All India Aakash Test Series for NEET - 2027

TEST - 1 (Code-A)

Click here for Code-B Sol.

Test Date : 19/07/2026

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

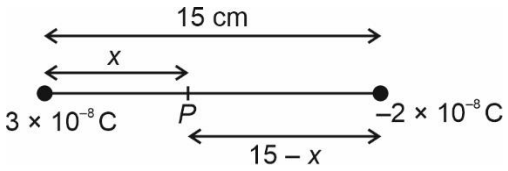
1. Answer (4)

Hint: Potential due to point charge at a distance r,

$V = \frac{Kq}{r}$

Sol.:

(1)

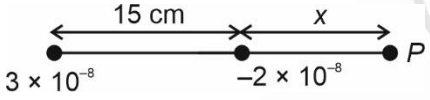


$\frac{K3\times10^{-8}}{x} = \frac{K.2\times10^{-8}}{15-x}$

$\frac{3}{x} = \frac{2}{15-x}$

$\Rightarrow \quad x = 9$ cm

(2)



$K\frac{3\times10^{-8}}{15+x} = K\frac{2\times10^{-8}}{x}$

$\frac{3}{15+x} = \frac{2}{x}$

$3x = 30 + 2x$

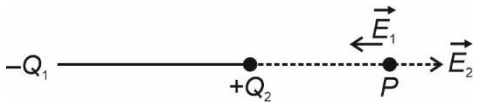
$x = 30$ cm

$\therefore$ At $x = 45$ cm from positive charge, electric potential is zero.

2. Answer (3)

Hint: Electric field due to (+) charge is radially outward and for (–) charge it is radially inward.

Sol.:



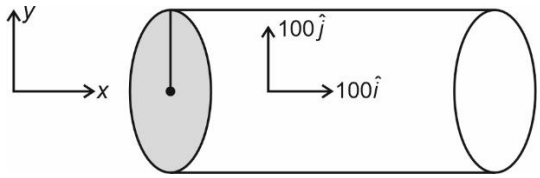
$\therefore \quad \vec{E}_1 \cdot \vec{E}_2 = E_1E_2 \cos 180° = -E_1E_2$

Also $\vec{E}_1 \times \vec{E}_2 = E_1E_2 \sin 180° = 0$

3. Answer (4)

Hint: Electric flux, $\phi = \vec{E}.\vec{A}$

Sol.:



$\phi = \vec{E}.\vec{A} = \left(100\hat{i} + 100\hat{j}\right) \cdot \pi r^2(\hat{i})$

$|\phi| = 100\ \pi r^2$ units

4. Answer (4)

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

Use characteristics of Coulomb's force.

Sol.:

- Coulomb's law follows inverse square law relation with distance
- It agrees with Newton's third law
- It measures force between two point charges.

5. Answer (1)

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

Sol.: Electric field will be due to all q_1, q_2 and $-q_3$ while electric flux will be only due to q_2 and $-q_3$.

6. Answer (3)

Hint: As per junction rule $\sum q_i = 0$

Sol.: Applying junction rule.

$1\ \mu F(V_0 - 6) + 2\ \mu F(V_0 - 4) + (V_0 - 0)7\ \mu F = 0$

$10V_0 = 14$

$V_0 = 1.4$ V

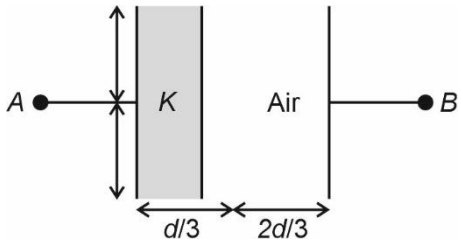
7. Answer (3)

Hint: Use $C_{med} = \frac{A\varepsilon_0}{d - t + \frac{t}{k}}$,

In series

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

Sol.:



$$\frac{1}{C_{AB}} = \frac{1}{\frac{KA\varepsilon_0}{\frac{d}{3}}} + \frac{1}{\frac{A\varepsilon_0}{\frac{2d}{3}}}$$

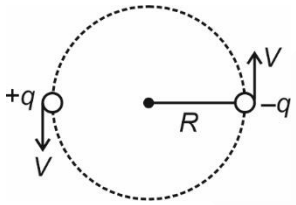
$$C_{AB} = \frac{\frac{3KA\varepsilon_0}{d}\cdot\frac{3}{2}\frac{A\varepsilon_0}{d}}{\frac{3A\varepsilon_0}{d}\left[K+\frac{1}{2}\right]}$$

$$C_{AB} = \frac{3}{2}\frac{KC}{\left[K+\frac{1}{2}\right]}$$

8. Answer (2)

Hint: $\text{T.E} = \frac{1}{2}mv^2 + \left(\frac{Kq_1q_2}{r}\right)$

Sol.:



Electrostatic force of attraction provides centripetal force

$$\frac{1}{4\pi\varepsilon_0}\frac{q^2}{4R^2} = \frac{mv^2}{R}$$

$$\text{Total K.E.} = 2\left(\frac{1}{2}mv^2\right)$$

$$= \frac{Kq^2}{4R}$$

$$\text{P.E} = \frac{-Kq^2}{2R}$$

$$\text{T.E} = \text{P.E} + \text{K.E} = \frac{-Kq^2}{4R}$$

9. Answer (4)

Hint: $\oint \vec{E}.d\vec{s} = \frac{q_{enc}}{\varepsilon_0}$

Sol.: If $\oint \vec{E}.d\vec{s} = 0$, then the net electric flux through that surface is zero implying the net charge enclosed within the surface is zero.

10. Answer (3)

Hint: For spherical conductor, $C = 4\pi\varepsilon_0 r$

Sol.: $C = \frac{Q}{V}$

$$C = \frac{Q}{\frac{Q}{4\pi\varepsilon_0 R}}$$

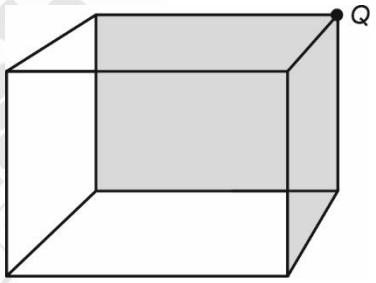
$$C = 4\pi\varepsilon_0 R$$

$$C = \frac{1}{9\times10^9}\times6.4\times10^6 = 711\,\mu\text{F}$$

11. Answer (3)

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

Sol.:



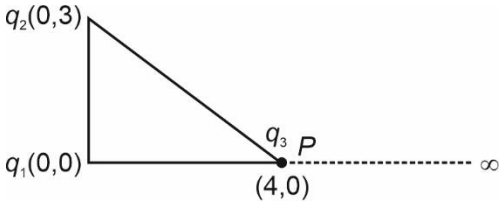
Total flux through the cube is $\frac{Q}{8\varepsilon_0}$. Total flux $\frac{Q}{8\varepsilon_0}$ is being shared by only those faces not touching the charge because faces which are touching the charge have their area vector perpendicular to the electric field coming from the charge Q. Hence flux through them is zero.

Hence flux though one of the faces not touching cube $= \frac{1}{3}\left(\frac{Q}{8\varepsilon_0}\right) = \frac{Q}{24\varepsilon_0}$

12. Answer (3)

Hint: The change in potential energy of system will be due to interaction of charge q_3 with q_1 and q_2.

Sol.:



$$V_P = k\left(\frac{q_1}{r_1}+\frac{q_2}{r_2}\right) = 9\times10^9\left[\frac{2\times10^{-6}}{4}+\frac{5\times10^{-6}}{5}\right]$$

$$= 9\times10^9\left[1.5\times10^{-6}\right]$$

$$= 13.5 \times 10^3 \text{ V}$$

$$\Delta U = q_3V_P - 0 = 3\times10^{-6}\times13.5\times10^3$$

$$\Delta U = 40.5 \times 10^{-3} \text{ J}$$

13. Answer (4)

Hint: Electric field due to a point charge, $\vec{E} = \frac{kq\hat{r}}{r^2}$

Sol.: For a regular polygon of n sides, the net electric field at its centre, distance r from each vertex, is $\frac{q}{4\pi\varepsilon_0 r^2}$, directed towards or away from the empty vertex depending on whether q is positive or negative.

14. Answer (2)

Hint: $\tau = pE\sin\theta$.

Sol.: $\tau = pE\sin\theta$

$\tau = (qa)E\sin\theta$ [$\sin\theta = 1$, for maximum torque]

$\tau = 5\times10^{-6}\times10^{-2}\times10^5 = 5\times10^{-3}$ Nm

15. Answer (3)

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

Sol.: Maximum length in a cuboid is the body diagonal which is equal to $\sqrt{a^2+a^2+\frac{a^2}{4}} = \frac{3}{2}a$

So maximum flux $= \frac{3}{2}\frac{a\lambda}{\varepsilon_0}$ as per Gauss's law

16. Answer (2)

Hint: $W_{ext} = q(\Delta V)$

Sol.: $V_B - V_A = \frac{U_B - U_A}{q} = \frac{W_{ext}}{q}$

$\Rightarrow V_B - V_A = \frac{100}{5} = 20$ V

$\Rightarrow V_A - V_B = -20$ V

17. Answer (4)

Hint: For a shell

$E_{inside} = 0$

$E_{outside} = \frac{kq}{r^2}$

Sol.: $E_P = \frac{kQ}{r^2}$

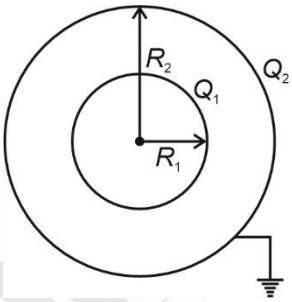
$E_Q = \frac{K.(Q+3Q)}{(2r)^2} = \frac{K4Q}{4r^2}$

$\frac{E_P}{E_Q} = \frac{1}{1}$

18. Answer (3)

Hint: For earthing $V = 0$

Sol.:



For outer sphere

$K\frac{Q_1}{R_2} + K\frac{Q_2}{R_2} = 0 \Rightarrow Q_1 = -Q_2$

For inner sphere

$\frac{KQ_1}{R_1} + \frac{KQ_2}{R_2} = 2$

$\frac{KQ_1}{R_1} - \frac{KQ_1}{R_2} = 2$

$KQ_1\left[\frac{1}{R_1} - \frac{1}{R_2}\right] = 2$

$KQ_1\left[\frac{1}{4} - \frac{1}{6}\right] = 2 \Rightarrow KQ_1\left[\frac{6-4}{24}\right] = 2$

$KQ_1 = 24$

$Q_1 = \frac{24}{K}$

19. Answer (2)

Hint: Energy stored in capacitor, $U = \frac{Q^2}{2C}$

$C' = KC$

Sol.: $C' = KC$

$C' = 4C$

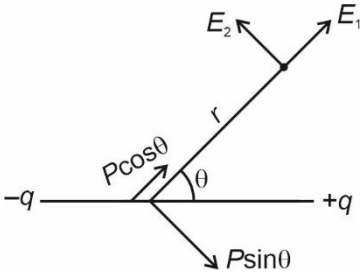
$$U = \frac{Q^2}{2C}$$

$$U' = \frac{Q^2}{2C'} = \frac{Q^2}{2.4C} = \frac{U}{4}$$

20. Answer (4)

Hint: $E = \frac{kP}{r^3}\sqrt{3\cos^2\theta + 1}$

Sol.:



$$E_1 = \frac{2P\cos\theta}{4\pi\varepsilon_0 r^3}$$

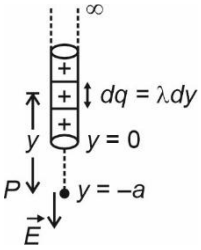
$$E_2 = \frac{P\sin\theta}{4\pi\varepsilon_0 r^3}$$

$$E = \sqrt{E_1^2 + E_2^2} = \frac{1}{4\pi E_0}\frac{P}{r^3}\sqrt{3\cos^2\theta + 1}$$

21. Answer (3)

Hint: Use, $\vec{E} = \frac{kq}{r^2}\hat{r}$

Sol.:



$$d\vec{E} = \frac{-1}{4\pi\varepsilon_0}\frac{dq}{y^2}\hat{j} \quad \text{(along -}y\text{ axis)}$$

Net field.

$$\vec{E} = -\int_a^\infty \frac{1}{4\pi\varepsilon_0}\frac{dq}{y^2}\hat{j}$$

$$= \frac{-\lambda\hat{j}}{4\pi\varepsilon_0}\int_a^\infty \frac{dy}{y^2} = \frac{-\lambda\hat{j}}{4\pi\varepsilon_0}\left[\frac{1}{a} - \frac{1}{\infty}\right]$$

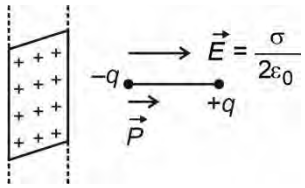
$$= \frac{-\lambda}{4\pi\varepsilon_0 a}\hat{j}$$

22. Answer (3)

Hint: Electric field due to infinite plane sheet, $E_{\text{sheet}} = \frac{\sigma}{2\varepsilon_0}$

$\tau = pE\sin\theta$

Sol.:



$$E = \frac{\sigma}{2\varepsilon_0}, \ \vec{\tau} = \vec{P}\times\vec{E}$$

$$\vec{\tau} = 0$$

$$U = -\vec{P}.\vec{E}$$

U is minimum.

23. Answer (2)

Hint: Energy density $= \frac{1}{2}\varepsilon_0 E^2$

Sol.: Energy density $= \frac{1}{2}\varepsilon_0 E^2$

$$= \frac{1}{2}\times 8.85\times 10^{-12}\times\left(\frac{100}{10^{-4}}\right)^2$$

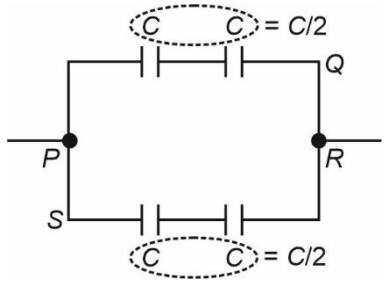
$$= \frac{1}{2}\times 8.85\times 10^{-12}\times 10^{12}$$

$= 4.425\ \text{J/m}^3$

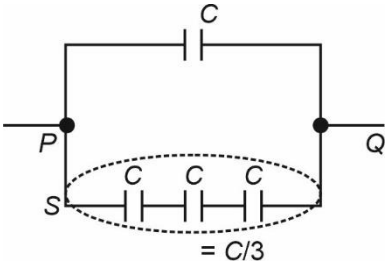
24. Answer (4)

Hint: $C_S = \frac{C_1C_2}{C_1 + C_2}, C_P = C_1 + C_2$

Sol.:



$$C_{PR} = \frac{C}{2} + \frac{C}{2} = C$$



$$C_{PQ} = C + \frac{C}{3} = \frac{4C}{3}$$

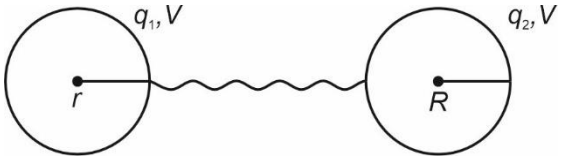
$$\therefore \frac{C_{PR}}{C_{PQ}} = \frac{C}{\frac{4C}{3}} = \frac{3}{4}$$

25. Answer (3)

Hint: Since the two spheres are connected with each other, hence in electrostatic equilibrium

$V_1 = V_2$

Sol.:



$$q_1 + q_2 = Q$$

$$\frac{q_1}{4\pi\varepsilon_0 r} = \frac{q_2}{4\pi\varepsilon_0 R}$$

$$\frac{q_1}{q_2} = \frac{r}{R}$$

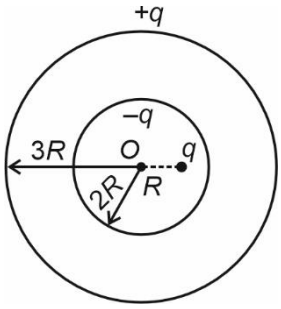
$$q_1 + \frac{q_1 R}{r} = Q$$

$$q_1 = \frac{Qr}{R + r}$$

26. Answer (3)

Hint: Net potential is due to charge q and due to induced charges.

Sol.:



Induced charges at inner and outer surface will be $-q$ and $+q$ respectively

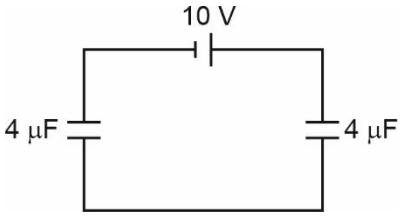
Net, potential at centre O

$$V_0 = k\left[\frac{q}{R} - \frac{q}{2R} + \frac{q}{3R}\right] = \frac{5kq}{6R}$$

27. Answer (1)

Hint: $q = CV$

Sol.:



Potential difference across each capacitor is $\frac{10}{2} = 5$ V

$q = CV$

$= 4\ \mu F \times 5\ V$

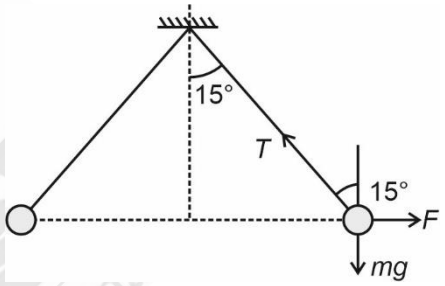
$= 20\ \mu C$

28. Answer (3)

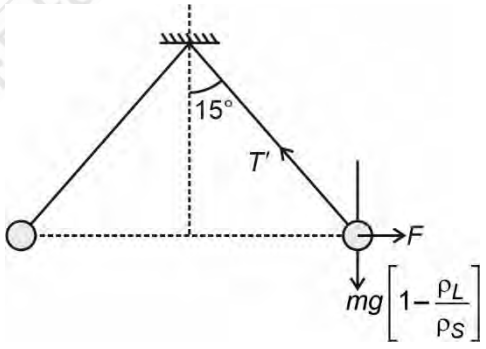
Hint: For equilibrium

$$\tan\theta = \frac{F}{mg}$$

Sol.:



$$\tan 15° = \frac{F}{mg} \quad \ldots(1)$$



$$\tan 15° = \frac{F}{Kmg\left[1 - \frac{\rho_L}{\rho_S}\right]} \quad \ldots(2)$$

$$1 - \frac{\rho_L}{\rho_S} = \frac{1}{K}$$

$$1 - \frac{0.6}{1.8} = \frac{1}{K}$$

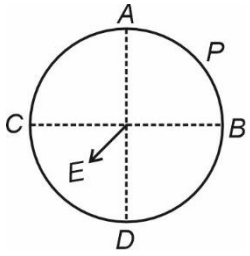
$$\frac{1}{K} = 1 - \frac{1}{3} = \frac{2}{3}$$

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

29. Answer (4)

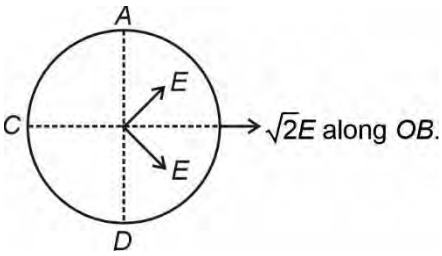
Hint: Use symmetry of field due to each quarter of ring.

