All India Aakash Test Series for NEET-2023

TEST - 5 (Code-E)

Test Date : 05/03/2023

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION-A

1. Answer (2)

Hint and Sol: Since the electric field inside the conductor is zero hence the dielectric constant for conductor is ∞. For vacuum dielectric constant is 1.

2. Answer (4)

Hint and Sol: Field lines are perpendicular to a conductor. If the charge is placed inside a cavity in a conductor then induced charge appears on cavity wall while if a charge is outside a cavity then no charge will appear on cavity wall.

3. Answer (2)

Hint: When dielectric is removed then overall capacitance of the system decreases.

Sol.: When dielectric is removed then capacitance of the system decreases. Hence for same potential difference the charge on both capacitor decreases. As a result the electron flows from –ve to +ve terminal of battery hence work done by battery will be negative.

4. Answer (3)

Hint: Use conservation of energy

Sol.: When capacitor is fully charged then, $Q = 4 \times 10^{-6} \times 20 = 80\ \mu C$. Energy stored in capacitor = $\frac{Q^2}{2C} = \frac{80 \times 80}{2 \times 4} = \frac{6400}{8} = 800\ \mu J$

Work done by battery = $Q.V = 80 \times 20 = 1600\ \mu J$

Energy lost as heat = $1600\ \mu J - 800\ \mu J = 800\ \mu J$

5. Answer (4)

Hint and Sol: For an isolated parallel plate capacitor the capacitance of the capacitor increases K times. Electric field as well as force between the plates decreases by K times.

$\vec{E} = \frac{\vec{E}_0}{K}$ and $\vec{F} = q\vec{E}$, for an isolated capacitor charge is going to remain same.

6. Answer (3)

Hint and Sol: Electric field strength at surface due to uniformly charged sphere = $\frac{kq}{R^2}$

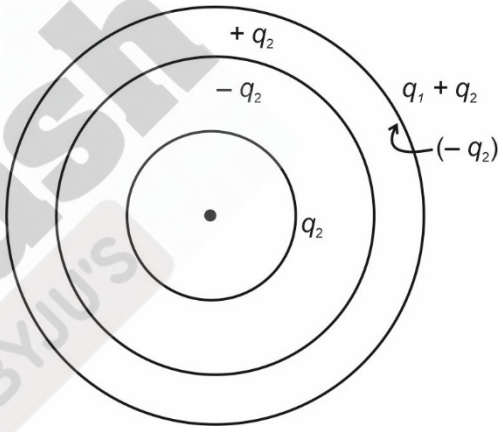
Electric potential at surface due to uniformly charged sphere = $\frac{kq}{R}$

Ratio = $\frac{kq \times R}{R^2 \times kq} = \frac{1}{R}$

7. Answer (3)

Hint: The electric field inside the conductor material is zero

Sol.:



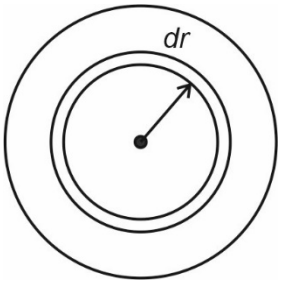
$\Rightarrow$ Above is the charge distribution due to given charge arrangement. Hence charge on outer surface of middle shell is q_2.

8. Answer (3)

Hint: Use Gauss Law

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

Now $\Rightarrow q_{enc} = \int \rho \cdot 4\pi r^2 \cdot dr$



$$q_{enc} = \int_0^{R/3} \rho \cdot 4\pi r^2 \cdot dr$$

$$\Rightarrow \int_0^{R/3} 4\pi K r^4 dr = 4\pi K \cdot \left[\frac{r^5}{5}\right]^{R/3}$$

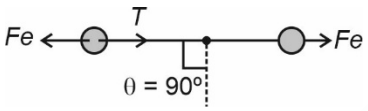
$$q_{enc} = \frac{4\pi K}{5} \cdot \frac{R^5}{243} \Rightarrow q_{enc} = \frac{4\pi K R^5}{1215}$$

Now, $E \times 4\pi \frac{R^2}{9} = \frac{4\pi K R^5}{1215\varepsilon_0} \Rightarrow E = \frac{KR^3}{135\varepsilon_0}$

9. Answer (3)

Hint: There will be weightlessness condition in satellite.

Sol.: Metal bobs will become weightless in satellite so only coulomb force will be there. The tension would be created only due to coulomb force.



10. Answer (1)

Hint: $\rho = \frac{m}{ne^2\tau}$

Sol.: For insulators and semiconductors number density increases with the increase in the temperature which compensates for any decrease in average relaxation time. Hence with increase in temperature resistivity decreases.

11. Answer (3)

Hint and Sol: Conductivity and resistivity are the properties of material so they are not going to change. However current remains same but current density decreases from point *A* to point *B*

$\vec{J} = \sigma\vec{E}$; Since $J_A > J_B \Rightarrow E_A > E_B$

12. Answer (3)

Hint: $V = E - ir$

Sol.: $0.4 \times 10 = 4.2 - 0.4\ r \Rightarrow 4 = 4.2 - 0.4r$

$\Rightarrow 0.4r = 0.2$

$\Rightarrow r = \frac{0.2}{0.4} = 0.5\ \Omega$

13. Answer (4)

Hint and Sol: It is a case of balanced Wheatstone bridge hence current through 20 Ω resistor will be zero.

14. Answer (1)

Hint: $P = \frac{V^2}{R}$

Sol.: $R = \frac{(220)^2}{60}$; $R_{eq} = \frac{R}{10} = \frac{(220)^2}{600}$

$\Rightarrow I = \frac{220 \times 600}{(220)^2}$

$\Rightarrow I = \frac{600}{220} = \frac{60}{22}$ A,

$P_{consumed} = \frac{60}{22} \times 220 = 600$ W

15. Answer (2)

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

Sol.: $R = R_0(1 + \alpha\ \Delta T) \Rightarrow 5.23 = 5(1 + \alpha \times 100)$

$\frac{5.23}{5} = 1 + \alpha \times 100$

$\Rightarrow 100\alpha = \frac{5.23 - 5}{5} \Rightarrow 100\alpha = \frac{0.23}{5}$

$\Rightarrow \alpha = \frac{0.046}{100} = 4.6 \times 10^{-4}\ ^\circ C^{-1}$

16. Answer (4)

Hint and Sol: Drift velocity,

$v_d = \frac{eE\tau}{m}$, $J = \sigma E$ and $\sigma = \frac{ne^2\tau}{m}$

17. Answer (1)

Hint: Potential = work/charge

Sol.: $[V] = \frac{[ML^2T^{-2}]}{[AT]} = [ML^2T^{-3}A^{-1}]$

18. Answer (1)

Hint: $\mu = \frac{v_d}{E}$

Sol.: $\mu = \frac{v_d}{E}$

$= \frac{2.5 \times 10^{-4}}{\frac{10}{20 \times 10^{-2}}} = \frac{2.5 \times 10^{-4} \times 20 \times 10^{-2}}{10}$

$= 5 \times 10^{-6}\ m^2\ V^{-1}\ s^{-1}$

19. Answer (1)

Hint: $V = IR$

Sol.: $R_{eq} = 6\Omega$, $I = \frac{12}{6} = 2$ A; $V_{2\Omega} = 2 \times 2 = 4$ V

and $V_{3\Omega} = 2 \times 3 = 6$ V

ratio = $\frac{4}{6} = \frac{2}{3}$

20. Answer (3)

Hint and Sol: Four cells with same polarity,

$E_{eq} = 4E - E = 3E$

21. Answer (1)

Hint and Sol: The electric field due to plane sheet of charge is $\frac{\sigma}{2\varepsilon_0}$.

22. Answer (1)

Hint and Sol: Since for same area of cross-sections, density of field lines is greater for area A hence $E_A > E_B$

23. Answer (4)

Hint: Potential depends on position on axis

Sol.: $V = \frac{kp\cos\theta}{r^2}$ for $\theta > 90°, V$ is negative

$W = QV$

$\therefore$ W may be positive or negative.

24. Answer (3)

Hint and Sol: The potential at centre of dipole is zero due to the dipole while due to point charge it would be $\frac{q}{4\pi\varepsilon_0 r}$.

25. Answer (3)

Hint: $\varepsilon = \frac{V_0}{\lambda}.\ell_1$

Sol.: $3 = \frac{V_0}{\lambda} \times 72$ and $2 = \frac{V_0}{\lambda} \times \ell_0$,

Now $\frac{V_0}{\lambda} = \frac{3}{72}$

$\Rightarrow \quad 2 = \frac{3}{72} \times \ell_0 \Rightarrow \ell_0 = \frac{2 \times 72}{3} \Rightarrow \ell_0 = 48$ cm

26. Answer (4)

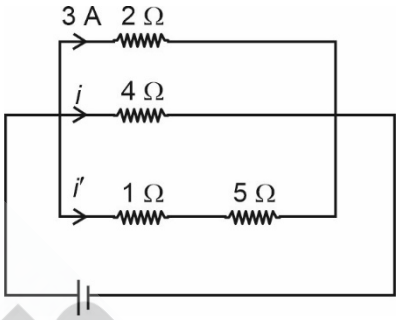
Hint and Sol: Potential drop on potentiometer wire should be more than e.m.f. to balance

$V = \frac{10 \times 10}{(10 + 20)} = \frac{10}{3}$ V < 4 V

27. Answer (1)

Hint: The current in parallel connection are divided in inverse ratio of their resistances

Sol.:



$2 \times 3 = i'(5 + 1)$

$i' = 1$ A

$P = VI \Rightarrow P = I^2R$

$P = (1)^2 \times 1 = 1$ W

28. Answer (1)

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

Sol.: $R = \frac{\rho\ell}{A} \Rightarrow R = \frac{\rho \times \ell^2}{(A \times \ell)}$

Volume will remain constant hence,

$R \propto \ell^2 \Rightarrow \frac{4}{R'} = \frac{\ell^2}{(\ell/2)^2} \Rightarrow \frac{4}{R'} = \frac{\ell^2 4}{\ell^2} \Rightarrow R' = 1\ \Omega$

29. Answer (3)

Hint and Sol: $V_A - V_B = 4 \times 4 + 6 + 4 \times 2$

$V_A - V_B = 4 \times 4 + 6 + 8$

$= 16 + 6 + 8$

$= 22 + 8 = 30$ V

30. Answer (2)

Hint: $R = \frac{\rho\ell}{A}$ and $\sigma = \frac{1}{\rho} \Rightarrow R = \frac{\ell}{A\sigma}$

Sol.: $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} \Rightarrow \frac{1}{\frac{\ell}{2A \cdot \sigma_{eq}}} = \frac{1}{\frac{\ell}{A \cdot \sigma_1}} + \frac{1}{\frac{\ell}{A \cdot \sigma_2}}$

$\Rightarrow \quad 2A \times \sigma_{eq} = A\sigma_1 + A\sigma_2$

$$\sigma_{eq} = \frac{\sigma_1 + \sigma_2}{2}$$

31. Answer (1)

Hint and Sol: During the charging of the battery the terminal potential difference is more than the emf of battery.

32. Answer (2)

Hint: Use Gauss law of electrostatics

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

$$E \times 4\pi b^2 = \frac{12Q}{\varepsilon_0} \Rightarrow E = \frac{3Q}{\pi b^2 \varepsilon_0}$$

33. Answer (4)

Hint and Sol:

- The electric field on Gaussian surface is due to all charges present both inside and outside the surface.
- The Gaussian surface should be selected in such a way that it does not pass through discrete charge however it can pass through continuous charge distribution.
- Gauss' law is much more useful where the system is having some symmetry of charge distribution.

34. Answer (3)

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

Sol.: Flux through circular base is

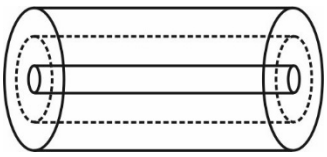
$\phi = E \cdot \pi R^2 \cdot \cos(\pi) = -\pi R^2 E$

$|\phi| = \pi R^2 E$

35. Answer (1)

Hint: Use Gauss' Law of electrostatic

Sol.:



Consider given cylindrical gaussian surface at a distance *r*. The length of cylinder is *l* taken.

$$E \times 2\pi r l = \frac{\lambda . \ell}{\varepsilon_0} \Rightarrow E = \frac{\lambda}{2\pi r \varepsilon_0}$$

SECTION-B

36. Answer (3)

Hint and Sol:

$$\Rightarrow \quad E_0 d = -[V_2 - V_1] \Rightarrow d = \frac{(V_1 - V_2)}{E_0}$$

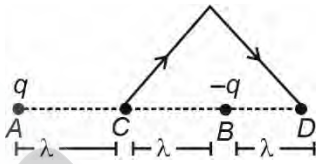
37. Answer (2)

Hint and Sol.: Potential due to induced charge at the centre of the shell is zero.

38. Answer (3)

Hint: Work done = change in potential energy

Sol.: $V_c = 0$



$V_D = V_{+q} + V_{-q}$,

Now, $V_q = \frac{k.q}{3\lambda}$ and $V_{-q} = -\frac{k.q}{\lambda}$

$$V_D = \frac{kq}{3\lambda} - \frac{kq}{\lambda}$$

$$V_D = \frac{-2kq}{3\lambda}$$

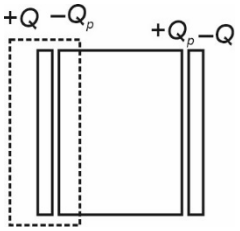
Work done in moving +Q charge

$$= Q[V_D - V_c] = +Q\left(-\frac{2kq}{3\lambda}\right)$$

$$= -\frac{2}{3}\frac{Qq}{\lambda} \times \frac{1}{4\pi\varepsilon_0} = \frac{-qQ}{6\pi\varepsilon_0\lambda}$$

39. Answer (3)

Hint and Sol:



$$\oint \vec{E} \cdot d\vec{s} = \frac{Q + Q_p}{\varepsilon_0}$$

Also, $Q_p = -Q\left[1 - \frac{1}{K}\right]$

$$\Rightarrow \oint \vec{E}\cdot d\vec{s} = \frac{Q}{\varepsilon_0} - \frac{1}{\varepsilon_0}\left[Q - \frac{Q}{K}\right] = \frac{Q}{\varepsilon_0} - \frac{Q}{\varepsilon_0} + \frac{Q}{K\varepsilon_0}$$

$$\Rightarrow \oint \vec{E}\cdot d\vec{s} = \frac{Q}{K\varepsilon_0}$$

40. Answer (1)

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

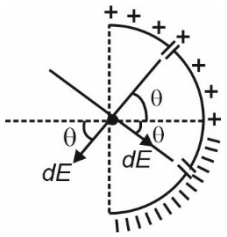
Sol.: $\tau = (q\times r)\times\frac{\sigma}{2\varepsilon_0}\times\sin\theta = \frac{\sigma qr}{2\varepsilon_0}\sin\theta$

41. Answer (2)

Hint: Use superposition principle

$$dE = \frac{k.dq}{r^2}$$

Sol.:



The horizontal component of electric field intensity due to two elements on ring will cancel each other and we will be left with only vertical component

$dE_{net} = 2dE\sin\theta$

$$\Rightarrow dE = \frac{2\times k\times\lambda d\theta\cdot r\sin\theta}{r^2}$$

$$\Rightarrow dE = \frac{2k\lambda}{r}\sin\theta d\theta$$

$$\Rightarrow E = \int_0^{\pi/2} dE = \frac{2k\lambda}{r}\int_0^{\pi/2}\sin\theta d\theta$$

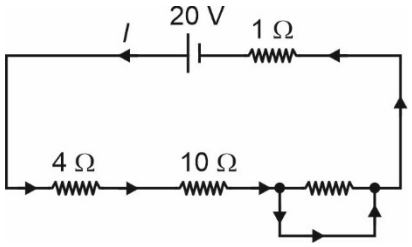
$$\Rightarrow \frac{2k\lambda}{r}\left[-\cos\theta\right]_0^{\pi/2}$$

$$\Rightarrow \frac{2k\lambda}{r}\left[-\cos(\pi/2)+\cos 0^\circ\right] \Rightarrow \frac{2\times\lambda}{4\pi\varepsilon_0 r} = \frac{\lambda}{2\pi\varepsilon_0 r}$$

42. Answer (3)

Hint: The potential at point *A* and *B* is same

Sol.: Since $V_A = V_B = 0 \Rightarrow$ The 5 Ω resistance is short circuited



$$\Rightarrow R_{eq} = 15\Omega$$

$$\Rightarrow i = \frac{V}{R} = \frac{20}{15} = \frac{4}{3}\text{A}$$

43. Answer (3)

Hint and Sol: For loop *ABCDEFA*

$i_1R + (i_1 - i_3)R + (i_1 - i_3)R - (i_2 + i_3)R - i_2R - i_2R = 0$

$$\underline{i_1\,R} + \underline{i_1\,R} - \overline{i_3\,R} + \underline{i_1\,R} - \overline{i_3\,R} - \underline{i_2\,R} - \overline{i_3\,R}$$

$$- \underline{2i_2\,R} = 0$$

$3i_1 - 3i_3 - 3i_2 = 0 \Rightarrow i_1 = i_3 + i_2 \Rightarrow i_3 = i_1 - i_2$

44. Answer (3)

Hint: $I_{avg} = \frac{\text{Total charge flown}}{\text{Total time taken}}$ and $I_{inst} = \frac{dq}{dt}$

Sol.:

$$I_{inst} = \frac{dq}{dt} = 3 + 10t \Rightarrow I_{2s} = 3 + 10\times 2 = 23\text{ A}$$

$$I_{avg} = \frac{\int_0^2 (3+10t)dt}{\int_0^2 dt}$$

$$= \frac{[3t]_0^2 + \left[\frac{10t^2}{2}\right]_0^2}{2} = \frac{3\times 2 + 5\times 4}{2} = \frac{6+20}{2} = 13\text{ A}$$

Required ratio = 13/23

45. Answer (4)

Hint and Sol: The junction rule is valid for steady state current and it is based upon the charge conservation. The electric potential difference is path independent *i.e.* across the loop, potential change is zero.

