are non-linear.

37. Answer (2)

Hint and Sol.: For semiconductor, resistivity decreases with increase in temperature.



38. Answer (3)

Hint: Potential difference across parallel resistance will be same.

Sol.: $P = VI$

$I=\frac{40}{20}=2\,\text{A}$

Now, $\frac{R\times2\times2}{R+2}=2$

$4R = 2R + 4$

$R = 2\ \Omega$

39. Answer (1)

Hint: Potential gradient is potential drop across wire per unit length

Sol.: $V = IR$

$V=I\rho\frac{\ell}{A}$

$\frac{V}{\ell}=\frac{I\rho}{A}$

$=\frac{0.4\times20\times10^{-8}}{4\times10^{-6}}=2\times10^{-2}\ \text{V/m}$

40. Answer (2)

Hint and Sol.: Given circuit is balanced wheat stone bridge, it does not depend on diagonal resistance, therefore current flowing through the battery remains same.

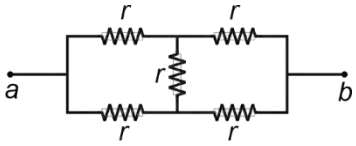
41. Answer (1)

Hint and Sol.: Kirchhoff's junction law is based on the law of conservation of charge. While Kirchhoff's voltage law is based on the law of conservation of energy.

42. Answer (3)

Hint: Use concept of balanced wheatstone bridge

Sol.:



$R_{ab}=\frac{2r\times2r}{2r+2r}=r$

43. Answer (4)

Hint: $P = VI$

Sol.: $I=\frac{P}{V}=\frac{40}{10}=4\,\text{A}$

Let resistance R be connected in series with bulb so that it glows with full intensity.

$10+4R=20$

$4R=10$

$R=2.5\ \Omega$

44. Answer (2)

Hint: $\mu = \frac{e\tau_e}{m_e}$

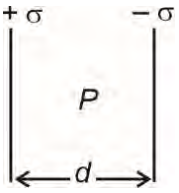
Sol.: $\mu = \frac{e\tau_e}{m_e}$

$\mu \propto \tau_e$

45. Answer (1)

Hint: $|\Delta V| = Ed$

Sol.:



$E_P = \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$

$\Delta V = \frac{\sigma d}{\varepsilon_0}$

46. Answer (2)

Hint: $dV = -\vec{E} \cdot d\vec{r}$

Sol.: $\int_{V_Q}^{V_R} dV = -\int_0^{d/\sqrt{2}} Edr\cos 0^\circ \Rightarrow V_R - V_Q = \frac{-Ed}{\sqrt{2}}$

$V_Q = V_P$

$\therefore\ V_R - V_P = \frac{-Ed}{\sqrt{2}}$

47. Answer (2)

Hint: $C = \frac{A\varepsilon_0 k}{d}$

Sol.: On removing dielectric capacitance will decrease.

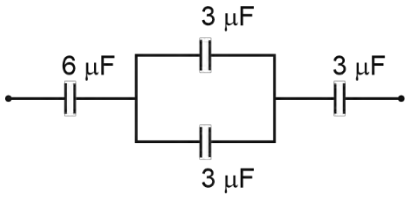
Also, $E = \frac{Q}{A\varepsilon_0 k}$

$U = \frac{Q^2}{2C}$

48. Answer (3)

Hint: Charge on the capacitors will be same in series combination

Sol.:



$\frac{q}{6} + \frac{q}{6} + \frac{q}{3} = 80$

$\frac{4q}{6} = 80$

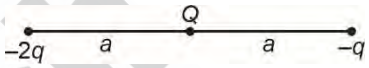
q = 120 μC

$V = \frac{q}{C} = \frac{120}{6}$ = 20 V

49. Answer (3)

Hint: $U = \frac{kq_1q_2}{r}$

Sol.:



$U = -\frac{2qQk}{a} + \frac{2q^2k}{2a} - \frac{kQq}{a}$

$U = -\frac{3kqQ}{a} + \frac{q^2k}{a}$

U = 0

$-\frac{3kqQ}{a} + \frac{q^2k}{a} = 0$

$\frac{Q}{q} = \frac{1}{3}$

50. Answer (3)

Hint: $|\vec{p}| = ql$ (Here q is magnitude of charge and l is distance between two charges).

Sol.: $\vec{p} = qa\hat{i} - qa\hat{i} + 2qa\hat{j}$

$= 2qa\hat{j}$

[CHEMISTRY]

SECTION-A

51. Answer (3)

Hint: $t = \frac{2.303}{k}\log\frac{[A]_o}{[A]_t}$

Sol.: $t = \frac{2.303}{k}\log\frac{100}{100-99.9} = \frac{3\times 2.303}{k}$

52. Answer (2)

Hint & Sol.: Order of reaction is applicable to elementary as well as complex reactions.

53. Answer (4)

Hint: Unit of rate constant = $\left(\text{mol L}^{-1}\right)^{1-n}\text{s}^{-1}$

Sol.:

Order of reaction (n)	Unit of rate constant
0^{th} order	mol L^{-1} s^{-1}
1^{st} order	s^{-1}
2^{nd} order	mol^{-1} L s^{-1}
3^{rd} order	mol^{-2} L^2 s^{-1}

54. Answer (2)

Hint:

$$r=\frac{-d\left[BrO_3^-\right]}{dt}=\frac{-1}{5}\frac{d\left[Br^-\right]}{dt}=-\frac{1}{6}\frac{d\left[H^+\right]}{dt}=\frac{1}{3}\frac{d[Br_2]}{dt}=\frac{1}{3}\frac{d[H_2O]}{dt}$$

Sol.: $\frac{\text{Rate of appearance of } Br_2}{\text{Rate of disappearance of } Br^-}=\frac{3r}{5r}=\frac{3}{5}$

55. Answer (1)

Hint: Rate = k $[A]^x$ $[B]^y$ where x and y are the order w.r.t A and B.