Sol.:



$$E_{\text{quarter Ring}} = \frac{\sqrt{2}k\lambda}{r}$$

(Where λ is uniform linear charge density)



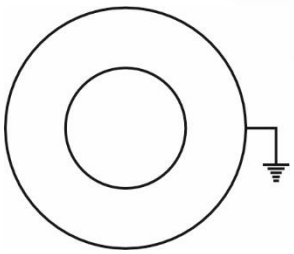
$$E_{\text{half ring}} = \frac{2K\lambda}{r}$$

$$E_{\text{half ring}} = \sqrt{2}\, E_{\text{quarter ring}}$$

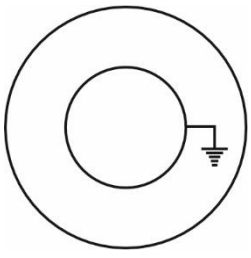
30. Answer (3)

Hint: Use $C = \frac{4\pi\varepsilon_0 r_1 r_2}{r_2 - r_1}$

Sol.:



$$C_1 = 4\pi\varepsilon_0 \frac{ab}{b-a}$$



$$C_2 = 4\pi\varepsilon_0 \frac{b^2}{b-a}$$

$$\frac{C_1}{C_2} = \frac{a}{b}$$

31. Answer (1)

Hint: In series combination voltage distributes in the inverse ratio of capacitance.

Sol.: $\frac{V_1}{V_2} = \frac{C_2}{C_1} = \frac{K_2 \frac{A\varepsilon_0}{2d}}{K_1 \frac{A\varepsilon_0}{d}} = \frac{K_2}{2K_1} = \frac{6}{2(2)} = \frac{3}{2}$

32. Answer (3)

Hint & Sol.: Force between the plates

$$F = \frac{q^2}{2A\varepsilon_0}$$

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

When d becomes $\frac{d}{2}$, C becomes 2 times and $q = CV$ means q becomes double

$\therefore$ Force become 4 times.

33. Answer (3)

Hint: use $q = ne$

Sol.: $q = ne$

$q = 10^{16} \times 1.6 \times 10^{-19}$.

$q = 1.6 \times 10^{-3} = 1.6$ mC

34. Answer (2)

Hint: Properties of electric field lines.

Sol.: The number of electric field lines originating or terminating on a charge is proportional to the magnitude of charge.

35. Answer (3)

Hint: $V = \frac{KP\cos\theta}{r^2}$

Sol.: $V = \frac{KP\cos\theta}{r^2} = \frac{KP\cos 60^\circ}{r^2}$

$$V = \frac{9\times10^9 \times 6\times10^{-9}}{(0.5)^2} \times \frac{1}{2}$$

$$V = 9\times6\times\frac{1}{2}\times2\times2$$

$V = 108$ V

36. Answer (3)

Hint: Three capacitors are in parallel combination.

Sol.: $Q_1 = \frac{A\varepsilon_0 V}{d}$

$Q_2 = \frac{-2A\varepsilon_0 V}{d}$

$Q_3 = \frac{2A\varepsilon_0 V}{d}$

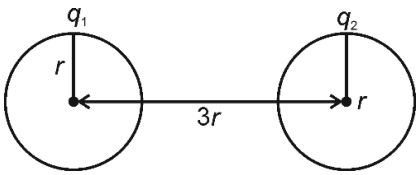
$Q_4 = \frac{-A\varepsilon_0 V}{d}$

37. Answer (3)

Hint: Self energy $U = \frac{Kq^2}{2r}$

$U_{interaction} = \frac{Kq_1q_2}{r}$

Sol.:



$U = U_1 + U_2 + U_{interaction}$

$U_1 = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1^2}{2r}\right)$ → Self energy

$U_2 = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_2^2}{2r}\right)$ → Self energy

$U_{interaction} = \frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{3r}$

$U = \frac{1}{4\pi\varepsilon_0}\left[\frac{q_1^2}{2r} + \frac{q_2^2}{2r} + \frac{q_1q_2}{3r}\right]$

38. Answer (2)

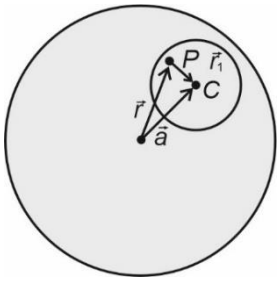
Hint: Characteristics of Coulomb's force.

Sol.: Coulomb's force is a conservative force. Coulomb's force may be attractive or repulsive Coulomb's force follows superposition principle and inverse square law.

39. Answer (2)

Hint: Electric field at any point $\vec{r}$ inside the sphere with a uniform charge density ρ (relative to its centre) is $\vec{E} = \frac{\rho}{3\varepsilon_0}\vec{r}$

Sol.:



$\vec{E}_P = \frac{\rho}{3\varepsilon_0}(\vec{r} + \vec{r}_1)$

$\vec{E}_P = \frac{\rho\vec{a}}{3\varepsilon_0}$

Hence field inside cavity is uniform and does not depend on the position of point P in the cavity.

40. Answer (2)

Hint: Common potential

$V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$

Sol.: Common potential $V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$

$V = \frac{C_1V_1 - C_2V_2}{C_1 + C_2} = \frac{3(300) - 2(200)}{5}$

$V = 100$

Charge flown $\Delta q = 3\ \mu F(300 - 100)$

$\Delta q = 600\ \mu C$

41. Answer (3)

Hint: Properties of equipotential surface.

Sol.: $\frac{W_{A\to B}}{q} = V_B - V_A$

For equipotential surface $V_A = V_B$

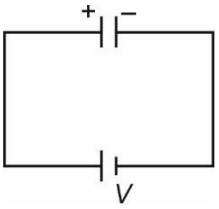
$\therefore\ W_{A\to B} = 0$

42. Answer (4)

Hint: use $C = \frac{A\varepsilon_0}{d}$, battery is connected so potential difference remains same.

$q = CV$

Sol.: $\Rightarrow$



V = Constant

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

With decrease in d, capacitance C increases

$\therefore$ $q = CV$ also increases.

43. Answer (4)

Hint: Change in electrostatic P.E, $\Delta U = q\Delta V$

Sol.: Potential energy increases, if charge is positive

Potential energy decreases, if charge is negative

44. Answer (2)

Hint: $\Sigma\vec{F}_{system} = 0 \Rightarrow \vec{F}_1 = -\vec{F}_2$

Sol.: $F_1 = m_1a_1$

$F_1 = \left(5\times10^{-8}\right)(8) = 4\times10^{-7}$ N

Now same force is experienced by other charge

$\therefore \quad F_2 = 4\times10^{-7} = m_2a_2 = m_2(10)$

$m_2 = 4 \times 10^{-8}$ kg $= 4 \times 10^{-5}$ g

Also $F = \dfrac{kq^2}{r^2} \Rightarrow 4\times10^{-7} = 9\times10^9 \dfrac{q^2}{\left(5\times10^{-3}\right)^2}$

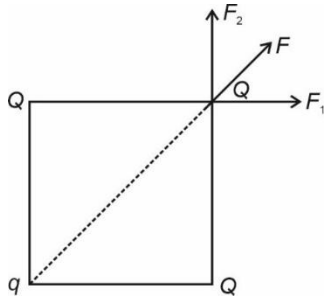
$q = 33.3 \times 10^{-12} = 33.3$ pC

45. Answer (2)

Hint: For equilibrium $\Sigma\vec{F} = 0$

$F = \dfrac{Kq_1q_2}{r^2}$

Sol.:



$\dfrac{\sqrt{2}KQ^2}{q^2} + \dfrac{KQq}{\left(\sqrt{2}a\right)^2} = 0$

$\Rightarrow \quad q = -2\sqrt{2}Q$

[CHEMISTRY]

46. Answer (3)

Hint : In solution, the component that is present in the largest quantity is known as solvent. Solvent determines the physical state in which solution exist.

Sol.:

Smoke	Solid in gas
Amalgam of mercury with sodium	Liquid in solid
Alloys	Solid in solid
Humidity	Liquid in gas

47. Answer (4)

Hint: Mole fraction, $X = \dfrac{n_1}{n_1 + n_2}$

Sol. Mole of methanol $= \dfrac{4x}{32} = \dfrac{1}{8}x$

Mole of water $= \dfrac{9}{18}x = \dfrac{1}{2}x$

Mole fraction of methanol $= \dfrac{\frac{1}{8}x}{\frac{1}{8}x + \frac{1}{2}x} = 0.2$

48. Answer (1)

Hint: $\text{Molarity} = \dfrac{W_{HNO_3}\times1000}{MW_{HNO_3}\times V_{solution(ml)}}$

Sol.: $2.5 = \dfrac{W_{HNO_3}\times1000}{63\times300}$

$W_{HNO_3} = \dfrac{2.5\times63\times300}{1000}$

$= \dfrac{7.5\times63}{10}$

$= 47.25$

Mass of acid $\times \dfrac{70}{100} = 47.25$

Mass of acid $= \dfrac{4725}{70}$ = 67.50 g

49. Answer (3)

Hint: According to Henry's law, higher the value of K_H at a given pressure, lower is the solubility of the gas in the liquid.

Sol.: Therefore, solubility order of given gases will be

Q > R > P

50. Answer (2)

Hint: $P_{water\ vapour} = X_{water\ vapour} \times P_{Total}$

$P_{Total} = P_{water\ vapour} + P_{dry\ air}$

Sol.: $P_{water} = 0.02 \times 1.5$

$= 0.03$

$P_{Total} = P_{water\ vapour} + P_{dry\ air}$

$1.5 = 0.03 + P_{dry\ air}$

$P_{dry\ air} = 1.5 - 0.03$

$= 1.47$ atm

51. Answer (2)

Hint: Solution having negative deviation from Raoult's law will form maximum boiling azeotrope

Sol.:

Ethanol + water	→	⊕ve deviation from Raoult's law
Water + nitric acid	→	⊖ve deviation from Raoult's law
Acetone + Chloroform	→	⊖ve deviation from Raoult's law
Ethanol + Acetone	→	⊕ve deviation from Raoult's law

52. Answer (1)

Hint: $\Delta T_f = iK_f m$

Sol.: i = 1

$$\frac{P^\circ - P_s}{P_s} = i\left[\frac{n_1}{n_2}\right]$$

$$\frac{650-630}{630} = 1\frac{n_1}{n_2}$$

$$\frac{20}{630} = \frac{n_1}{n_2}$$

$$\Delta T_f = 1 \times 5.12 \times \frac{2 \times 1000}{63 \times 78}$$

$= 2.08$ K

53. Answer (4)

Hint: Formation of solution is a spontaneous process therefore $\Delta G < 0$

Sol.: $\Delta H_{mix} = 0$

$\Delta S_{system} > 0$; because disorder increases

$\Delta S_{surr} = 0$; no heat is exchanged in case of ideal solution.

54. Answer (1)

Hint: $i = 1 + (n-1)\alpha$

Sol.: $Al_2SO_4 \rightarrow 2Al^{3+} + 3SO_4^{2-}$

1

$1-\alpha \qquad 2\alpha \qquad 3\alpha \qquad (i = 1+4\alpha)$

$= 1 + 4 \times 0.6$

$= 3.4$

$LiCl \rightarrow i = 1 + (2-1)\,0.9 = 1.9$

$Na_3PO_4 \rightarrow i = 1 + 3 \times 0.7 = 3.1$

$BaSO_4 \rightarrow i = 1 + \alpha = 1 + 0.5 = 1.5$

55. Answer (2)

Hint: For strong electrolytes van't Hoff factor (i) increases on dilution.

Value of *i*

Sol.:

KCl	0.1 m	0.01 m	0.001 m
Value of (i)	1.85	1.94	1.98

56. Answer (4)

Hint : To increase the solubility of CO_2 in soft drinks and soda water, the bottle is sealed under High pressure.

Sol.: At high altitudes and partial pressure of oxygen is less than that at the ground level.

57. Answer (3)

Hint & Sol.: When a non-volatile solute is added to a solvent, the vapour pressure of the solvent decreases.

58. Answer (2)

Hint: The osmotic pressure method has the advantage over other methods as pressure measurement is around the room temperature and the molarity of the solution is used instead of molality.

Sol.: Osmotic pressure is widely used to determine molar masses of proteins, polymers and other macromolecules.

59. Answer (4)

Hint : For a binary liquid forming a minimum-boiling azeotrope, the boiling point of the azeotrope is lower than that of both pure component.

Sol.: At the azeotropic composition, the total vapour pressure of the solution becomes greater than the vapour pressure of both pure component at the same temperature.

60. Answer (1)

Hint: $\Delta T_b = (T_b)_f - (T_b)_i$

$(T_b)_f = \Delta T_b + (T_b)_i$

$\Delta T_b = iK_b m$

Sol.: $\Delta T_b \propto i \times m$

(a) 0.01 m K_2SO_4 i = 3

$\Delta T_b = 3 \times K_b \times 0.01 = 0.03\ K_b$

(b) 0.015 m glucose, $i = 1$

$\Delta T_b = 1 \times K_b \times 0.015 = 0.015\ K_b$

(c) 0.01 m $NaNO_3$, i = 2

$\Delta T_b = 2 \times K_b \times 0.01 = 0.02\ K_b$

(d) 0.01 m urea, i = 1

$\Delta T_b = 1 \times K_b \times 0.01 = 0.01\ K_b$

61. Answer (1)

Hint: Higher the value of $E^\circ_{oxidation}$, stronger is the reducing power.

Sol.: Therefore, the correct order of reducing power of the metals will be

K > Mg > Cr > Cu

62. Answer (1)

Hint: $E^\circ_{cell} = E^\circ_{Red} + E^\circ_{ox}$

Sol.: $E^\circ_{cell} = 0.16\ V + 0.74\ V$

= 0.90 V

63. Answer (2)

Hint: $\underset{2\,mol}{2H_2O} \rightarrow 4H^+ + O_2 + 4e$ 4 F required

Sol.: $Cr_2O_7^{2-} + 14H^+ + 6e \rightarrow 2Cr^{+3} + 7H_2O$ 6 F required

$\underset{1.5mol}{Ba^{2+}} + 2e \rightarrow Ba$ 3 F required

$2Fe^{3+} + 2e \rightarrow 2Fe^{+2}$ 2 F required

64. Answer (2)

Hint: $\frac{w}{E} = \frac{i \times t}{96487}$

Sol.: $\frac{w}{63.5} \times 2 = \frac{1.5 \times 20 \times 60}{96487}$

$w = \frac{1.5 \times 1200 \times 63.5}{2 \times 96487}$

= 0.5923 g

65. Answer (4)

Hint: For weak electrolytes. Λ°_m cannot be obtained by extrapolation of Λ_m to zero concentration.

Sol.: The value of the constant 'A' for a given solvent and temperature depends on the type of electrolyte *i.e.*, the charges on the cation and anion produced on the dissociation of the electrolyte in the solution. Thus, NaCl, $CaCl_2$, $MgSO_4$ are known as 1–1, 2–1 and 2–2 electrolytes respectively. All electrolytes of a particular type have the same value for 'A'.

66. Answer (3)

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

Sol.: $2Fe(s) \rightarrow 2Fe^{2+}(aq) + 4e$

$$\frac{O_2(g) + 4H^+ + 4e \rightarrow 2H_2O}{2Fe(s) + O_2(g) + 4H^+(aq) \rightarrow 2Fe^{2+}(aq) + 2H_2O(l)}$$

n = 4

$$E_{cell} = 1.67 - \frac{0.059}{4}\log\frac{\left[Fe^{2+}\right]^2}{p(O_2) \times \left[H^+\right]^4}$$

$$= 1.67 - \frac{0.059}{4}\log\frac{\left(10^{-2}\right)^2}{10^{-1} \times \left(10^{-2}\right)^4}$$

$$= 1.67 - \frac{0.059}{4}\log 10^5$$

$$= 1.67 - \frac{0.059}{4} \times 5$$

= 1.596 V

67. Answer (4)

Hint: Theoretical thermodynamic efficiency of a fuel cell is given by $\frac{\Delta G}{\Delta H}$

Sol.: $\eta = \frac{\Delta G}{\Delta H}$

[Change in Gibbs free energy over change in enthalpy]

68. Answer (2)

Hint: Check whether Ce^{4+} can oxidise Cl^- or Br^-

Sol.: $E^\circ(Cl_2/Cl^-) = 1.36$ V, $E^\circ(Ce^{4+}/Ce^{3+}) = 1.61$ V and 1.61 > 1.40

Hence Ce^{4+} oxidises Cl^- to Cl_2

69. Answer (3)

Hint & Sol.: Na^+ ions are discharged at the cathode in preference to H^+ ions, yielding sodium, which dissolves in mercury to form sodium amalgam.

70. Answer (2)

Hint: $w = \frac{E}{96500} \times I \times t$

Sol.: At cathode $2Cl^- \rightarrow Cl_2 + 2e$

n = 2

no. of mole × n-factor = $\frac{I \times t}{96500}$

$0.1 \times 2 = \frac{3 \times t}{96500}$

t = 107.22 minutes

71. Answer (1)

Hint:

$$\Lambda_m^\circ(CH_3COOH) = \Lambda_m^\circ(CH_3COONa) + \frac{\Lambda_m^\circ(H_2SO_4)}{2} - \frac{\Lambda_m^\circ(Na_2SO_4)}{2}$$

Sol.: $\lambda_{H^+}^\circ + \lambda_{CH_3COO^-}^\circ = \lambda_{CH_3COO^-}^\circ + \lambda_{Na}^\circ + \frac{2\lambda_{H^+}^\circ}{2} + \frac{\lambda_{SO_4^{2-}}^\circ}{2} - \frac{2\lambda_{Na^+}^\circ}{2} - \frac{\lambda_{SO_4}^\circ}{2}$

$= z + \frac{(x-y)}{2}$

72. Answer (4)

Hint: The conductivity of electrolytic solutions increases with the increase of temperature

Sol.: The conductivity of electrolytic (ionic) solutions depends on:

The nature of the electrolyte added

Size of the ions produced and their solvation

The nature of the solvent and its viscosity

Concentration of the electrolyte

temperature

73. Answer (4)

Hint:

Material	(Conductivity/Sm^{-1})
Glass	1.0×10^{-16}

Sol.:

CuO	1×10^{-7}
Teflon	1.0×10^{-18}
Silver	6.2×10^{3}

74. Answer (4)

Hint: Degree of dissociation for weak acid

$$\% \alpha = \frac{\Lambda_m}{\Lambda_m^\circ} \times 100$$

Sol.: $\Lambda_m = \frac{1.85 \times 10^{-5} \times 1000}{10^{-3}}$

$= 18.5$

$\Lambda_m^\circ = 349.6 + 40.9$

$= 390.4$

$\alpha = \frac{18.5}{390.4} \times 100$

$= 4.7\%$

75. Answer (2)

Hint & Sol.:

Compound	Λ_m° (S cm^2 mol^{-1})
HCl	425.9
NaOH	249.2
NaCl	126.4
KCl	149.8

76. Answer (1)

Hint: $E_{Cell} = E_{cell}^\circ - \frac{0.059}{n}\log Q$, $\Delta G = -nFE_{cell}$

Sol.: $Sn(s) \rightarrow Sn^{2+} + 2e$

$$\frac{Cu^{2+} + 2e \rightarrow Cu}{Sn(s) + Cu^{2+} \rightarrow Sn^{2+} + Cu}$$

$E_{cell}^\circ = E_{Red}^\circ + E_{ox}^\circ$

$= 0.34\ V + 0.14\ V$

$= 0.48\ V$

$E_{cell} = 0.48 - \frac{0.059}{2}\log\frac{10^{-3}}{10^{-2}}$

$= 0.48 + \frac{0.059}{2} = 0.5095$

$\Delta G = -nFE = -2 \times F \times 0.51$

$= -98.43\ kJ\ mol^{-1}$

77. Answer (4)

Hint: Copper sulphate solutions cannot be stored in zinc pot.