46. Answer (2)

Hint and Sol: The value of x would be obtained for maximum power delivered at load *i.e.* at $R = r$ and $P = \frac{E^2}{4r}$

47. Answer (3)

Hint: Ammeter measures the current

Sol.: $R_{eq} = \frac{R_1R_2}{R_1+R_2} + r = \frac{R}{2} + r$

Current through the battery is i

$$i = \frac{V}{\frac{R}{2}+r}$$

Current through resistance R

$$i' = \frac{i}{2}$$

$$i' = \frac{V}{R+2r}$$

48. Answer (2)

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

Sol.: $R_0 = \frac{\rho.\ell}{\pi r^2}$ and $R_{AB} = \frac{\rho.\ell}{\pi.4r^2}$

$$\Rightarrow R_{AB} = \frac{R_0}{4}$$

Since they are connected in series hence

$$R_{eq} = R_0 + \frac{R_0}{4} = \frac{5R_0}{4}$$

$$\Rightarrow i = \frac{E}{\frac{5R_0}{4}} = \frac{4E}{5R_0}$$

49. Answer (1)

Hint and Sol : $R_{AC} = \frac{R_0}{\ell} \times \frac{3\ell}{4} = \frac{3R_0}{4}$,

Now resistance R and $\frac{3R_0}{4}$ will be in parallel hence

$$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{\frac{3R_0}{4}} \Rightarrow \frac{1}{R} + \frac{4}{3R_0}$$

$$\frac{1}{R_{eq}} = \frac{3R_0+4R}{3R_0R} \Rightarrow R_{eq} = \frac{3R_0R}{3R_0+4R}$$

50. Answer (2)

Hint: Dielectric constant of metal is infinity

Sol.:

$$C = \frac{A\varepsilon_0}{\left(\frac{d-t}{1}\right)+\frac{t}{k}}$$

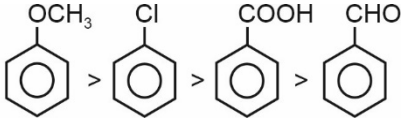
$$C = \frac{A\varepsilon_0}{(d-t)} > \left(\frac{A\varepsilon_0}{d}\right)$$

[CHEMISTRY]

SECTION-A

51. Answer (2)

Hint: Electron donating group increases the reactivity towards electrophilic aromatic substitution.

Sol.: EAS : 

52. Answer (1)

Hint: Wurtz reaction is useful to produce alkanes with even number of carbon atoms.

Sol.: When different types of alkyl halides are taken in Wurtz reaction, a mixture of alkanes are produced.

53. Answer (2)

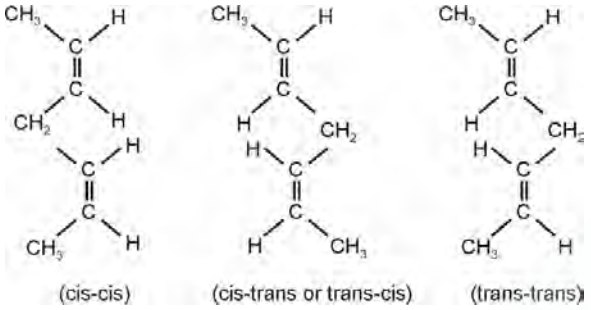
Hint: In Kolbe's electrolysis, the alkane obtained is always symmetrical and higher alkane is formed due to formation of new C–C bond.

Sol.: $2CH_3CH_2COO^-Na^+ + 2H_2O \xrightarrow{\text{Electrolysis}} \underbrace{CH_3CH_2CH_2CH_3 + 2CO_2}_{\text{Anode}} + \underbrace{H_2}_{\text{Cathode}} + 2NaOH$

54. Answer (4)

Hint: Geometrical isomers are cis-trans isomers which are obtained on different arrangements of atom around C–C double bond.

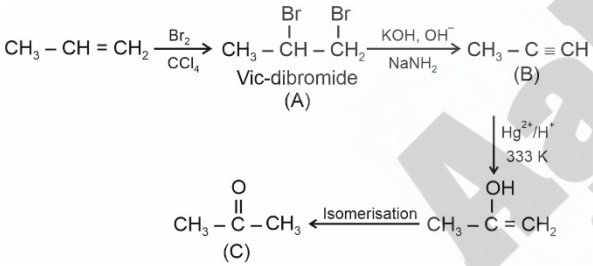
Sol.:



55. Answer (2)

Hint: Halogens in presence of CCl_4 as solvent undergo electrophilic addition reaction with alkenes and form vicinal dihalides with alkenes.

Sol.:



56. Answer (1)

Hint: Greater the *s* character, more is the acidic strength.

Sol.: Electron donating group decreases the acidic strength

Acidic strength : HC≡CH > CH_3–C≡CH > CH_3–$CH=CH_2$ > $CH_3CH_2CH_3$

57. Answer (2)

Hint: Greater the molecular mass and lesser the branching in carbon chain, greater is the boiling point of alkane.

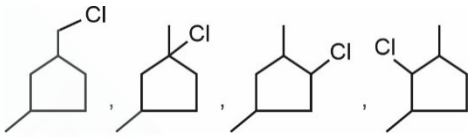
Sol.:

Compound	Boiling point /K
2-Methylpropane	261.0
Pentane	309.1
2-Methylbutane	300.9
2, 2-Dimethylpropane	282.5

58. Answer (3)

Hint: More the number of distinct hydrogen atoms, more will be the monochloro derivates of alkane.

Sol.: Possible monochloro derivates of 1, 3-Dimethylcyclopentane are four.



59. Answer (3)

Hint: S_N2 reaction follows second order kinetics.

Sol.: S_N2 is bimolecular nucleophilic substitution reaction and occurs in single step with the formation of transition state and in case of optically active halide Walden inversion takes place.

60. Answer (1)

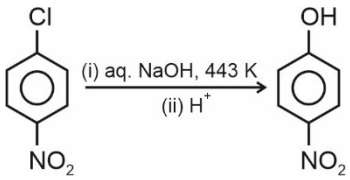
Hint: More the solvation of ion, lesser is the nucleophilic strength.

Sol.: In polar protic solvent, like ethanol, the order of nucleophilic strength is : $I^- > Br^- > Cl^- > F^-$

61. Answer (1)

Hint: Strong electron withdrawing group at ortho or para position in haloarenes increases their reactivity towards nucleophilic substitution reaction.

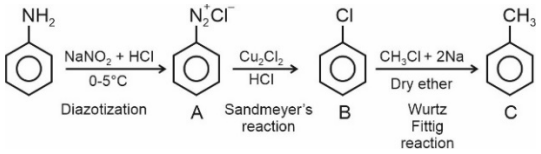
Sol.: $-NO_2$ is a strong electron withdrawing group.



62. Answer (2)

Hint: Alkyl arene is obtained when a mixture of haloalkane and haloarene is treated with sodium in presence of dry ether.

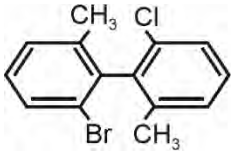
Sol.:



63. Answer (3)

Hint: Biphenyls containing different bulky groups at ortho positions are non-planar

Sol.:



is optically active, as it is non-planar and has no plane of symmetry.

64. Answer (4)

Hint: Gaseous by products are easier to separate.

Sol.: $CH_3CH_2OH + SOCl_2 \rightarrow CH_3CH_2Cl + SO_2 \uparrow + HCl \uparrow$

The obtained by products are gaseous in nature

65. Answer (1)

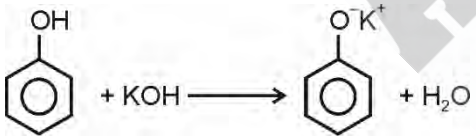
Hint: Ambidentate nucleophile has more than one nucleophilic sites.

Sol.: CN^- has two nucleophilic sites viz, C and N in which attack through C sites leads to formation of alkyl cyanide whereas attack through N leads to formation of isocyanide.

66. Answer (1)

Hint: Compounds which are more acidic than water will react with aqueous alkali

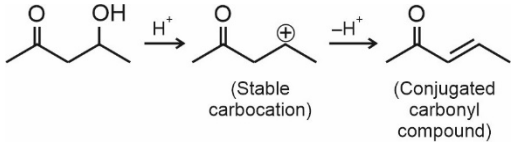
Sol.:



67. Answer (1)

Hint: Higher the stability of carbocation formed, greater is the ease of dehydration. Also conjugated carbonyl compounds formed are more stable.

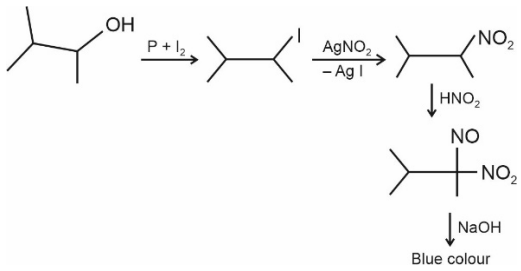
Sol.:



68. Answer (2)

Hint: Secondary alcohol gives blue colour in Victor Meyer test.

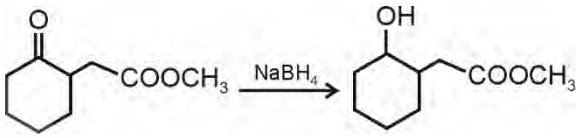
Sol.:



69. Answer (4)

Hint: $NaBH_4$ cannot reduce ester group.

Sol.:



70. Answer (2)

Hint: Higher the intermolecular force of attraction, higher is the boiling point.

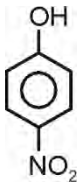
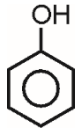
Sol.: Alcohols have higher boiling point than other class of compounds due to stronger intermolecular hydrogen bonding in them.

Boiling Point : n-Pentane < Ethoxypropane < Pentanal < Pentan-1-ol

71. Answer (1)

Hint: Electron withdrawing group ($-NO_2$) increases the acidity of phenol.

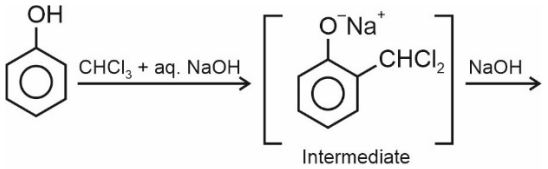
Sol.:

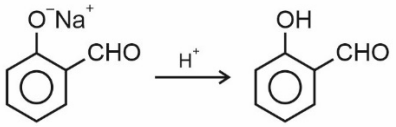
Compound	pK_a
	7.1
	10.0
	10.2

72. Answer (2)

Hint: Reimer Tiemann reaction converts phenol into salicylaldehyde on treatment with chloroform in presence of sodium hydroxide.

Sol.:





Salicylaldehyde

73. Answer (2)

Hint: Sucrose breaks down into glucose and fructose in presence of invertase.

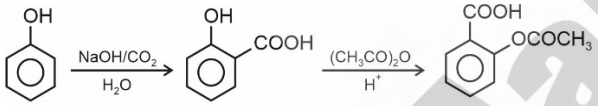
Sol.: Glucose and fructose undergoes fermentation in presence of zymase

$$C_6H_{12}O_6 \xrightarrow{\text{Zymase}} C_2H_5OH + 2CO_2$$

74. Answer (2)

Hint: Phenol on treatment with NaOH gives phenoxide ion which further undergoes electrophilic substitution reaction with CO_2.

Sol.:

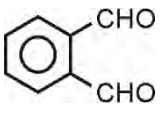
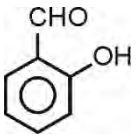
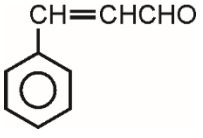


Kolbe's reaction | Salicylic acid (A) | Acetylation | Aspirin (B)

75. Answer (2)

Hint: Benzene-1, 2-dicarbaldehyde is phthalaldehyde

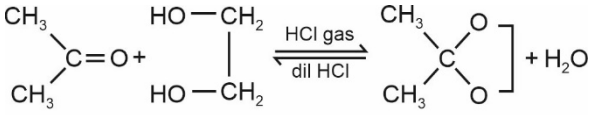
Sol.:

Acrolein	:	CH_2=CHCHO
Phthaldehyde	:	
Salicylaldehyde	:	
Cinnamaldehyde	:	

76. Answer (1)

Hint: Dry HCl gas increases electrophilicity of carbonyl carbon facilitating the nucleophilic attack of ethylene glycol.

Sol.:

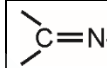
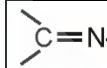


Ethylene glycol ketal

77. Answer (4)

Hint: Oxime is formed when NH_4OH reacts with carbonyl group of aldehyde and ketone.

Sol.:

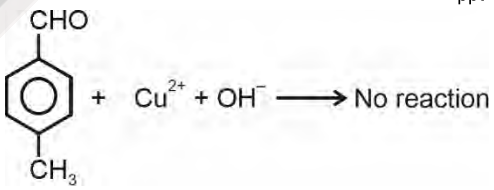
Carbonyl derivative	Product name
	Phenylhydrazone
	Hydrazone
	Oxime
	Semicarbazone

78. Answer (3)

Hint: Aromatic aldehydes does not give Fehling's test.

Sol.:

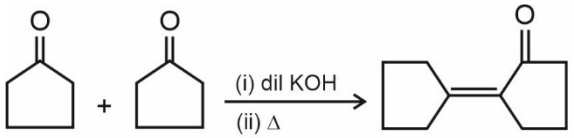
$$\underset{\text{Aliphatic aldehyde}}{R-CHO} + \underset{\text{Fehling's reagent}}{2Cu^{2+} + 5OH^-} \rightarrow RCOO^- + \underset{\text{Red-brown ppt}}{Cu_2O} + 3H_2O$$



79. Answer (2)

Hint: Aldehyde or ketone which contains α-H, on reaction with dil. NaOH undergoes aldol condensation which produces α-β unsaturated carbonyl compound

Sol.:



α-β unsaturated carbonyl compound

80. Answer (4)

Hint: Primary alcohols get readily oxidised to carboxylic acids with Jones reagent.

Sol.: This is Stephen reaction

$$CH_3CH_2CN \xrightarrow{SnCl_2+HCl} RCH=NH \xrightarrow{H_3O^+} \underset{\text{Aldehyde}}{CH_3CH_2CHO}$$

81. Answer (1)

Hint: Electron withdrawing group increases the acidic strength of carboxylic acids.

Sol.: Lesser the acidic strength, more will be the pK_a value

pK_a value : $CF_3COOH < HCOOH < C_6H_5COOH < C_6H_5CH_2COOH$

82. Answer (2)

Hint: Hydrocarbon with one carbon less is produced when sodium salt of carboxylic acid undergoes decarboxylation.

Sol.: $CH_3CH_2COONa \xrightarrow[\Delta]{NaOH \text{ and } CaO} CH_3CH_3 + Na_2CO_3$

83. Answer (2)

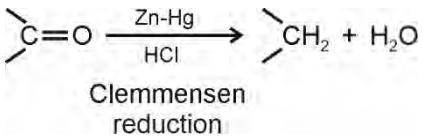
Hint: Species containing $CH_3-\overset{\overset{O}{\|}}{C}-$ and $CH_3-\underset{\underset{OH}{|}}{CH}-$ groups can give iodoform test.

Sol.: $CH_3-CHO \xrightarrow[I_2]{NaOH} HCOONa + \underset{\text{Iodoform}}{CHI_3}$

$CH_3CH_2CHO \xrightarrow[I_2]{NaOH} \text{No reaction}$

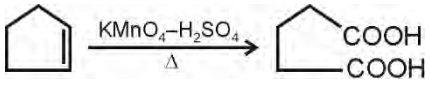
84. Answer (4)

Hint: Clemmensen reduction takes place in acidic medium.

Sol.: 

85. Answer (3)

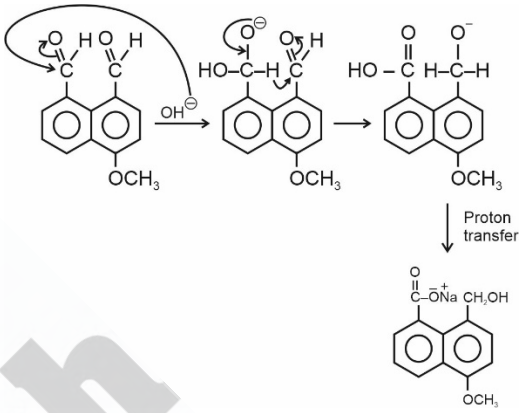
Hint: $KMnO_4$ is a strong oxidising agent.

