



Aakash

Medical | IIT-JEE | Foundations

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

(Advanced INTENSIVE Mastery for 720)

MM : 720

CST-I

Time : 3 Hrs. 20 Min.

Answers

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

02/04/2024



CODE-A

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Answers & Solutions

PHYSICS

SECTION-A

1. Answer (1)
Distance travelled in 3rd second

$$S_3 = u + \frac{a}{2} (2n - 1)$$

$$a = \frac{10}{20} = \frac{1}{2} \text{ m s}^{-2}$$

$$S_3 = \left(\frac{1}{2}\right) \left(\frac{1}{2}\right) (6 - 1) = \frac{5}{4} \text{ m}$$

$$\text{work done} = 10 \times \frac{5}{4} = \frac{50}{4} \text{ J} \\ = 12.5 \text{ J}$$

2. Answer (2)

$$v = \frac{1}{2} t^2$$

$$a_t = \frac{dv}{dt} = t \text{ m s}^{-2}$$

at $t = 2 \text{ s}$

$$|\vec{F}| = ma$$

$$= 5 \times 2 = 10 \text{ N}$$

$$P = |\vec{F} \cdot \vec{v}|$$

$$= 10 \times \frac{1}{2} \times 4 \text{ W}$$

$$P = 20 \text{ W}$$

3. Answer (1)

When the capacitor becomes short-circuited phase difference ϕ will increase

$$\tan\phi = \frac{X_L - X_C}{R}$$

If $X_C = 0$ tan ϕ will increase.

4. Answer (4)

$$U = \frac{1}{2} LI^2 = \frac{1}{2} L \frac{V^2}{R^2}$$

$$U' = \frac{1}{2} \frac{L}{16} \left(\frac{16V}{R}\right)^2$$

$$\frac{U}{U'} = \frac{1}{16}$$

$$\Rightarrow U' = 16U$$

5. Answer (3)

For emitting photoelectrons

$$\phi_0 < E$$

For Mo and Ca work function is less than 4.20 eV.

6. Answer (4)

$$R = R_0 (A)^{\frac{1}{3}}$$

$$\frac{R_1}{R_2} = \frac{R_0 (27)^{\frac{1}{3}}}{R_0 (8)^{\frac{1}{3}}} = \frac{3}{2}$$

7. Answer (2)

$$Y = \overline{A+B}$$

i.e. NOR gate

8. Answer (2)

D_1 is reverse-biased and D_2 is forward-biased

$$\text{So current through } R_3, i = \frac{20}{6+4} = 2 \text{ A}$$

9. Answer (2)

$$y = 10 \sin\pi (0.01 \times x - 2.00 t)$$

$$v = \frac{\omega}{k}$$

$$v = \frac{2}{0.01}$$

$$v = 200 \text{ cm/s}$$

10. Answer (3)

$$E = \frac{Kq}{r^2}$$

$$\frac{E_1}{E_2} = \frac{(3R)^2}{(2R)^2}$$

$$= \frac{9}{4}$$

11. Answer (4)

$$dV = -E_y dy$$

$$\int_{V_A}^{V_B} dV = - \int_{4}^{1} 10 dy$$

$$V_B - V_A = -10 (1 - 4) \\ = 30 \text{ volt}$$

12. Answer (2)

$$a + 4\pi^2 x = 0$$

$$\omega = \sqrt{4\pi^2} \\ = 2\pi$$

$$T = \frac{2\pi}{2\pi} \\ = 1 \text{ s}$$

13. Answer (1)

$$\text{We know, } \tau = I(\alpha)$$

$$20 = 10 (\alpha)$$

$$\therefore \alpha = 2 \text{ rad/s}^2$$

$$\text{Also, } \omega = \omega_0 + \alpha t$$

$$\omega = (2)(4) = 8 \text{ rad/s}$$

14. Answer (3)

According to perpendicular axes theorem

$$I_d + I_d = \frac{MR^2}{2}$$

$$\therefore I_d = \frac{MR^2}{4}$$

15. Answer (4)

$$\text{We know, } mg' = mg \left(1 - \frac{d}{R}\right)$$

$$\text{for } mg' = 0$$

$$1 - \frac{d}{R} = 0 \quad \boxed{\therefore d = R}$$

16. Answer (2)

We know,

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

$$B = -\frac{10 \times 10^6}{\frac{0.2}{100}} = 5 \times 10^9 \text{ Pa}$$

$$B = 5 \text{ GPa}$$

17. Answer (3)

$$[\text{Work}] = [\text{KE}] = [\text{ML}^2\text{T}^{-2}]$$

$$[\text{Torque}] = [\text{PE}] = [\text{ML}^2\text{T}^{-2}]$$

$$[\text{Force}] = [\text{MLT}^{-2}]$$

$$[\text{Pressure}] = [\text{ML}^{-1}\text{T}^{-2}]$$

$$[\text{Angular momentum}] = [\text{Planck's constant}] \\ = [\text{ML}^2\text{T}^{-1}]$$