Sol.: The electric charge for electrode deposition of one gram equivalent of a substance is 96500 Coulombs per second.

The function of salt bridge is to allow the moment of ions from one solution to other without mixing of the two solutions.

In corrosion, a metal is oxidised by loss of electrons to oxygen.

Aluminium metal is produced by electrolysis of aluminium oxide in presence of cryolite.

78. Answer (4)

Hint: The overall reaction is represented by

$Zn(Hg) + HgO(s) \rightarrow ZnO(s) + Hg(l)$

Sol.: The cell potential is approximately 1.35 V and remains constant during its life as the overall reaction does not involve any ion in solution whose concentration can change during its life time.

79. Answer (2)

Hint & Sol. : Reaction at cathode

Dry cell: $MnO_2 + NH_4^+ + e^- \rightarrow MnO(OH) + NH_3$

Mercury cell: $HgO + H_2O + 2e^- \rightarrow Hg(l) + 2OH^-$

Lead storage battery (on discharging):

$PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e \rightarrow PbSO_4(s) + 2H_2O(l)$

$H_2 - O_2$ fuel cell :

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

80. Answer (3)

Hint: $\Delta G^\circ = -nFE^\circ$

$\Delta G^\circ = -RT\ln K_{eq}$

Sol.: If $E^\circ_{cell} = +ve$

Then $\Delta G^\circ < 0$, $K_{eq} > 1$

81. Answer (4)

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

Sol.: $E_{H^+/H_2} = 0 - \frac{0.059}{2}\log\frac{(P_{H_2})}{(10^{-7})^2}$

$P_{H_2} = 10^{-14}$ atm

82. Answer (3)

Hint: $\Delta T_f = iK_f m$

Sol.: $i = 1 + (n - 1)\alpha$

$= 1 + (2 - 1)\ 0.40$

$= 1.4$

$\Delta T_f = 1.4 \times 1.86 \times 0.1$

$= 0.26$

$0.26 = 0 - T_{f(Solution)}$

$T_{f(Solution)} = -0.26°C$

83. Answer (2)

Hint: Osmotic pressure (π) = CRT

$\pi \propto C$

Sol.: For glucose solution,

$$C_1 = \frac{20}{180} \times \frac{1000}{500} = 0.22\ M$$

For urea solution, $C_2 = \frac{20}{60} \times \frac{1000}{500} = 0.66\ M$

For sucrose solution, $C_3 = \frac{20}{342} \times \frac{1000}{500} = 0.117\ M$

Hence, correct order of osmatic pressure will be

$P_3 < P_1 < P_2$

84. Answer (4)

Hint: $P_A^\circ X_A + P_B^\circ X_B = P_S$

Sol.:

$$P_{Total} = 210 \times \left(\frac{\frac{26}{119.5}}{\frac{26}{119.5} + \frac{40}{85}}\right) + 415 \times \left(\frac{\frac{40}{85}}{\frac{26}{119.5} + \frac{40}{85}}\right)$$

$$= 210 \times \left(\frac{0.217}{0.217 + 0.47}\right) + 415 \times \left(\frac{0.47}{0.217 + 0.47}\right)$$

$$= 210 \times \frac{0.217}{0.687} + 415 \times \frac{0.47}{0.687}$$

= 66.33 + 283.91

= 350.24 mm Hg

85. Answer (2)

Hint: Blood cells retain their normal shape in solution which are isotonic to blood.

Sol.: The values of K_f and K_b, depends upon molar mass of solvent.

86. Answer (4)

Hint: For negative deviation from ideal behaviour intermolecular attractive forces between A-A and B-B are weaker than those between A-B

Sol.: $\Delta_{mix} V < 0$ at constant T and P

$\Delta_{mix} H < 0$ at constant T and P

87. Answer (1)

Hint: $\Delta T_f = i \times K_f \times m$

Sol.: $\Delta T_f = 4$

$$4 = 1 \times \frac{1.86 \times w}{62 \times 2}$$

$$w = \frac{62 \times 8}{1.86}$$

= 266.67 g

88. Answer (4)

Hint: $\frac{P^\circ - P_s}{P_s} = \frac{n_2}{n_1 + n_2}$

Sol.: $\frac{P^\circ - 0.7P^\circ}{0.7P^\circ} = \frac{w}{\frac{50 \times 114}{114}}$

$$\frac{3}{7} = \frac{w}{50 \times 1}$$

$$w = \frac{3}{7} \times 50 = \frac{150}{7}$$

89. Answer (3)

Hint: $\frac{I}{R} = k\frac{A}{\ell}$

Sol.: $\frac{I}{A} = k \times R$

$= 0.015 \times 50$

$= 0.75\ cm^{-1}$

90. Answer (3)

Hint: For dilute sulphuric acid, oxidation of water is preferred at anode

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

Sol.: Electrolysis of an aqueous of $AgNO_3$ using platinum electrode.

At anode

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

[BOTANY]

91. Answer (2)

Hint: Gametes are the two most important units of sexual reproduction in flowering plants.

Sol.: In flowering plants, male gametes are formed by anther and female gametes are formed in gynoecium. These structures are situated on the swollen part of the pedicel called thalamus.

92. Answer (4)

Hint: The nucleus of the functional megaspore in the ovule divides mitotically to form two nuclei which move to the opposite poles, forming the 2-nucleate embryo sac.

Sol.: Of the eight nuclei, six are surrounded by cell walls and organised into cells. The remaining two nuclei, called polar nuclei, are also surrounded by a common cell wall and form the large central cell.

93. Answer (4)

Hint: For artificial hybridization, it is important to make sure that only the desired pollen grains are used for pollination and the stigma is protected from contamination (from unwanted pollen).

Sol.: Outbreeding devices prevent autogamy in flowering plants and thus are helpful in artificial hybridization.

94. Answer (1)

Hint: A floral primordium has meristematic cells which develops into a flower.

Sol.: Much before the actual flower is seen on a plant, several hormonal and structural changes are initiated which lead to the differentiation and further development of the floral primordium.

95. Answer (2)

Hint: Egg apparatus is a component of embryo sac.

Sol.: Egg apparatus in the embryo sac is made up of three haploid cells – two synergids and an egg cell.

96. Answer (2)

Hint: If the female parent bears bisexual flowers, removal of anthers from the flower bud before the anther dehisces using a pair of forceps is necessary. This step is referred to as emasculation.

Sol.: For artificial hybridization, emasculated flowers are covered with a bag made up of butter paper, to prevent contamination of its stigma with unwanted pollen. This process is called bagging.

97. Answer (3)

Hint: Occurrence of more than one embryo in a seed is referred to as polyembryony.

Sol.: The embryos in the seeds showing polyembryony can be developed from the cells of integument, cells of nucellus, diploid egg cell or zygote. Pericarp refers to fruit wall.

98. Answer (2)

Hint: Synergids have special cellular thickenings at the micropylar tip called filiform apparatus.

Sol.: Filiform apparatus plays an important role in guiding the pollen tubes into the synergid.

99. Answer (2)

Hint: Double fertilisation involves two types of fusions, *i.e.*, fusion of one male gamete with egg cell and fusion of polar nuclei with other male gamete.

Sol.: Disintegration of various haploid cells such as vegetative cells is not the phenomenon related to double fertilization.

100. Answer (3)

Hint: A typical angiosperm anther is bilobed with each lobe having two theca, *i.e.*, they are dithecous.

Sol.: The three-celled structure of the embryo sac at the micropylar end is egg apparatus. Apomictic seed are formed without the process of fertilization.

101. Answer (4)

Hint: A typical angiosperm embryo sac, at maturity, is 7-celled structure.

Sol.: There are three sequential mitotic nuclear divisions in the megaspore resulting in the formation of the 8-nucleate stages of the embryo sac. Among them, the two polar nuclei are situated below the egg apparatus in the large central cell. Thus, a typical angiosperm embryo sac, at maturity, though 8-nucleate is 7-celled.

102. Answer (2)

Hint: Suspensor cells in angiosperms are formed by mitotic division in zygote. Therefore, these cells are diploid.

Sol.: Primary endosperm cell and cells of aleurone layer are triploid. Cells of tapetum are generally polyploid.

103. Answer (2)

Hint: *Vallisneria* is an aquatic plant. Hygroscopic nature of anther wall for pollen dispersal is required in terrestrial plants.

Sol.: C is sporogenous tissue. Its cells are diploid. F are pollen grains and they are haploid. E is cell of tapetum. In most of the flowering plants, cells of tapetum are polyploid.

104. Answer (3)

Hint: Plants such as *Oxalis*, produce two types of flowers – chasmogamous flowers and cleistogamous flowers. Cross-pollen landing on the stigma can occur in chasmogamous flowers.

Sol.: In angiosperms, both male and female gametes are non-motile. Pollination in seed producing plants needs external agents but union of male and female gametes does not.

105. Answer (1)

Hint: After fertilisation, development of endosperm and embryo occurs. Ovules mature into seeds and ovary into fruit.

Sol.: The cells of endosperm are filled with reserve food materials and are used for the nutrition of the developing embryo.

106. Answer (3)

Hint: Cells of sporogenous tissue of an anther differentiate into microspore mother cell.

Sol.: Each cell of the sporogenous tissue of an anther is a potential microspore mother cell therefore, all the cells of the sporogenous tissue of an anther is capable of giving rise to a microspore tetrad.

107. Answer (4)

Hint: Cleistogamous flowers produce assured seed-set even in the absence of pollinators.

Sol.: Plants such as *Viola* (common pansy), *Oxalis*, and *Commelina* produce cleistogamous flowers which do not open at all.

108. Answer (1)

Hint: Free nuclear division in angiosperms occurs during the development of gametophyte.

Sol.: In the most common type of endosperm development, the PEN undergoes successive nuclear divisions to give rise to free nuclei. This stage of endosperm development is called free-nuclear endosperm. Free-nuclear division also occur during the development of embryo sac.

109. Answer (2)

Hint: The process of formation of microspores from a pollen mother cell (PMC) is called microsporogenesis.

Sol.: The process of microsporogenesis in angiosperms does **not** involve mitosis. This occurs through meiosis in which a diploid microspore mother cell (pollen mother cell) forms four haploid microspores.

110. Answer (3)

Hint: Maize is a monoecious plant, *i.e.*, this plant has both male and female flowers on the same plant.

Sol.: In plants such as maize, free nuclear division and asymmetric cell division occur during the formation of female and male gametophytes, respectively. In monoecious plants, both geitonogamy and xenogamy can occur. Usually one of the two synergids start to degenerate just with pollination.

111. Answer (4)

Hint: White kernel of coconut is cellular endosperm.

Sol.: In coconut, endosperm is not completely consumed by the developing embryo. The cells of endosperm are filled with reserve food materials and are used for the nutrition of the developing embryo.

112. Answer (4)

Hint: The stigma serves as a landing platform for pollen grains.

Sol.: The gynoecium represents the female reproductive part of the flower. When the gynoecium consists of a single pistil it is called monocarpellary and when it has more than one pistil it is called multicarpellary.

113. Answer (4)

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

Sol.: Only a small proportion of plants use abiotic agents. Pollen grains coming in contact with the stigma is a chance factor in both wind and water pollination. Among the animals, insects, particularly bees are the dominant biotic pollinating agents.

114. Answer (4)

Hint: The mature seeds of groundnut are non-endospermic whereas the mature seeds of maize are endospermic.

Sol.: Endosperm of maize has reserve food and cotyledons of groundnut have reserve food for further development.

115. Answer (1)

Hint: Sporopollenin is one of the most resistant organic materials known. No enzyme that degrades sporopollenin is so far known.

Sol.: Sporopollenin is synthesized by the innermost layer of anther wall, *i.e.*, tapetum.

116. Answer (2)

Hint: Radius is half of the diameter.

Sol.: Pollen grains are generally spherical measuring about 25-50 micrometers in diameter, *i.e*., about 12-25 micrometers in radius.

117. Answer (3)

Hint: The embryo may enter a state of inactivity called dormancy.

Sol.: The wall of the ovary develops into the wall of fruit called pericarp. This residual, persistent nucellus is the perisperm. The cylindrical portion below the level of cotyledons is hypocotyl that terminates at its lower end in the radicle or root tip.

118. Answer (2)

Hint: The generative cell of pollen grain is small and floats in the cytoplasm of the vegetative cell.

Sol.: When the pollen grain of flowering plants is mature it contains two cells. Pollen grains are generally spherical measuring about 25-50 micrometers in diameter.

119. Answer (4)

Hint: Majority of plants use biotic agents, such as bees, butterflies, flies, beetles, wasps, ants, moths, birds and bats for pollination.

Sol. In gymnosperms, seeds are not enclosed inside the fruit. In these plants, pollination occurs through air currents.

120. Answer (1)

Hint: A typical dicotyledonous embryo, consists of an embryonal axis and two cotyledons.

Sol.: In monocotyledons, the lower end of the embryonal axis has radical and root cap enclosed in an undifferentiated sheath called coleorrhiza.

121. Answer (2)

Hint: The basic architecture does not vary from pollen to pollen within a species of plant.

Sol.: Viability of pollen grains of a large number of species can be maintained for years in liquid nitrogen (–196ºC). The generative cell divides and forms the two male gametes during the growth of pollen tube in the stigma.

122. Answer (3)

Hint: Nectar and pollen grains are the usual floral rewards for pollinating animals.

Sol.: In some species, floral rewards for pollinating animals are in providing safe places to lay eggs. Animals are attracted to flowers by colour and/or fragrance. These are not rewards from plants to the pollinating animals.

123. Answer (1)

Hint: In monocots, such as wheat and maize, single cotyledon is called scutellum that is situated towards one side (lateral) of the embryonal axis.

Sol.: Seeds of monocot plants have bulky endosperm that stores food reserve which provides nourishment to embryo during seed germination.

124. Answer (4)

Hint: Pollen grain represents the male gametophyte in flowering plants.

Sol.: Pollen grains have a prominent two-layered wall. The hard outer layer is exine and inner wall is intine. Pollen grain exine has prominent apertures called germ pores where sporopollenin is absent.

125. Answer (1)

Hint: Insects, when consume pollen or the nectar without bringing about pollination, they do not benefit the plant in return.

Sol.: Insects that consume pollen or the nectar without bringing about pollination are referred to as pollen or nectar robbers.

126. Answer (1)

Hint: In angiosperms, the seed is the final product of sexual reproduction. It is often described as a fertilised ovule.

Sol.: As the seed matures, its water content is reduced and seeds become relatively dry. The general metabolic activity of the embryo slows down.

127. Answer (1)

Hint: Ovules are found inside the ovary in the ovarian cavity.

Sol.: Inside the ovary, the ovarian cavity is also called locule.

128. Answer (2)

Sol.: Continued self-pollination results in inbreeding depression because self-pollination limits the genetic variability in the generations.

129. Answer (3)

Hint: Parthenocarpic fruits are formed without fertilization.

Sol.: When the seeds are produced without fertilisation, these are called apomictic seeds. An apomictic seed can have endosperm to nourish the developing embryo.

130. Answer (3)

Hint: A typical angiosperm ovule has one or two protective envelopes called integuments.

Sol.: Integuments encircle the nucellus except at the tip where a small opening called the micropyle is present. Egg apparatus is present at the micropylar end of the ovule.

131. Answer (4)

Hint: When male and female flowers are present on different plants, that is each plant is either male or female, this condition is referred to as dioecy.

Sol.: When pollen is released before the stigma becomes receptive, this condition is called protandry. Self-incompatibility is a genetic mechanism and prevents self-pollen from fertilising the ovules by inhibiting pollen germination or pollen tube growth in the pistil.

132. Answer (1)

Hint: Dehydrated seeds can be stored for longer periods. As the seeds have sufficient food reserves, young seedlings are nourished until they are capable of photosynthesis on their own.

Sol.: Dehydration and dormancy of mature seeds are crucial for storage of seeds which can be used as food throughout the year and also to raise crop in the next season.

133. Answer (2)

Hint: The MMC undergoes meiotic division. Meiosis results in the production of four megaspores.

Sol.: In a majority of flowering plants, one of the megaspores is functional, while the other three degenerate. Only the functional megaspore develops into the female gametophyte, *i.e.*, embryo sac.

134. Answer (1)

Hint: Self-incompatibility cannot be a device to promote genetic variability in the plants in which bud pollination occurs.

Sol.: The pistil has the ability to recognise the pollen, whether it is of the right type or of the wrong type. If the pollen is of the right type, the pistil accepts the pollen and promotes post-pollination events that leads to fertilisation.

135. Answer (1)

Hint: The two polar nuclei in the embryo sac fuse together as the male gametes enter the synergids.

Sol.: After the pollen grains (male gametophyte) mature in the microsporangium, dehiscence of anther occurs. After pollination, pollen germinate and the pollen tube enters the embryo sac releasing two male gametes.

[ZOOLOGY]

136. Answer (4)

Hint: Includes the part that form the extra-testicular duct system

Sol.: In human males, from cauda epididymis, a partially coiled tube called vas deferens ascends into the abdomen through the inguinal canal and passes over the urinary bladder. The ductus deferens/vas deferens dilates to form ampulla, which receives the duct from the seminal vesicle behind the urinary bladder and forms an ejaculatory duct.

Rete testis is a part of the intra-testicular genital duct system.

137. Answer (4)

Hint: Focus on the nature of the hormones

Sol.: Inhibin, estrogen, progesterone and relaxin are released by ovaries.

Inhibin : Produced by the granulosa cells in the ovary; it exerts a negative feedback on FSH secretion from the pituitary and this prevents many follicles from maturing at once.

Estrogen: Responsible for the development of the female secondary sexual characteristics

Progesterone: Known as the 'pregnancy hormone'.

Relaxin: Secreted by the corpus luteum in the later part of the pregnancy; it is a protein hormone.

Relaxin relaxes the pelvic joint and causes the cervix to soften and widen for delivery of the baby.

138. Answer (1)

Hint: Lies above the urethral opening

Sol.: The female external genitalia includes mons pubis, labia minora, labia majora, hymen and clitoris. Clitoris is a tiny finger-like structure which lies at the upper junction of the two labia minora above the urethral opening.

Mons pubis is a cushion of fatty tissue covered by skin and pubic hair. The labia majora are fleshy folds of skin, which extend down from mons pubis and surrounds the vaginal opening.

The labia minora are paired folds of tissue in the form of lips under the labia majora.

The opening of vagina is often covered partially by a membrane called hymen.

139. Answer (4)

Hint: Remember the tissue that connects bone to bone

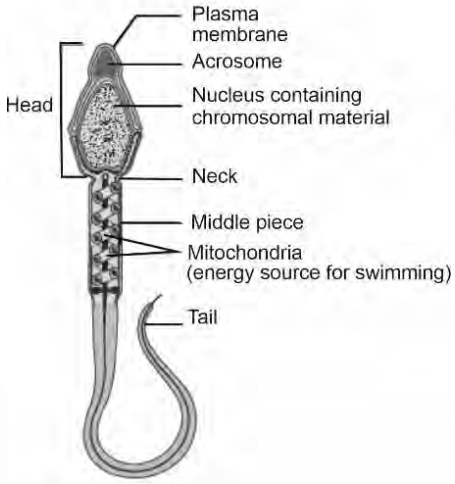
Sol.: Uterus is also called womb. It is supported by ligaments attached to the pelvic wall. The placenta is formed by foetal as well as maternal tissues.