Sol.: 

SECTION-B

86. Answer (3)

Hint:
- Aldehyde with no α-H undergoes Cannizzaro reaction.
- Attack of nucleophile on aldehyde is selected on the basis of electron deficiency in a molecule.

Sol.: 

87. Answer (1)

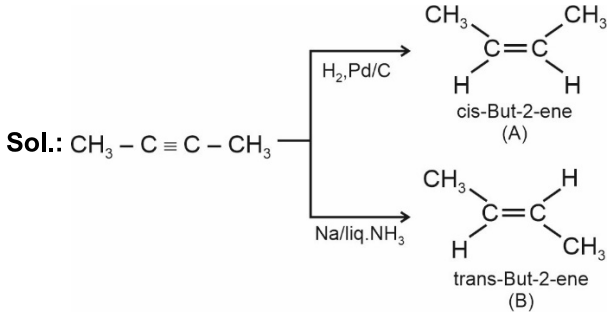
Hint: Upon ozonolysis, the carbon-carbon double bond is cleaved and get converted into carbonyl compounds.

Sol.:

$$\underset{\text{2-Methylbut-2-ene}}{CH_3-\overset{CH_3}{\overset{|}{C}}=CH-CH_3} \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3} \underset{\text{Ozonolysis}}{CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + CH_3-CHO}$$

88. Answer (1)

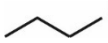
Hint: Alkynes on treatment with Lindlar's catalyst (Pd/C) yields cis-alkene

Sol.: 

The cis isomer is more polar than trans isomer as the dipole moment of trans isomers is almost zero. The trans isomer has higher melting point then the cis form.

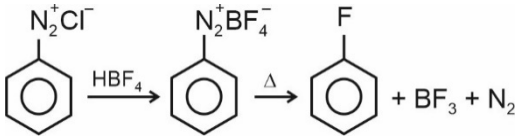
89. Answer (2)

Hint: Less hindered carboxylic acids undergo esterification more readily.

Sol.:  acid having minimum steric hindance, hence it will undergo esterification most readily as the tetrahedral intermediate formed will be more stable.

90. Answer (1)

Hint: Benzene diazonium chloride is a very good leaving group

Sol.: 

91. Answer (4)

Hint: In presence of peroxide, HBr is added to unsymmetrical alkene in accordance to anti-Markovnikov's rule.

Sol.:

$$CH_3-\underset{\underset{CH_3}{|}}{CH}-CH=CH_2 + HBr \xrightarrow{(C_6H_5CO)_2O_2} \underset{\underset{CH_3}{|}}{CH_3-CH}-CH_2-CH_2Br$$

Major product

92. Answer (3)

Hint: More the stability of carbocation formed, higher is the reactivity towards S_N1 reaction.

Sol.: ∵ 3° carbocation is most stable,

∴  is most reactive towards S_N1 reaction

93. Answer (3)

Hint: Tertiary alcohol gives immediate turbidity on treatment with Lucas reagent (conc. HCl and $ZnCl_2$).

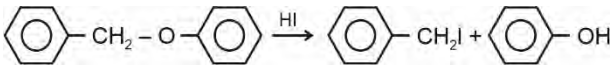
Sol.:

$$CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH + HCl \xrightarrow[\text{Lucas reagent}]{ZnCl_2} CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-Cl + H_2O$$

94. Answer (4)

Hint: C – O bond between C of benzene and O has partial double bond character ∴ difficult to break.

Sol.:



95. Answer (2)

Hint: In hydroboration oxidation reaction, H_2O is added to alkene on the less substituted carbon with no rearrangement.

Sol.:

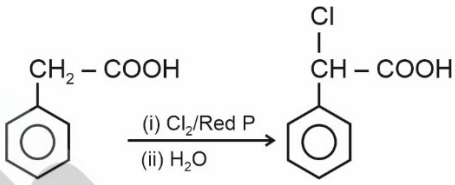
$$CH_3-\underset{\underset{CH_3}{|}}{C}=CH-CH_3 \xrightarrow[(ii)\ H_2O_2/OH^-]{(i)\ B_2H_6/THF} CH_3-\underset{\underset{CH_3}{|}}{CH}-\overset{\overset{OH}{|}}{CH}-CH_3$$

Major

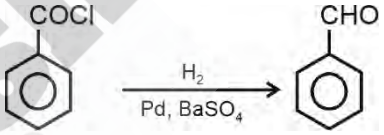
96. Answer (1)

Hint: Etard reaction is used to prepare benzaldehydes from toluene.

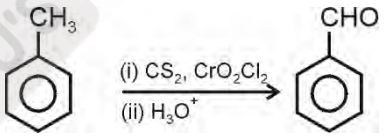
Sol.: • HVZ reaction



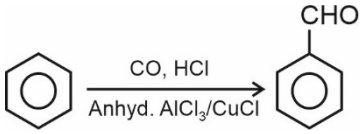
• Rosenmund reduction



• Etard reaction



• Gattermann Koch reaction



97. Answer (3)

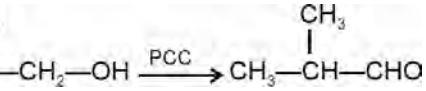
Hint: DIBAL-H selectivity reduce nitrile to imine which upon hydrolysis gives aldehyde.

Sol.:

$$CH_2=CH-CH_2-CN \xrightarrow[(ii)\ H_2O]{(i)\ DIBAL-H} CH_2=CH-CH_2-CHO$$

98. Answer (3)

Hint: Acidic $KMnO_4$ acts as strong oxidising agent.

Sol.: 

PCC oxidises primary alcohol to aldehydes in good yield.

99. Answer (4)

Hint: Ketones does not give Tollen's test.

Sol.: In Tollen's test, aldehydes are oxidised to corresponding carboxylate anion in basic medium and a silver mirror is produced due to formation of silver metal.

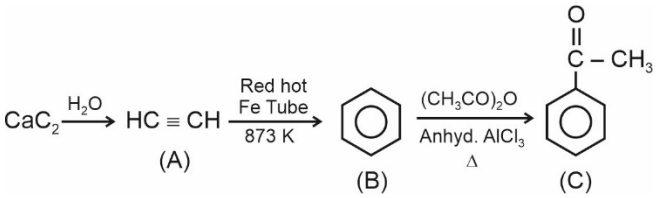
$$R-CHO+2\underset{\text{Tollen's reagent}}{\left[Ag(NH_3)_2\right]^+}+3OH^- \rightarrow RCOO^- +2Ag+2H_2O+4NH_3$$

Basic medium is favourable.

100. Answer (2)

Hint: Ethyne on passing through red hot iron tube at 873 K undergoes cyclic polymerization.

Sol.:



[BOTANY]

SECTION-A

101. Answer (4)

Hint: Life span is a specific trait of each organism and is not necessarily correlated with size or complexity of organisms.

Sol.: Life span is the period from birth to the natural death of an organism. Mango tree has much shorter life span as compared to peepal tree.

102. Answer (1)

Hint: In dioecious plants male and female reproductive parts are present on two different plant bodies.

Sol.: *Chara* is mostly monoecious *i.e.,* male and female reproductive parts are present on same plant body.

103. Answer (3)

Hint: Asexual reproduction involves single parent.

Sol.: Asexual reproduction is uniparental. It may or may not involve gamete formation and gametic fusion is absent. Progenies which are genetically and morphologically similar are known as clones.

104. Answer (2)

Hint: *Bryophyllum* shows formation of leaf buds. Rhizome is found in ginger.

Sol.: Water hyacinth is an aquatic plant. Its propagation occurs by breaking of offset.

105. Answer (3)

Hint: 'Water hyacinth' is one of the most invasive weeds, that propagates rapidly by offset formation.

Sol.: Water hyacinth drains out oxygen from the water, which leads to the death of fishes, thus also known as Terror of Bengal or scourge of water bodies.

106. Answer (4)

Hint: Every sexually reproducing organism has three phases in life *i.e.*,

(1) Juvenile phase

(2) Mature phase

(3) Senescent phase

Sol.: The period of growth from birth to reproductive maturity is pre-reproductive phase which is known as juvenile phase in animals and vegetative phase in plants.

107. Answer (1)

Hint: Plants showing flowering and fruiting once in their life span are monocarpic plants. All annuals, all biennials and few perennials plants are monocarpic.

Sol.: Rice, bamboo species and Neelakurinji *Strobilanthes kunthiana* are monocarpic plants. Mango is a polycarpic plant.

108. Answer (1)

Hint: Heterogametes are produced by majority of sexually reproducing organisms.

Sol.: *Fucus, Chara* and humans produce morphologically dissimilar gametes, *i.e.*, heterogametes.

109. Answer (3)

Hint: In majority of organisms, oogamous type of reproduction is observed where male gamete is small and motile and female gamete is large and stationary.

Sol.: Gametes are haploid and can be produced by either mitosis or by meiosis depending upon the ploidy of the gamete mother cell.

Meiocyte of apple contains 34 chromosomes it produces gametes by meiosis, thus, gametes are haploid having 17 chromosomes.

110. Answer (1)

Hint: In budding, due to unequal cytokinesis an outgrowth or protuberance is formed known as bud, which detaches and grows into complete individual.

Sol.: In binary fission, parent cell itself divides into two equal daughter cells thus, parent cell loses its identity and disappears.

111. Answer (4)

Hint: The innermost layer of anther wall which provides nourishment to developing pollen grains.

Sol.: Tapetum is the innermost, nutritive layer of anther wall. Cells of this layer show increased DNA content like polyploid, or multinucleate condition.

112. Answer (3)

Hint: Typical anther consist of four microsporangia.

Sol.: Stamen is male reproductive part of flower. It has two parts, long slender stalk called the filament and terminal anther. The proximal end of the filament is attached to the thalamus or the petal of the flower. A typical angiosperm anther is bilobed and tetrasporangiate.

113. Answer (2)

Hint: Pollen grains are carrier of male gametes.

Sol.: In angiosperms, pollen grains are generally spherical structures measuring 25-50 µm in diameter.

114. Answer (4)

Hint: Pollens lose viability within 30 minutes of their release in some cereals such as rice and wheat.

Sol.: Pollens in some members of Rosaceae, Leguminosae and Solanaceae, maintain viability for several months.

115. Answer (3)

Hint: Cleistogamous flowers are closed flowers which never open at all.

Sol.: In cleistogamy there is no requirement of pollinating agents and autogamy is ensured.

116. Answer (4)

Hint: Multicarpellary apocarpous condition represents many carpels, free from each other.

Sol.: *Hibiscus*, *Papaver* and tomato have multicarpellary syncarpous condition but *Michelia* exhibits multicarpellary apocarpous condition.

117. Answer (3)

Hint: Pollen grains or micropores are male gametophytes.

Sol.: Each microspore mother cells undergoes meiotic division to produce four haploid microspores or pollens. Thus, to produce 64 microspores, number of meiotic divisions required $= \frac{64}{4} = 16$ meiotic divisions.

118. Answer (2)

Hint: Integuments are outermost protective covering of megasporangium or ovule enclosing cells with abundant reserve food materials.

Sol.: Micropyle is the point where integuments are absent, for entry of pollen tube. Chalaza is basal portion of ovule opposite to micropyle.

Funicle is stalk by which ovules are attached to placenta.

119. Answer (4)

Hint: Largest cell of embryo sac is central cell.

Sol.: Central cell is the largest cell having two polar nuclei which participate in triple fusion. Egg apparatus is three celled, three nucleated, present towards micropylar end having two synergids and one non motile female gamete.

- Synergids have filiform apparatus to guide the entry of pollen tube.

120. Answer (4)

Hint: Cross pollination increases genetic variations.

Sol.: Geitonogamy is transfer of pollen grains from the anther to the stigma of another flower of the same plant. It is functionally cross pollination but genetically similar to autogamy and hence will not increase genetic variation.

Self-pollination or autogamy increases homozygosity. Dioecious condition prevents both autogamy as well as geitonogamy.

121. Answer (1)

Hint: Emasculation is removal of anthers before their maturation from bisexual flowers during artificial hybridisation.

Sol.: Parthenocarpy is formation of fruits without fertilisation. Polyembryony is occurrence of more than one embryo within an embryo sac. Apomixis is formation of seed without fertilisation.

122. Answer (3)

Hint: Dominant trait expresses itself in both heterozygous as well as homozygous condition.

Sol.: Green seed, terminal flower and white flower are recessive traits. Green pod colour is dominant trait.

123. Answer (3)

Hint: Genes are units of inheritance. They contain the information that is required to express a particular trait.

Sol.: Genes which code for a pair of contrasting traits are known as alleles, *i.e.*, they are slightly different forms of the same gene.

124. Answer (1)

Hint: Types of gametes are determined by number of heterozygous condition.

Sol.: Types of gametes = 2^n where, 'n' is number of heterozygous condition.

Thus, $2^2 = 4$ types of gametes will be produced.

125. Answer (1)

Hint: Pleiotropism is the phenomenon when a single gene produces more than one phenotypic effect.

Sol.: In co-dominance F_1 hybrid resembles to both the parents equally. In incomplete dominance, F_1 hybrid does not resemble to any of its parents instead an intermediate phenotype between the two is produced. Multiple allelism is occurrence of more than two alleles for one particular gene.

126. Answer (1)

Hint: Phenylketonuria (PKU) is an autosomal recessive disorder caused due to mutation in single gene.

Sol.: Down's syndrome is an autosomal trisomy of chromosome 21.

Klinefelter's syndrome is a sexual trisomy (44 + XXY) and Turner's syndrome is sexual monosomy (44 + X0).

127. Answer (3)

Hint: Law of dominance is based on the results of monohybrid cross.

Sol.: Law of dominance is used to explain the expression of only one of the traits of a character in a monohybrid cross.

128. Answer (4)

Hint: An individual with O blood group has genotype $I^{\circ}I^{\circ}$ (also represented as *ii*)

Sol.:

$I^A I^B$ × $I^A I^{\circ}$

(AB) (A)

	I^A	I^B
I^A	$I^A I^A$ (A)	$I^A I^B$ (AB)
I°	$I^A I^{\circ}$ (A)	$I^B I^{\circ}$ (B)

No progeny will have O blood group if parents have AB and A blood group.

129. Answer (4)

Hint: Characters like eye colour, body colour and wing size of *Drosophila* have contrasting traits.

Sol.: White eye colour, yellow body colour and miniature wing size are recessive traits.

130. Answer (3)

Hint: In a cross between recessive female and dominant male w.r.t. eye colour and body colour in *Drosophila,* there were 98.7% parental types and 1.3% recombinants in F_2 generation.

Sol.: 1.3% recombinants include 50% males and 50% females so, males with recombinant genotypes will be $\frac{1.3}{2} = 0.65\%$

131. Answer (1)

Hint: Phenylalanine hydroxylase enzyme normally converts the amino acid phenylalanine into tyrosine.

Sol.: Mutation in the given gene results in defective enzyme resulting in accumulation of phenylalanine.

132. Answer (4)

Hint: Male heterogamety is ability of males to produce two different types of gametes as they have heteromorphic sex chromosomes.

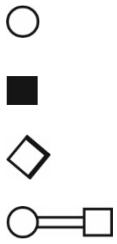
Sol.: Grasshopper, humans and *Drosophila* show male heterogamety.

Birds show female heterogamety (ZW).

133. Answer (4)

Hint: Consanguineous mating is mating between relatives

Sol.:



→ Unaffected female

→ Affected male

→ Sex unspecified

→ Consanguineous mating

134. Answer (1)

Hint: Out cross is a cross between F_1 hybrid and its dominant parent.

Sol. : Monohybrid cross is used to study inheritance of one gene.

135. Answer (3)

Hint: Mutation is a phenomenon which results in alteration of DNA sequences that leads to variations.

Sol.: Change in segment of DNA, results alteration in chromosomes leading to chromosomal abnormalities or aberrations, which are commonly observed in cancer cells.

SECTION-B

136. Answer (4)

Hint: Flowering plants are angiosperms, in which male gametes are non-motile.

Sol.: In most of the algae, bryophytes and pteridophytes, male gametes are small, motile, flagellated and are transferred with the help of water. In angiosperms male gametes are non-motile which are carried via pollen grains.

137. Answer (3)

Hint: Rice plant is an annual plant

Sol.: (1) Rose Plant → 5-7 years

(2) Banana Tree → 25 years

(3) Rice Plant → 3-4 months

(4) Banyan Tree → 200-300 years

138. Answer (3)

Hint: Sporogenous tissue occupies the centre of each microsporangium in the anther.

Sol.: Wind and water pollinated flowers are not very colorful and do not produce nectar.

139. Answer (3)

Hint: Cells of middle layers of anther wall are ephemeral.

Sol.: Cells of the middle layers of anther wall are short lived and degenerate at maturity.

140. Answer (3)

Hint: When the pollen grain matures it contains two cells, the vegetative cell and generative cell. Vegetative cell is bigger in size, has abundant food reserve and a large irregularly shaped nucleus.

Sol.: The generative cell is small and floats in the cytoplasm of the vegetative cell. It is spindle shaped with dense cytoplasm and nucleus. It divides mitotically to give rise to the two male gametes.