Sol.: $r=k[A]^x[B]^y$ _____(i)

$2r=k[2A]^x[B]^y$ _____(ii)

$4r=k[2A]^x[2B]^y$ _____(iii)

Using equation (i), (ii) and (iii), we get

x = 1, y = 1

$\therefore$ Rate = $k[A]^1[B]^1$

56. Answer (2)

Hint: Slowest step is the rate determining step

Sol.: (1) $O_3 \rightleftharpoons O_2+O$

$$K_{eq}=\frac{[O_2][O]}{[O_3]}$$

$$[O]=K_{eq}\frac{[O_3]}{[O_2]} \quad \text{_____(i)}$$

(2) $O_3+O \xrightarrow{\text{slow}} 2O_2$

$r=k[O_3][O]$

$$=k[O_3]K_{eq}\frac{[O_3]}{[O_2]}=k'[O_3]^2[O_2]^{-1}$$

Overall order = (2) + (–1) = 1

57. Answer (4)

Hint: $t_{1/2} \propto a^{1-n}$

Sol.: For first order reaction

$t_{1/2} \propto a^{1-1} \propto a^{\circ}$

Means half life of first order reaction is independent of initial concentration of reactant.

58. Answer (4)

Hint: $t=\frac{2.303}{k}\log\frac{[A]_o}{[A]_t}$ for first order reaction.

Sol.: $t=\frac{2.303}{2.303\times10^{-3}}\log\frac{(4)}{(0.4)}$

= 1000 s

59. Answer (3)

Hint and Sol.: For the galvanization of iron, zinc is used.

60. Answer (3)

Hint: Ionic mobilities increases on dilution.

Sol.:

- For strong electrolyte Λ_m increases on dilution as the ionic mobilities increases.
- Conductivity decreases on dilution as the number of ions per unit volume decreases.

61. Answer (2)

Hint: For the species undergoing disproportionation

$E_C^{\circ}-E_A^{\circ}=E_{cell}^{\circ}>0$

Sol.: For the reactions

$AO^{2+} \rightarrow A^{3+}+AO_2^+$

$E_{cell}^{\circ}=E_{AO^{2+}/A^{3+}}-E_{AO_2^{2+}/AO^{2+}}$

$=0.34-(-1.0)$

$=1.34\,V=+ve$

$\therefore$ Disproportionation of AO^{2+} will take place

62. Answer (4)

Hint: $E_{cell}^{\circ}=\frac{RT}{nF}\ln K=\frac{2.303RT}{nF}\log K$

Sol.: $E_{cell}^{\circ}=\frac{2.303RT}{2\times F}\log K$

$0.5=\frac{0.05}{2}\log K$

$K=10^{20}$

63. Answer (1)

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

Sol.: For the reaction

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

n=2

$\Delta_rG^{\circ}=-2\times F\times1.05$

$=-202.65\ kJmol^{-1}$

64. Answer (4)

Hint: Greater is the reduction potential, lesser is the reducing power.

Sol.: Order of reduction potential: Au > Cu > Pb > Zn

Order of reducing power: Au < Cu < Pb < Zn

65. Answer (2)

Hint:

$$\Lambda_m^\circ CH_3COOH = \frac{1}{2}\Lambda_m^\circ\left[(CH_3COO)_2Mg\right] + \frac{1}{2}\Lambda_m^\circ(H_2SO_4) - \frac{1}{2}\Lambda_m^\circ(MgSO_4)$$

Sol.: Using Kohlrausch's Law

$$\Lambda_m^\circ CH_3COOH = \frac{z}{2} + \frac{x}{2} - \frac{y}{2}$$

66. Answer (3)

Hint & Sol.: In fuel cell, combustion energy of a fuel is directly used to convert into electrical energy e.g. H_2-O_2 fuel cell.

67. Answer (2)

Hint: Oxidation potential of Ag is greater than NO_3^- as well as H_2O.

Sol.: At anode

- $Ag(s) \rightarrow Ag^+(aq) + 1e^-$

At cathode

- $Ag^+(aq) + 1e^- \rightarrow Ag(s)$

68. Answer (2)

Hint: For aluminium, $Z = \frac{27}{3F}$

Sol.: Using Faraday 1st law

W = ZQ

$$2.7 = \frac{27}{3F} \times Q \Rightarrow Q = 0.3F$$

69. Answer (4)

Hint & Sol.: Ebullioscopic constant depends on nature of solvent only therefore for all aqueous solution value of K_b is same.

70. Answer (3)

Hint: $P = K_H x$

Sol.: 0.2 molal means 0.2 mol H_2S in 1 kg water.

$$x = \frac{n_{H_2S}}{n_{H_2S} + n_{H_2O}} = \frac{0.2}{0.2 + \left(\frac{1000}{18}\right)} = 3.6 \times 10^{-3}$$

$$K_H = \frac{P}{x} = \frac{1}{3.6 \times 10^{-3}} \simeq 278 \text{ atm}$$

71. Answer (1)

Hint: Dissolved oxygen is more in cold water than warm water.

Sol.: Due to greater oxygen content in cold water, aquatic species are more comfortable in cold water than warm water.

Solubility of gases in liquid increases with decrease in temperature.

72. Answer (4)

Hint & Sol.: ΔH_{mix} and ΔV_{mix} = 0 for ideal solutions.

73. Answer (2)

Hint: $K_4\left[Fe(CN)_6\right] \rightarrow 4K^+ + \left[Fe(CN)_6\right]^{4-}$

van't Hoff factor = 5

Sol.:

Species	**van't Hoff factor**
$CaSO_4$	i = 2
$Al_2(SO_4)_3$	i = 5
$CaCl_2$	i = 3
$AlCl_3$	i = 4

74. Answer (2)

Hint: Volume changes with change in temperature.