During labour, uterine smooth muscle contractions increase in strength and frequency until the foetus is expelled out.

140. Answer (4)

Hint: Used for motility

Sol.:



Ovum contains mitochondria.

Spermatozoa contains very little cytoplasm as compared to the ovum.

The plasma membrane of the ovum is called oolemma.

Ova are non-motile whereas, sperms are motile and possess a long flagellum or tail for motility.

141. Answer (3)

Hint: Antibodies are proteinaceous in nature.

Sol.: Human milk consists of water, organic and inorganic substances. Its main constituents are fat (fat droplets), casein (milk protein), lactose (milk sugar), mineral salts (sodium, calcium, potassium, *etc.*) and vitamins.

The human milk contains IgA.

Antibodies are glycoproteins. Proteins are always heteropolymers.

142. Answer (4)

Hint: Ploidy of zygote is similar to that of the oogonium.

Sol.: Extrusion of the second polar body from egg nucleus occurs after the entry of sperm, but before fertilization.

Fertilization leads to the formation of a single-celled diploid zygote.

The secondary oocyte does not undergo reductional division; it rather undergoes equational

division (meiosis - II) to form a mature ovum and a second polar body.

The primary oocyte undergoes reductional division (meiosis-I).

At the time of ovulation, the secondary oocyte remains arrested in metaphase-II of the second meiotic division.

143. Answer (4)

Hint: Spermatogenesis and oogenesis are natural biological processes.

Sol.: In humans, the reproductive events include formation of gametes (gametogenesis), which occurs in both males (spermatogenesis) and females (oogenesis).

Transfer of sperms into the female genital tract is called insemination.

Capacitation is defined as a complex process occurring in sperm after their release in the female genital tract, which prepares them to reach the oocyte and become responsive to stimuli that induce acrosomal reaction.

144. Answer (4)

Hint: Corpus luteum secretes various hormones.

Sol.: When a female child is born, each primary oocyte is surrounded by a single layer of granulosa cells and is called the primary follicle.

If the ovum is not fertilized, the corpus luteum in the ovary degenerates (involutes) about 2 days before the end of the menstrual cycle, transforming into the corpus albicans. This degeneration causes a rapid, sharp decline in estrogen and progesterone levels, which removes hormonal support for the endometrium that triggers menstruation.

145. Answer (3)

Hint: Function of placental hormone.

Sol.: hCG plays a crucial role in maintaining early pregnancy by supporting the corpus luteum, which in turn sustains the progesterone production essential for maintaining the endometrium.

Low FSH and LH are seen during pregnancy because of the negative feedback effect produced by the surging levels of progesterone and estrogen.

GnRH is secreted by the hypothalamus.

Decreased FSH level prevents follicular recruitment and maturation.

146. Answer (3)

Hint: Urethra is a part of the urinary system in females.

Sol.: The urethra acts as a common passage for both the urinary and reproductive systems in males.

The urethral meatus at the tip of the penis allows for the excretion of urine and the expulsion of semen during ejaculation.

In females, urethra functions exclusively to transport urine from the bladder to the external urethral orifice.

The cavity of the cervix is called the cervical canal.

The perivitelline space is the space between the zona pellucida and the cell membrane of an oocyte.

Amnion is an extra-embryonic membrane. It is composed of an inner layer of ectoderm and an outer layer of mesoderm.

147. Answer (2)

Hint: Nebenkern is a part of the human sperm.

Sol.:

- Acrosome – It is a lysosome like vesicle overlying the sperm nucleus and it is derived from the Golgi during spermatogenesis.
- Perimetrium – Outer serosal coat of the uterus
- Trophoectoderm – Embryo formation
- Nebenkern – It is the mitochondrial arrangement in the sperm.

148. Answer (2)

Hint: Female primates undergo menstruation.

Sol.: Both first and second polar bodies are haploid in nature.

The reproductive cycle in the female primates (monkey, apes and human beings) is called the menstrual cycle.

In humans, each breast typically contains 15-20 lobes, but each of these lobes contains numerous alveoli that connect to mammary tubules, which then merge into larger mammary ducts.

Infundibulum leads to a wider part of the oviduct, called ampulla.

149. Answer (4)

Hint: We have 22 pairs of autosomes.

Sol.: Humans have 46 chromosomes in total in which 22 pairs are autosomes and 1 pair consists of sex chromosomes.

150. Answer (4)

Hint: Equal to the number of fingers in your left hand.

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 the pelvic region.

These parts of the reproductive system along with a pair of the mammary glands are integrated structurally and functionally to support ovulation, fertilisation, pregnancy, birth and child care.

151. Answer (3)

Hint: Equal to the number of eyes you have

Sol.: The pre-ovulatory phase of the cycle is more variable in length than the other phases and accounts for most of the differences in the length of the cycle. It lasts from day 6 to 13 in a 28- days cycle.

The high levels of estrogen during the pre-ovulatory phase exerts a positive feedback effect on the cells that secrete LH and GnRH.

The follicular phase (in the ovary) and the proliferative phase (in the uterus) occur simultaneously, not sequentially.

152. Answer (1)

Hint: Cessation of menstrual cycle is called menopause.

Sol.: Menopause is a senile change which occurs in the ovaries around the age of 50 years.

During this period, the ovarian follicles degenerate and there is deficiency of estrogen and progesterone.

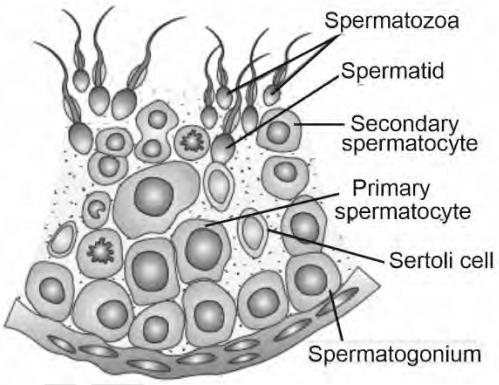
FSH and LH are produced after menopause in large and continuous quantities, but as the remaining primordial follicles become atretic, the production of estrogen by the ovaries falls virtually to zero.

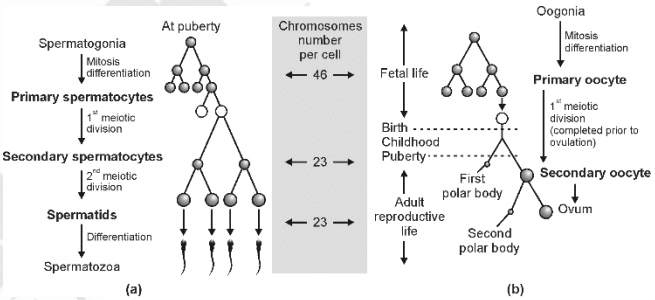
The loss of estrogen often causes marked physiological changes in the function of the body including decreased strength and calcification of bones.

153. Answer (2)

Hint: Spermiogenesis and spermination are different terminologies.

Sol.:





Transformation of spermatids into sperms is termed as spermiogenesis.

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

154. Answer (3)

Hint: Each testis has compartments.

Sol.: The testes are paired oval structures in the scrotum. The testis is covered by a dense fibrous connective tissue layer. Each testis has about 250 compartments called testicular lobules. These compartments contain highly coiled seminiferous tubules.

Testes are the primary sex organs in males as they are directly involved in sperm production.

155. Answer (1)

Hint: True for 'nurse cells'.

Sol.: Sertoli or sustentacular or nurse cells provide nourishment to the developing spermatozoa.

Interstitial spaces of testes contain interstitial cells or Leydig cells, immunologically competent cells, blood vessels, *etc*.

The enlarged end of penis, called the glans penis, is covered by a loose fold of skin called foreskin.

Rete testis forms the intra-testicular genital duct system.

156. Answer (3)

Hint: Infundibulum is closer to the ovary.

Sol.: Oviduct is a part of the female accessory ducts. Each fallopian tube is about 10 – 12 cm long and extends from the periphery of each ovary to the uterus. Fallopian tube is lined by columnar epithelial cells which possess oval and basal nucleus. Infundibulum opens directly into the abdominal cavity.

157. Answer (4)

Hint: Follicles are found in the ovarian cortex

Sol.: As the follicle matures into a Graafian follicle, it enlarges and migrates towards the ovarian surface. Just before ovulation, it forms a protrusion on the ovarian surface. This superficial positioning allows the secondary oocyte to be captured by the fimbriae of the oviduct.

158. Answer (3)

Hint: Scrotum helps in maintaining the required temperature.

Sol.: The testes are situated outside the abdominal cavity within a pouch called scrotum. The scrotum helps in maintaining the low temperature of the testes (2 – 2.5°C lower than the normal internal body temperature) necessary for spermatogenesis.

159. Answer (4)

Hint: Follicles release estrogen

Sol.: In the early follicular phase, estrogen mainly provides negative feedback to the hypothalamus.

Blocking this feedback increases the GnRH secretion, which ultimately increases the secretion of FSH and LH.

The rise in FSH will rescue follicles that would normally undergo atresia, leading to the recruitment and development of a large cohort of follicles.

160. Answer (3)

Hint: Relate with the site of formation of different stages.

Sol.: A morula is an early stage embryo, typically appearing as a solid ball of 8 to 16 blastomeres.

By 3 – 4 days post-fertilisation, morula is formed in the fallopian tube.

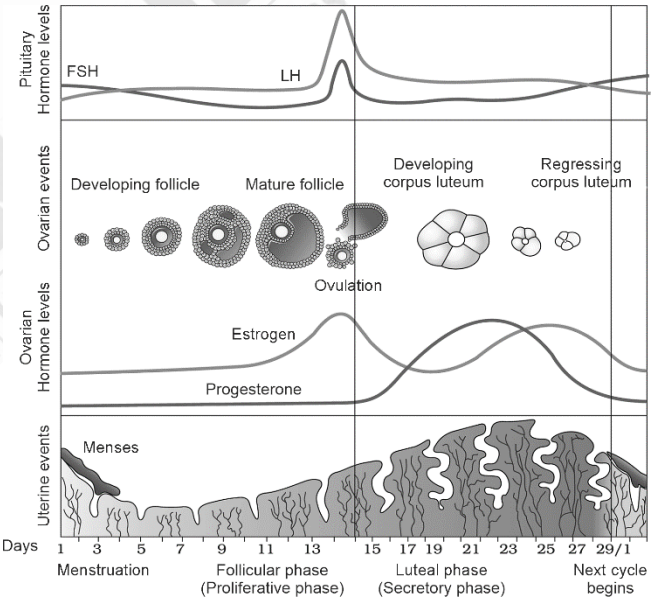
Blastocyst is a hollow ball of cells. It contains 64 cells. Morula divides to form the blastocyst.

The amount of DNA content in the blastocyst will be higher as compared to the early stage of morula.

161. Answer (4)

Hint: Identify the function of pregnancy hormone.

Sol.:



The endometrium is most thickened and richly supplied by arteries during the secretory phase, when level of progesterone is high.

162. Answer (1)

Hint: The structure is a part of the extra-testicular genital duct system.

Sol.: Secretions of epididymis, vas deferens, seminal vesicle and prostate are essential for maturation and motility of sperms.

The vas deferens is lined by pseudostratified columnar epithelium.

Several tubes called vasa efferentia arise from rete testis.

Tubuli recti is a part of the intra – testicular genital duct system.

163. Answer (3)

Hint: Oogenesis is initiated during the embryonic development stage.

Sol.: Primary oocytes are formed during the foetal life of a woman, and then they enter meiosis-I and get arrested in prophase-I (diplotene stage) until puberty.

Therefore, in a 37-years old woman, the primary oocyte is actually older than the woman herself, by the duration of her foetal life.

164. Answer (3)

Hint: Contains stem cells

Sol.: Inner cell mass is the part of the blastocyst that gives rise to the embryo, including all the three germ layers (ectoderm, mesoderm, and endoderm) that form tissues like muscle, heart and eyes.

Trophoblast gives rise to the placenta and other extra-embryonic membranes.

Zona pellucida disappears before implantation.

Blastocoel is the fluid-filled cavity within the blastocyst.

165. Answer (4)

Hint: Apart from the steroidal hormones, other hormones also affect the menstrual cycle.

Sol.: High level of prolactin would lead to amenorrhea [Absence of menstruation].

Hypothyroidism as well as hyperthyroidism affect the menstrual cycle.

Melatonin influences the menstrual cycle by affecting the release of LH and FSH.

166. Answer (3)

Hint: By the end of the second trimester, major-organ systems are developed.

Sol.: By 24 weeks of pregnancy (the end of second trimester):

→ Limbs with digits are already formed

(By 2nd month)

→ External genitalia is well-developed

(By 12 weeks)

→ Foetal movements is seen and hair on head appear by the 5th month

→ Fine hair (also called lanugo) covers the body and eyelids also get separated at the end of third trimester.

167. Answer (4)

Hint: Progesterone sustains the pregnancy.

Sol.: Parturition is a neuro-endocrine mechanism.

The following are observed during the onset of parturition:

(a) Foetal cortisol increases:

- The foetal adrenal cortex becomes highly active.
- Cortisol acts on the placenta to enhance estrogen synthesis.

(b) Estrogen level rises:

- Estrogen increases the number of oxytocin receptors in the uterine muscle (myometrium).

(c) Oxytocin level rises (from the posterior pituitary of the mother)

- Initiates stronger uterine contractions.
- These contractions stretch the cervix further, triggering more oxytocin release.

(d) Progesterone's functional effect declines during this period.

168. Answer (2)

Hint: Similar structure is also present in the human lungs.

Sol.: Alveolar epithelial cells synthesise milk. Milk is stored temporarily in the lumen of the alveoli.

Myoepithelial cells of the alveoli contract under the influence of oxytocin to push milk into the ducts.

Milk is synthesized in the alveolar cells of the mammary gland and it reaches to the exterior *via* the given pathway:

Alveoli → Mammary tubule → Mammary duct → Mammary ampulla → Lactiferous duct

169. Answer (3)

Hint: Releases progesterone

Sol.: The corpus luteum forms only after ovulation from the ruptured Graafian follicle and persists throughout the luteal phase.

It regress before the next cycle, if fertilisation does not occur.

- **Primary follicle :**

→ Present from the beginning of the cycle and even in ovaries before puberty.

→ Seen mainly during the follicular phase, not luteal.

- **Graafian follicle :**

→ Fully mature follicle is seen just before ovulation (late follicular phase).

→ It ruptures at ovulation and thus, it is absent in the luteal phase.

- **Secondary oocyte :**

→ Formed just before ovulation and released during ovulation

→ If not fertilized, it degenerates. Thus, it is not present throughout the luteal phase.

170. Answer (4)

Hint: Structure that has arrested cell division gives rise to zona pellucida.

Sol.: Zona pellucida is a thick, non-cellular transparent layer composed of glycoproteins that surround the plasma membrane of the oocyte.

Upon fertilization, the fusion of sperm with the oocyte triggers the cortical reaction. This reaction induces biochemical changes that modify the zona pellucida, making it impermeable to additional sperm and thus prevent the polyspermy.

The embryo must hatch from the zona pellucida, only after reaching the uterus to begin proper implantation.

Zona pellucida is formed by the secondary oocyte.

171. Answer (3)

Hint: Also known as the birth cord.

Sol.: The umbilical cord is the vital connection between the foetus and the placenta. The development of umbilical cord begins in the embryology period around 3rd week, with the formation of the connecting stalk.

The umbilical vessels carry the foetal blood back and forth to the placenta, with the umbilical vein carrying oxygenated blood with nutrients from the placenta to the foetus and the umbilical arteries transporting deoxygenated blood with waste products from the foetus to the placenta. Waste removal happens *via* placental exchange, the cord only transports foetal blood to and from the placenta.

172. Answer (3)

Hint: Multiple of 4.

Sol.: Ovulation occurs 14 days before the next menstruation (fixed luteal phase). If ovulation is on day 24, total cycle length = 24 + 14 = 38 days.

Thus, menstrual + proliferative phases (follicular part) = 24 days.

173. Answer (2)

Hint: One of them is 4-5 cm in length.

Sol.: In adults, each testis is oval in shape, with a length of about 4 to 5 cm and a width of about 2 to 3 cm. Whereas, each ovary is about 2 to 4 cm in length, and 1.5 – 3 cm in width.

174. Answer (3)

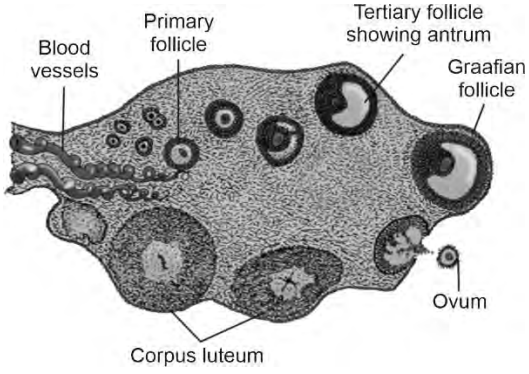
Hint: : Exclude the biochemical components.

Sol.: Seminal plasma refers only to the glandular secretions from seminal vesicles, prostate, and bulbourethral glands. It contains fructose, enzymes, calcium, mucus, salts, *etc*. Sperms are suspended in this fluid but are not a part of the plasma itself.

175. Answer (3)

Hint: Theca layer gets differentiated.

Sol.:



176. Answer (2)

Hint: Chestnut shaped gland.

Sol.: The male accessory glands include paired seminal vesicles, a prostate and paired bulbourethral glands (Cowper's glands). Secretions of these glands constitute the seminal plasma which is rich in fructose, calcium and certain enzymes. The secretions of bulbourethral glands help in the lubrication of the penis.

Seminal vesicle is situated behind the bladder.

Bulbourethral gland lies adjacent to the urethra at the base of penis.

177. Answer (2)

Hint: Gametogenesis is controlled by hormones.

Sol.: The ovaries are located one on each side of the lower abdomen.

The human male ejaculates about 200 to 300 million sperms during a coitus of which, for normal fertility, at least 60 per cent sperms must have normal shape and size and at least 40 per cent of them must show vigorous motility.

At puberty, only 60,000-80,000 primary follicles are left in each ovary.

178. Answer (1)

Hint: Steroid hormone.

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

Estrogen is mainly responsible for the formation of mammary ducts in females.

FSH acts on Sertoli cells.

Progesterone is majorly responsible for the formation of mammary alveoli in females.

179. Answer (2)

Hint: 'Mono' originates from the Greek word *'monos*', meaning 'one'.

Sol.: Monozygotic (identical) twins are formed from a single fertilized egg (zygote) that splits into two, sharing the same genome and sex. They result from one sperm fertilizing one egg. They are not always connected by two placentas; they often share the same one.

180. Answer (3)

Hint: Rapid division

Sol.: The blastomeres in the blastocyst are arranged into an outer layer called the trophoblast and an inner group of cells called the inner cell mass. The trophoblast layer gets attached to the endometrium. After attachment, the uterine cells divide rapidly and cover the blastocyst. As a result, the blastocyst becomes embedded in the endometrium of the uterus. This is called implantation and it leads to pregnancy.

The mammary glands of the female undergo differentiation during pregnancy and starts producing milk towards the end of pregnancy by the process called lactation.