141. Answer (2)

Hint: ABO blood group is controlled by gene *I* which has three alleles I^A, I^B and *i*.

Sol.: A total of six different genotypes and four different phenotypes are possible for human ABO blood group in the population.

142. Answer (2)

Hint: Selfing is crossing the members of same genotypes.

Sol.: RrYy × RrYy → Parents

	R	r
R	RR	Rr
r	Rr	rr

	Y	y
Y	YY	Yy
y	Yy	yy

$Rr \rightarrow \frac{2}{4}$ $\quad YY \rightarrow \frac{1}{4}$

$\therefore RrYy \rightarrow \frac{2}{4} \times \frac{1}{4} \Rightarrow \frac{2}{16}$

143. Answer (4)

Hint: Test cross is a cross between F_1 hybrid and its recessive parent.

Sol.: Both genotypic and phenotypic ratios are same in the result of test cross *i.e.* 1 : 1

Tt × tt

↓ ↓

T t t

Tt	tt	Genotype
Tall	Dwarf	Phenotype
1 :	1	Ratio

144. Answer (4)

Hint: In XX – XO type of sex determination (male heterogamety), males produce 50% of sperms without sex chromosomes.

Sol.: Birds and butterflies show female heterogamety.

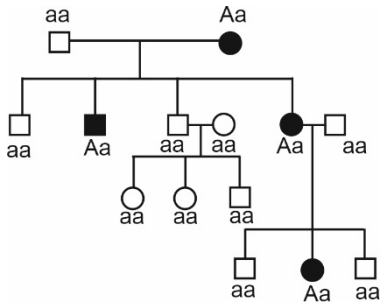
Drosophila shows XX–XY type of sex determination.

145. **Delete**

Hint: In this pattern of inheritance, a single copy of the mutated gene is enough to cause the disorder.

Sol.:

- In 1st generation male parent is unaffected but its male child is affected thus it cannot be Y-linked.
- It is not showing criss-cross inheritance pattern, thus, it is not X-linked recessive.
- Every generation is showing the effect thus, it is an autosomal dominant trait.



146. Answer (4)

Hint: X-linked recessive disorders show criss-cross inheritance pattern.

Sol.: Haemophilia is an X-linked recessive disorder which shows its transmission from unaffected (carrier) female to some of the male progenies.

Sickle cell anaemia, phenylketonuria and thalassemia are autosomal recessive disorders.

147. Answer (2)

Hint: Colour blindness is sex linked (X-linked) recessive disorder which is more commonly expressed in males and very rarely in females.

Sol.: Colour blindness occurs in about 8% males and 0.4% females in a population.

148. Answer (1)

Hint: Alfred Sturtevant mapped the distance between genes on the chromosome.

Sol.: Thomas Hunt Morgan carried out several dihybrid in *Drosophila* to study genes that were sex linked.

He also coined the term linkage.

149. Answer (3)

Hint : Substitution is replacement of one base pair or nucleotide with another.

Sol.: Failure of cytokinesis after telophase stage of cell division results in an increase in whole set of chromosomes and this is known as polyploidy. Aneuploidy is due to failure of segregation of chromatids during cell division.

150. Answer (4)

Hint: Down's syndrome is due to trisomy of chromosome 21. It was first described by Langdon Down (1866).

Sol.: The affected individual is short statured with small round head, furrowed tongue and partially open mouth.

Palm is broad with characteristic palm crease. Physical, psychomotor and mental development is retarded.

Down's syndrome occurs due to aneuploidy not due to polyploidy.

[ZOOLOGY]

SECTION-A

151. Answer (2)

Hint : Member of largest phylum

Sol. : Animals which possess both male and female reproductive organs are called hermaphrodite (bisexual) animals.

Earthworm, sponge, tapeworm and leech are the examples of hermaphrodites.

Cockroach is an example of a unisexual organism.

152. Answer (2)

Hint : Crop and gizzard.

Sol. : Birds (*Pavo*) and reptiles (*Testudo*) possess cleidoic eggs (eggs covered by hard calcareous shell).

In many terrestrial organisms belonging to higher vertebrates such as reptiles, birds and mammals, syngamy occurs inside the body of the organism called internal fertilisation.

153. Answer (3)

Hint : Universal structure in all sexually reproducing organisms

Sol. : Zygote is the vital link that ensures continuity of species between organisms of one generation and the next. Every sexually reproducing organism, including human beings begin life as a single cell– the zygote.

154. Answer (3)

Hint : A temporary endocrine tissue

Sol. : The signals for parturition originate from the fully developed foetus and the placenta which induce mild uterine contractions called foetal ejection reflex.

155. Answer (4)

Hint : Hormones which are proteinaceous

Sol. : Placenta acts as a temporary endocrine tissue and produces several hormones like hCG, hPL, estrogens, progestogens, *etc*.

In the later phase of pregnancy, a hormone called relaxin is also secreted by the ovary.

hCG, hPL (produced by placenta) and relaxin (produced by corpus luteum in ovary) are produced in women only during pregnancy.

156. Answer (3)

Hint : The structure transforms into a structure having fluid filled cavity.

Sol. : The embryo with 8 to 16 blastomeres is called a morula. The morula continues to divide and transforms into blastocyst having fluid filled cavity (blastocoel).

157. Answer (3)

Hint : Ovarian hormones

Sol. : During pregnancy, hCG is secreted by placenta and high levels of circulating hCG maintain the corpus luteum beyond its normal life time. Corpus luteum continues to secrete progesterone and estrogen. Progesterone maintains the endometrium in nutrient rich state.

158. Answer (4)

Hint : Ten times the number of facial bones in humans

Sol. :

Organism	Approximate life span (in years)
(a) Crow	15
(b) Parrot	140
(c) Tortoise	100-150
(d) Crocodile	60

159. Answer (3)

Hint : Both maternal and foetal parts are involved in the formation

Sol. : The chorionic villi (foetal part) and uterine tissue (maternal part) become interdigitated with each other and jointly form placenta.

The blastomeres in the blastocyst are arranged into an outer layer called trophoblast and an inner group of cells attached to trophoblast called the inner cell mass.

160. Answer (2)

Hint : Same ploidy as that of oogonia

Sol. :

Structure	Ploidy
(a) Polar body	– Haploid (n)
(b) Spermatid	– Haploid (n)
(c) Secondary oocyte	– Haploid (n)
(d) Primary spermatocyte	– Diploid (2n)

161. Answer (1)

Hint : Lippes loop is an inert IUD

Sol. : LNG-20 and progestasert are hormone releasing IUDs.

Multiload 375, Cu7 and CuT are copper releasing IUDs. Lippes loop is an example of non-medicated IUDs.

162. Answer (1)

Hint : The part cut and tied in vasectomy.

Sol. : The seminiferous tubules of the testis open into the vasa efferentia through rete testis. The vasa efferentia leave the testis and open into epididymis located along the posterior surface of each testis. The epididymis leads to vas deferens that ascends to the abdomen and loops over the urinary bladder. It receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.

163. Answer (4)

Hint : Provides lower temperature

Sol. : The testes are situated outside the abdominal cavity within a pouch called scrotum.

Each testis has about 250 compartments called testicular lobules.

164. Answer (2)

Hint : These extend down from the mons pubis

Sol. : The labia majora are fleshy folds of tissue, which extend down from the mons pubis and surround the vaginal opening. The labia minora are paired folds of tissue under the labia majora. The opening of the vagina is often covered partially by a membrane called hymen. The clitoris is a tiny finger-like structure which lies at the upper junction of the two labia minora above the urethral opening.

165. Answer (4)

Hint : Outer protective layer of uterus

Sol. : The wall of the uterus has three layers of tissues. The external thin membranous perimetrium, middle thick layer of smooth muscle, myometrium and inner glandular layer called endometrium that lines the uterine cavity.

166. Answer (1)

Hint : Transfer of semen (sperms) into the female genital tract is termed as insemination

Sol. : Spermiogenesis

(Transformation of spermatids into spermatozoa)

↓

Spermiation

(Release of sperms from the seminiferous tubules)

↓

Ejaculation

(Release of semen from the male reproductive system through urethra)

↓

Insemination

(Release of semen into the female genital tract)

167. Answer (4)

Hint : 2^{nd} phase of menstrual cycle

Sol. :
- Sertoli cells are regulated by FSH. FSH stimulates follicular development as well as secretion of estrogens by the growing follicles.
- LH causes the transformation of the ruptured follicle to corpus luteum.
- Estrogen increases the thickening of the endometrium.
- Prolactin is involved in the secretion of milk after childbirth.

168. Answer (3)

Hint : Limbs are well developed by the end of first trimester.

Sol. : By the end of the second month of pregnancy, the foetus develops limbs and digits. By the end of 12 weeks (first trimester), most of the major organ systems are formed, for example, the limbs and external genital organs are well developed.

169. Answer (2)

Hint : Water canal system

Sol. : Gemmules are present in freshwater sponges such as *Spongilla* and in certain marine sponges *e.g.*, *Sycon*.

170. Answer (4)

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

Sol. : In Intra Uterine Insemination (IUI), the semen collected either from the husband or a healthy donor is artificially introduced into the uterus of the female.

171. Answer (1)

Hint : The fraction of blood in each cardiac output filtered by kidneys in a minute

Sol. : Intentional or voluntary termination of pregnancy before full term is called medical termination of pregnancy (MTP) or induced abortion. Nearly 45 to 50 million MTPs are performed in a year all over the world which accounts to 1/5th of the total number of conceived pregnancies in a year.

172. Answer (4)

Hint : Disease caused by bacteria

Sol. : Except for hepatitis-B, genital herpes and HIV infections, other diseases are completely curable if detected early and treated properly.

173. Answer (4)

Hint : Few side effects and high contraceptive value

Sol. : Progestogens alone or in combination with estrogen can also be used by females as injections or implants under the skin. Their mode of action is similar to that of oral contraceptives pills and their effective periods are much longer.

174. Answer (3)

Hint : Developed at CDRI, Lucknow

Sol. : Saheli–the new oral contraceptive for the females contains a non-steroidal preparation. It is a 'once a week' pill with very few side effects and high contraceptive value.

175. Answer (4)

Hint : Used in infertility cases due to low sperm count in ejaculate

Sol. : In artificial insemination (AI), the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus (IUI – intra-uterine insemination) of the female.

176. Answer (4)

Hint : Hormonal contraceptive

Sol. : Progestasert is a hormone releasing IUD. Lactational amenorrhoea, coitus interruptus and periodic abstinence are natural methods of contraception.

177. Answer (1)

Hint : Chemical contraceptive

Sol. : Diaphragms, cervical caps and vaults are barriers made of rubber that are inserted into the female reproductive tract to cover the cervix during coitus. They prevent conception by blocking the entry of sperms through the cervix. They are reusable. Spermicidal creams, jellies and foams are usually used alongwith these barriers to increase their contraceptive efficiency.

178. Answer (4)

Hint : Cowper's gland

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

179. Answer (3)

Hint : Narrow lumen

Sol. : Each fallopian tube is about 10-12 cm long and extends from the periphery of each ovary to the uterus, the part closer to the ovary is the funnel-shaped infundibulum. The edges of the infundibulum possess finger-like projections called fimbriae, which help in collection of the ovum after ovulation. The infundibulum leads to a wider part of the oviduct called ampulla. The last part of the oviduct, isthmus has a narrow lumen and it joins the uterus.

180. Answer (4)

Hint : Inserted by doctors or expert nurses

Sol. : IUDs are ideal contraceptives for the females who want to delay pregnancy and/or space children. It is one of most widely accepted methods of contraception in India.

181. Answer (3)

Hint : Occurs before follicular phase

Sol. :
- Menstrual cycle starts with the menstrual phase, when menstrual flow occurs and it lasts for 3-5 days.
- On 14^{th} day, rapid secretion of LH leading to its maximum level (LH surge) induces rupture of Graafian follicle and thereby the release of ovum (ovulation). Post-ovulatory phase is always of 14 days.

182. Answer (1)

Hint : Corona radiata is present outside the zona pellucida

Sol. : The secretions of the acrosome help the sperm to enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane. The secretions of the acrosome help the sperm to first dissolve the corona radiata.

183. Answer (4)

Hint : Action of Cu^{2+} ions

Sol. : IUDs increase phagocytosis of sperms within the uterus and the Cu ions released suppress sperm motility and the fertilising capacity of sperms. The hormone releasing IUDs, in addition, make the uterus unsuitable for implantation and the cervix hostile to the sperm.

184. Answer (2)

Hint : Gametes are haploid.

Sol. : In fruitfly number of chromosomes in meiocyte and gamete are 8 and 4 respectively.

The chromosome number in meiocyte and gamete of butterfly are 380 and 190 respectively.

185. Answer (2)

Hint : Secretion of gonadotropins increases gradually during this phase

Sol. : In proliferative phase, regeneration of endometrium occurs.

Ovarian cycle has three phases – Ovulatory phase, follicular phase and luteal phase. In uterine cycle, proliferative phase is followed by secretory phase.

SECTION-B

186. Answer (2)

Hint : Participate in menstruation

Sol. : Ectopic pregnancy is referred to implantation of embryo at a site other than uterus.

187. Answer (3)

Hint : Capacitation involves removal of membrane cholesterol present over acrosome.

Sol. : After insemination, capacitation of sperm occurs in the female genital system and it refers to changes in the sperm before fertilization.

188. Answer (3)

Hint : Humans have XX-XY type of sex determination.

Sol. :
- Both primary spermatocytes and primary oocytes are diploid (2n) structures formed after mitosis differentiation from spermatogonia and oogonia, respectively.
- Primary spermatocytes have 46 chromosomes *i.e.*, 44 autosomes, one X-chromosome and one Y-chromosome.
- Primary oocyte has 46 chromosome *i.e.*, 44 autosomes and two X-chromosomes.

189. Answer (1)

Hint : Pills are repeated after the gap of 7 days.

Sol. : Pills have to be taken daily for a period of 21 days starting preferably within the first five days of menstrual cycle. After a gap of 7 days (during which menstruation occurs) it has to be repeated in the same pattern till the female desires to prevent conception.

190. Answer (2)

Hint : Implantation takes place in the innermost wall of uterus.

Sol. :
- In human females, the blastocyst gets implanted in endometrium by the trophoblast cells.
- The second maturation division of the mammalian ovum is completed only after the ovum has been penetrated by a sperm.
- The second maturation of the human sperm takes place in the testis.

191. Answer (3)

Hint : Syphilis can be treated by antibiotics

Sol. :

	STI	Causative agent
1.	Chlamydiasis	*Chlamydia trachomatis*
2.	Gonorrhoea	*Neisseria gonorrhoea*
3.	Trichomoniasis	*Trichomonas vaginalis*
4.	Genital Herpes	Herpes simplex virus

192. Answer (3)

Hint : Stimulates corpus luteum to secrete hormones

Sol. : Both LH and FSH attain a peak level in the middle of 28 days menstrual cycle (14th day). Rapid secretion of leading to LH surge induces ovulation. (Ovulation is also assisted by increased levels of FSH and estrogen).

193. Answer (1)

Hint : Nucleus to cytoplasmic ratio increases.

Sol. : Morula has almost equal quantity of cytoplasm as an uncleaved zygote but much more DNA.

194. Answer (1)

Hint : Chromosome number in gamete of dog is less than number of chromosomes in meiocyte of human beings.

Sol. :

	Chromosome no. in meiocyte (2n)	Chromosome no. in gamete (n)
Human beings	46	23
Dog	78	39

195. Answer (2)

Hint : Function of zygote

Sol. : Reproduction is defined as a biological process in which an organism gives rise to young ones (offspring) similar to itself. The offspring grow, mature and in turn produce new offsprings. Thus, there is a cycle of birth, growth and death. Reproduction enables the continuity of the species, generation after generation.

196. Answer (2)

Hint : The seminal plasma along with the sperms constitute the semen.

Sol. : 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.

197. Answer (4)

Hint : Identify the female reproductive part.

Sol. : Secretions of epididymis, vas deferens, seminal vesicles and prostate are essential for maturation and motility of sperms. The seminal plasma along with the sperms constitute the semen.

198. Answer (4)

Hint : Process before spermiation

Sol. : FSH acts on the Sertoli cells and stimulates secretion of some factors which help in the process of spermiogenesis.

199. Answer (1)

Hint : Milk is sucked out through lactiferous duct

Sol. : The glandular tissue of each breast is divided into 15-20 mammary lobes containing clusters of cells called alveoli. The cells of alveoli secrete milk, which is stored in the cavities (lumens) of alveoli. The alveoli open into mammary tubules. The tubules of each lobe join to form a mammary duct.