Sol.: Molarity, normality and $\left(\frac{w}{V}\right)\%$ all contains volume terms therefore depend on temperature.

Molality does not contain volume term therefore it is temperature independent.

75. Answer (3)

Hint: For negative deviation from Raoult's law, the interactions between A---A, B----B should be weaker than A----B.

Sol.: Due to intermolecular hydrogen bonding, the solution of acetone and chloroform shows negative deviation from Raoult's Law.

76. Answer (4)

Hint: $y_A = \frac{P_A^\circ x_A}{P_A^\circ x_A + P_B^\circ x_B}$

Sol.: $P_A = P_A^\circ x_A = 200$

$$x_A = \frac{200}{P_A^\circ} = \frac{200}{400} = 0.5, \quad x_B = 1 - x_A = 0.5$$

$$y_A = \frac{P_A^\circ x_A}{P_A^\circ x_A + P_B^\circ x_B} = \frac{200}{200 + 100 \times 0.5} = \frac{4}{5}, \; y_B = \frac{1}{5}$$

Molar ratio = $\frac{y_A}{y_B} = \frac{4/5}{1/5} = 4:1$

77. Answer (1)

Hint: $\Delta T_f = ik_f m$

Sol.: For P_1 solution, $im = \frac{10}{60} \times \frac{1000}{250} = \frac{2}{3}$

$(\Delta T_f)_1 = \frac{2}{3} K_f = 0.66\ K_f$

$(T_f)_1 = -\frac{2}{3} K_f = -0.66 K_f$

For P_2 solution, $im = \frac{2 \times 10}{58.5} \times \frac{1000}{250} = 1.36$ m

$(\Delta T_f)_2 = 1.36\ K_f$

$(T_f)_2 = -1.36\ K_f$

For P_3 solution, $im = \frac{10}{180} \times \frac{1000}{250} = 0.22$ m

$(\Delta T_f)_3 = 0.22\ K_f$

$(T_f)_3 = -0.22\ K_f$

Order of freezing point: $P_3 > P_1 > P_2$

78. Answer (1)

Hint: There are eight tetrahedral voids per unit cell of fcc lattice.

Sol.: No. of X atoms per unit cell

$= \frac{1}{8} \times 8 + \frac{1}{2} \times 6 = 4$

No. of Y atoms per unit cell $= \frac{1}{2} \times 8 = 4$

Formula of the compound Y_4X_4 or YX.

79. Answer (3)

Hint: Diamagnetic substance are weakly repelled by magnetic field.

Sol.: Ferrimagnetic substance looses ferrimagnetic property and becomes paramagnetic on heating.

80. Answer (4)

Hint: F-centres are anionic sites occupied by unpaired electrons which is called Farbenzenter for colour centre.

Sol.: In metal excess defect, due to anionic vacancies formation of F-centres take place.

81. Answer (4)

Hint: $d = \frac{zM}{N_A a^3}$

Sol.: $d = \frac{4 \times 50}{\left(6 \times 10^{23}\right) \times \left(200 \times 10^{-10}\right)^3} = 41.67\,g\,cm^{-3}$

82. Answer (1)

Hint: In end-centred unit cell, one constituent particle is present at the centre of any two opposite faces beside the ones present at its corners.

Sol.: Orthorhombic and monoclinic crystal system contain end-centred variations.

83. Answer (2)

Hint: No. of closed packed atoms : octahedral voids : Tetrahedral voids : : 1 : 1 : 2

Sol.: Since fcc unit cell contains 4 atom per unit cell therefore number of tetrahedral and octahedral voids are 8 and 4 respectively so total voids are 12.

84. Answer (2)

Hint: $d = \frac{ZM}{N_A a^3}$

Sol.: $d_{sc} = \frac{1 \times M}{N_A (2r)^3}$ $\left[\because \text{for simple cubic, } a = 2r\right]$

$d_{fcc} = \frac{4 \times M}{N_A \left(2\sqrt{2}r\right)^3}$ $\left[\because \text{for fcc, } a = 2\sqrt{2}r\right]$

$\frac{d_{fcc}}{d_{sc}} = \left(\frac{2}{2\sqrt{2}}\right)^3 \times \frac{4}{1} = \frac{\sqrt{2}}{1}$

85. Answer (3)

Hint: Total charge on cations must be equal to total charge on anions.

Sol.: Let the number of Ni^{3+} ions = x

Then, number of Ni^{2+} ions = 0.94 – x

$(0.94 - x) \times 2 + x \times 3 = 2$

$1.88 - 2x + 3x = 2$

$x = 2 - 1.88 = 0.12$

Fraction of $Ni^{3+} = \frac{x}{0.94} = \frac{0.12}{0.94} = \frac{6}{47}$

SECTION-B

86. Answer (1)

Hint & Sol.: Decomposition of gaseous ammonia on a hot platinum surface at high pressure is an example of zero order reaction.

$2NH_3(g) \xrightarrow[\text{Pt catalyst}]{1130\ K} N_2(g) + 3H_2(g)$

87. Answer (3)

Hint: $\frac{r_{t+\Delta t}}{r_t} = (2)^{\frac{\Delta t}{10}}$

Sol.: $\frac{r_{55^\circ}}{r_{25^\circ}} = (2)^{\frac{55-25}{10}} = 8$

88. Answer (4)

Hint: $k = Ae^{-E_a/RT}$

Sol.: $\ln k = \ln A - \frac{E_a}{R}\left(\frac{1}{T}\right)$

Or $\log k = \log A - \frac{E_a}{2.303R}\left(\frac{1}{T}\right)$

On comparing with y = mx + C

slope (m) $= \frac{-E_a}{2.303R}$

89. Answer (1)

Hint: Cell constant = $\frac{l}{A}$

Sol.: Cell constant $G^* = \kappa \times R$

90. Answer (1)

Hint & Sol.: In lead storage batteries, 38% aqueous sulphuric acid is used as an electrolyte.