❑ ❑ ❑

All India Aakash Test Series for NEET - 2027

TEST - 1 (Code-B)

Click here for Code-A Sol.

Test Date : 19/07/2026

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

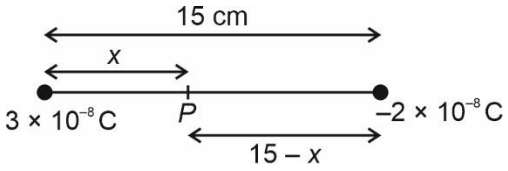
1. Answer (4)

Hint: Potential due to point charge at a distance r,

$V = \frac{Kq}{r}$

Sol.:

(1)

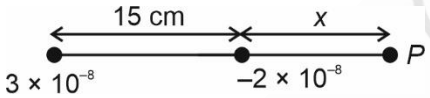


$\frac{K3\times10^{-8}}{x} = \frac{K.2\times10^{-8}}{15-x}$

$\frac{3}{x} = \frac{2}{15-x}$

$\Rightarrow \quad x = 9$ cm

(2)



$K\frac{3\times10^{-8}}{15+x} = K\frac{2\times10^{-8}}{x}$

$\frac{3}{15+x} = \frac{2}{x}$

$3x = 30 + 2x$

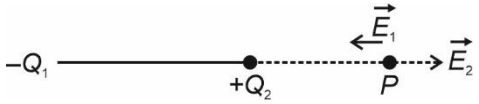
$x = 30$ cm

$\therefore$ At $x = 45$ cm from positive charge, electric potential is zero.

2. Answer (3)

Hint: Electric field due to (+) charge is radially outward and for (–) charge it is radially inward.

Sol.:



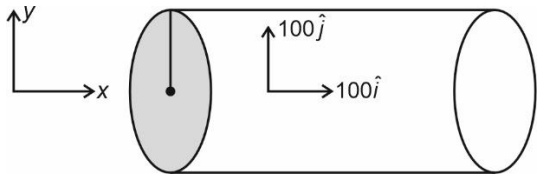
$\therefore \quad \vec{E}_1 \cdot \vec{E}_2 = E_1E_2 \cos 180° = -E_1E_2$

Also $\vec{E}_1 \times \vec{E}_2 = E_1E_2 \sin 180° = 0$

3. Answer (4)

Hint: Electric flux, $\phi = \vec{E}.\vec{A}$

Sol.:



$\phi = \vec{E}.\vec{A} = \left(100\hat{i} + 100\hat{j}\right)\cdot \pi r^2(\hat{i})$

$|\phi| = 100\ \pi r^2$ units

4. Answer (4)

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

Use characteristics of Coulomb's force.

Sol.:

- Coulomb's law follows inverse square law relation with distance
- It agrees with Newton's third law
- It measures force between two point charges.

5. Answer (1)

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

Sol.: Electric field will be due to all q_1, q_2 and $-q_3$ while electric flux will be only due to q_2 and $-q_3$.

6. Answer (3)

Hint: As per junction rule $\sum q_i = 0$

Sol.: Applying junction rule.

$1\ \mu F(V_0 - 6) + 2\ \mu F(V_0 - 4) + (V_0 - 0)7\ \mu F = 0$

$10V_0 = 14$

$V_0 = 1.4$ V

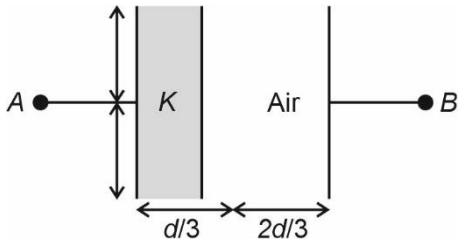
7. Answer (3)

Hint: Use $C_{med} = \frac{A\varepsilon_0}{d - t + \frac{t}{k}}$,

In series

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

Sol.:



$$\frac{1}{C_{AB}} = \frac{1}{\frac{KA\varepsilon_0}{\frac{d}{3}}} + \frac{1}{\frac{A\varepsilon_0}{\frac{2d}{3}}}$$

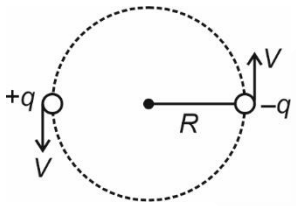
$$C_{AB} = \frac{\frac{3KA\varepsilon_0}{d}\cdot\frac{3}{2}\frac{A\varepsilon_0}{d}}{\frac{3A\varepsilon_0}{d}\left[K+\frac{1}{2}\right]}$$

$$C_{AB} = \frac{3}{2}\frac{KC}{\left[K+\frac{1}{2}\right]}$$

8. Answer (2)

Hint: $\text{T.E} = \frac{1}{2}mv^2 + \left(\frac{Kq_1q_2}{r}\right)$

Sol.:



Electrostatic force of attraction provides centripetal force

$$\frac{1}{4\pi\varepsilon_0}\frac{q^2}{4R^2} = \frac{mv^2}{R}$$

$$\text{Total K.E.} = 2\left(\frac{1}{2}mv^2\right)$$

$$= \frac{Kq^2}{4R}$$

$$\text{P.E} = \frac{-Kq^2}{2R}$$

$$\text{T.E} = \text{P.E} + \text{K.E} = \frac{-Kq^2}{4R}$$

9. Answer (4)

Hint: $\oint \vec{E}.d\vec{s} = \frac{q_{enc}}{\varepsilon_0}$

Sol.: If $\oint \vec{E}.d\vec{s} = 0$, then the net electric flux through that surface is zero implying the net charge enclosed within the surface is zero.

10. Answer (3)

Hint: For spherical conductor, $C = 4\pi\varepsilon_0 r$

Sol.: $C = \frac{Q}{V}$

$$C = \frac{Q}{\frac{Q}{4\pi\varepsilon_0 R}}$$

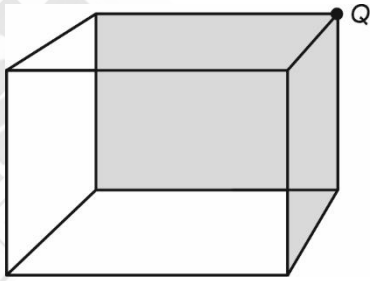
$$C = 4\pi\varepsilon_0 R$$

$$C = \frac{1}{9\times10^9}\times6.4\times10^6 = 711\,\mu\text{F}$$

11. Answer (3)

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

Sol.:



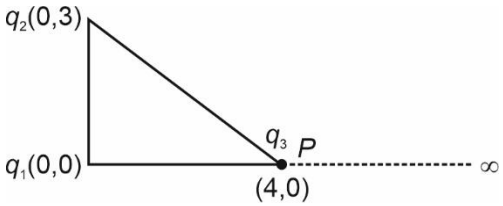
Total flux through the cube is $\frac{Q}{8\varepsilon_0}$. Total flux $\frac{Q}{8\varepsilon_0}$ is being shared by only those faces not touching the charge because faces which are touching the charge have their area vector perpendicular to the electric field coming from the charge Q. Hence flux through them is zero.

Hence flux though one of the faces not touching cube $= \frac{1}{3}\left(\frac{Q}{8\varepsilon_0}\right) = \frac{Q}{24\varepsilon_0}$

12. Answer (3)

Hint: The change in potential energy of system will be due to interaction of charge q_3 with q_1 and q_2.

Sol.:



$$V_P = k\left(\frac{q_1}{r_1}+\frac{q_2}{r_2}\right) = 9\times10^9\left[\frac{2\times10^{-6}}{4}+\frac{5\times10^{-6}}{5}\right]$$

$$= 9\times10^9\left[1.5\times10^{-6}\right]$$

$$= 13.5 \times 10^3 \text{ V}$$

$$\Delta U = q_3V_P - 0 = 3\times10^{-6}\times13.5\times10^3$$

$$\Delta U = 40.5 \times 10^{-3} \text{ J}$$

13. Answer (4)

Hint: Electric field due to a point charge, $\vec{E} = \frac{kq\hat{r}}{r^2}$

Sol.: For a regular polygon of n sides, the net electric field at its centre, distance r from each vertex, is $\frac{q}{4\pi\varepsilon_0 r^2}$, directed towards or away from the empty vertex depending on whether q is positive or negative.

14. Answer (2)

Hint: $\tau = pE\sin\theta$.

Sol.: $\tau = pE\sin\theta$

$\tau = (qa)E\sin\theta$ [$\sin\theta = 1$, for maximum torque]

$\tau = 5\times10^{-6}\times10^{-2}\times10^5 = 5\times10^{-3}$ Nm

15. Answer (3)

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

Sol.: Maximum length in a cuboid is the body diagonal which is equal to $\sqrt{a^2+a^2+\frac{a^2}{4}} = \frac{3}{2}a$

So maximum flux $= \frac{3}{2}\frac{a\lambda}{\varepsilon_0}$ as per Gauss's law

16. Answer (2)

Hint: $W_{ext} = q(\Delta V)$

Sol.: $V_B - V_A = \frac{U_B - U_A}{q} = \frac{W_{ext}}{q}$

$\Rightarrow V_B - V_A = \frac{100}{5} = 20$ V

$\Rightarrow V_A - V_B = -20$ V

17. Answer (4)

Hint: For a shell

$E_{inside} = 0$

$E_{outside} = \frac{kq}{r^2}$

Sol.: $E_P = \frac{kQ}{r^2}$

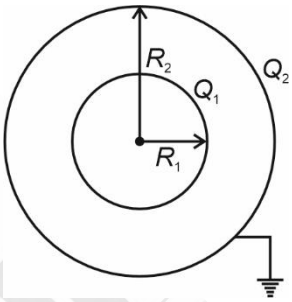
$E_Q = \frac{K.(Q+3Q)}{(2r)^2} = \frac{K4Q}{4r^2}$

$\frac{E_P}{E_Q} = \frac{1}{1}$

18. Answer (3)

Hint: For earthing $V = 0$

Sol.:



For outer sphere

$K\frac{Q_1}{R_2} + K\frac{Q_2}{R_2} = 0 \Rightarrow Q_1 = -Q_2$

For inner sphere

$\frac{KQ_1}{R_1} + \frac{KQ_2}{R_2} = 2$

$\frac{KQ_1}{R_1} - \frac{KQ_1}{R_2} = 2$

$KQ_1\left[\frac{1}{R_1} - \frac{1}{R_2}\right] = 2$

$KQ_1\left[\frac{1}{4} - \frac{1}{6}\right] = 2 \Rightarrow KQ_1\left[\frac{6-4}{24}\right] = 2$

$KQ_1 = 24$

$Q_1 = \frac{24}{K}$

19. Answer (2)

Hint: Energy stored in capacitor, $U = \frac{Q^2}{2C}$

$C' = KC$

Sol.: $C' = KC$

$C' = 4C$

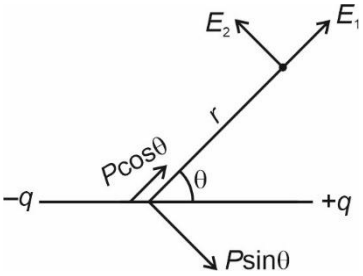
$$U = \frac{Q^2}{2C}$$

$$U' = \frac{Q^2}{2C'} = \frac{Q^2}{2.4C} = \frac{U}{4}$$

20. Answer (4)

Hint: $E = \frac{kP}{r^3}\sqrt{3\cos^2\theta + 1}$

Sol.:



$$E_1 = \frac{2P\cos\theta}{4\pi\varepsilon_0 r^3}$$

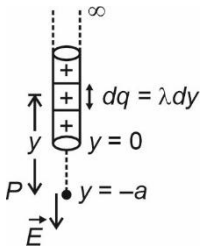
$$E_2 = \frac{P\sin\theta}{4\pi\varepsilon_0 r^3}$$

$$E = \sqrt{E_1^2 + E_2^2} = \frac{1}{4\pi E_0}\frac{P}{r^3}\sqrt{3\cos^2\theta + 1}$$

21. Answer (3)

Hint: Use, $\vec{E} = \frac{kq}{r^2}\hat{r}$

Sol.:



$$d\vec{E} = \frac{-1}{4\pi\varepsilon_0}\frac{dq}{y^2}\hat{j} \quad \text{(along -}y\text{ axis)}$$

Net field.

$$\vec{E} = -\int_a^\infty \frac{1}{4\pi\varepsilon_0}\frac{dq}{y^2}\hat{j}$$

$$= \frac{-\lambda\hat{j}}{4\pi\varepsilon_0}\int_a^\infty \frac{dy}{y^2} = \frac{-\lambda\hat{j}}{4\pi\varepsilon_0}\left[\frac{1}{a} - \frac{1}{\infty}\right]$$

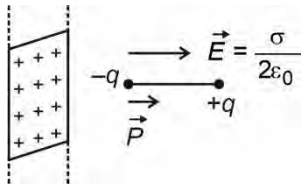
$$= \frac{-\lambda}{4\pi\varepsilon_0 a}\hat{j}$$

22. Answer (3)

Hint: Electric field due to infinite plane sheet, $E_{\text{sheet}} = \frac{\sigma}{2\varepsilon_0}$

$\tau = pE\sin\theta$

Sol.:



$$E = \frac{\sigma}{2\varepsilon_0},\ \vec{\tau} = \vec{P}\times\vec{E}$$

$\vec{\tau} = 0$

$U = -\vec{P}.\vec{E}$

U is minimum.

23. Answer (2)

Hint: Energy density $= \frac{1}{2}\varepsilon_0 E^2$

Sol.: Energy density $= \frac{1}{2}\varepsilon_0 E^2$

$$= \frac{1}{2}\times 8.85\times 10^{-12}\times\left(\frac{100}{10^{-4}}\right)^2$$

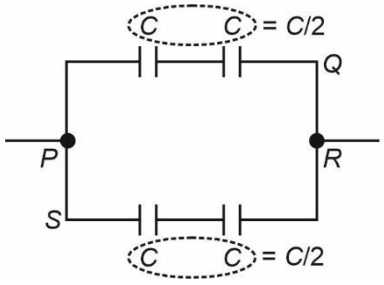
$$= \frac{1}{2}\times 8.85\times 10^{-12}\times 10^{12}$$

$= 4.425\ \text{J/m}^3$

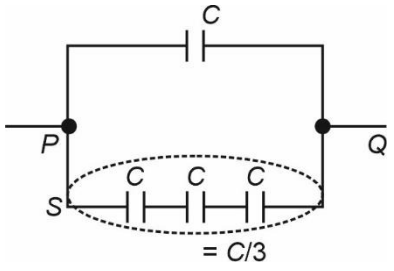
24. Answer (4)

Hint: $C_S = \frac{C_1C_2}{C_1 + C_2},\ C_P = C_1 + C_2$

Sol.:



$$C_{PR} = \frac{C}{2} + \frac{C}{2} = C$$



$$C_{PQ} = C + \frac{C}{3} = \frac{4C}{3}$$

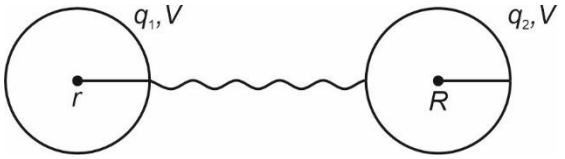
$$\therefore \frac{C_{PR}}{C_{PQ}} = \frac{C}{\frac{4C}{3}} = \frac{3}{4}$$

25. Answer (3)

Hint: Since the two spheres are connected with each other, hence in electrostatic equilibrium

$V_1 = V_2$

Sol.:



$$q_1 + q_2 = Q$$

$$\frac{q_1}{4\pi\varepsilon_0 r} = \frac{q_2}{4\pi\varepsilon_0 R}$$

$$\frac{q_1}{q_2} = \frac{r}{R}$$

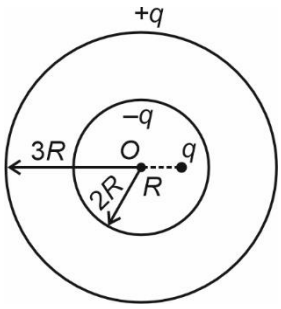
$$q_1 + \frac{q_1 R}{r} = Q$$

$$q_1 = \frac{Qr}{R+r}$$

26. Answer (3)

Hint: Net potential is due to charge q and due to induced charges.

Sol.:



Induced charges at inner and outer surface will be $-q$ and $+q$ respectively

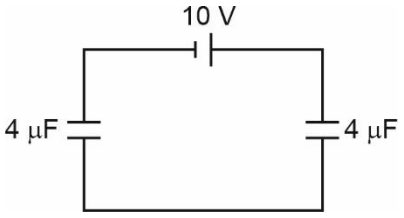
Net, potential at centre O

$$V_0 = k\left[\frac{q}{R} - \frac{q}{2R} + \frac{q}{3R}\right] = \frac{5kq}{6R}$$

27. Answer (1)

Hint: $q = CV$

Sol.:



Potential difference across each capacitor is $\frac{10}{2} = 5$ V

$q = CV$

$= 4\ \mu F \times 5\ V$

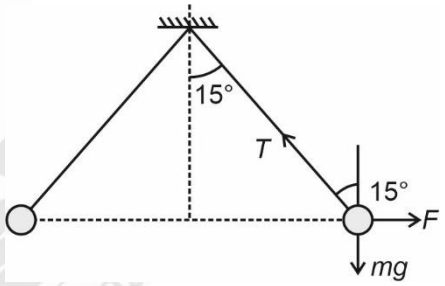
$= 20\ \mu C$

28. Answer (3)

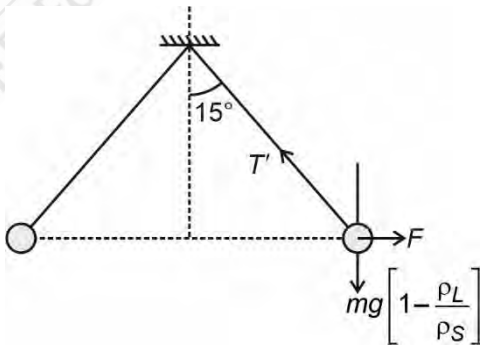
Hint: For equilibrium

$$\tan\theta = \frac{F}{mg}$$

Sol.:



$$\tan 15° = \frac{F}{mg} \quad \ldots(1)$$



$$\tan 15° = \frac{F}{Kmg\left[1-\frac{\rho_L}{\rho_S}\right]} \quad \ldots(2)$$

$$1 - \frac{\rho_L}{\rho_S} = \frac{1}{K}$$

$$1 - \frac{0.6}{1.8} = \frac{1}{K}$$

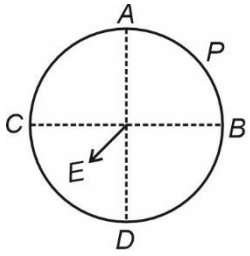
$$\frac{1}{K} = 1 - \frac{1}{3} = \frac{2}{3}$$

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

29. Answer (4)

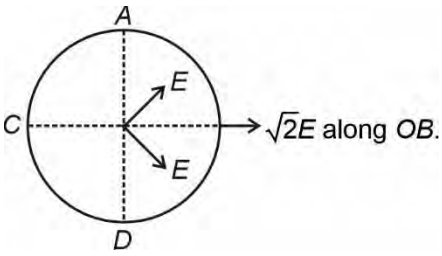
Hint: Use symmetry of field due to each quarter of ring.