200. Answer (3)

Hint : More than no. of phalanges in each human limb

Sol. : Day of ovulation = No. of days in menstrual cycle – 14

= (32 – 14) day

= 18th day

❑ ❑ ❑

All India Aakash Test Series for NEET-2023

TEST - 5 (Code-F)

Test Date : 05/03/2023

ANSWERS

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

HINTS & SOLUTIONS

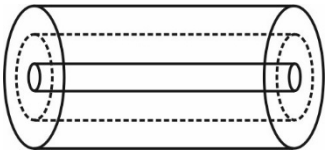
[PHYSICS]

SECTION-A

1. Answer (1)

Hint: Use Gauss' Law of electrostatic

Sol.:



Consider given cylindrical gaussian surface at a distance *r*. The length of cylinder is *l* taken.

$$E \times 2\pi rl = \frac{\lambda . \ell}{\varepsilon_0} \Rightarrow E = \frac{\lambda}{2\pi r \varepsilon_0}$$

2. Answer (3)

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

Sol.: Flux through circular base is

$$\phi = E \cdot \pi R^2 \cdot \cos(\pi) = -\pi R^2 E$$

$|\phi| = \pi R^2 E$

3. Answer (4)

Hint and Sol:

- The electric field on Gaussian surface is due to all charges present both inside and outside the surface.
- The Gaussian surface should be selected in such a way that it does not pass through discrete charge however it can pass through continuous charge distribution.
- Gauss' law is much more useful where the system is having some symmetry of charge distribution.

4. Answer (2)

Hint: Use Gauss law of electrostatics

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

$$E \times 4\pi b^2 = \frac{12Q}{\varepsilon_0} \Rightarrow E = \frac{3Q}{\pi b^2 \varepsilon_0}$$

5. Answer (1)

Hint and Sol: During the charging of the battery the terminal potential difference is more than the emf of battery.

6. Answer (2)

Hint: $R = \frac{\rho \ell}{A}$ and $\sigma = \frac{1}{\rho} \Rightarrow R = \frac{\ell}{A\sigma}$

Sol.: $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} \Rightarrow \frac{1}{\frac{\ell}{2A \cdot \sigma_{eq}}} = \frac{1}{\frac{\ell}{A \cdot \sigma_1}} + \frac{1}{\frac{\ell}{A \cdot \sigma_2}}$

$\Rightarrow \quad 2A \times \sigma_{eq} = A\sigma_1 + A\sigma_2$

$$\sigma_{eq} = \frac{\sigma_1 + \sigma_2}{2}$$

7. Answer (3)

Hint and Sol: $V_A - V_B = 4 \times 4 + 6 + 4 \times 2$

$V_A - V_B = 4 \times 4 + 6 + 8$

$= 16 + 6 + 8$

$= 22 + 8 = 30$ V

8. Answer (1)

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

Sol.: $R = \frac{\rho \ell}{A} \Rightarrow R = \frac{\rho \times \ell^2}{(A \times \ell)}$

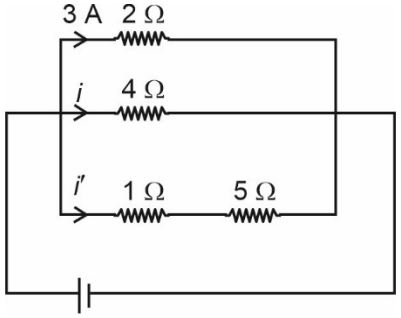
Volume will remain constant hence,

$$R \propto \ell^2 \Rightarrow \frac{4}{R'} = \frac{\ell^2}{(\ell/2)^2} \Rightarrow \frac{4}{R'} = \frac{\ell^2 4}{\ell^2} \Rightarrow R' = 1\ \Omega$$

9. Answer (1)

Hint: The current in parallel connection are divided in inverse ratio of their resistances

Sol.:



$2 \times 3 = i'(5 + 1)$

$i' = 1$ A

$P = VI \Rightarrow P = I^2R$

$P = (1)^2 \times 1 = 1$ W

10. Answer (4)

Hint and Sol: Potential drop on potentiometer wire should be more than e.m.f. to balance

$$V = \frac{10 \times 10}{(10 + 20)} = \frac{10}{3} \text{ V} < 4 \text{ V}$$

11. Answer (3)

Hint: $\varepsilon = \frac{V_0}{\lambda}.\ell_1$

Sol.: $3 = \frac{V_0}{\lambda} \times 72$ and $2 = \frac{V_0}{\lambda} \times \ell_0$,

Now $\frac{V_0}{\lambda} = \frac{3}{72}$

$$\Rightarrow \quad 2 = \frac{3}{72} \times \ell_0 \Rightarrow \ell_0 = \frac{2 \times 72}{3} \Rightarrow \ell_0 = 48 \text{ cm}$$

12. Answer (3)

Hint and Sol: The potential at centre of dipole is zero due to the dipole while due to point charge it would be $\frac{q}{4\pi\varepsilon_0 r}$.

13. Answer (4)

Hint: Potential depends on position on axis

Sol.: $V = \frac{kp\cos\theta}{r^2}$ for $\theta > 90°, V$ is negative

$W = QV$

$\therefore$ W may be positive or negative.

14. Answer (1)

Hint and Sol: Since for same area of cross-sections, density of field lines is greater for area A hence $E_A > E_B$

15. Answer (1)

Hint and Sol: The electric field due to plane sheet of charge is $\frac{\sigma}{2\varepsilon_0}$.

16. Answer (3)

Hint and Sol: Four cells with same polarity,

$E_{eq} = 4E - E = 3E$

17. Answer (1)

Hint: $V = IR$

Sol.: $R_{eq} = 6\Omega$, $I = \frac{12}{6} = 2$ A; $V_{2\Omega} = 2 \times 2 = 4$ V

and $V_{3\Omega} = 2 \times 3 = 6$ V

ratio = $\frac{4}{6} = \frac{2}{3}$

18. Answer (1)

Hint: $\mu = \frac{v_d}{E}$

Sol.: $\mu = \frac{v_d}{E}$

$$= \frac{\frac{2.5 \times 10^{-4}}{10}}{20 \times 10^{-2}} = \frac{2.5 \times 10^{-4} \times 20 \times 10^{-2}}{10}$$

$= 5 \times 10^{-6}$ m^2 V^{-1} s^{-1}

19. Answer (1)

Hint: Potential = work/charge

Sol.: $[V] = \frac{[ML^2T^{-2}]}{[AT]} = [ML^2T^{-3}A^{-1}]$

20. Answer (4)

Hint and Sol: Drift velocity,

$v_d = \frac{eE\tau}{m}$, $J = \sigma E$ and $\sigma = \frac{ne^2\tau}{m}$

21. Answer (2)

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

Sol.: $R = R_0(1 + \alpha\,\Delta T) \Rightarrow 5.23 = 5(1 + \alpha \times 100)$

$$\frac{5.23}{5} = 1 + \alpha \times 100$$

$$\Rightarrow 100\alpha = \frac{5.23 - 5}{5} \Rightarrow 100\alpha = \frac{0.23}{5}$$

$$\Rightarrow \alpha = \frac{0.046}{100} = 4.6 \times 10^{-4} {}^\circ\text{C}^{-1}$$

22. Answer (1)

Hint: $P = \frac{V^2}{R}$

Sol.: $R = \frac{(220)^2}{60}$; $R_{eq} = \frac{R}{10} = \frac{(220)^2}{600}$

$$\Rightarrow I = \frac{220 \times 600}{(220)^2}$$

$$\Rightarrow I = \frac{600}{220} = \frac{60}{22}\text{A},$$

$$P_{\text{consumed}} = \frac{60}{22} \times 220 = 600 \text{ W}$$

23. Answer (4)

Hint and Sol: It is a case of balanced Wheatstone bridge hence current through 20 Ω resistor will be zero.

24. Answer (3)

Hint: $V = E - ir$

Sol.: $0.4 \times 10 = 4.2 - 0.4\ r \Rightarrow 4 = 4.2 - 0.4r$
$\Rightarrow 0.4r = 0.2$

$$\Rightarrow r = \frac{0.2}{0.4} = 0.5\ \Omega$$

25. Answer (3)

Hint and Sol: Conductivity and resistivity are the properties of material so they are not going to change. However current remains same but current density decreases from point *A* to point *B*

$\vec{J} = \sigma\vec{E}$; Since $J_A > J_B \Rightarrow E_A > E_B$

26. Answer (1)

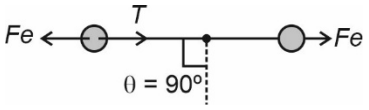
Hint: $\rho = \frac{m}{ne^2\tau}$

Sol.: For insulators and semiconductors number density increases with the increase in the temperature which compensates for any decrease in average relaxation time. Hence with increase in temperature resistivity decreases.

27. Answer (3)

Hint: There will be weightlessness condition in satellite.

Sol.: Metal bobs will become weightless in satellite so only coulomb force will be there. The tension would be created only due to coulomb force.

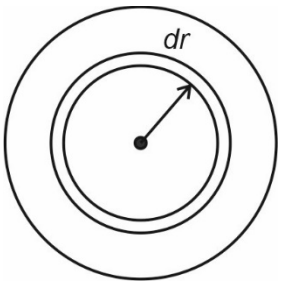


28. Answer (3)

Hint: Use Gauss Law

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

Now $\Rightarrow q_{\text{enc}} = \int \rho \cdot 4\pi r^2 \cdot dr$



$$q_{\text{enc}} = \int_0^{R/3} \rho \cdot 4\pi r^2 \cdot dr$$

$$\Rightarrow \int_0^{R/3} 4\pi K r^4 dr = 4\pi K \cdot \left[\frac{r^5}{5}\right]^{R/3}$$

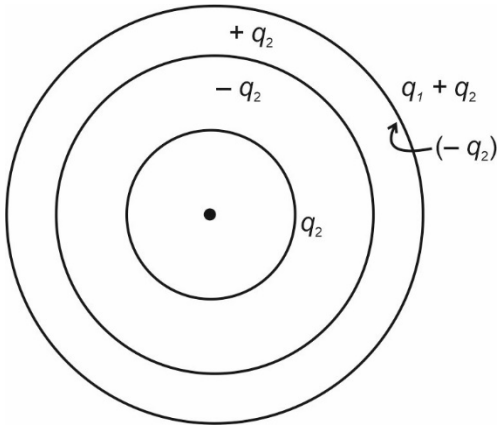
$$q_{\text{enc}} = \frac{4\pi K}{5} \cdot \frac{R^5}{243} \Rightarrow q_{\text{enc}} = \frac{4\pi K R^5}{1215}$$

Now, $E \times 4\pi \frac{R^2}{9} = \frac{4\pi K R^5}{1215\varepsilon_0} \Rightarrow E = \frac{KR^3}{135\varepsilon_0}$

29. Answer (3)

Hint: The electric field inside the conductor material is zero

Sol.:



$\Rightarrow$ Above is the charge distribution due to given charge arrangement. Hence charge on outer surface of middle shell is q_2.

30. Answer (3)

Hint and Sol: Electric field strength at surface due to uniformly charged sphere = $\frac{kq}{R^2}$

Electric potential at surface due to uniformly charged sphere = $\frac{kq}{R}$

Ratio = $\frac{kq \times R}{R^2 \times kq} = \frac{1}{R}$

31. Answer (4)

Hint and Sol: For an isolated parallel plate capacitor the capacitance of the capacitor increases K times. Electric field as well as force between the plates decreases by K times.

$\vec{E} = \frac{\vec{E}_0}{K}$ and $\vec{F} = q\vec{E}$, for an isolated capacitor charge is going to remain same.

32. Answer (3)

Hint: Use conservation of energy

Sol.: When capacitor is fully charged then, $Q = 4 \times 10^{-6} \times 20 = 80\ \mu C$. Energy stored in capacitor = $\frac{Q^2}{2C} = \frac{80 \times 80}{2 \times 4} = \frac{6400}{8} = 800\ \mu J$

Work done by battery = $Q.V = 80 \times 20 = 1600\ \mu J$

Energy lost as heat = 1600 μJ – 800 μJ = 800 μJ

33. Answer (2)

Hint: When dielectric is removed then overall capacitance of the system decreases.

Sol.: When dielectric is removed then capacitance of the system decreases. Hence for same potential difference the charge on both capacitor decreases. As a result the electron flows from –ve to +ve terminal of battery hence work done by battery will be negative.

34. Answer (4)

Hint and Sol: Field lines are perpendicular to a conductor. If the charge is placed inside a cavity in a conductor then induced charge appears on cavity wall while if a charge is outside a cavity then no charge will appear on cavity wall.

35. Answer (2)

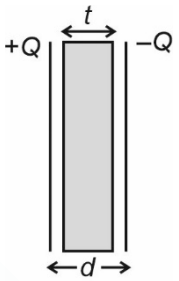
Hint and Sol: Since the electric field inside the conductor is zero hence the dielectric constant for conductor is ∞. For vacuum dielectric constant is 1.

SECTION-B

36. Answer (2)

Hint: Dielectric constant of metal is infinity

Sol.:



$C = \frac{A\varepsilon_0}{\left(\frac{d-t}{1}\right) + \frac{t}{k}}$

$C = \frac{A\varepsilon_0}{(d-t)} > \left(\frac{A\varepsilon_0}{d}\right)$

37. Answer (1)

Hint and Sol : $R_{AC} = \frac{R_0}{\ell} \times \frac{3\ell}{4} = \frac{3R_0}{4}$,

Now resistance R and $\frac{3R_0}{4}$ will be in parallel hence

$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{\frac{3R_0}{4}} \Rightarrow \frac{1}{R} + \frac{4}{3R_0}$

$\frac{1}{R_{eq}} = \frac{3R_0 + 4R}{3R_0R} \Rightarrow R_{eq} = \frac{3R_0R}{3R_0 + 4R}$

38. Answer (2)

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

Sol.: $R_0 = \frac{\rho.\ell}{\pi r^2}$ and $R_{AB} = \frac{\rho.\ell}{\pi.4r^2}$

$\Rightarrow R_{AB} = \frac{R_0}{4}$

Since they are connected in series hence $R_{eq} = R_0 + \frac{R_0}{4} = \frac{5R_0}{4}$

$\Rightarrow i = \frac{E}{\frac{5R_0}{4}} = \frac{4E}{5R_0}$

39. Answer (3)

Hint: Ammeter measures the current

Sol.: $R_{eq} = \frac{R_1R_2}{R_1+R_2} + r = \frac{R}{2} + r$

Current through the battery is i

$$i = \frac{V}{\frac{R}{2}+r}$$

Current through resistance R

$$i' = \frac{i}{2}$$

$$i' = \frac{V}{R+2r}$$

40. Answer (2)

Hint and Sol: The value of x would be obtained for maximum power delivered at load *i.e.* at $R = r$ and $P = \frac{E^2}{4r}$

41. Answer (4)

Hint and Sol: The junction rule is valid for steady state current and it is based upon the charge conservation. The electric potential difference is path independent *i.e.* across the loop, potential change is zero.

42. Answer (3)

Hint: $I_{avg} = \frac{\text{Total charge flown}}{\text{Total time taken}}$ and $I_{inst} = \frac{dq}{dt}$

Sol.: $I_{inst} = \frac{dq}{dt} = 3 + 10t \Rightarrow I_{2s} = 3 + 10 \times 2 = 23$ A

$$I_{avg} = \frac{\int_0^2 (3+10t)\,dt}{\int_0^2 dt}$$

$$= \frac{[3t]_0^2 + \left[\frac{10t^2}{2}\right]_0^2}{2} = \frac{3\times 2 + 5\times 4}{2} = \frac{6+20}{2} = 13 \text{ A}$$

Required ratio = 13/23

43. Answer (3)

Hint and Sol: For loop *ABCDEFA*

$i_1R + (i_1 - i_3)R + (i_1 - i_3)R - (i_2 + i_3)R - i_2R - i_2R = 0$

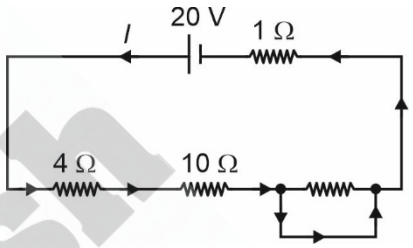
$$\underline{i_1\,R} + \underline{i_1\,R} - \overline{i_3\,R} + \underline{i_1\,R} - \overline{i_3\,R} - \underline{i_2\,R} - \overline{i_3\,R} - \underline{2i_2\,R} = 0$$

$3i_1 - 3i_3 - 3i_2 = 0 \Rightarrow i_1 = i_3 + i_2 \Rightarrow i_3 = i_1 - i_2$

44. Answer (3)

Hint: The potential at point A and B is same

Sol.: Since $V_A = V_B = 0 \Rightarrow$ The 5 Ω resistance is short circuited



$$\Rightarrow R_{eq} = 15\,\Omega$$

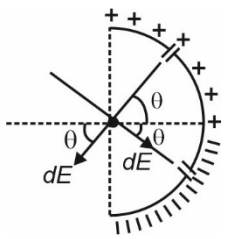
$$\Rightarrow i = \frac{V}{R} = \frac{20}{15} = \frac{4}{3}\text{A}$$

45. Answer (2)

Hint: Use superposition principle

$dE = \frac{k.dq}{r^2}$

Sol.:



The horizontal component of electric field intensity due to two elements on ring will cancel each other and we will be left with only vertical component