91. Answer (1)

Hint & Sol.:

Ions	H^+	Na^+	K^+	Ca^{2+}
($S\ cm^2\ mol^{-1}$)	349.6	50.1	73.5	119

92. Answer (1)

Hint & Sol.: Graphite is a conductor while CuO, Si and Ge are semiconductors.

93. Answer (2)

Hint: $E_{cell} = E^\circ_{cell} - \frac{0.059}{n}\log Q$

Sol.: $Mg(s) + Cu^{2+}(aq) \rightleftharpoons Cu(s) + Mg^{2+}(aq)$

$$Q = \frac{[Cu]\left[Mg^{2+}\right]}{[Mg]\left[Cu^{2+}\right]} = \frac{(0.001)}{(0.01)} = 0.1$$

$$E^\circ_{cell} = E^\circ_C - E^\circ_A = 0.34 - (-2.37) = 2.71V$$

$$E_{cell} = 2.71 - \frac{0.059}{2}\log(0.1) = 2.74\,V$$

94. Answer (3)

Hint: Relative lowering in vapour pressure = mole fraction of solute.

Sol.: $\because \frac{\Delta P}{P^o_A} \times 100 = 50 \therefore x_B = 0.5$

$$x_B = \frac{n_B}{n_A + n_B} = \frac{w/50}{\frac{171}{114} + \frac{w}{50}} = 0.5$$

$w = 75\,g$

95. Answer (2)

Hint: $i = 1 - \alpha + \frac{\alpha}{n}$

Sol.: van't Hoff factor $(i) = 1 - 0.4 + \frac{0.4}{3}$

(i) = 0.73

96. Answer (3)

Hint: Azeotropes are constant boiling mixtures.

Sol.:

- Large positive deviation from Raoult's law form minimum boiling azeotrope at a specific composition.
- Azeotropes have same composition in liquid and vapour phase therefore it is not possible to separate the components by fractional distillation.

97. Answer (4)

Hint & Sol.: Osmotic pressure method is widely used to determine molar masses of proteins and polymers as the pressure measurement is around the room temperature and molarity is used instead of molality.

98. Answer (4)

Hint: Packing efficiency of fcc unit cell is 74%.

Sol.: In ccp lattice, tetrahedral voids are present at body diagonal of unit cell.

99. Answer (3)

Hint: Triclinic crystal system is the most unsymmetrical system.

Sol.: For triclinic crystal system, $\alpha \neq \beta \neq \gamma \neq 90°$ and $a \neq b \neq c$.

100. Answer (3)

Hint:

Close packing of spheres in one dimension

Sol.: In one dimensional close packed arrangement, the coordination number is 2.

[BOTANY]

SECTION-A

101. Answer (2)

Hint: In 60% of angiosperms, pollens are shed at two celled stage.

Sol.: Anther is bilobed with each lobe having two theca. Synergids have filiform apparatus.

102. Answer (2)

Hint: Both *Citrus* and mango have apomictic seeds.

Sol.: They have multiple embryos in their seeds. They have zygotic embryo too.

103. Answer (3)

Hint: Banana is a seedless fruit.

Sol.: In banana, seeds are absent as fruits develop without fertilisation. True fruits arise only from the ovary.

104. Answer (1)

Hint: There is record of some old yet viable seeds.

Sol.: A large number of seeds can remain alive for several years. Some seeds can live for hundreds of years.

105. Answer (4)

Hint: Perisperm arise from persistent, residual nucellus.

Sol.: Perisperm is diploid tissue.

106. Answer (3)

Hint: Epiblast represents the remains of second cotyledon.

Sol.: Epiblast and coleorhiza are absent in dicot embryos. Root cap is seen in both dicot and monocot embryos.

107. Answer (4)

Hint: Leguminous seeds are non-endospermous.

Sol.: Mature bean seeds lack endosperm whereas castor, maize and wheat have endosperm.

108. Answer (3)

Hint: The coconut water from tender coconut and its white kernel are food storing tissues.

Sol.: The coconut water is formed by free nuclear endosperm development while white kernel is formed by cellular mode of endosperm development.

109. Answer (4)

Hint: Double fertilisation includes two types of fusions.

Sol.: Syngamy and triple fusion (fusion of male gamete with secondary nucleus) refers to double fertilisation.

110. Answer (1)

Hint: Unisexual flowers does not require emasculation.

Sol.: Removal of anther or emasculation is required in unisexual flowers. It is not required in maize as it has unisexual flowers.

111. Answer (4)

Hint: Central cell is binucleate.

Sol.: Central cell contains two polar nuclei. Filiform apparatus is found in synergids.

112. Answer (3)

Hint: Homogamy promotes self pollination.

Sol.: Synchronised pollen release and stigma receptivity refers to homogamy. Homogamy is not an outbreeding device.

113. Answer (4)

Hint: In dioecious plants both autogamy as well as geitonogamy are prevented.

Sol.: Castor and maize show geitonogamy. China rose shows autogamy while papaya shows xenogamy.

114. Answer (3)

Hint: Such flowers are found in *Oxalis* and *Commelina*.

Sol.: Flowers which do not open at all are termed as cleistogamous flowers, *e.g.*, *Oxalis* and *Commelina*.

115. Answer (2)

Hint: Monosporic embryo sac development is the most common type.

Sol.: Monosporic embryo sac is 7 celled, 8 nucleate and has 3 celled egg apparatus. It arises from single functional megaspore formed after 1 meiosis in megaspore mother cell and 3 sequential mitosis in megaspore.