18. Answer (3)

Athlete completes one round in 20 second. In 2 minutes 20 seconds he would have completed 7 rounds hence the displacement of athlete would be zero.

19. Answer (3)

$$a = \frac{dv}{dt} = 6 - 3v, \text{ at } t = 0, v = 0 \Rightarrow a = 6 \text{ m/s}^2$$

20. Answer (1)

We know that equation of trajectory is given by,

$$y = xt \tan\theta - \frac{gx^2}{2u^2 \cos^2 \theta}$$

$$h = dt \tan\theta - \frac{gd^2}{2u^2 \cos^2 \theta}$$

$$\Rightarrow h + \frac{gd^2}{2u^2 \cos^2 \theta} = d \tan\theta$$

21. Answer (2)

We know that $F = \frac{dp}{dt} \Rightarrow dp = Fdt$ i.e, impulse of the force is given by the area under force-time curve.

$$\text{Impulse} = \frac{1}{2} \times 6 \times 4 = 12 \text{ N s}$$

22. Answer (2)

$$\text{Average translational kinetic energy} = \frac{3}{2} K_B T$$

$$\text{Average rotational kinetic energy} = \frac{2}{2} K_B T$$

$$\Rightarrow \text{Ratio} = 3 : 2$$

23. Answer (1)

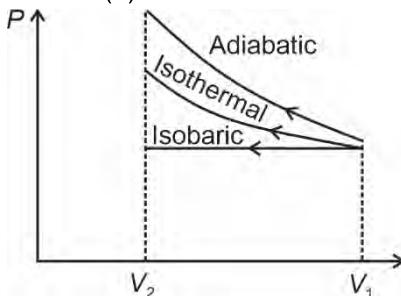
Distance between any two points on an object increase with increase in temperature.

24. Answer (1)

$$W = \int P dV$$

As volume is continuously increasing so work done will keep increasing.

25. Answer (2)

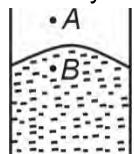


Final pressure is maximum for adiabatic compression.

26. Answer (1)

Rise or fall of liquid in capillary tube depends on angle of contact which may be acute, obtuse or right angle.

For a glass capillary having mercury $P_B > P_A$, excess pressure is always on the concave side.



27. Answer (1)

$$I_{\text{net}} = 4I \cos^2\left(\frac{\Delta\phi}{2}\right)$$

$$\text{for } \Delta x = \frac{\lambda}{4}$$

$$\Delta\phi = \frac{2\pi}{\lambda} \times \frac{\lambda}{4} = \frac{\pi}{2}$$

$$I_0 = 4I \cos^2\left(\frac{\pi}{4}\right) = 4I \times \frac{1}{2}$$

$$I_0 = 2I \Rightarrow I = \frac{I_0}{2}$$

$$\text{for } \Delta x = \lambda, I = 4 \times \frac{I_0}{2} \cos^2(2\pi) = 2I_0$$

28. Answer (3)

$$\text{Use } \frac{1}{f_{\text{eq}}} = \frac{1}{f_m} - \frac{2}{f_L}$$

$$\Rightarrow \frac{1}{f_{\text{eq}}} = \frac{-2}{20} \Rightarrow f_{\text{eq}} = -10 \text{ cm}$$

Hence, it will behave as concave mirror of focal length 10 cm.