$dE_{net} = 2dE\sin\theta$

$$\Rightarrow dE = \frac{2\times k\times\lambda d\theta\cdot r\sin\theta}{r^2}$$

$$\Rightarrow dE = \frac{2k\lambda}{r}\sin\theta d\theta$$

$$\Rightarrow E=\int_0^{\pi/2} dE=\frac{2k\lambda}{r}\int_0^{\pi/2}\sin\theta d\theta$$

$$\Rightarrow \frac{2k\lambda}{r}\left[-\cos\theta\right]_0^{\pi/2}$$

$$\Rightarrow \frac{2k\lambda}{r}\left[-\cos(\pi/2)+\cos 0^\circ\right]\Rightarrow\frac{2\times\lambda}{4\pi\varepsilon_0 r}=\frac{\lambda}{2\pi\varepsilon_0 r}$$

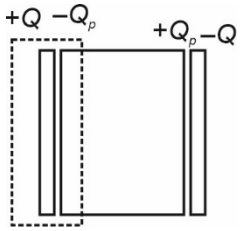
46. Answer (1)

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

Sol.: $\tau=(q\times r)\times\frac{\sigma}{2\varepsilon_0}\times\sin\theta=\frac{\sigma qr}{2\varepsilon_0}\sin\theta$

47. Answer (3)

Hint and Sol:



$$\oint\vec{E}\cdot d\vec{s}=\frac{Q+Q_p}{\varepsilon_0}$$

Also, $Q_p=-Q\left[1-\frac{1}{K}\right]$

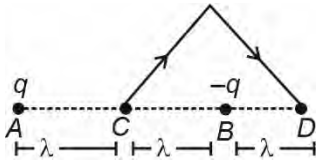
$$\Rightarrow \oint\vec{E}\cdot d\vec{s}=\frac{Q}{\varepsilon_0}-\frac{1}{\varepsilon_0}\left[Q-\frac{Q}{K}\right]=\frac{Q}{\varepsilon_0}-\frac{Q}{\varepsilon_0}+\frac{Q}{K\varepsilon_0}$$

$$\Rightarrow \oint\vec{E}\cdot d\vec{s}=\frac{Q}{K\varepsilon_0}$$

48. Answer (3)

Hint: Work done = change in potential energy

Sol.: $V_c=0$



$V_D=V_{+q}+V_{-q}$,

Now, $V_q=\frac{k.q}{3\lambda}$ and $V_{-q}=-\frac{k.q}{\lambda}$

$$V_D=\frac{kq}{3\lambda}-\frac{kq}{\lambda}$$

$$V_D=\frac{-2kq}{3\lambda}$$

Work done in moving $+Q$ charge

$$=Q[V_D-V_c]=+Q\left(-\frac{2kq}{3\lambda}\right)$$

$$=-\frac{2}{3}\frac{Qq}{\lambda}\times\frac{1}{4\pi\varepsilon_0}=\frac{-qQ}{6\pi\varepsilon_0\lambda}$$

49. Answer (2)

Hint and Sol.: Potential due to induced charge at the centre of the shell is zero.

50. Answer (3)

Hint and Sol:

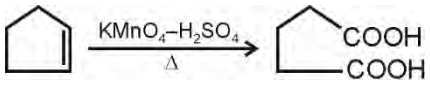
$$\Rightarrow E_0 d=-[V_2-V_1]\Rightarrow d=\frac{(V_1-V_2)}{E_0}$$

[CHEMISTRY]

SECTION-A

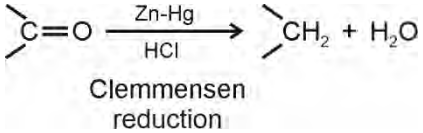
51. Answer (3)

Hint: $KMnO_4$ is a strong oxidising agent.

Sol.: 

52. Answer (4)

Hint: Clemmensen reduction takes place in acidic medium.

Sol.: 

53. Answer (2)

Hint: Species containing $CH_3-\overset{\overset{O}{\|}}{C}-$ and $CH_3-\overset{\overset{OH}{|}}{CH}-$ groups can give iodoform test.

Sol.: $CH_3-CHO\xrightarrow[I_2]{NaOH}HCOONa+\underset{\text{Iodoform}}{CHI_3}$

$CH_3CH_2CHO\xrightarrow[I_2]{NaOH}$ No reaction

54. Answer (2)

Hint: Hydrocarbon with one carbon less is produced when sodium salt of carboxylic acid undergoes decarboxylation.

Sol.: $CH_3CH_2COONa \xrightarrow[\Delta]{NaOH \text{ and } CaO} CH_3CH_3 + Na_2CO_3$

55. Answer (1)

Hint: Electron withdrawing group increases the acidic strength of carboxylic acids.

Sol.: Lesser the acidic strength, more will be the pK_a value

pK_a value : $CF_3COOH < HCOOH < C_6H_5COOH < C_6H_5CH_2COOH$

56. Answer (4)

Hint: Primary alcohols get readily oxidised to carboxylic acids with Jones reagent.

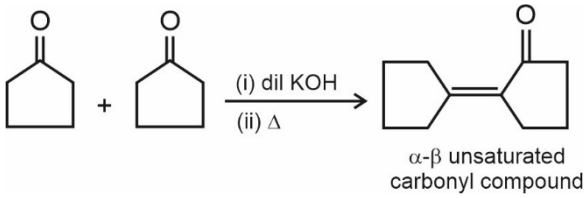
Sol.: This is Stephen reaction

$$CH_3CH_2CN \xrightarrow{SnCl_2+HCl} RCH=NH \xrightarrow{H_3O^+} \underset{\text{Aldehyde}}{CH_3CH_2CHO}$$

57. Answer (2)

Hint: Aldehyde or ketone which contains α-H, on reaction with dil. NaOH undergoes aldol condensation which produces α-β unsaturated carbonyl compound

Sol.:

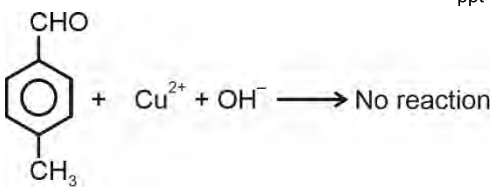


58. Answer (3)

Hint: Aromatic aldehydes does not give Fehling's test.

Sol.:

$$\underset{\text{Aliphatic aldehyde}}{R-CHO} + \underset{\text{Fehling's reagent}}{2Cu^{2+} + 5OH^-} \rightarrow RCOO^- + \underset{\text{Red-brown ppt}}{Cu_2O} + 3H_2O$$



59. Answer (4)

Hint: Oxime is formed when NH_4OH reacts with carbonyl group of aldehyde and ketone.

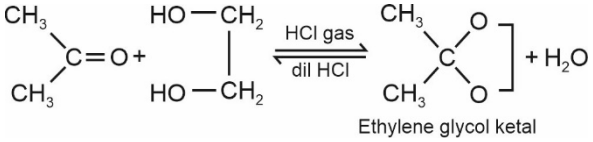
Sol.:

Carbonyl derivative	Product name
$>C=N-NH-Ph$	Phenylhydrazone
$>C=N-NH_2$	Hydrazone
$>C=N-OH$	Oxime
$>C=N-NH-\overset{\overset{O}{\|\|}}{C}-NH_2$	Semicarbazone

60. Answer (1)

Hint: Dry HCl gas increases electrophilicity of carbonyl carbon facilitating the nucleophilic attack of ethylene glycol.

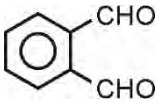
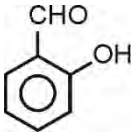
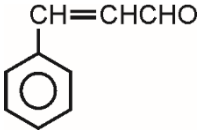
Sol.:



61. Answer (2)

Hint: Benzene-1, 2-dicarbaldehyde is phthalaldehyde

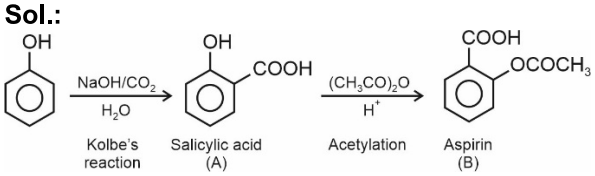
Sol.:

Acrolein	:	$CH_2=CHCHO$
Phthaldehyde	:	
Salicylaldehyde	:	
Cinnamaldehyde	:	

62. Answer (2)

Hint: Phenol on treatment with NaOH gives phenoxide ion which further undergoes electrophilic substitution reaction with CO_2.

Sol.:



63. Answer (2)

Hint: Sucrose breaks down into glucose and fructose in presence of invertase.

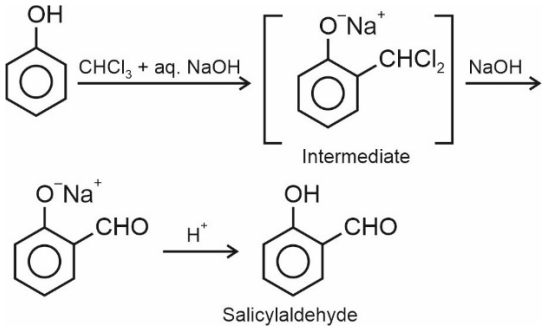
Sol.: Glucose and fructose undergoes fermentation in presence of zymase

$$C_6H_{12}O_6 \xrightarrow{\text{Zymase}} C_2H_5OH + 2CO_2$$

64. Answer (2)

Hint: Reimer Tiemann reaction converts phenol into salicylaldehyde on treatment with chloroform in presence of sodium hydroxide.

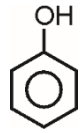
Sol.:



65. Answer (1)

Hint: Electron withdrawing group ($-NO_2$) increases the acidity of phenol.

Sol.:

Compound	pK_a
	7.1
	10.0
	10.2

66. Answer (2)

Hint: Higher the intermolecular force of attraction, higher is the boiling point.

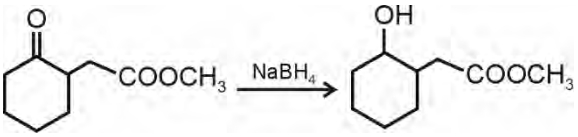
Sol.: Alcohols have higher boiling point than other class of compounds due to stronger intermolecular hydrogen bonding in them.

Boiling Point : n-Pentane < Ethoxypropane < Pentanal < Pentan-1-ol

67. Answer (4)

Hint: $NaBH_4$ cannot reduce ester group.

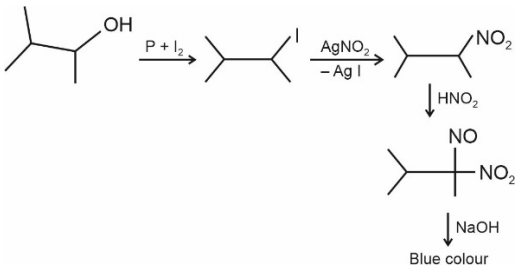
Sol.:



68. Answer (2)

Hint: Secondary alcohol gives blue colour in Victor Meyer test.

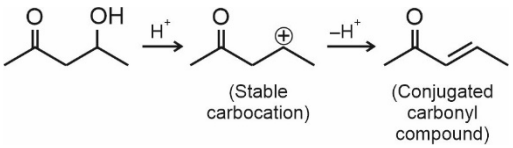
Sol.:



69. Answer (1)

Hint: Higher the stability of carbocation formed, greater is the ease of dehydration. Also conjugated carbonyl compounds formed are more stable.

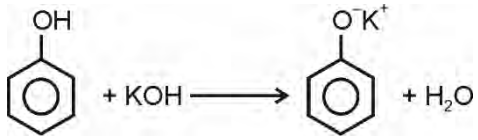
Sol.:



70. Answer (1)

Hint: Compounds which are more acidic than water will react with aqueous alkali

Sol.:



71. Answer (1)

Hint: Ambidentate nucleophile has more than one nucleophilic sites.

Sol.: CN^- has two nucleophilic sites viz, C and N in which attack through C sites leads to formation of alkyl cyanide whereas attack through N leads to formation of isocyanide.

72. Answer (4)

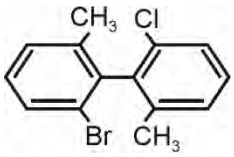
Hint: Gaseous by products are easier to separate.

Sol.: $CH_3CH_2OH + SOCl_2 \rightarrow CH_3CH_2Cl + SO_2 \uparrow + HCl \uparrow$

The obtained by products are gaseous in nature

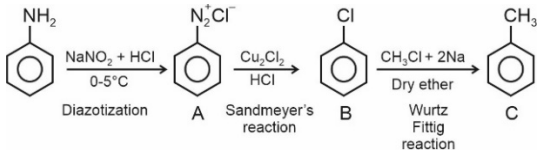
73. Answer (3)

Hint: Biphenyls containing different bulky groups at ortho positions are non-planar

Sol.:  is optically active, as it is non-planar and has no plane of symmetry.

74. Answer (2)

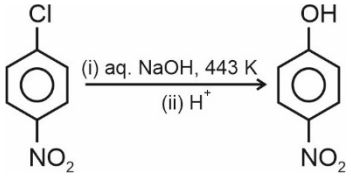
Hint: Alkyl arene is obtained when a mixture of haloalkane and haloarene is treated with sodium in presence of dry ether.

Sol.: 

75. Answer (1)

Hint: Strong electron withdrawing group at ortho or para position in haloarenes increases their reactivity towards nucleophilic substitution reaction.

Sol.: $-NO_2$ is a strong electron withdrawing group.



76. Answer (1)

Hint: More the solvation of ion, lesser is the nucleophilic strength.

Sol.: In polar protic solvent, like ethanol, the order of nucleophilic strength is : $I^- > Br^- > Cl^- > F^-$

77. Answer (3)

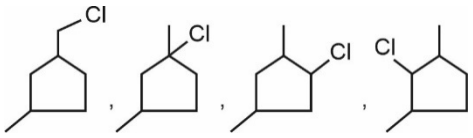
Hint: S_N2 reaction follows second order kinetics.

Sol.: S_N2 is bimolecular nucleophilic substitution reaction and occurs in single step with the formation of transition state and in case of optically active halide Walden inversion takes place.

78. Answer (3)

Hint: More the number of distinct hydrogen atoms, more will be the monochloro derivates of alkane.

Sol.: Possible monochloro derivates of 1, 3-Dimethylcyclopentane are four.



79. Answer (2)

Hint: Greater the molecular mass and lesser the branching in carbon chain, greater is the boiling point of alkane.

Sol.:

Compound	Boiling point /K
2-Methylpropane	261.0
Pentane	309.1
2-Methylbutane	300.9
2, 2-Dimethylpropane	282.5

80. Answer (1)

Hint: Greater the *s* character, more is the acidic strength.

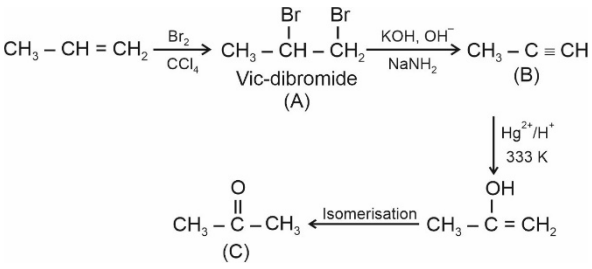
Sol.: Electron donating group decreases the acidic strength

Acidic strength : $HC\equiv CH > CH_3-C\equiv CH > CH_3-CH=CH_2 > CH_3CH_2CH_3$

81. Answer (2)

Hint: Halogens in presence of CCl_4 as solvent undergo electrophilic addition reaction with alkenes and form vicinal dihalides with alkenes.

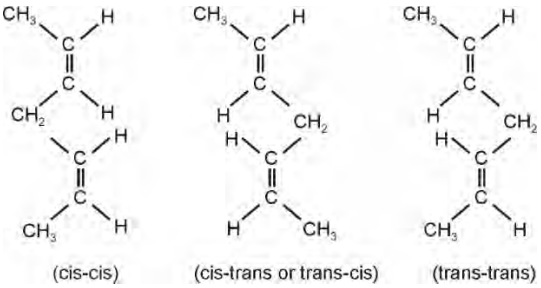
Sol.:



82. Answer (4)

Hint: Geometrical isomers are cis-trans isomers which are obtained on different arrangements of atom around C–C double bond.

Sol.:



(cis-cis) (cis-trans or trans-cis) (trans-trans)

83. Answer (2)

Hint: In Kolbe's electrolysis, the alkane obtained is always symmetrical and higher alkane is formed due to formation of new C–C bond.

Sol.:

$$\underset{\text{Anode}}{\underbrace{2CH_3CH_2COO^-Na^+ + 2H_2O \xrightarrow{\text{Electrolysis}} CH_3CH_2CH_2CH_3 + 2CO_2 +}} \quad \underset{\text{Cathode}}{\underbrace{H_2}} + 2NaOH$$

84. Answer (1)

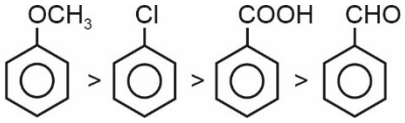
Hint: Wurtz reaction is useful to produce alkanes with even number of carbon atoms.

Sol.: When different types of alkyl halides are taken in Wurtz reaction, a mixture of alkanes are produced.

85. Answer (2)

Hint: Electron donating group increases the reactivity towards electrophilic aromatic substitution.