116. Answer (3)

Hint: Some primates, rodents and reptiles also act as pollinators.

Sol.: Large animals such as lemurs, lizards etc. also acts as pollinating agents.

117. Answer (1)

Hint: *Zostera* and *Hydrilla* both show hydrophily.

Sol.: *Zostera* is marine plant while *Hydrilla* is a fresh water plant showing hydrophily.

118. Answer (1)

Hint: Nectar and pollen are usual floral rewards for animal pollinators.

Sol.: Insect pollinated flowers are usually large, if small, they are clustered into inflorescence. They are fragrant. Night bloomers are usually white coloured.

119. Answer (4)

Hint: Secondary nucleus is formed after fusion of two polar nuclei.

Sol.: Secondary nucleus is '2n' or diploid whereas antipodals, synergids and egg are haploid.

120. Answer (4)

Hint: A megasporangium may have more than one embryo sacs.

Sol.: The food storing tissue of megasporangium is called nucellus. Endosperm is formed after triple fusion.

121. Answer (3)

Hint: A mature pollen grain is generally two celled.

Sol.: The vegetative cell is bigger and generative cell is smaller. Pollen grains have prominent germ pores.

122. Answer (3)

Hint: Pollen grain is considered as male gametophyte while embryo sac is considered as female gametophyte of typical angiospermic plants.

Sol.: Pollen grains are two/three celled while embryo sac is seven celled structure. They are products of meiosis and contain gametes. A pollen grain has two male gametes whereas an embryo sac has only one egg, *i.e.,* female gamete.

123. Answer (3)

Hint: Tapetum is the innermost layer of anther wall.

Sol.: Anther wall is four layered. The outer three layers provide protection and help in dehiscence of anther.

124. Answer (2)

Hint: This structure is always diploid.

Sol.: Zygote is the vital link that ensures continuity of species between two successive generations.

125. Answer (2)

Hint: Algae and bryophytes produce motile male gametes that swim in water to reach the female gamete.

Sol.: In algae and bryophytes large number of male gametes are produced to compensate the loss of gametes which occur during their transfer to female gametes.

126. Answer (4)

Hint: Variations are seen in offsprings produced by sexual reproduction.

Sol.: *Chara* sexually reproduces by fusion of heterogametes, sperm/antherozoids and egg.

127. Answer (2)

Hint: Monocarpic plants flower once in their life.

Sol.: Neelakuranji is a perennial plant and flower once in its lifetime.

128. Answer (3)

Hint: Zygote is produced by fusion of gametes.

Sol.: Zygotes are always diploid as they are produced by fusion of haploid gametes.

129. Answer (4)

Hint: Coconut is a monoecious plant.

Sol.: In coconut, staminate and pistillate flowers are produced on same plant.

130. Answer (4)

Hint: Interflowering period is seen in polycarpic plants.

Sol.: Interflowering period is part of mature phase in polycarpic plants.

131. Answer (3)

Hint: Leaves of several plants have adventitious buds that help in vegetative propagation.

Sol.: *Bryophyllum* vegetatively propagates via leaf buds.

132. Answer (2)

Hint: Algae mainly reproduce by zoospores.

Sol.: *Amoeba* – Binary fission

Penicillium – Conidia

Chalmydomonas – Zoospores

Yeast—Budding

133. Answer (4)

Hint: Annual plants have life span of less than a year.

Sol.: Life span of rice – 3-4 months

Life span of rose – 5-7 years

Life span of mango – 200 years

Life span of banana – 25 years

134. Answer (1)

Hint: Polycarpic plants flower repeatedly at intervals in their life.

Sol.: Interflowering phase is seen in polycarpic plants and they do not show clear-cut distinction of the three phases.

135. Answer (2)

Hint: Some algae produce isogametes.

Sol.: *Cladophora* forms isogametes while *Chara*, *Volvox* and *Fucus* form heterogametes.

SECTION-B

136. Answer (4)

Sol.: *Michelia* has multicarpellary apocarpous ovary. *Papaver* and lily have multicarpellary syncarpous ovary. Pea has monocarpellary ovary.

137. Answer (4)

Hint: Pollinators are not required, if flowers do not open.

Sol.: Pollinators are not required in cleistogamy.

138. Answer (4)

Hint: *Vallisneria* is a water pollinated plant.

Sol.: *Vallisneria* shows epihydrophily.

139. Answer (2)

Hint: All aquatic plants are not pollinated by water current.

Sol.: Water lily gets pollinated by insects.

140. Answer (4)

Sol.: Pollen-pistil interaction refers to the events that occur from pollen deposition on the stigma until pollen tube entry in ovule.

141. Answer (2)

Hint: Endosperm develops from PEN (Primary endosperm nucleus).

Sol.: Endosperm is triploid tissue. It develops prior to embryo formation.

142. Answer (4)

Hint: Orange show apomixis or adventive embryony.

Sol.: Apomictic embryos of orange seeds arise from nucellar cells. These embryos are diploid and are genetically identical except the one which arise from zygote.

143. Answer (2)

Hint: Nectar acts as reward for animal pollinators.

Sol.: Insect pollinated flowers produce nectar or fragrance to attract insects, and these are absent in wind pollinated flowers.

144. Answer (2)

Hint: Members of Solanaceae have pollen viability for several months.

Sol.: Pollen grains of tomato plant may remain viable for several months.

145. Answer (4)

Hint: Exine is the outermost layer of pollen grain.

Sol.: Sporopollenin is found in exine. Intine is made of pectin and cellulose.

146. Answer (2)

Hint: A stamen can be attached to a thalamus or a petal.

Sol.: Filament of a stamen is long and slender stalk that can get attached to thalamus.