Sol.:



$$E_{\text{quarter Ring}} = \frac{\sqrt{2}k\lambda}{r}$$

(Where λ is uniform linear charge density)



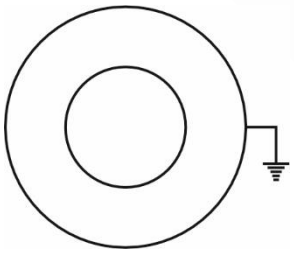
$$E_{\text{half ring}} = \frac{2K\lambda}{r}$$

$$E_{\text{half ring}} = \sqrt{2}\,E_{\text{quarter ring}}$$

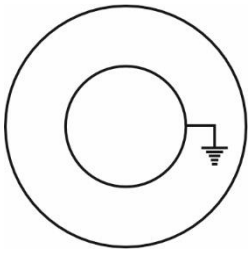
30. Answer (3)

Hint: Use $C = \frac{4\pi\varepsilon_0 r_1 r_2}{r_2 - r_1}$

Sol.:



$$C_1 = 4\pi\varepsilon_0 \frac{ab}{b-a}$$



$$C_2 = 4\pi\varepsilon_0 \frac{b^2}{b-a}$$

$$\frac{C_1}{C_2} = \frac{a}{b}$$

31. Answer (1)

Hint: In series combination voltage distributes in the inverse ratio of capacitance.

Sol.: $\frac{V_1}{V_2} = \frac{C_2}{C_1} = \frac{K_2\frac{A\varepsilon_0}{2d}}{K_1\frac{A\varepsilon_0}{d}} = \frac{K_2}{2K_1} = \frac{6}{2(2)} = \frac{3}{2}$

32. Answer (3)

Hint & Sol.: Force between the plates

$$F = \frac{q^2}{2A\varepsilon_0}$$

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

When d becomes $\frac{d}{2}$, C becomes 2 times and $q = CV$ means q becomes double

$\therefore$ Force become 4 times.

33. Answer (3)

Hint: use $q = ne$

Sol.: $q = ne$

$q = 10^{16} \times 1.6 \times 10^{-19}$.

$q = 1.6 \times 10^{-3} = 1.6$ mC

34. Answer (2)

Hint: Properties of electric field lines.

Sol.: The number of electric field lines originating or terminating on a charge is proportional to the magnitude of charge.

35. Answer (3)

Hint: $V = \frac{KP\cos\theta}{r^2}$

Sol.: $V = \frac{KP\cos\theta}{r^2} = \frac{KP\cos 60^\circ}{r^2}$

$$V = \frac{9\times10^9\times6\times10^{-9}}{(0.5)^2}\times\frac{1}{2}$$

$$V = 9\times6\times\frac{1}{2}\times2\times2$$

$V = 108$ V

36. Answer (3)

Hint: Three capacitors are in parallel combination.

Sol.: $Q_1 = \frac{A\varepsilon_0 V}{d}$

$Q_2 = \frac{-2A\varepsilon_0 V}{d}$

$Q_3 = \frac{2A\varepsilon_0 V}{d}$

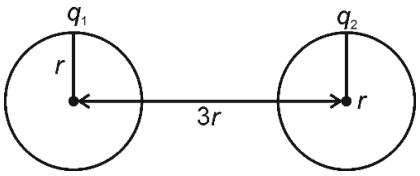
$Q_4 = \frac{-A\varepsilon_0 V}{d}$

37. Answer (3)

Hint: Self energy $U = \frac{Kq^2}{2r}$

$U_{interaction} = \frac{Kq_1q_2}{r}$

Sol.:



$U = U_1 + U_2 + U_{interaction}$

$U_1 = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1^2}{2r}\right)$ → Self energy

$U_2 = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_2^2}{2r}\right)$ → Self energy

$U_{interaction} = \frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{3r}$

$U = \frac{1}{4\pi\varepsilon_0}\left[\frac{q_1^2}{2r} + \frac{q_2^2}{2r} + \frac{q_1q_2}{3r}\right]$

38. Answer (2)

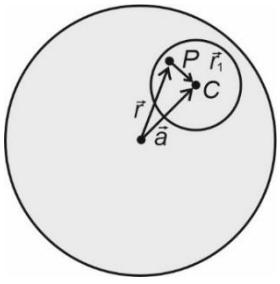
Hint: Characteristics of Coulomb's force.

Sol.: Coulomb's force is a conservative force. Coulomb's force may be attractive or repulsive Coulomb's force follows superposition principle and inverse square law.

39. Answer (2)

Hint: Electric field at any point $\vec{r}$ inside the sphere with a uniform charge density ρ (relative to its centre) is $\vec{E} = \frac{\rho}{3\varepsilon_0}\vec{r}$

Sol.:



$\vec{E}_P = \frac{\rho}{3\varepsilon_0}(\vec{r} + \vec{r}_1)$

$\vec{E}_P = \frac{\rho\vec{a}}{3\varepsilon_0}$

Hence field inside cavity is uniform and does not depend on the position of point P in the cavity.

40. Answer (2)

Hint: Common potential

$V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$

Sol.: Common potential $V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$

$V = \frac{C_1V_1 - C_2V_2}{C_1 + C_2} = \frac{3(300) - 2(200)}{5}$

$V = 100$

Charge flown $\Delta q = 3\ \mu F(300 - 100)$

$\Delta q = 600\ \mu C$

41. Answer (3)

Hint: Properties of equipotential surface.

Sol.: $\frac{W_{A\to B}}{q} = V_B - V_A$

For equipotential surface $V_A = V_B$

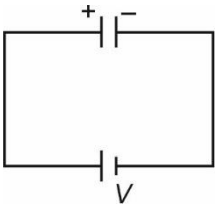
$\therefore\ W_{A\to B} = 0$

42. Answer (4)

Hint: use $C = \frac{A\varepsilon_0}{d}$, battery is connected so potential difference remains same.

$q = CV$

Sol.: $\Rightarrow$



V = Constant

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

With decrease in d, capacitance C increases

$\therefore$ $q = CV$ also increases.

43. Answer (4)

Hint: Change in electrostatic P.E, $\Delta U = q\Delta V$

Sol.: Potential energy increases, if charge is positive

Potential energy decreases, if charge is negative

44. Answer (2)

Hint: $\Sigma\vec{F}_{system} = 0 \Rightarrow \vec{F}_1 = -\vec{F}_2$

Sol.: $F_1 = m_1a_1$

$F_1 = \left(5\times10^{-8}\right)(8) = 4\times10^{-7}$ N

Now same force is experienced by other charge

$\therefore \quad F_2 = 4\times10^{-7} = m_2a_2 = m_2(10)$

$m_2 = 4 \times 10^{-8}$ kg $= 4 \times 10^{-5}$ g

Also $F = \dfrac{kq^2}{r^2} \Rightarrow 4\times10^{-7} = 9\times10^9\dfrac{q^2}{\left(5\times10^{-3}\right)^2}$

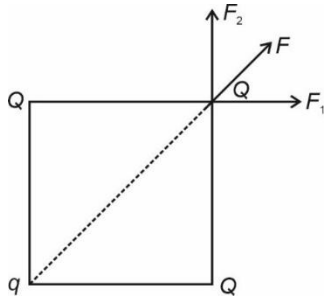
$q = 33.3 \times 10^{-12} = 33.3$ pC

45. Answer (2)

Hint: For equilibrium $\Sigma\vec{F} = 0$

$F = \dfrac{Kq_1q_2}{r^2}$

Sol.:



$\dfrac{\sqrt{2}KQ^2}{q^2} + \dfrac{KQq}{\left(\sqrt{2}a\right)^2} = 0$

$\Rightarrow \quad q = -2\sqrt{2}Q$

[CHEMISTRY]

46. Answer (3)

Hint: For dilute sulphuric acid, oxidation of water is preferred at anode

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

Sol.: Electrolysis of an aqueous of $AgNO_3$ using platinum electrode.

At anode

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

47. Answer (3)

Hint: $\dfrac{I}{R} = k\dfrac{A}{\ell}$

Sol.: $\dfrac{I}{A} = k\times R$

$= 0.015 \times 50$

$= 0.75$ cm^{-1}

48. Answer (4)

Hint: $\dfrac{P^\circ - P_s}{P_s} = \dfrac{n_2}{n_1+n_2}$

Sol.: $\dfrac{P^\circ - 0.7P^\circ}{0.7P^\circ} = \dfrac{w}{\frac{50\times114}{114}}$

$\dfrac{3}{7} = \dfrac{w}{50\times1}$

$w = \dfrac{3}{7}\times50 = \dfrac{150}{7}$

49. Answer (1)

Hint: $\Delta T_f = i \times K_f \times m$

Sol.: $\Delta T_f = 4$

$4 = 1\times\dfrac{1.86\times w}{62\times2}$

$w = \dfrac{62\times8}{1.86}$

$= 266.67$ g

50. Answer (4)

Hint: For negative deviation from ideal behaviour intermolecular attractive forces between A-A and B-B are weaker than those between A-B

Sol.: $\Delta_{mix} V < 0$ at constant T and P

$\Delta_{mix} H < 0$ at constant T and P

51. Answer (2)

Hint: Blood cells retain their normal shape in solution which are isotonic to blood.

Sol.: The values of K_f and K_b, depends upon molar mass of solvent.

52. Answer (4)

Hint: $P_A^\circ X_A + P_B^\circ X_B = P_S$

Sol.:

$$P_{Total} = 210\times\left(\frac{\frac{26}{119.5}}{\frac{26}{119.5}+\frac{40}{85}}\right) + 415\times\left(\frac{\frac{40}{85}}{\frac{26}{119.5}+\frac{40}{85}}\right)$$

$$= 210 \times \left(\frac{0.217}{0.217+0.47}\right) + 415 \times \left(\frac{0.47}{0.217+0.47}\right)$$

$$= 210 \times \frac{0.217}{0.687} + 415 \times \frac{0.47}{0.687}$$

= 66.33 + 283.91

= 350.24 mm Hg

53. Answer (2)

Hint: Osmotic pressure (π) = CRT

$\pi \propto C$

Sol.: For glucose solution,

$$C_1 = \frac{20}{180} \times \frac{1000}{500} = 0.22 \text{ M}$$

For urea solution, $C_2 = \frac{20}{60} \times \frac{1000}{500} = 0.66$ M

For sucrose solution, $C_3 = \frac{20}{342} \times \frac{1000}{500} = 0.117$ M

Hence, correct order of osmatic pressure will be

$P_3 < P_1 < P_2$

54. Answer (3)

Hint: $\Delta T_f = iK_f m$

Sol.: $i = 1 + (n - 1)\alpha$

$= 1 + (2 - 1)\ 0.40$

$= 1.4$

$\Delta T_f = 1.4 \times 1.86 \times 0.1$

$= 0.26$

$0.26 = 0 - T_{f(Solution)}$

$T_{f(Solution)} = -0.26°C$

55. Answer (4)

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

Sol.: $E_{H^+/H_2} = 0 - \frac{0.059}{2} \log \frac{(P_{H_2})}{(10^{-7})^2}$

$P_{H_2} = 10^{-14}$ atm

56. Answer (3)

Hint: $\Delta G° = -nFE°$

$\Delta G° = -RT\ln K_{eq}$

Sol.: If $E^\circ_{cell} = +ve$

Then $\Delta G° < 0$, $K_{eq} > 1$

57. Answer (2)

Hint & Sol. : Reaction at cathode

Dry cell: $MnO_2 + NH_4^+ + e^- \rightarrow MnO(OH) + NH_3$

Mercury cell: $HgO + H_2O + 2e^- \rightarrow Hg(l) + 2OH^-$

Lead storage battery (on discharging):

$$PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e \rightarrow PbSO_4(s) + 2H_2O(l)$$

$H_2 - O_2$ fuel cell :

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

58. Answer (4)

Hint: The overall reaction is represented by

$Zn(Hg) + HgO(s) \rightarrow ZnO(s) + Hg(l)$

Sol.: The cell potential is approximately 1.35 V and remains constant during its life as the overall reaction does not involve any ion in solution whose concentration can change during its life time.

59. Answer (4)

Hint: Copper sulphate solutions cannot be stored in zinc pot.

Sol.: The electric charge for electrode deposition of one gram equivalent of a substance is 96500 Coulombs per second.

The function of salt bridge is to allow the moment of ions from one solution to other without mixing of the two solutions.

In corrosion, a metal is oxidised by loss of electrons to oxygen.

Aluminium metal is produced by electrolysis of aluminium oxide in presence of cryolite.

60. Answer (1)

Hint: $E_{Cell} = E^\circ_{cell} - \frac{0.059}{n} \log Q$, $\Delta G = -nFE_{cell}$

Sol.: $Sn(s) \rightarrow Sn^{2+} + 2e$

$$\frac{Cu^{2+} + 2e \rightarrow Cu}{Sn(s) + Cu^{2+} \rightarrow Sn^{2+} + Cu}$$

$E^\circ_{cell} = E^\circ_{Red} + E^\circ_{ox}$

$= 0.34$ V + 0.14 V

$= 0.48$ V

$$E_{cell} = 0.48 - \frac{0.059}{2} \log \frac{10^{-3}}{10^{-2}}$$

$$= 0.48 + \frac{0.059}{2} = 0.5095$$

$\Delta G = -nFE = -2 \times F \times 0.51$

$= -98.43$ kJ mol^{-1}

61. Answer (2)

Hint & Sol.:

Compound	$\Lambda_m^\circ\left(S\ cm^2\ mol^{-1}\right)$
HCl	425.9
NaOH	249.2
NaCl	126.4
KCl	149.8

62. Answer (4)

Hint: Degree of dissociation for weak acid

$$\%\ \alpha = \frac{\Lambda_m}{\Lambda_m^\circ} \times 100$$

Sol.: $\Lambda_m = \frac{1.85 \times 10^{-5} \times 1000}{10^{-3}}$

$= 18.5$

$\Lambda_m^\circ = 349.6 + 40.9$

$= 390.4$

$\alpha = \frac{18.5}{390.4} \times 100$

$= 4.7\%$

63. Answer (4)

Hint:

Material	(Conductivity/Sm^{-1})
Glass	1.0×10^{-16}

Sol.:

CuO	1×10^{-7}
Teflon	1.0×10^{-18}
Silver	6.2×10^{3}

64. Answer (4)

Hint: The conductivity of electrolytic solutions increases with the increase of temperature

Sol.: The conductivity of electrolytic (ionic) solutions depends on:

The nature of the electrolyte added

Size of the ions produced and their solvation

The nature of the solvent and its viscosity

Concentration of the electrolyte temperature

65. Answer (1)

Hint:

$$\Lambda_m^\circ\left(CH_3COOH\right) = \Lambda_m^\circ\left(CH_3COONa\right) + \frac{\Lambda_m^\circ\left(H_2SO_4\right)}{2} - \frac{\Lambda_m^\circ\left(Na_2SO_4\right)}{2}$$

Sol.: $\lambda_{H^+}^\circ + \lambda_{CH_3COO^-}^\circ = \lambda_{CH_3COO^-}^\circ + \lambda_{Na}^\circ + \frac{2\lambda_{H^+}^\circ}{2} + \frac{\lambda_{SO_4^{2-}}^\circ}{2} - \frac{2\lambda_{Na^+}^\circ}{2} - \frac{\lambda_{SO_4}^\circ}{2}$

$= z + \frac{(x-y)}{2}$

66. Answer (2)

Hint: $w = \frac{E}{96500} \times I \times t$

Sol.: At cathode $2Cl^- \rightarrow Cl_2 + 2e$

n = 2

no. of mole × n-factor = $\frac{I \times t}{96500}$

$0.1 \times 2 = \frac{3 \times t}{96500}$

t = 107.22 minutes

67. Answer (3)

Hint & Sol.: Na^+ ions are discharged at the cathode in preference to H^+ ions, yielding sodium, which dissolves in mercury to form sodium amalgam.

68. Answer (2)

Hint: Check whether Ce^{4+} can oxidise Cl^- or Br^-

Sol.: $E°(Cl_2/Cl^-) = 1.36$ V, $E°(Ce^{4+}/Ce^{3+}) = 1.61$ V and $1.61 > 1.40$

Hence Ce^{4+} oxidises Cl^- to Cl_2

69. Answer (4)

Hint: Theoretical thermodynamic efficiency of a fuel cell is given by $\frac{\Delta G}{\Delta H}$

Sol.: $\eta = \frac{\Delta G}{\Delta H}$

[Change in Gibbs free energy over change in enthalpy]

70. Answer (3)

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

Sol.: $2Fe(s) \rightarrow 2Fe^{2+}(aq) + 4e$

$$\frac{O_2(g) + 4H^+ + 4e \rightarrow 2H_2O}{2Fe(s) + O_2(g) + 4H^+(aq) \rightarrow 2Fe^{2+}(aq) + 2H_2O(l)}$$

n = 4

$$E_{cell} = 1.67 - \frac{0.059}{4}\log\frac{\left[Fe^{2+}\right]^2}{p(O_2) \times \left[H^+\right]^4}$$

$$= 1.67 - \frac{0.059}{4}\log\frac{\left(10^{-2}\right)^2}{10^{-1}\times\left(10^{-2}\right)^4}$$

$$= 1.67 - \frac{0.059}{4}\log 10^5$$

$$= 1.67 - \frac{0.059}{4}\times 5$$

= 1.596 V

71. Answer (4)

Hint: For weak electrolytes. Λ_m° cannot be obtained by extrapolation of Λ_m to zero concentration.

Sol.: The value of the constant 'A' for a given solvent and temperature depends on the type of electrolyte *i.e.*, the charges on the cation and anion produced on the dissociation of the electrolyte in the solution. Thus, NaCl, $CaCl_2$, $MgSO_4$ are known as 1–1, 2–1 and 2–2 electrolytes respectively. All electrolytes of a particular type have the same value for 'A'.

72. Answer (2)

Hint: $\frac{w}{E} = \frac{i\times t}{96487}$

Sol.: $\frac{w}{63.5}\times 2 = \frac{1.5\times 20\times 60}{96487}$

$$w = \frac{1.5\times 1200\times 63.5}{2\times 96487}$$

= 0.5923 g

73. Answer (2)

Hint: $\underset{2\,mol}{2H_2O} \rightarrow 4H^+ + O_2 + 4e$ 4 F required

Sol.: $Cr_2O_7^{2-} + 14H^+ + 6e \rightarrow 2Cr^{+3} + 7H_2O$

6 F required

$\underset{1.5mol}{Ba^{2+}} + 2e \rightarrow Ba$ 3 F required

$2Fe^{3+} + 2e \rightarrow 2Fe^{+2}$ 2 F required

74. Answer (1)

Hint: $E_{cell}^\circ = E_{Red}^\circ + E_{ox}^\circ$

Sol.: $E_{cell}^\circ = 0.16\ V + 0.74\ V$

= 0.90 V

75. Answer (1)

Hint: Higher the value of $E_{oxidation}^\circ$, stronger is the reducing power.

Sol.: Therefore, the correct order of reducing power of the metals will be

K > Mg > Cr > Cu

76. Answer (1)

Hint: $\Delta T_b = (T_b)_f - (T_b)_i$

$(T_b)_f = \Delta T_b + (T_b)_i$

$\Delta T_b = iK_bm$

Sol.: $\Delta T_b \propto i\times m$

(a) 0.01 m K_2SO_4 i = 3

$\Delta T_b = 3 \times K_b \times 0.01 = 0.03\ K_b$

(b) 0.015 m glucose, *i* = 1

$\Delta T_b = 1 \times K_b \times 0.015 = 0.015\ K_b$

(c) 0.01 m $NaNO_3$, i = 2

$\Delta T_b = 2 \times K_b \times 0.01 = 0.02\ K_b$

(d) 0.01 m urea, i = 1

$\Delta T_b = 1 \times K_b \times 0.01 = 0.01\ K_b$

77. Answer (4)

Hint : For a binary liquid forming a minimum-boiling azeotrope, the boiling point of the azeotrope is lower than that of both pure component.