Sol.: EAS :

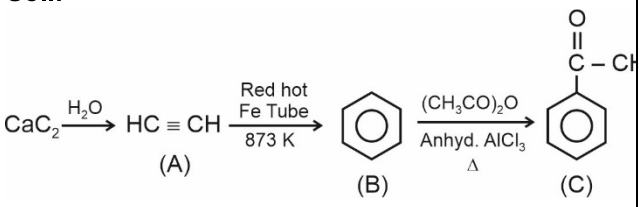


SECTION-B

86. Answer (2)

Hint: Ethyne on passing through red hot iron tube at 873 K undergoes cyclic polymerization.

Sol.:



87. Answer (4)

Hint: Ketones does not give Tollen's test.

Sol.: In Tollen's test, aldehydes are oxidised to corresponding carboxylate anion in basic medium and a silver mirror is produced due to formation of silver metal.

$$\underset{\text{Tollen's reagent}}{R-CHO + 2\left[Ag(NH_3)_2\right]^+ + 3OH^-} \rightarrow RCOO^- + 2Ag + 2H_2O + 4NH_3$$

Basic medium is favourable.

88. Answer (3)

Hint: Acidic $KMnO_4$ acts as strong oxidising agent.

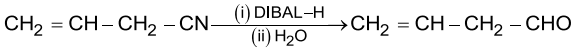
Sol.:

PCC oxidises primary alcohol to aldehydes in good yield.

89. Answer (3)

Hint: DIBAL-H selectivity reduce nitrile to imine which upon hydrolysis gives aldehyde.

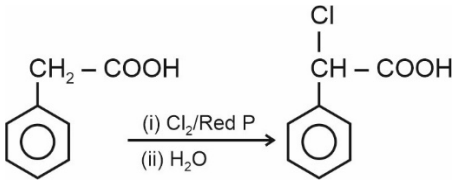
Sol.:



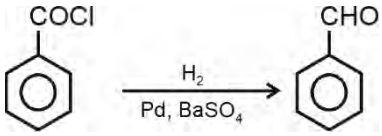
90. Answer (1)

Hint: Etard reaction is used to prepare benzaldehydes from toluene.

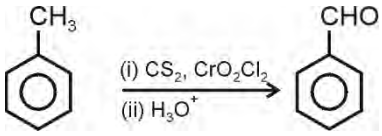
Sol.: • HVZ reaction



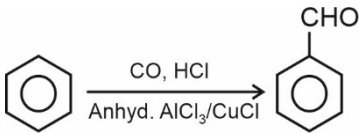
- Rosenmund reduction



- Etard reaction



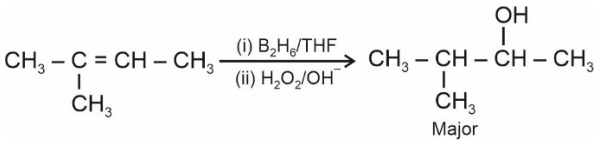
- Gattermann Koch reaction



91. Answer (2)

Hint: In hydroboration oxidation reaction, H_2O is added to alkene on the less substituted carbon with no rearrangement.

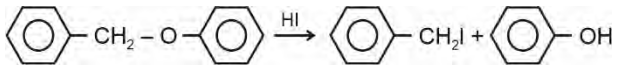
Sol.:



92. Answer (4)

Hint: C – O bond between C of benzene and O has partial double bond character ∴ difficult to break.

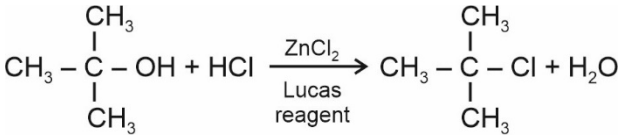
Sol.:



93. Answer (3)

Hint: Tertiary alcohol gives immediate turbidity on treatment with Lucas reagent (conc. HCl and $ZnCl_2$).

Sol.:



94. Answer (3)

Hint: More the stability of carbocation formed, higher is the reactivity towards S_N1 reaction.

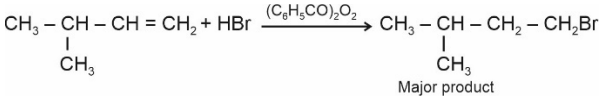
Sol.: ∵ 3° carbocation is most stable,

∴  is most reactive towards S_N1 reaction

95. Answer (4)

Hint: In presence of peroxide, HBr is added to unsymmetrical alkene in accordance to anti-Markovnikov's rule.

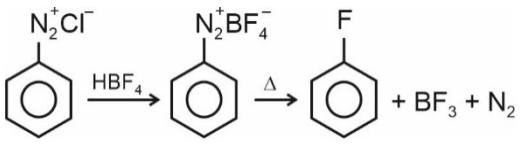
Sol.:



96. Answer (1)

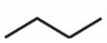
Hint: Benzene diazonium chloride is a very good leaving group

Sol.:



97. Answer (2)

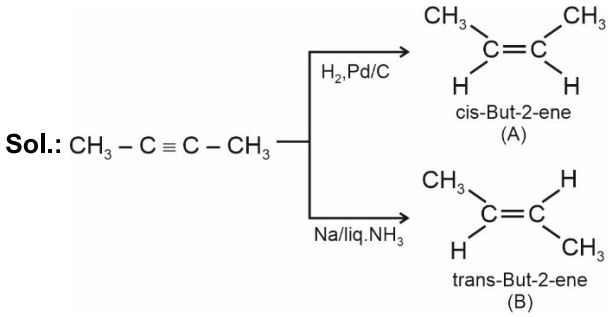
Hint: Less hindered carboxylic acids undergo esterification more readily.

Sol.:  acid having minimum steric hindance, hence it will undergo esterification most readily as the tetrahedral intermediate formed will be more stable.

98. Answer (1)

Hint: Alkynes on treatment with Lindlar's catalyst (Pd/C) yields cis-alkene

Sol.:

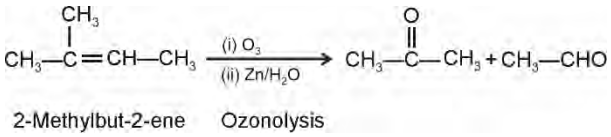


The cis isomer is more polar than trans isomer as the dipole moment of trans isomers is almost zero. The trans isomer has higher melting point then the cis form.

99. Answer (1)

Hint: Upon ozonolysis, the carbon-carbon double bond is cleaved and get converted into carbonyl compounds.

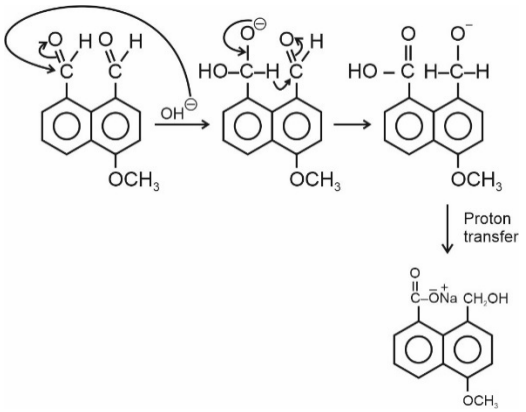
Sol.:



100. Answer (3)

Hint:
- Aldehyde with no α-H undergoes Cannizzaro reaction.
- Attack of nucleophile on aldehyde is selected on the basis of electron deficiency in a molecule.

Sol.:



[BOTANY]

SECTION-A

101. Answer (3)

Hint: Mutation is a phenomenon which results in alteration of DNA sequences that leads to variations.

Sol.: Change in segment of DNA, results alteration in chromosomes leading to chromosomal abnormalities or aberrations, which are commonly observed in cancer cells.

102. Answer (1)

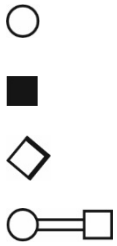
Hint: Out cross is a cross between F_1 hybrid and its dominant parent.

Sol. : Monohybrid cross is used to study inheritance of one gene.

103. Answer (4)

Hint: Consanguineous mating is mating between relatives

Sol.:



→ Unaffected female

→ Affected male

→ Sex unspecified

→ Consanguineous mating

104. Answer (4)

Hint: Male heterogamety is ability of males to produce two different types of gametes as they have heteromorphic sex chromosomes.

Sol.: Grasshopper, humans and *Drosophila* show male heterogamety.

Birds show female heterogamety (ZW).

105. Answer (1)

Hint: Phenylalanine hydroxylase enzyme normally converts the amino acid phenylalanine into tyrosine.

Sol.: Mutation in the given gene results in defective enzyme resulting in accumulation of phenylalanine.

106. Answer (3)

Hint: In a cross between recessive female and dominant male w.r.t. eye colour and body colour in *Drosophila,* there were 98.7% parental types and 1.3% recombinants in F_2 generation.

Sol.: 1.3% recombinants include 50% males and 50% females so, males with recombinant genotypes will be $\frac{1.3}{2} = 0.65\%$

107. Answer (4)

Hint: Characters like eye colour, body colour and wing size of *Drosophila* have contrasting traits.

Sol.: White eye colour, yellow body colour and miniature wing size are recessive traits.

108. Answer (4)

Hint: An individual with O blood group has genotype $I^{\circ}I^{\circ}$ (also represented as *ii*)

Sol.:

$I^A I^B$ × $I^A I^{\circ}$

(AB) (A)

	I^A	I^B
I^A	$I^A I^A$ (A)	$I^A I^B$ (AB)
I°	$I^A I^{\circ}$ (A)	$I^B I^{\circ}$ (B)

No progeny will have O blood group if parents have AB and A blood group.

109. Answer (3)

Hint: Law of dominance is based on the results of monohybrid cross.

Sol.: Law of dominance is used to explain the expression of only one of the traits of a character in a monohybrid cross.

110. Answer (1)

Hint: Phenylketonuria (PKU) is an autosomal recessive disorder caused due to mutation in single gene.

Sol.: Down's syndrome is an autosomal trisomy of chromosome 21.

Klinefelter's syndrome is a sexual trisomy (44 + XXY) and Turner's syndrome is sexual monosomy (44 + X0).

111. Answer (1)

Hint: Pleiotropism is the phenomenon when a single gene produces more than one phenotypic effect.

Sol.: In co-dominance F_1 hybrid resembles to both the parents equally. In incomplete dominance, F_1 hybrid does not resemble to any of its parents instead an intermediate phenotype between the two is produced. Multiple allelism is occurrence of more than two alleles for one particular gene.

112. Answer (1)

Hint: Types of gametes are determined by number of heterozygous condition.

Sol.: Types of gametes = 2^n where, 'n' is number of heterozygous condition.

Thus, $2^2 = 4$ types of gametes will be produced.

113. Answer (3)

Hint: Genes are units of inheritance. They contain the information that is required to express a particular trait.

Sol.: Genes which code for a pair of contrasting traits are known as alleles, *i.e.*, they are slightly different forms of the same gene.

114. Answer (3)

Hint: Dominant trait expresses itself in both heterozygous as well as homozygous condition.

Sol.: Green seed, terminal flower and white flower are recessive traits. Green pod colour is dominant trait.

115. Answer (1)

Hint: Emasculation is removal of anthers before their maturation from bisexual flowers during artificial hybridisation.

Sol.: Parthenocarpy is formation of fruits without fertilisation. Polyembryony is occurrence of more than one embryo within an embryo sac. Apomixis is formation of seed without fertilisation.

116. Answer (4)

Hint: Cross pollination increases genetic variations.

Sol.: Geitonogamy is transfer of pollen grains from the anther to the stigma of another flower of the same plant. It is functionally cross pollination but genetically similar to autogamy and hence will not increase genetic variation.

Self-pollination or autogamy increases homozygosity. Dioecious condition prevents both autogamy as well as geitonogamy.

117. Answer (4)

Hint: Largest cell of embryo sac is central cell.

Sol.: Central cell is the largest cell having two polar nuclei which participate in triple fusion. Egg apparatus is three celled, three nucleated, present towards micropylar end having two synergids and one non motile female gamete.

- Synergids have filiform apparatus to guide the entry of pollen tube.

118. Answer (2)

Hint: Integuments are outermost protective covering of megasporangium or ovule enclosing cells with abundant reserve food materials.

Sol.: Micropyle is the point where integuments are absent, for entry of pollen tube. Chalaza is basal portion of ovule opposite to micropyle.

Funicle is stalk by which ovules are attached to placenta.

119. Answer (3)

Hint: Pollen grains or micropores are male gametophytes.

Sol.: Each microspore mother cells undergoes meiotic division to produce four haploid microspores or pollens. Thus, to produce 64 microspores, number of meiotic divisions required

$= \frac{64}{4} = 16$ meiotic divisions.

120. Answer (4)

Hint: Multicarpellary apocarpous condition represents many carpels, free from each other.

Sol.: *Hibiscus*, *Papaver* and tomato have multicarpellary syncarpous condition but *Michelia* exhibits multicarpellary apocarpous condition.

121. Answer (3)

Hint: Cleistogamous flowers are closed flowers which never open at all.

Sol.: In cleistogamy there is no requirement of pollinating agents and autogamy is ensured.

122. Answer (4)

Hint: Pollens lose viability within 30 minutes of their release in some cereals such as rice and wheat.

Sol.: Pollens in some members of Rosaceae, Leguminosae and Solanaceae, maintain viability for several months.

123. Answer (2)

Hint: Pollen grains are carrier of male gametes.

Sol.: In angiosperms, pollen grains are generally spherical structures measuring 25-50 µm in diameter.

124. Answer (3)

Hint: Typical anther consist of four microsporangia.

Sol.: Stamen is male reproductive part of flower. It has two parts, long slender stalk called the filament and terminal anther. The proximal end of the filament is attached to the thalamus or the petal of the flower. A typical angiosperm anther is bilobed and tetrasporangiate.

125. Answer (4)

Hint: The innermost layer of anther wall which provides nourishment to developing pollen grains.

Sol.: Tapetum is the innermost, nutritive layer of anther wall. Cells of this layer show increased DNA content like polyploid, or multinucleate condition.

126. Answer (1)

Hint: In budding, due to unequal cytokinesis an outgrowth or protuberance is formed known as bud, which detaches and grows into complete individual.

Sol.: In binary fission, parent cell itself divides into two equal daughter cells thus, parent cell loses its identity and disappears.

127. Answer (3)

Hint: In majority of organisms, oogamous type of reproduction is observed where male gamete is small and motile and female gamete is large and stationary.

Sol.: Gametes are haploid and can be produced by either mitosis or by meiosis depending upon the ploidy of the gamete mother cell.

Meiocyte of apple contains 34 chromosomes it produces gametes by meiosis, thus, gametes are haploid having 17 chromosomes.

128. Answer (1)

Hint: Heterogametes are produced by majority of sexually reproducing organisms.

Sol.: *Fucus, Chara* and humans produce morphologically dissimilar gametes, *i.e.*, heterogametes.

129. Answer (1)

Hint: Plants showing flowering and fruiting once in their life span are monocarpic plants. All annuals, all biennials and few perennials plants are monocarpic.

Sol.: Rice, bamboo species and Neelakurinji Strobilanthes kunthiana are monocarpic plants. Mango is a polycarpic plant.

130. Answer (4)

Hint: Every sexually reproducing organism has three phases in life *i.e.*,

(1) Juvenile phase

(2) Mature phase

(3) Senescent phase

Sol.: The period of growth from birth to reproductive maturity is pre-reproductive phase which is known as juvenile phase in animals and vegetative phase in plants.

131. Answer (3)

Hint: 'Water hyacinth' is one of the most invasive weeds, that propagates rapidly by offset formation.

Sol.: Water hyacinth drains out oxygen from the water, which leads to the death of fishes, thus also known as Terror of Bengal or scourge of water bodies.

132. Answer (2)

Hint: *Bryophyllum* shows formation of leaf buds. Rhizome is found in ginger.

Sol.: Water hyacinth is an aquatic plant. Its propagation occurs by breaking of offset.

133. Answer (3)

Hint: Asexual reproduction involves single parent.

Sol.: Asexual reproduction is uniparental. It may or may not involve gamete formation and gametic fusion is absent. Progenies which are genetically and morphologically similar are known as clones.

134. Answer (1)

Hint: In dioecious plants male and female reproductive parts are present on two different plant bodies.

Sol.: *Chara* is mostly monoecious *i.e.,* male and female reproductive parts are present on same plant body.

135. Answer (4)

Hint: Life span is a specific trait of each organism and is not necessarily correlated with size or complexity of organisms.

Sol.: Life span is the period from birth to the natural death of an organism. Mango tree has much shorter life span as compared to peepal tree.

SECTION-B

136. Answer (4)

Hint: Down's syndrome is due to trisomy of chromosome 21. It was first described by Langdon Down (1866).

Sol.: The affected individual is short statured with small round head, furrowed tongue and partially open mouth.

Palm is broad with characteristic palm crease. Physical, psychomotor and mental development is retarded.

Down's syndrome occurs due to aneuploidy not due to polyploidy.

137. Answer (3)

Hint : Substitution is replacement of one base pair or nucleotide with another.

Sol.: Failure of cytokinesis after telophase stage of cell division results in an increase in whole set of chromosomes and this is known as polyploidy. Aneuploidy is due to failure of segregation of chromatids during cell division.

138. Answer (1)

Hint: Alfred Sturtevant mapped the distance between genes on the chromosome.

Sol.: Thomas Hunt Morgan carried out several dihybrid in *Drosophila* to study genes that were sex linked.

He also coined the term linkage.

139. Answer (2)

Hint: Colour blindness is sex linked (X-linked) recessive disorder which is more commonly expressed in males and very rarely in females.