147. Answer (4)

Hint: Embryogenesis is formation of embryo from zygote.

Sol.: Embryogenesis is a post-fertilisation event. Rest all are pre-fertilisation events.

148. Answer (3)

Hint: Sexual reproduction produces variations.

Sol.: Sexual reproduction is a slow, elaborate and complex process.

149. Answer (3)

Hint: Multicellular organisms reproduce by fragmentation.

Sol.: *Chlamydomonas* is a unicellular alga. It asexually reproduces by zoospores.

150. Answer (2)

Hint: Life span is specific trait of each organism.

Sol.: Life span is not related with size or complexity of organisms, so crow and parrot have difference in their life spans.

[ZOOLOGY]

SECTION-A

151. Answer (2)

Hint: Related to the juvenile phase.

Sol.: Life spans of organisms are not necessarily correlated with their sizes.

In animals, the juvenile phase is followed by morphological and physiological changes prior to active reproductive behaviour.

152. Answer (2)

Hint: FSH acts on the nurse cells.

Sol.: LH acts on the Leydig cells and stimulates synthesis and secretion of androgens. FSH acts on the Sertoli cells and stimulates secretion of some factors which help in spermiogenesis. FSH stimulates growth and development of the ovarian follicles in females.

153. Answer (2)

Hint: Characterized by the presence of pseudopodia.

Sol.: In sponges (*Spongilla*), the parent individual releases a specialised mass of cells enclosed in a common opaque envelope called gemmule. Gemmules are thought to be internal buds formed by endogenous budding during unfavourable conditions.

In *Hydra*, if the body breaks into distinct pieces, each fragment grows into an adult capable of producing offsprings.

154. Answer (2)

Hint: Rete testis is intra-testicular duct.

Sol.: Path of sperm through the male body:

Seminiferous tubules → Rete testis → Vasa efferentia ↓ Epididymis ↓ Vas deferens ↓ Ejaculatory duct → Urethra

155. Answer (1)

Hint: Chromosome number in meiocyte of cat is 38.

Sol.: Chromosome number in gamete of cat is 19.

Chromosome number in gamete of dog is 39.

Chromosome number in gamete of rat is 21.

Chromosome number in gamete of humans is 23.

156. Answer (1)

Hint: 'A' is a solid ball of cells

Sol.: The embryo with 8 to 16 blastomeres is called morula. The morula continues to divide and transforms into blastocyst as it moves further into the uterus. The blastula of humans is called blastocyst.

157. Answer (2)

Hint: It is also found in mucous secretions of human body.

Sol.: The milk produced during the initial few days of lactation is called colostrum. It is slightly yellow in colour, rich in calories and antibodies (IgA). This antibody provides passive immunity to the child. IgG is the only antibody that can cross the placenta and confer immunity to the foetus.

158. Answer (3)

Hint: Origin of axial filament

Sol.: The sperm head contains an elongated nucleus, the anterior portion of which is covered by a cap-like structure, acrosome. Middle piece possesses numerous mitochondria which produce energy for the movement of tail which facilitates sperm motility, essential for fertilisation. Neck contains two centriole–proximal and distal.

159. Answer (3)

Hint: Identify the hormone responsible for ovulation.

Sol.: LH hormone causes the cells of the ruptured follicle to form corpus luteum. It also stimulates the corpus luteum to secrete estrogen and progesterone. With the rise in estrogen and progesterone, the levels of FSH and LH drop. Low levels of LH cause degeneration of corpus luteum.

160. Answer (4)

Hint: Oxytocin means quick birth.

Sol.: An important role is played by release of prostaglandins for initiation of uterine contractions during parturition in humans. Increase in estrogen facilitates increase in receptors for oxytocin which leads to stronger and stronger uterine contractions.

161. Answer (3)

Hint: Fertilised eggs are covered by hard calcareous shell.

Sol.: Majority of mammals including human beings are viviparous animals while animals like reptiles and birds are oviparous.

Because of proper embryonic care and protection, the chances of survival of young ones is greater in viviparous animals.

162. Answer (1)

Hint: Insemination is transfer of sperm into the female genital tract.

Sol.: The reproductive events in human include formation of gametes (gametogenesis), i.e., sperms in male and ovum in females, transfer of sperms into the female genital tract (insemination) and fusion of male and female gametes (fertilisation) leading to formation of zygote. This is followed by formation and development of blastocyst (blastulation) and its attachment to uterine wall (implantation), embryonic development (gestation) and delivery of the baby (parturition).

163. Answer (2)

Hint: Carbon dioxide is exhaled out during breathing.

Sol.: Placenta acts as an endocrine tissue and produces several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogen, progestogens, etc. Detection of hCG in the urine is the basis of pregnancy/Gravindex test. The placenta facilitates the supply of oxygen and nutrients to the embryo and also removal of carbon dioxide and excretory/waste materials produced by the embryo.

164. Answer (2)

Hint: Degeneration of corpus luteum leads to menstruation.

Sol.: Blood flowing in umbilical cord of mammalian embryo is 100% foetal and connects maternal endometrium with embryo.

The corpus luteum secretes large amount of progesterone required for maintenance of endometrium. The menstrual phase is followed by follicular phase.

165. Answer (3)

Hint: Related to the part of male gamete that contains hydrolytic enzymes.

Sol.: When a sperm comes in contact with egg membrane, the acrosome starts releasing its hydrolytic enzymes or sperm lysins which help in dissolving various layers of ovum. This is known as acrosomal reaction.

The middle piece possesses numerous mitochondria that produce energy for the movement of tail that facilitates motility.

166. Answer (2)

Hint: The mammary tubules of each lobe join to form a mammary duct.