Sol.: At the azeotropic composition, the total vapour pressure of the solution becomes greater than the vapour pressure of both pure component at the same temperature.

78. Answer (2)

Hint: The osmotic pressure method has the advantage over other methods as pressure measurement is around the room temperature and the molarity of the solution is used instead of molality.

Sol.: Osmotic pressure is widely used to determine molar masses of proteins, polymers and other macromolecules.

79. Answer (3)

Hint & Sol.: When a non-volatile solute is added to a solvent, the vapour pressure of the solvent decreases.

80. Answer (4)

Hint : To increase the solubility of CO_2 in soft drinks and soda water, the bottle is sealed under High pressure.

Sol.: At high altitudes and partial pressure of oxygen is less than that at the ground level.

81. Answer (2)

Hint: For strong electrolytes van't Hoff factor (i) increases on dilution.

Value of *i*

Sol.:

KCl	0.1 m	0.01 m	0.001 m
Value of (i)	1.85	1.94	1.98

82. Answer (1)

Hint: $i = 1 + (n - 1)\alpha$

Sol.: $Al_2SO_4 \rightarrow 2Al^{3+} + 3SO_4^{2-}$

1

$1-\alpha \qquad 2\alpha \qquad 3\alpha \qquad (i = 1+4\alpha)$

$= 1+4\times0.6$

$= 3.4$

$LiCl \rightarrow i = 1 + (2 - 1)\ 0.9 = 1.9$

$Na_3PO_4 \rightarrow i = 1 + 3 \times 0.7 = 3.1$

$BaSO_4 \rightarrow i = 1 + \alpha = 1 + 0.5 = 1.5$

83. Answer (4)

Hint: Formation of solution is a spontaneous process therefore $\Delta G < 0$

Sol.: $\Delta H_{mix} = 0$

$\Delta S_{system} > 0$; because disorder increases

$\Delta S_{surr} = 0$; no heat is exchanged in case of ideal solution.

84. Answer (1)

Hint: $\Delta T_f = iK_f m$

Sol.: i = 1

$$\frac{P^\circ - P_s}{P_s} = i\left[\frac{n_1}{n_2}\right]$$

$$\frac{650-630}{630} = 1\frac{n_1}{n_2}$$

$$\frac{20}{630} = \frac{n_1}{n_2}$$

$$\Delta T_f = 1\times5.12\times\frac{2\times1000}{63\times78}$$

= 2.08 K

85. Answer (2)

Hint: Solution having negative deviation from Raoult's law will form maximum boiling azeotrope

Sol.:

Ethanol + water	→	⊕ve deviation from Raoult's law
Water + nitric acid	→	⊖ve deviation from Raoult's law
Acetone + Chloroform	→	⊖ve deviation from Raoult's law
Ethanol + Acetone	→	⊕ve deviation from Raoult's law

86. Answer (2)

Hint: $P_{water\ vapour} = X_{water\ vapour} \times P_{Total}$

$P_{Total} = P_{water\ vapour} + P_{dry\ air}$

Sol.: $P_{water} = 0.02 \times 1.5$

$= 0.03$

$P_{Total} = P_{water\ vapour} + P_{dry\ air}$

$1.5 = 0.03 + P_{dry\ air}$

$P_{dry\ air} = 1.5 - 0.03$

= 1.47 atm

87. Answer (3)

Hint: According to Henry's law, higher the value of K_H at a given pressure, lower is the solubility of the gas in the liquid.

Sol.: Therefore, solubility order of given gases will be

Q > R > P

88. Answer (1)

Hint: $\text{Molarity} = \dfrac{W_{HNO_3}\times1000}{MW_{HNO_3}\times V_{solution(ml)}}$

Sol.: $2.5 = \dfrac{W_{HNO_3}\times1000}{63\times300}$

$$W_{HNO_3} = \frac{2.5\times63\times300}{1000}$$

$$= \frac{7.5\times63}{10}$$

= 47.25

$$\text{Mass of acid} \times \frac{70}{100} = 47.25$$

$$\text{Mass of acid} = \frac{4725}{70} = 67.50\ g$$

89. Answer (4)

Hint: Mole fraction, $X = \frac{n_1}{n_1 + n_2}$

Sol. Mole of methanol $= \frac{4x}{32} = \frac{1}{8}x$

Mole of water $= \frac{9}{18}x = \frac{1}{2}x$

Mole fraction of methanol $= \frac{\frac{1}{8}x}{\frac{1}{8}x + \frac{1}{2}x} = 0.2$

90. Answer (3)

Hint : In solution, the component that is present in the largest quantity is known as solvent. Solvent determines the physical state in which solution exist.

Sol.:

Smoke	Solid in gas
Amalgam of mercury with sodium	Liquid in solid
Alloys	Solid in solid
Humidity	Liquid in gas

[BOTANY]

91. Answer (1)

Hint: The two polar nuclei in the embryo sac fuse together as the male gametes enter the synergids.

Sol.: After the pollen grains (male gametophyte) mature in the microsporangium, dehiscence of anther occurs. After pollination, pollen germinate and the pollen tube enters the embryo sac releasing two male gametes.

92. Answer (1)

Hint: Self-incompatibility cannot be a device to promote genetic variability in the plants in which bud pollination occurs.

Sol.: The pistil has the ability to recognise the pollen, whether it is of the right type or of the wrong type. If the pollen is of the right type, the pistil accepts the pollen and promotes post-pollination events that leads to fertilisation.

93. Answer (2)

Hint: The MMC undergoes meiotic division. Meiosis results in the production of four megaspores.

Sol.: In a majority of flowering plants, one of the megaspores is functional, while the other three degenerate. Only the functional megaspore develops into the female gametophyte, *i.e.*, embryo sac.

94. Answer (1)

Hint: Dehydrated seeds can be stored for longer periods. As the seeds have sufficient food reserves, young seedlings are nourished until they are capable of photosynthesis on their own.

Sol.: Dehydration and dormancy of mature seeds are crucial for storage of seeds which can be used as food throughout the year and also to raise crop in the next season.

95. Answer (4)

Hint: When male and female flowers are present on different plants, that is each plant is either male or female, this condition is referred to as dioecy.

Sol.: When pollen is released before the stigma becomes receptive, this condition is called protandry. Self-incompatibility is a genetic mechanism and prevents self-pollen from fertilising the ovules by inhibiting pollen germination or pollen tube growth in the pistil.

96. Answer (3)

Hint: A typical angiosperm ovule has one or two protective envelopes called integuments.

Sol.: Integuments encircle the nucellus except at the tip where a small opening called the micropyle is present. Egg apparatus is present at the micropylar end of the ovule.

97. Answer (3)

Hint: Parthenocarpic fruits are formed without fertilization.

Sol.: When the seeds are produced without fertilisation, these are called apomictic seeds. An apomictic seed can have endosperm to nourish the developing embryo.

98. Answer (2)

Sol.: Continued self-pollination results in inbreeding depression because self-pollination limits the genetic variability in the generations.

99. Answer (1)

Hint: Ovules are found inside the ovary in the ovarian cavity.

Sol.: Inside the ovary, the ovarian cavity is also called locule.

100. Answer (1)

Hint: In angiosperms, the seed is the final product of sexual reproduction. It is often described as a fertilised ovule.

Sol.: As the seed matures, its water content is reduced and seeds become relatively dry. The general metabolic activity of the embryo slows down.

101. Answer (1)

Hint: Insects, when consume pollen or the nectar without bringing about pollination, they do not benefit the plant in return.

Sol.: Insects that consume pollen or the nectar without bringing about pollination are referred to as pollen or nectar robbers.

102. Answer (4)

Hint: Pollen grain represents the male gametophyte in flowering plants.

Sol.: Pollen grains have a prominent two-layered wall. The hard outer layer is exine and inner wall is intine. Pollen grain exine has prominent apertures called germ pores where sporopollenin is absent.

103. Answer (1)

Hint: In monocots, such as wheat and maize, single cotyledon is called scutellum that is situated towards one side (lateral) of the embryonal axis.

Sol.: Seeds of monocot plants have bulky endosperm that stores food reserve which provides nourishment to embryo during seed germination.

104. Answer (3)

Hint: Nectar and pollen grains are the usual floral rewards for pollinating animals.

Sol.: In some species, floral rewards for pollinating animals are in providing safe places to lay eggs. Animals are attracted to flowers by colour and/or fragrance. These are not rewards from plants to the pollinating animals.

105. Answer (2)

Hint: The basic architecture does not vary from pollen to pollen within a species of plant.

Sol.: Viability of pollen grains of a large number of species can be maintained for years in liquid nitrogen (–196ºC). The generative cell divides and forms the two male gametes during the growth of pollen tube in the stigma.

106. Answer (1)

Hint: A typical dicotyledonous embryo, consists of an embryonal axis and two cotyledons.

Sol.: In monocotyledons, the lower end of the embryonal axis has radical and root cap enclosed in an undifferentiated sheath called coleorrhiza.

107. Answer (4)

Hint: Majority of plants use biotic agents, such as bees, butterflies, flies, beetles, wasps, ants, moths, birds and bats for pollination.

Sol. In gymnosperms, seeds are not enclosed inside the fruit. In these plants, pollination occurs through air currents.

108. Answer (2)

Hint: The generative cell of pollen grain is small and floats in the cytoplasm of the vegetative cell.

Sol.: When the pollen grain of flowering plants is mature it contains two cells. Pollen grains are generally spherical measuring about 25-50 micrometers in diameter.

109. Answer (3)

Hint: The embryo may enter a state of inactivity called dormancy.

Sol.: The wall of the ovary develops into the wall of fruit called pericarp. This residual, persistent nucellus is the perisperm. The cylindrical portion below the level of cotyledons is hypocotyl that terminates at its lower end in the radicle or root tip.

110. Answer (2)

Hint: Radius is half of the diameter.

Sol.: Pollen grains are generally spherical measuring about 25-50 micrometers in diameter, *i.e.*, about 12-25 micrometers in radius.

111. Answer (1)

Hint: Sporopollenin is one of the most resistant organic materials known. No enzyme that degrades sporopollenin is so far known.

Sol.: Sporopollenin is synthesized by the innermost layer of anther wall, *i.e.*, tapetum.

112. Answer (4)

Hint: The mature seeds of groundnut are non-endospermic whereas the mature seeds of maize are endospermic.

Sol.: Endosperm of maize has reserve food and cotyledons of groundnut have reserve food for further development.

113. Answer (4)

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

Sol.: Only a small proportion of plants use abiotic agents. Pollen grains coming in contact with the stigma is a chance factor in both wind and water pollination. Among the animals, insects, particularly bees are the dominant biotic pollinating agents.

114. Answer (4)

Hint: The stigma serves as a landing platform for pollen grains.

Sol.: The gynoecium represents the female reproductive part of the flower. When the gynoecium consists of a single pistil it is called monocarpellary and when it has more than one pistil it is called multicarpellary.

115. Answer (4)

Hint: White kernel of coconut is cellular endosperm.

Sol.: In coconut, endosperm is not completely consumed by the developing embryo. The cells of endosperm are filled with reserve food materials and are used for the nutrition of the developing embryo.

116. Answer (3)

Hint: Maize is a monoecious plant, *i.e.*, this plant has both male and female flowers on the same plant.

Sol.: In plants such as maize, free nuclear division and asymmetric cell division occur during the formation of female and male gametophytes, respectively. In monoecious plants, both geitonogamy and xenogamy can occur. Usually one of the two synergids start to degenerate just with pollination.

117. Answer (2)

Hint: The process of formation of microspores from a pollen mother cell (PMC) is called microsporogenesis.

Sol.: The process of microsporogenesis in angiosperms does **not** involve mitosis. This occurs through meiosis in which a diploid microspore mother cell (pollen mother cell) forms four haploid microspores.

118. Answer (1)

Hint: Free nuclear division in angiosperms occurs during the development of gametophyte.

Sol.: In the most common type of endosperm development, the PEN undergoes successive nuclear divisions to give rise to free nuclei. This stage of endosperm development is called free-nuclear endosperm. Free-nuclear division also occur during the development of embryo sac.

119. Answer (4)

Hint: Cleistogamous flowers produce assured seed-set even in the absence of pollinators.

Sol.: Plants such as *Viola* (common pansy), *Oxalis*, and *Commelina* produce cleistogamous flowers which do not open at all.

120. Answer (3)

Hint: Cells of sporogenous tissue of an anther differentiate into microspore mother cell.

Sol.: Each cell of the sporogenous tissue of an anther is a potential microspore mother cell therefore, all the cells of the sporogenous tissue of an anther is capable of giving rise to a microspore tetrad.

121. Answer (1)

Hint: After fertilisation, development of endosperm and embryo occurs. Ovules mature into seeds and ovary into fruit.

Sol.: The cells of endosperm are filled with reserve food materials and are used for the nutrition of the developing embryo.

122. Answer (3)

Hint: Plants such as *Oxalis*, produce two types of flowers – chasmogamous flowers and cleistogamous flowers. Cross-pollen landing on the stigma can occur in chasmogamous flowers.

Sol.: In angiosperms, both male and female gametes are non-motile. Pollination in seed producing plants needs external agents but union of male and female gametes does not.

123. Answer (2)

Hint: *Vallisneria* is an aquatic plant. Hygroscopic nature of anther wall for pollen dispersal is required in terrestrial plants.

Sol.: C is sporogenous tissue. Its cells are diploid. F are pollen grains and they are haploid. E is cell of tapetum. In most of the flowering plants, cells of tapetum are polyploid.

124. Answer (2)

Hint: Suspensor cells in angiosperms are formed by mitotic division in zygote. Therefore, these cells are diploid.

Sol.: Primary endosperm cell and cells of aleurone layer are triploid. Cells of tapetum are generally polyploid.

125. Answer (4)

Hint: A typical angiosperm embryo sac, at maturity, is 7-celled structure.

Sol.: There are three sequential mitotic nuclear divisions in the megaspore resulting in the formation of the 8-nucleate stages of the embryo sac. Among them, the two polar nuclei are situated below the egg apparatus in the large central cell. Thus, a typical angiosperm embryo sac, at maturity, though 8-nucleate is 7-celled.

126. Answer (3)

Hint: A typical angiosperm anther is bilobed with each lobe having two theca, *i.e.*, they are dithecous.

Sol.: The three-celled structure of the embryo sac at the micropylar end is egg apparatus. Apomictic seed are formed without the process of fertilization.

127. Answer (2)

Hint: Double fertilisation involves two types of fusions, *i.e.*, fusion of one male gamete with egg cell and fusion of polar nuclei with other male gamete.

Sol.: Disintegration of various haploid cells such as vegetative cells is not the phenomenon related to double fertilization.

128. Answer (2)

Hint: Synergids have special cellular thickenings at the micropylar tip called filiform apparatus.

Sol.: Filiform apparatus plays an important role in guiding the pollen tubes into the synergid.

129. Answer (3)

Hint: Occurrence of more than one embryo in a seed is referred to as polyembryony.

Sol.: The embryos in the seeds showing polyembryony can be developed from the cells of integument, cells of nucellus, diploid egg cell or zygote. Pericarp refers to fruit wall.

130. Answer (2)

Hint: If the female parent bears bisexual flowers, removal of anthers from the flower bud before the anther dehisces using a pair of forceps is necessary. This step is referred to as emasculation.

Sol.: For artificial hybridization, emasculated flowers are covered with a bag made up of butter paper, to prevent contamination of its stigma with unwanted pollen. This process is called bagging.

131. Answer (2)

Hint: Egg apparatus is a component of embryo sac.

Sol.: Egg apparatus in the embryo sac is made up of three haploid cells – two synergids and an egg cell.

132. Answer (1)

Hint: A floral primordium has meristematic cells which develops into a flower.

Sol.: Much before the actual flower is seen on a plant, several hormonal and structural changes are initiated which lead to the differentiation and further development of the floral primordium.

133. Answer (4)

Hint: For artificial hybridization, it is important to make sure that only the desired pollen grains are used for pollination and the stigma is protected from contamination (from unwanted pollen).

Sol.: Outbreeding devices prevent autogamy in flowering plants and thus are helpful in artificial hybridization.

134. Answer (4)

Hint: The nucleus of the functional megaspore in the ovule divides mitotically to form two nuclei which move to the opposite poles, forming the 2-nucleate embryo sac.

Sol.: Of the eight nuclei, six are surrounded by cell walls and organised into cells. The remaining two nuclei, called polar nuclei, are also surrounded by a common cell wall and form the large central cell.

135. Answer (2)

Hint: Gametes are the two most important units of sexual reproduction in flowering plants.

Sol.: In flowering plants, male gametes are formed by anther and female gametes are formed in gynoecium. These structures are situated on the swollen part of the pedicel called thalamus.

[ZOOLOGY]

136. Answer (3)

Hint: Rapid division

Sol.: The blastomeres in the blastocyst are arranged into an outer layer called the trophoblast and an inner group of cells called the inner cell mass. The trophoblast layer gets attached to the endometrium. After attachment, the uterine cells divide rapidly and cover the blastocyst. As a result, the blastocyst becomes embedded in the endometrium of the uterus. This is called implantation and it leads to pregnancy.

The mammary glands of the female undergo differentiation during pregnancy and starts producing milk towards the end of pregnancy by the process called lactation.

137. Answer (2)

Hint: 'Mono' originates from the Greek word *'monos*', meaning 'one'.

Sol.: Monozygotic (identical) twins are formed from a single fertilized egg (zygote) that splits into two, sharing the same genome and sex. They result from one sperm fertilizing one egg. They are not always connected by two placentas; they often share the same one.

138. Answer (1)

Hint: Steroid hormone.

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

Estrogen is mainly responsible for the formation of mammary ducts in females.

FSH acts on Sertoli cells.

Progesterone is majorly responsible for the formation of mammary alveoli in females.

139. Answer (2)

Hint: Gametogenesis is controlled by hormones.

Sol.: The ovaries are located one on each side of the lower abdomen.

The human male ejaculates about 200 to 300 million sperms during a coitus of which, for normal fertility, at least 60 per cent sperms must have normal shape and size and at least 40 per cent of them must show vigorous motility.

At puberty, only 60,000-80,000 primary follicles are left in each ovary.

140. Answer (2)

Hint: Chestnut shaped gland.

Sol.: The male accessory glands include paired seminal vesicles, a prostate and paired bulbourethral glands (Cowper's glands). Secretions of these glands constitute the seminal plasma which is rich in fructose, calcium and certain enzymes. The secretions of bulbourethral glands help in the lubrication of the penis.

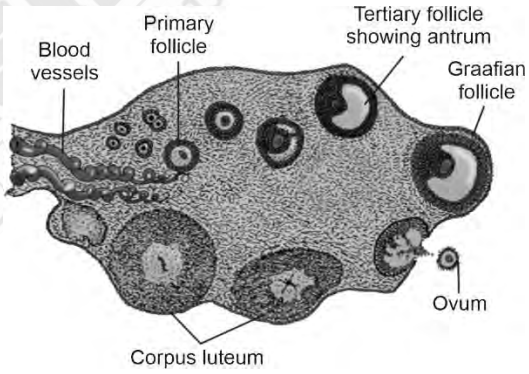
Seminal vesicle is situated behind the bladder.