Sol.: Colour blindness occurs in about 8% males and 0.4% females in a population.

140. Answer (4)

Hint: X-linked recessive disorders show criss-cross inheritance pattern.

Sol.: Haemophilia is an X-linked recessive disorder which shows its transmission from unaffected (carrier) female to some of the male progenies.

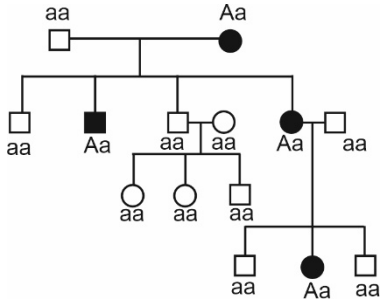
Sickle cell anaemia, phenylketonuria and thalassemia are autosomal recessive disorders.

141. Delete

Hint: In this pattern of inheritance, a single copy of the mutated gene is enough to cause the disorder.

Sol.:

- In 1st generation male parent is unaffected but its male child is affected thus it cannot be Y-linked.
- It is not showing criss-cross inheritance pattern, thus, it is not X-linked recessive.
- Every generation is showing the effect thus, it is an autosomal dominant trait.



142. Answer (4)

Hint: In XX – XO type of sex determination (male heterogamety), males produce 50% of sperms without sex chromosomes.

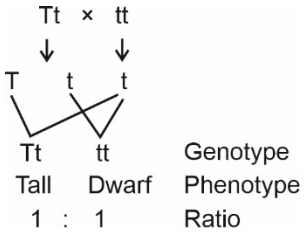
Sol.: Birds and butterflies show female heterogamety.

Drosophila shows XX–XY type of sex determination.

143. Answer (4)

Hint: Test cross is a cross between F_1 hybrid and its recessive parent.

Sol.: Both genotypic and phenotypic ratios are same in the result of test cross *i.e.* 1 : 1



144. Answer (2)

Hint: Selfing is crossing the members of same genotypes.

Sol.: RrYy × RrYy → Parents

	R	r
R	RR	Rr
r	Rr	rr

	Y	y
Y	YY	Yy
y	Yy	yy

$Rr \rightarrow \frac{2}{4}$ $\quad YY \rightarrow \frac{1}{4}$

$\therefore RrYy \rightarrow \frac{2}{4} \times \frac{1}{4} \Rightarrow \frac{2}{16}$

145. Answer (2)

Hint: ABO blood group is controlled by gene *I* which has three alleles I^A, I^B and *i*.

Sol.: A total of six different genotypes and four different phenotypes are possible for human ABO blood group in the population.

146. Answer (3)

Hint: When the pollen grain matures it contains two cells, the vegetative cell and generative cell. Vegetative cell is bigger in size, has abundant food reserve and a large irregularly shaped nucleus.

Sol.: The generative cell is small and floats in the cytoplasm of the vegetative cell. It is spindle shaped with dense cytoplasm and nucleus. It divides mitotically to give rise to the two male gametes.

147. Answer (3)

Hint: Cells of middle layers of anther wall are ephemeral.

Sol.: Cells of the middle layers of anther wall are short lived and degenerate at maturity.

148. Answer (3)

Hint: Sporogenous tissue occupies the centre of each microsporangium in the anther.

Sol.: Wind and water pollinated flowers are not very colorful and do not produce nectar.

149. Answer (3)

Hint: Rice plant is an annual plant

Sol.: (1) Rose Plant → 5-7 years

(2) Banana Tree → 25 years

(3) Rice Plant → 3-4 months

(4) Banyan Tree → 200-300 years

150. Answer (4)

Hint: Flowering plants are angiosperms, in which male gametes are non-motile.

Sol.: In most of the algae, bryophytes and pteridophytes, male gametes are small, motile, flagellated and are transferred with the help of water. In angiosperms male gametes are non-motile which are carried via pollen grains.

[ZOOLOGY]

SECTION-A

151. Answer (2)

Hint : Secretion of gonadotropins increases gradually during this phase

Sol. : In proliferative phase, regeneration of endometrium occurs.

Ovarian cycle has three phases – Ovulatory phase, follicular phase and luteal phase. In uterine cycle, proliferative phase is followed by secretory phase.

152. Answer (2)

Hint : Gametes are haploid.

Sol. : In fruitfly number of chromosomes in meiocyte and gamete are 8 and 4 respectively.

The chromosome number in meiocyte and gamete of butterfly are 380 and 190 respectively.

153. Answer (4)

Hint : Action of Cu^{2+} ions

Sol. : IUDs increase phagocytosis of sperms within the uterus and the Cu ions released suppress sperm motility and the fertilising capacity of sperms. The hormone releasing IUDs, in addition, make the uterus unsuitable for implantation and the cervix hostile to the sperm.

154. Answer (1)

Hint : Corona radiata is present outside the zona pellucida

Sol. : The secretions of the acrosome help the sperm to enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane. The secretions of the acrosome help the sperm to first dissolve the corona radiata.

155. Answer (3)

Hint : Occurs before follicular phase

Sol. :
- Menstrual cycle starts with the menstrual phase, when menstrual flow occurs and it lasts for 3-5 days.
- On 14^{th} day, rapid secretion of LH leading to its maximum level (LH surge) induces rupture of Graafian follicle and thereby the release of ovum (ovulation). Post-ovulatory phase is always of 14 days.

156. Answer (4)

Hint : Inserted by doctors or expert nurses

Sol. : IUDs are ideal contraceptives for the females who want to delay pregnancy and/or space children. It is one of most widely accepted methods of contraception in India.

157. Answer (3)

Hint : Narrow lumen

Sol. : Each fallopian tube is about 10-12 cm long and extends from the periphery of each ovary to the uterus, the part closer to the ovary is the funnel-shaped infundibulum. The edges of the infundibulum possess finger-like projections called fimbriae, which help in collection of the ovum after ovulation. The infundibulum leads to a wider part of the oviduct called ampulla. The last part of the oviduct, isthmus has a narrow lumen and it joins the uterus.

158. Answer (4)

Hint : Cowper's gland

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

159. Answer (1)

Hint : Chemical contraceptive

Sol. : Diaphragms, cervical caps and vaults are barriers made of rubber that are inserted into the female reproductive tract to cover the cervix during coitus. They prevent conception by blocking the entry of sperms through the cervix. They are reusable. Spermicidal creams, jellies and foams are usually used alongwith these barriers to increase their contraceptive efficiency.

160. Answer (4)

Hint : Hormonal contraceptive

Sol. : Progestasert is a hormone releasing IUD. Lactational amenorrhoea, coitus interruptus and periodic abstinence are natural methods of contraception.

161. Answer (4)

Hint : Used in infertility cases due to low sperm count in ejaculate

Sol. : In artificial insemination (AI), the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus (IUI – intra-uterine insemination) of the female.

162. Answer (3)

Hint : Developed at CDRI, Lucknow

Sol. : Saheli–the new oral contraceptive for the females contains a non-steroidal preparation. It is a 'once a week' pill with very few side effects and high contraceptive value.

163. Answer (4)

Hint : Few side effects and high contraceptive value

Sol. : Progestogens alone or in combination with estrogen can also be used by females as injections or implants under the skin. Their mode of action is similar to that of oral contraceptives pills and their effective periods are much longer.

164. Answer (4)

Hint : Disease caused by bacteria

Sol. : Except for hepatitis-B, genital herpes and HIV infections, other diseases are completely curable if detected early and treated properly.

165. Answer (1)

Hint : The fraction of blood in each cardiac output filtered by kidneys in a minute

Sol. : Intentional or voluntary termination of pregnancy before full term is called medical termination of pregnancy (MTP) or induced abortion. Nearly 45 to 50 million MTPs are performed in a year all over the world which accounts to 1/5th of the total number of conceived pregnancies in a year.

166. Answer (4)

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

Sol. : In Intra Uterine Insemination (IUI), the semen collected either from the husband or a healthy donor is artificially introduced into the uterus of the female.

167. Answer (2)

Hint : Water canal system

Sol. : Gemmules are present in freshwater sponges such as *Spongilla* and in certain marine sponges *e.g.*, *Sycon*.

168. Answer (3)

Hint : Limbs are well developed by the end of first trimester.

Sol. : By the end of the second month of pregnancy, the foetus develops limbs and digits. By the end of 12 weeks (first trimester), most of the major organ systems are formed, for example, the limbs and external genital organs are well developed.

169. Answer (4)

Hint : 2nd phase of menstrual cycle

Sol. :
- Sertoli cells are regulated by FSH. FSH stimulates follicular development as well as secretion of estrogens by the growing follicles.
- LH causes the transformation of the ruptured follicle to corpus luteum.
- Estrogen increases the thickening of the endometrium.
- Prolactin is involved in the secretion of milk after childbirth.

170. Answer (1)

Hint : Transfer of semen (sperms) into the female genital tract is termed as insemination

Sol. : Spermiogenesis

(Transformation of spermatids into spermatozoa)

↓

Spermiation

(Release of sperms from the seminiferous tubules)

↓

Ejaculation

(Release of semen from the male reproductive system through urethra)

↓

Insemination

(Release of semen into the female genital tract)

171. Answer (4)

Hint : Outer protective layer of uterus

Sol. : The wall of the uterus has three layers of tissues. The external thin membranous perimetrium, middle thick layer of smooth muscle, myometrium and inner glandular layer called endometrium that lines the uterine cavity.

172. Answer (2)

Hint : These extend down from the mons pubis

Sol. : The labia majora are fleshy folds of tissue, which extend down from the mons pubis and surround the vaginal opening. The labia minora are paired folds of tissue under the labia majora. The opening of the vagina is often covered partially by a membrane called hymen. The clitoris is a tiny finger-like structure which lies at the upper junction of the two labia minora above the urethral opening.

173. Answer (4)

Hint : Provides lower temperature

Sol. : The testes are situated outside the abdominal cavity within a pouch called scrotum.

Each testis has about 250 compartments called testicular lobules.

174. Answer (1)

Hint : The part cut and tied in vasectomy.

Sol. : The seminiferous tubules of the testis open into the vasa efferentia through rete testis. The vasa efferentia leave the testis and open into epididymis located along the posterior surface of each testis. The epididymis leads to vas deferens that ascends to the abdomen and loops over the urinary bladder. It receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.

175. Answer (1)

Hint : Lippes loop is an inert IUD

Sol. : LNG-20 and progestasert are hormone releasing IUDs.

Multiload 375, Cu7 and CuT are copper releasing IUDs. Lippes loop is an example of non-medicated IUDs.

176. Answer (2)

Hint : Same ploidy as that of oogonia

Sol. :

	Structure	**Ploidy**
(a)	Polar body	– Haploid (n)
(b)	Spermatid	– Haploid (n)
(c)	Secondary oocyte	– Haploid (n)
(d)	Primary spermatocyte	– Diploid (2n)

177. Answer (3)

Hint : Both maternal and foetal parts are involved in the formation

Sol. : The chorionic villi (foetal part) and uterine tissue (maternal part) become interdigitated with each other and jointly form placenta.

The blastomeres in the blastocyst are arranged into an outer layer called trophoblast and an inner group of cells attached to trophoblast called the inner cell mass.

178. Answer (4)

Hint : Ten times the number of facial bones in humans

Sol. :

	Organism	**Approximate life span (in years)**
(a)	Crow	15
(b)	Parrot	140
(c)	Tortoise	100-150
(d)	Crocodile	60

179. Answer (3)

Hint : Ovarian hormones

Sol. : During pregnancy, hCG is secreted by placenta and high levels of circulating hCG maintain the corpus luteum beyond its normal life time. Corpus luteum continues to secrete progesterone and estrogen. Progesterone maintains the endometrium in nutrient rich state.

180. Answer (3)

Hint : The structure transforms into a structure having fluid filled cavity.

Sol. : The embryo with 8 to 16 blastomeres is called a morula. The morula continues to divide and transforms into blastocyst having fluid filled cavity (blastocoel).

181. Answer (4)

Hint : Hormones which are proteinaceous

Sol. : Placenta acts as a temporary endocrine tissue and produces several hormones like hCG, hPL, estrogens, progestogens, *etc*.

In the later phase of pregnancy, a hormone called relaxin is also secreted by the ovary.

hCG, hPL (produced by placenta) and relaxin (produced by corpus luteum in ovary) are produced in women only during pregnancy.

182. Answer (3)

Hint : A temporary endocrine tissue

Sol. : The signals for parturition originate from the fully developed foetus and the placenta which induce mild uterine contractions called foetal ejection reflex.

183. Answer (3)

Hint : Universal structure in all sexually reproducing organisms

Sol. : Zygote is the vital link that ensures continuity of species between organisms of one generation and the next. Every sexually reproducing organism, including human beings begin life as a single cell– the zygote.

184. Answer (2)

Hint : Crop and gizzard.

Sol. : Birds (*Pavo*) and reptiles (*Testudo*) possess cleidoic eggs (eggs covered by hard calcareous shell).

In many terrestrial organisms belonging to higher vertebrates such as reptiles, birds and mammals, syngamy occurs inside the body of the organism called internal fertilisation.

185. Answer (2)

Hint : Member of largest phylum

Sol. : Animals which possess both male and female reproductive organs are called hermaphrodite (bisexual) animals.

Earthworm, sponge, tapeworm and leech are the examples of hermaphrodites.

Cockroach is an example of a unisexual organism.

SECTION-B

186. Answer (3)

Hint : More than no. of phalanges in each human limb

Sol. : Day of ovulation = No. of days in menstrual cycle – 14

= (32 – 14) day

= 18^{th} day

187. Answer (1)

Hint : Milk is sucked out through lactiferous duct

Sol. : The glandular tissue of each breast is divided into 15-20 mammary lobes containing clusters of cells called alveoli. The cells of alveoli secrete milk, which is stored in the cavities (lumens) of alveoli. The alveoli open into mammary tubules. The tubules of each lobe join to form a mammary duct.

188. Answer (4)

Hint : Process before spermiation

Sol. : FSH acts on the Sertoli cells and stimulates secretion of some factors which help in the process of spermiogenesis.

189. Answer (4)

Hint : Identify the female reproductive part.

Sol. : Secretions of epididymis, vas deferens, seminal vesicles and prostate are essential for maturation and motility of sperms. The seminal plasma along with the sperms constitute the semen.

190. Answer (2)

Hint : The seminal plasma along with the sperms constitute the semen.

Sol. : 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.

191. Answer (2)

Hint : Function of zygote

Sol. : Reproduction is defined as a biological process in which an organism gives rise to young ones (offspring) similar to itself. The offspring grow, mature and in turn produce new offsprings. Thus, there is a cycle of birth, growth and death. Reproduction enables the continuity of the species, generation after generation.

192. Answer (1)

Hint : Chromosome number in gamete of dog is less than number of chromosomes in meiocyte of human beings.

Sol. :

	Chromosome no. in meiocyte (2n)	**Chromosome no. in gamete (n)**
Human beings	46	23
Dog	78	39

193. Answer (1)

Hint : Nucleus to cytoplasmic ratio increases.

Sol. : Morula has almost equal quantity of cytoplasm as an uncleaved zygote but much more DNA.

194. Answer (3)

Hint : Stimulates corpus luteum to secrete hormones

Sol. : Both LH and FSH attain a peak level in the middle of 28 days menstrual cycle (14^{th} day). Rapid secretion of leading to LH surge induces ovulation. (Ovulation is also assisted by increased levels of FSH and estrogen).

195. Answer (3)

Hint : Syphilis can be treated by antibiotics

Sol. :

	STI	Causative agent
1.	Chlamydiasis	*Chlamydia trachomatis*
2.	Gonorrhoea	*Neisseria gonorrhoea*
3.	Trichomoniasis	*Trichomonas vaginalis*
4.	Genital Herpes	Herpes simplex virus

196. Answer (2)

Hint : Implantation takes place in the innermost wall of uterus.

Sol. :
- In human females, the blastocyst gets implanted in endometrium by the trophoblast cells.
- The second maturation division of the mammalian ovum is completed only after the ovum has been penetrated by a sperm.
- The second maturation of the human sperm takes place in the testis.

197. Answer (1)

Hint : Pills are repeated after the gap of 7 days.

Sol. : Pills have to be taken daily for a period of 21 days starting preferably within the first five days of menstrual cycle. After a gap of 7 days (during which menstruation occurs) it has to be repeated in the same pattern till the female desires to prevent conception.

198. Answer (3)

Hint : Humans have XX-XY type of sex determination.

Sol. :
- Both primary spermatocytes and primary oocytes are diploid (2n) structures formed after mitosis differentiation from spermatogonia and oogonia, respectively.
- Primary spermatocytes have 46 chromosomes *i.e.*, 44 autosomes, one X-chromosome and one Y-chromosome.
- Primary oocyte has 46 chromosome *i.e.*, 44 autosomes and two X-chromosomes.

199. Answer (3)

Hint : Capacitation involves removal of membrane cholesterol present over acrosome.

Sol. : After insemination, capacitation of sperm occurs in the female genital system and it refers to changes in the sperm before fertilization.

200. Answer (2)

Hint : Participate in menstruation

Sol. : Ectopic pregnancy is referred to implantation of embryo at a site other than uterus.

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