Sol.: The glandular tissue of each breast is divided into 15-20 mammary lobes containing cluster of cells called alveoli. The cells of alveoli secrete milk, which is stored in the cavities of alveoli. The alveoli open into mammary tubules. The tubules of each lobule join to form a mammary duct. Several mammary ducts join to form a wider mammary ampulla which is connected to lactiferous duct through which milk is sucked out.

167. Answer (3)

Hint: Milk secreting glands in females.

Sol.:

Ampulla is the best site for fertilisation.

Cervix and vagina forms the birth canal.

Uterine fundus is the normal site for implantation.

168. Answer (3)

Hint: Cells surrounding primary oocyte.

Sol.: In males, inhibin is secreted by Sertoli cells, which suppress FSH synthesis.

In females, granulosa cells of ovary secrete inhibin.

169. Answer (2)

Hint: Foetal ejection reflex triggers the release of oxytocin from the maternal pituitary

Sol.: Oxytocin released from maternal pituitary, acts on the uterine muscle and causes stronger uterine contractions which in turn stimulates further secretion of oxytocin. The stimulatory reflex between the uterine contractions and oxytocin secretion continues resulting in stronger and stronger contractions. The signals for parturition originate from the fully developed foetus and the placenta which induce foetal ejection reflex.

170. Answer (1)

Hint: First sign of growing foetus may be noticed by listening to the heart sound through stethoscope.

Sol.:

Formation of heart	–	After 1st month
First movements of foetus	–	During 5th month
Eyelids separate, Body covered with fine hair	–	By the end of 24 weeks (second trimester)

171. Answer (3)

Hint: High estrogen and progesterone inhibit the release of gonadotropins.

Sol.: Luteal phase (secretory phase) is the most constant phase of menstrual cycle, that is of 14 days. During this, the remaining part of the Graafian follicle transforms into corpus luteum. The corpus luteum secretes large amount of progesterone which is essential for the maintenance of endometrium.

172. Answer (4)

Hint: Identify the hormone which softens pubic symphysis.

Sol.: Hormones hCG, hPL and relaxin are produced in women only during pregnancy. In the later phase of pregnancy, a hormone called relaxin is secreted by ovary.

173. Answer (2)

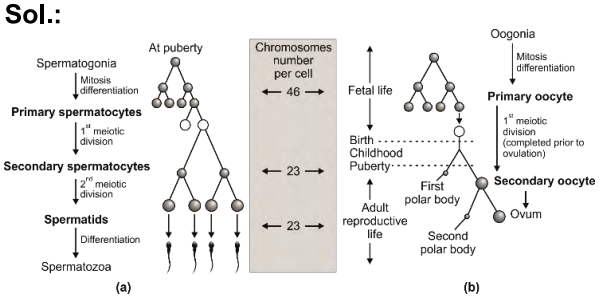
Hint: Leydig cells synthesise and secrete androgens.

Sol.: Each seminiferous tubule is lined on its inside by male germ cells (spermatogonia) and Sertoli cells. Fertilisation can only occur if the ovum and sperms are transported simultaneously to the ampullary region. This is the reason why not all copulations lead to fertilisation and pregnancy. The sex of the baby is determined by the father and not by the mother.

174. Answer (2)

Hint: A tiny first polar body is formed after first meiotic division.

Sol.:



175. Answer (2)

Hint: It undergoes cyclical changes during menstrual cycle.

Sol.: Blastocyst becomes embedded in the endometrium of uterus. The wall of uterus has 3 layers of tissue. The external thin membranous perimetrium, middle thick layer of smooth muscles, myometrium and inner glandular layer called endometrium that lines the uterine cavity. After attachment, the uterine cells divide rapidly and covers the blastocyst.

176. Answer (3)

Hint: Normal reproductive phase extends between menarche to menopause.

Sol.: Sperm formation continue even in old men, but formation of ova ceases in women around the age of 50 years. For normal fertility, at least 60% sperms must have normal shape and size and at least 40% of them must show vigorous motility.

177. Answer (4)

Hint: Surrounds the vaginal opening

Sol.: 'A' is labia majora.

'B' is labia minora.

The clitoris is a tiny finger-like structure lies at the upper junction of two labia minora. Mons pubis is a cushion of fatty tissue covered by skin and pubic hair.

178. Answer (1)

Hint: During spermiogenesis, much of the cytoplasm is lost.

Sol.: Transformation of spermatid into sperm (spermatozoa) is termed as spermiogenesis.

A spermatid is non-motile and heavy. The weight of gamete is reduced along with the development of locomotory structures. Both spermatids and sperms are haploid.

179. Answer (2)

Hint: *Pheretima* is hermaphrodite.

Sol.: The most vital event of sexual reproduction is the fusion of gametes (fertilisation).

In rotifers, honeybees and even some lizards and birds (turkey), the female gamete undergoes development to form new organisms without fertilisation. This phenomenon is called parthenogenesis.

180. Answer (2)

Hint: Inner group of cells in blastocyst.

Sol.: Inner cell mass contains certain cells called stem cells which have the potency to give rise to all the tissues and organs of developing embryo.

Trophoblast forms the extra-embryonic membranes.

181. Answer (3)

Hint: Duration of luteal phase is always fixed.

Sol.: Cyclic menstruation is an indicator of normal reproductive phase and extends between menarche and menopause.

182. Answer (4)

Hint: Identify a haploid cell

Sol.:

Spermatogonia, primary spermatocytes	–	Diploid
Oogonia, primary oocytes	–	Diploid
Secondary spermatocytes, sperms	–	Haploid
Secondary oocytes, ovum (ootid)	–	Haploid

183. Answer (3)

Hint: Seminiferous tubules are less than 4 in number, in each lobule.

Sol.: Each testis has about 250 compartments called testicular lobules. Each lobule contains 1 to 3 highly coiled seminiferous tubules in which sperms are produced.