Bulbourethral gland lies adjacent to the urethra at the base of penis.

141. Answer (3)

Hint: Theca layer gets differentiated.

Sol.:



142. Answer (3)

Hint: : Exclude the biochemical components.

Sol.: Seminal plasma refers only to the glandular secretions from seminal vesicles, prostate, and bulbourethral glands. It contains fructose, enzymes, calcium, mucus, salts, *etc*. Sperms are suspended in this fluid but are not a part of the plasma itself.

143. Answer (2)

Hint: One of them is 4-5 cm in length.

Sol.: In adults, each testis is oval in shape, with a length of about 4 to 5 cm and a width of about 2 to 3 cm. Whereas, each ovary is about 2 to 4 cm in length, and 1.5 – 3 cm in width.

144. Answer (3)

Hint: Multiple of 4.

Sol.: Ovulation occurs 14 days before the next menstruation (fixed luteal phase). If ovulation is on day 24, total cycle length = 24 + 14 = 38 days.

Thus, menstrual + proliferative phases (follicular part) = 24 days.

145. Answer (3)

Hint: Also known as the birth cord.

Sol.: The umbilical cord is the vital connection between the foetus and the placenta. The development of umbilical cord begins in the embryology period around 3rd week, with the formation of the connecting stalk.

The umbilical vessels carry the foetal blood back and forth to the placenta, with the umbilical vein carrying oxygenated blood with nutrients from the placenta to the foetus and the umbilical arteries transporting deoxygenated blood with waste products from the foetus to the placenta. Waste removal happens *via* placental exchange, the cord only transports foetal blood to and from the placenta.

146. Answer (4)

Hint: Structure that has arrested cell division gives rise to zona pellucida.

Sol.: Zona pellucida is a thick, non-cellular transparent layer composed of glycoproteins that surround the plasma membrane of the oocyte.

Upon fertilization, the fusion of sperm with the oocyte triggers the cortical reaction. This reaction induces biochemical changes that modify the zona pellucida, making it impermeable to additional sperm and thus prevent the polyspermy.

The embryo must hatch from the zona pellucida, only after reaching the uterus to begin proper implantation.

Zona pellucida is formed by the secondary oocyte.

147. Answer (3)

Hint: Releases progesterone

Sol.: The corpus luteum forms only after ovulation from the ruptured Graafian follicle and persists throughout the luteal phase.

It regress before the next cycle, if fertilisation does not occur.

- **Primary follicle :**

→ Present from the beginning of the cycle and even in ovaries before puberty.

→ Seen mainly during the follicular phase, not luteal.

- **Graafian follicle :**

→ Fully mature follicle is seen just before ovulation (late follicular phase).

→ It ruptures at ovulation and thus, it is absent in the luteal phase.

- **Secondary oocyte :**

→ Formed just before ovulation and released during ovulation

→ If not fertilized, it degenerates. Thus, it is not present throughout the luteal phase.

148. Answer (2)

Hint: Similar structure is also present in the human lungs.

Sol.: Alveolar epithelial cells synthesise milk. Milk is stored temporarily in the lumen of the alveoli.

Myoepithelial cells of the alveoli contract under the influence of oxytocin to push milk into the ducts.

Milk is synthesized in the alveolar cells of the mammary gland and it reaches to the exterior *via* the given pathway:

Alveoli → Mammary tubule → Mammary duct → Mammary ampulla → Lactiferous duct

149. Answer (4)

Hint: Progesterone sustains the pregnancy.

Sol.: Parturition is a neuro-endocrine mechanism.

The following are observed during the onset of parturition:

(a) Foetal cortisol increases:
- The foetal adrenal cortex becomes highly active.
- Cortisol acts on the placenta to enhance estrogen synthesis.

(b) Estrogen level rises:
- Estrogen increases the number of oxytocin receptors in the uterine muscle (myometrium).

(c) Oxytocin level rises (from the posterior pituitary of the mother)

- Initiates stronger uterine contractions.
- These contractions stretch the cervix further, triggering more oxytocin release.

(d) Progesterone's functional effect declines during this period.

150. Answer (3)

Hint: By the end of the second trimester, major-organ systems are developed.

Sol.: By 24 weeks of pregnancy (the end of second trimester):

→ Limbs with digits are already formed (By 2nd month)

→ External genitalia is well-developed (By 12 weeks)

→ Foetal movements is seen and hair on head appear by the 5th month

→ Fine hair (also called lanugo) covers the body and eyelids also get separated at the end of third trimester.

151. Answer (4)

Hint: Apart from the steroidal hormones, other hormones also affect the menstrual cycle.

Sol.: High level of prolactin would lead to amenorrhea [Absence of menstruation].

Hypothyroidism as well as hyperthyroidism affect the menstrual cycle.

Melatonin influences the menstrual cycle by affecting the release of LH and FSH.

152. Answer (3)

Hint: Contains stem cells

Sol.: Inner cell mass is the part of the blastocyst that gives rise to the embryo, including all the three germ layers (ectoderm, mesoderm, and endoderm) that form tissues like muscle, heart and eyes.

Trophoblast gives rise to the placenta and other extra-embryonic membranes.

Zona pellucida disappears before implantation.

Blastocoel is the fluid-filled cavity within the blastocyst.

153. Answer (3)

Hint: Oogenesis is initiated during the embryonic development stage.

Sol.: Primary oocytes are formed during the foetal life of a woman, and then they enter meiosis-I and get arrested in prophase-I (diplotene stage) until puberty.

Therefore, in a 37-years old woman, the primary oocyte is actually older than the woman herself, by the duration of her foetal life.

154. Answer (1)

Hint: The structure is a part of the extra-testicular genital duct system.

Sol.: Secretions of epididymis, vas deferens, seminal vesicle and prostate are essential for maturation and motility of sperms.

The vas deferens is lined by pseudostratified columnar epithelium.

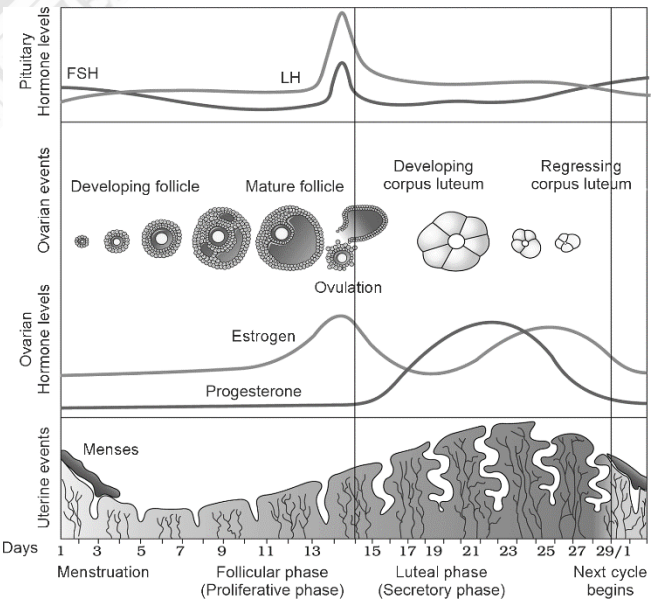
Several tubes called vasa efferentia arise from rete testis.

Tubuli recti is a part of the intra – testicular genital duct system.

155. Answer (4)

Hint: Identify the function of pregnancy hormone.

Sol.:



The endometrium is most thickened and richly supplied by arteries during the secretory phase, when level of progesterone is high.

156. Answer (3)

Hint: Relate with the site of formation of different stages.

Sol.: A morula is an early stage embryo, typically appearing as a solid ball of 8 to 16 blastomeres.

By 3 – 4 days post-fertilisation, morula is formed in the fallopian tube.

Blastocyst is a hollow ball of cells. It contains 64 cells. Morula divides to form the blastocyst.

The amount of DNA content in the blastocyst will be higher as compared to the early stage of morula.

157. Answer (4)

Hint: Follicles release estrogen

Sol.: In the early follicular phase, estrogen mainly provides negative feedback to the hypothalamus.

Blocking this feedback increases the GnRH secretion, which ultimately increases the secretion of FSH and LH.

The rise in FSH will rescue follicles that would normally undergo atresia, leading to the recruitment and development of a large cohort of follicles.

158. Answer (3)

Hint: Scrotum helps in maintaining the required temperature.

Sol.: The testes are situated outside the abdominal cavity within a pouch called scrotum. The scrotum helps in maintaining the low temperature of the testes (2 – 2.5°C lower than the normal internal body temperature) necessary for spermatogenesis.

159. Answer (4)

Hint: Follicles are found in the ovarian cortex

Sol.: As the follicle matures into a Graafian follicle, it enlarges and migrates towards the ovarian surface. Just before ovulation, it forms a protrusion on the ovarian surface. This superficial positioning allows the secondary oocyte to be captured by the fimbriae of the oviduct.

160. Answer (3)

Hint: Infundibulum is closer to the ovary.

Sol.: Oviduct is a part of the female accessory ducts. Each fallopian tube is about 10 – 12 cm long and extends from the periphery of each ovary to the uterus. Fallopian tube is lined by columnar epithelial cells which possess oval and basal nucleus. Infundibulum opens directly into the abdominal cavity.

161. Answer (1)

Hint: True for 'nurse cells'.

Sol.: Sertoli or sustentacular or nurse cells provide nourishment to the developing spermatozoa.

Interstitial spaces of testes contain interstitial cells or Leydig cells, immunologically competent cells, blood vessels, *etc*.

The enlarged end of penis, called the glans penis, is covered by a loose fold of skin called foreskin.

Rete testis forms the intra-testicular genital duct system.

162. Answer (3)

Hint: Each testis has compartments.

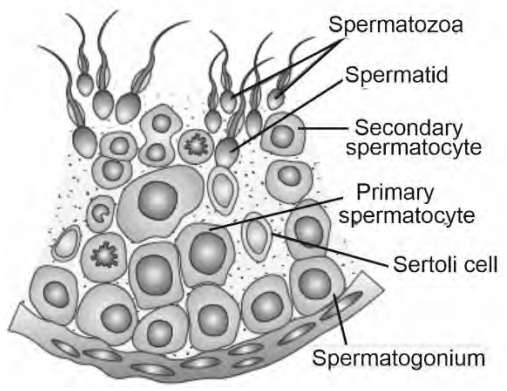
Sol.: The testes are paired oval structures in the scrotum. The testis is covered by a dense fibrous connective tissue layer. Each testis has about 250 compartments called testicular lobules. These compartments contain highly coiled seminiferous tubules.

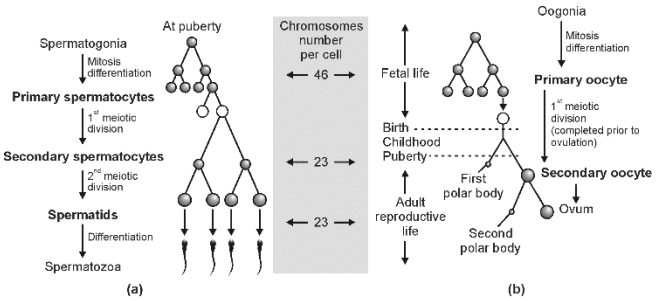
Testes are the primary sex organs in males as they are directly involved in sperm production.

163. Answer (2)

Hint: Spermiogenesis and spermination are different terminologies.

Sol.:





Transformation of spermatids into sperms is termed as spermiogenesis.

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

164. Answer (1)

Hint: Cessation of menstrual cycle is called menopause.

Sol.: Menopause is a senile change which occurs in the ovaries around the age of 50 years.

During this period, the ovarian follicles degenerate and there is deficiency of estrogen and progesterone.

FSH and LH are produced after menopause in large and continuous quantities, but as the remaining primordial follicles become atretic, the production of estrogen by the ovaries falls virtually to zero.

The loss of estrogen often causes marked physiological changes in the function of the body including decreased strength and calcification of bones.

165. Answer (3)

Hint: Equal to the number of eyes you have

Sol.: The pre-ovulatory phase of the cycle is more variable in length than the other phases and accounts for most of the differences in the length of the cycle. It lasts from day 6 to 13 in a 28- days cycle.

The high levels of estrogen during the pre-ovulatory phase exerts a positive feedback effect on the cells that secrete LH and GnRH.

The follicular phase (in the ovary) and the proliferative phase (in the uterus) occur simultaneously, not sequentially.

166. Answer (4)

Hint: Equal to the number of fingers in your left hand.

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 the pelvic region.

These parts of the reproductive system along with a pair of the mammary glands are integrated structurally and functionally to support ovulation, fertilisation, pregnancy, birth and child care.

167. Answer (4)

Hint: We have 22 pairs of autosomes.

Sol.: Humans have 46 chromosomes in total in which 22 pairs are autosomes and 1 pair consists of sex chromosomes.

168. Answer (2)

Hint: Female primates undergo menstruation.

Sol.: Both first and second polar bodies are haploid in nature.

The reproductive cycle in the female primates (monkey, apes and human beings) is called the menstrual cycle.

In humans, each breast typically contains 15-20 lobes, but each of these lobes contains numerous alveoli that connect to mammary tubules, which then merge into larger mammary ducts.

Infundibulum leads to a wider part of the oviduct, called ampulla.

169. Answer (2)

Hint: Nebenkern is a part of the human sperm.

Sol.:

- Acrosome – It is a lysosome like vesicle overlying the sperm nucleus and it is derived from the Golgi during spermatogenesis.
- Perimetrium – Outer serosal coat of the uterus
- Trophoectoderm – Embryo formation
- Nebenkern – It is the mitochondrial arrangement in the sperm.

170. Answer (3)

Hint: Urethra is a part of the urinary system in females.

Sol.: The urethra acts as a common passage for both the urinary and reproductive systems in males.

The urethral meatus at the tip of the penis allows for the excretion of urine and the expulsion of semen during ejaculation.

In females, urethra functions exclusively to transport urine from the bladder to the external urethral orifice.

The cavity of the cervix is called the cervical canal.

The perivitelline space is the space between the zona pellucida and the cell membrane of an oocyte.

Amnion is an extra-embryonic membrane. It is composed of an inner layer of ectoderm and an outer layer of mesoderm.

171. Answer (3)

Hint: Function of placental hormone.

Sol.: hCG plays a crucial role in maintaining early pregnancy by supporting the corpus luteum, which in turn sustains the progesterone production essential for maintaining the endometrium.

Low FSH and LH are seen during pregnancy because of the negative feedback effect produced by the surging levels of progesterone and estrogen.

GnRH is secreted by the hypothalamus.

Decreased FSH level prevents follicular recruitment and maturation.

172. Answer (4)

Hint: Corpus luteum secretes various hormones.

Sol.: When a female child is born, each primary oocyte is surrounded by a single layer of granulosa cells and is called the primary follicle.

If the ovum is not fertilized, the corpus luteum in the ovary degenerates (involutes) about 2 days before the end of the menstrual cycle, transforming into the corpus albicans. This degeneration causes a rapid, sharp decline in estrogen and progesterone levels, which removes hormonal support for the endometrium that triggers menstruation.

173. Answer (4)

Hint: Spermatogenesis and oogenesis are natural biological processes.

Sol.: In humans, the reproductive events include formation of gametes (gametogenesis), which occurs in both males (spermatogenesis) and females (oogenesis).

Transfer of sperms into the female genital tract is called insemination.

Capacitation is defined as a complex process occurring in sperm after their release in the female genital tract, which prepares them to reach the oocyte and become responsive to stimuli that induce acrosomal reaction.

174. Answer (4)

Hint: Ploidy of zygote is similar to that of the oogonium.

Sol.: Extrusion of the second polar body from egg nucleus occurs after the entry of sperm, but before fertilization.

Fertilization leads to the formation of a single-celled diploid zygote.

The secondary oocyte does not undergo reductional division; it rather undergoes equational division (meiosis - II) to form a mature ovum and a second polar body.

The primary oocyte undergoes reductional division (meiosis-I).

At the time of ovulation, the secondary oocyte remains arrested in metaphase-II of the second meiotic division.

175. Answer (3)

Hint: Antibodies are proteinaceous in nature.

Sol.: Human milk consists of water, organic and inorganic substances. Its main constituents are fat (fat droplets), casein (milk protein), lactose (milk sugar), mineral salts (sodium, calcium, potassium, *etc.*) and vitamins.

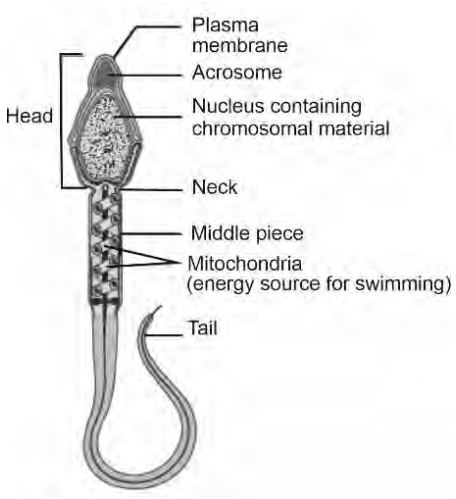
The human milk contains IgA.

Antibodies are glycoproteins. Proteins are always heteropolymers.

176. Answer (4)

Hint: Used for motility

Sol.:



Ovum contains mitochondria.

Spermatozoa contains very little cytoplasm as compared to the ovum.

The plasma membrane of the ovum is called oolemma.

Ova are non-motile whereas, sperms are motile and possess a long flagellum or tail for motility.

177. Answer (4)

Hint: Remember the tissue that connects bone to bone

Sol.: Uterus is also called womb. It is supported by ligaments attached to the pelvic wall. The placenta is formed by foetal as well as maternal tissues.

During labour, uterine smooth muscle contractions increase in strength and frequency until the foetus is expelled out.

178. Answer (1)

Hint: Lies above the urethral opening

Sol.: The female external genitalia includes mons pubis, labia minora, labia majora, hymen and clitoris. Clitoris is a tiny finger-like structure which lies at the upper junction of the two labia minora above the urethral opening.

Mons pubis is a cushion of fatty tissue covered by skin and pubic hair. The labia majora are fleshy folds of skin, which extend down from mons pubis and surrounds the vaginal opening.

The labia minora are paired folds of tissue in the form of lips under the labia majora.

The opening of vagina is often covered partially by a membrane called hymen.

179. Answer (4)

Hint: Focus on the nature of the hormones

Sol.: Inhibin, estrogen, progesterone and relaxin are released by ovaries.

Inhibin : Produced by the granulosa cells in the ovary; it exerts a negative feedback on FSH secretion from the pituitary and this prevents many follicles from maturing at once.

Estrogen: Responsible for the development of the female secondary sexual characteristics

Progesterone: Known as the 'pregnancy hormone'.

Relaxin: Secreted by the corpus luteum in the later part of the pregnancy; it is a protein hormone.

Relaxin relaxes the pelvic joint and causes the cervix to soften and widen for delivery of the baby.

180. Answer (4)

Hint: Includes the part that form the extra-testicular duct system

Sol.: In human males, from cauda epididymis, a partially coiled tube called vas deferens ascends into the abdomen through the inguinal canal and passes over the urinary bladder. The ductus deferens/vas deferens dilates to form ampulla, which receives the duct from the seminal vesicle behind the urinary bladder and forms an ejaculatory duct.

Rete testis is a part of the intra-testicular genital duct system.

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