29. Answer (4)

Use,

$$\frac{1}{f} = (\mu_L - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

$$\frac{1}{f} = \left(\frac{5}{3} - 1 \right) \left(-\frac{1}{20} \right)$$

$$\frac{1}{f} = \frac{2}{3} \times \frac{-1}{20}$$

$$f = -30 \text{ cm}$$

30. Answer (3)

$$c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$$

$$\Rightarrow \sqrt{\mu_0 \epsilon_0} = \frac{1}{c}$$

$$\mu_0 \epsilon_0 = \frac{1}{c^2}$$

$$\begin{aligned} \text{Unit of } \mu_0 \epsilon_0 &= \frac{1}{(\text{m/s})^2} \\ &= \text{s}^2 \text{ m}^{-2} \end{aligned}$$

31. Answer (1)

$$\text{We know } V = iR \quad \dots \text{(i)}$$

$$\text{and } I = neAV_d \quad \dots \text{(ii)}$$

$$\therefore V \propto V_d$$

32. Answer (4)

In parallel:

$$E_{\text{eq}} = \frac{\frac{E_1}{r_1} + \frac{E_2}{r_2}}{\frac{1}{r_1} + \frac{1}{r_2}} = \frac{\frac{2E}{r}}{\frac{r}{r_1} + \frac{r}{r_2}} = E$$

$$r_{\text{eq}} = \frac{r}{2}$$

$$\therefore i = \frac{V}{R_{\text{eq}}} \Rightarrow i_1 = \frac{E}{3 + \frac{r}{2}} \quad \dots \text{(i)}$$

In series:

$$E_{\text{eq}} = E_1 + E_2 = 2E$$

$$r_{\text{eq}} = r_1 + r_2 = 2r$$

$$\therefore i_2 = \frac{V}{R_{\text{eq}}} = \frac{2E}{3 + 2r} \quad \dots \text{(ii)}$$

Given $i_1 = i_2$

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

$$3 + 2r = 6 + r$$

$$r = 3 \Omega$$

33. Answer (3)

Force per unit length between two long current-carrying wires is given by $\frac{\mu_0 i_1 i_2}{2\pi d}$.

Hence, force is dependent on current as well as the separation between them.

34. Answer (1)

Magnetic field due to circular arc at its centre is

$$B = \frac{\mu_0 i \theta}{4\pi R}$$

$$\text{For } \theta = \frac{2\pi}{3}$$

$$B = \frac{\mu_0 i \frac{2\pi}{3}}{4\pi R} = \frac{\mu_0 i}{6R}$$

35. Answer (2)

Given $\chi = 699$

Permeability of material, $\mu = \mu_0 (1 + \chi)$

$$\mu = 4\pi \times 10^{-7} (1 + 699)$$

$$= 28\pi \times 10^{-5} \text{ H m}^{-1}$$

SECTION-B

36. Answer (1)

$$v_1 = \frac{qE}{m} t$$

$$v_2 = \frac{2qE}{m} t$$

$$\frac{K_1}{K_2} = \frac{\frac{1}{2}mv_1^2}{\frac{1}{2}mv_2^2}$$

$$= \frac{1}{4}$$

37. Answer (4)

We know, if battery is disconnected

$\therefore q \rightarrow$ remains same

But $C \xrightarrow{\text{becomes}} KC$

$$\therefore V = \frac{q}{C}$$

$$\therefore V \xrightarrow{\text{becomes}} \frac{V}{K}$$

$$\text{Also } V = \frac{1}{2} \frac{q^2}{C}$$

$$\therefore U \xrightarrow{\text{becomes}} \frac{U}{K}$$

38. Answer (3)

Width of central maxima in diffraction pattern is given by

$$w = \frac{2\lambda d}{a}$$

$$w = \frac{2 \times 400 \times 10^{-9} \times 1}{10^{-3}} = 8 \times 10^{-4}$$

$$w = 0.8 \text{ mm}$$

39. Answer (2)

$$\frac{f_o}{f_e} = 4 \text{ & } f_o + f_e = 45$$

$$\Rightarrow 5f_e = 45 \Rightarrow f_e = 9 \text{ cm}$$

$$\Rightarrow f_o = 36 \text{ cm}$$

40. Answer (4)

$$E = \frac{-d\phi}{dt} = \frac{0.02 \times (4-2)}{2 \times 10^{-3}}$$

$$i = \frac{\epsilon}{R} = \frac{0.02 \times 2}{2 \times 10^{-3} \times 4}$$

$$P = 0.02 \times \frac{2}{2 \times 10^{-3}} \times \frac{0.02}{4 \times 10^{-3}}$$

$$= \frac{8 \times 10^{-4}}{8 \times 10^{-6}} \text{ W}$$

$$= 100 \text{ W}$$

41. Answer (2)

$$I_0 = \frac{200\sqrt{2}}{20\sqrt{2}} = 10 \text{ A}$$

$$i(t) = 10 \sin(100\pi t - \frac{\pi}{4}) \text{ A}$$

Voltage across inductor leads the current by $\frac{\pi}{2}$.