184. Answer (3)

Hint: Bony fishes exhibit external fertilisation.

Sol.: Organisms exhibiting external fertilisation show great synchrony between the sexes and release a large number of gametes into the surrounding medium (water) in order to enhance the chances of syngamy. This happens in the bony

fishes and frogs, when a large number of offsprings are produced. A major disadvantage is that the offsprings are extremely vulnerable to predators, threatening their survival upto adulthood.

185. Answer (4)

Hint: Identify an ovarian event

Sol.: Menstrual cycle comprises uterine events and ovarian events. The phases in uterine events are proliferative phase, secretory phase and menstruation. The phases in ovarian events are follicular phase, ovulatory phase and luteal phase.

SECTION-B

186. Answer (3)

Hint: During embryogenesis, cells of zygote become more specialised to form embryo.

Sol.: Cell division (mitosis) increases the number of cells in the developing embryo; cell differentiation and cell modification help group of cells to undergo certain modifications to form specialised tissues and organs to form an organism.

187. Answer (2)

Hint: It is surrounded by more layers of granulosa cells and a new theca.

Sol.: Receptors for binding of sperm (male gamete) in female mammals are present on zona pellucida. It is secreted by secondary oocyte.

188. Answer (1)

Hint: Mammary glands produce milk for the new born.

Sol.: The female reproductive system consists of a pair of ovaries along with a pair of oviducts, uterus, cervix, vagina and the external genitalia located in pelvic region. These parts of the system along with a pair of the mammary glands are integrated structurally and functionally to support the process of ovulation, fertilisation, pregnancy, birth and child care.

189. Answer (3)

Hint: Second meiotic division occurs in fallopian tube.

Sol.: During oogenesis, after Ist meiotic division primary oocyte results in formation of secondary oocyte and first polar body. First polar body is released into perivitelline space. After second meiotic division, secondary oocyte forms ovum and second polar body. Second polar body is released in perivitelline space.

190. Answer (4)

Hint: Primary sex organs are involved in gametogenesis.

Sol.: Seminiferous tubules are highly coiled tubules that produce sperms. Sertoli or sustentacular or nurse cells provide nourishment to developing spermatozoa and regulate spermatogenesis. Leydig cells are interstitial cells which secrete androgens.

191. Answer (2)

Hint: When favourable conditions return, *Amoeba* produce many minute amoebae.

Sol.: Under unfavourable conditions, the *Amoeba* withdraws its pseudopodia and secretes a three-layered hard covering or cyst around itself. This phenomenon is termed as encystation. When favourable conditions return, the encysted *Amoeba* divides by multiple fission and produces many minute amoebae or pseudopodiospores; the cyst wall bursts out and the spores are liberated in surrounding medium to grow up into many amoebae.

192. Answer (4)

Hint: It opposes the functioning of RAAS.

Sol.: During pregnancy, the levels of hormones like estrogen, progestogen, cortisol (secreted by zona fasciculata of adrenal cortex), prolactin (secreted by hypophysis and stimulate milk formation in mammary glands), thyroxine (secreted by follicular cells of thyroid gland) etc. are increased several folds in the maternal blood.

193. Answer (3)

Hint: It helps in the lubrication of penis.

Sol.: Secretions of epididymis, vas deferens, seminal vesicle and prostate gland are essential for the maturation and motility of sperms. Bulbourethral glands or Cowper's glands secrete a viscous mucus which acts as a lubricant.

194. Answer (4)

Hint: Tertiary follicle is characterised by a fluid filled cavity called antrum.

Sol.: During embryonic development stage, oogenesis is initiated and oogonia starts division and enter into prophase-I of the meiotic division and get temporarily arrested at that stage. Primary oocyte within the tertiary follicle grows in size and completes its first meiotic division prior to ovulation. It is an unequal division resulting in the formation of a large haploid secondary oocyte and a tiny first polar body.

195. Answer (4)

Hint: During cleavage, nucleus to cytoplasm ratio increases.

Sol.: The second meiotic division of secondary oocyte is not completed until the ovum has been penetrated by a sperm. Human sperm is viable for upto 48 hours. The secondary oocyte forms a membrane called zona pellucida.

196. Answer (2)

Hint: By this time, most of the major organ system are formed.

Sol.: By the end of 12 weeks, most of the organs are formed, for example, the limbs and external genitalia are well developed. After 1 month of pregnancy, the embryo's heart is formed. By the end of 2^{nd} month of pregnancy, the foetus develops limbs and digits.

197. Answer (2)

Hint: Vasa efferentia leaves the testis and open into epididymis.

Sol.: Epididymis leads to vas deferens that ascends to abdomen and loops over the urinary bladder. Vas deferens receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct. These ducts store and transport the sperms from the testis to the outside through urethra. Urethral meatus is external opening of urethra.

198. Answer (3)

Hint: More than one oocyte may be ovulated.

Sol.: Sometimes, two or more follicles reach maturity in one month or cycle, so more than one oocyte may be ovulated. This is the commonest cause of multiple births. In such cases the siblings are fraternal, not identical.

Due to pressure of growing blastocyst, a slit is produced in zona pellucida through which it squeezes out. The growing blastocyst comes out of this slit. At times, it gets broken into two parts which then gives rise to identical twins or monozygotic twins.

199. Answer (2)

Hint: Sexual reproduction is biparental.

Sol.: When two parents (opposite sex) participate in the reproductive process and also involve fusion of male and female gametes, it is called sexual reproduction. Sexual mode of reproduction enables creation of new variants, so that survival advantage is enhanced.

200. Answer (2)

Hint: Life span of parrot is greater than that of crocodile and dog.

Sol.: Life span of parrot = 140 yrs = A

Life span of crocodile = 60 yrs = B

Life span of dog = 20 yrs = C

❑ ❑ ❑