$$V_i(t) = 10 \times 20 \sin(100\pi t - \frac{\pi}{4} + \frac{\pi}{2}) \text{ V}$$

$$= 200 \sin(100\pi t + \frac{\pi}{4}) \text{ V}$$

42. Answer (2)

$$V = \frac{4}{3}\pi R^3$$

$$\frac{dV}{dt} = \frac{4}{3}\pi \cdot 3R^2 \cdot \frac{dR}{dt}$$

$$\left(\frac{dV}{dt}\right)_{R=2\text{ cm}} = \frac{4}{3}\pi \times 3 \times 4 \times 1$$

$$= 16\pi \text{ cm}^3 \text{ s}^{-1}$$

43. Answer (2)

For the block to just move, $F = (f)_{\max} = \mu_s N$

$$\Rightarrow F = \frac{1}{2\sqrt{3}} \times \sqrt{3} \times 10 = 5 \text{ N}$$

44. Answer (3)

We know,

according to law of conservation of angular momentum

$$L_i = L_f$$

$$mvl + 0 = \left[\frac{3m(2l)^2}{12} + ml^2 \right] \omega$$

$$mvl = (2ml^2) \omega$$

$$\therefore \omega = \frac{v}{2l}$$

45. Answer (1)

We know,

$$dW = Vdm$$

$$\therefore W = \int_0^m Vdm$$

$$= \int_0^m \frac{-Gm}{R} dm$$

$$= \frac{-G}{R} \left[\frac{m^2}{2} \right]_0^m$$

$$W = \frac{-Gm^2}{2R} = \text{Self energy of hollow sphere}$$

46. Answer (4)

Wettability of a surface by a liquid depends primarily on angle of contact between the surface and the liquid.

47. Answer (2)

Time period of second pendulum is 2 s

$$\Delta T = \frac{1}{2} \alpha \Delta \theta \times T$$

$$= \frac{1}{2} \times 1.2 \times 10^{-5} \times 30 \times 2$$

$$\Delta T = 36 \times 10^{-5} \text{ s}$$

New time period

$$\begin{aligned} T &= T + \Delta T \\ &= 2 + 0.00036 \\ &= 2.00036 \text{ s} \end{aligned}$$

48. Answer (4)

For Lyman series

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

$$\lambda = \frac{4}{3R} \quad \dots (1)$$

For Balmer series

$$\frac{1}{\lambda'} = R \left(\frac{1}{(2)^2} - \frac{1}{(3)^2} \right)$$

$$\lambda' = \frac{36}{5R} \quad \dots (2)$$

$$\frac{\lambda'}{\lambda} = \frac{36}{5R} \times \frac{3R}{4} = \frac{27}{5} \Rightarrow \lambda' = \frac{27}{5} \lambda$$

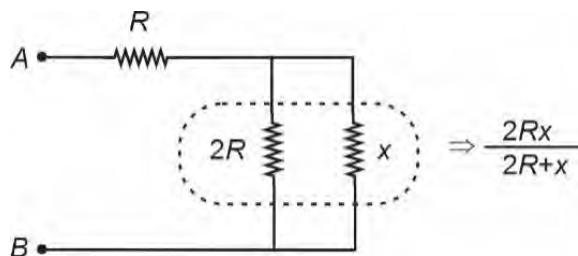
49. Answer (4)

$$Y = (A + \bar{B}) \cdot (\bar{A} + B)$$

$$Y = AB + \bar{A}\bar{B}$$

50. Answer (2)

Let the net resistance between points A and B is x, then



$$R_{eq} = \frac{2Rx}{2R+x} + R = x$$

$$2Rx + 2R^2 + Rx = 2Rx + x^2$$

$$x^2 - Rx - 2R^2 = 0$$

$$x = \frac{-(-R) \pm \sqrt{R^2 + 4 \times 1 \times 2R^2}}{2 \times 1} = \frac{R \pm 3R}{2}$$

$$x = 2R.$$

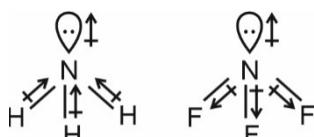
60. Answer (1)

$$N_2 \Rightarrow \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^2 = \pi 2p_y^2 \sigma 2p_z^2$$

To form N_2^+ , e^- will be removed from $\sigma 2p_z$ orbital.

61. Answer (3)

Both NH_3 and NF_3 are trigonal pyramidal in shape but in NH_3 the orbital dipole due to lone pair is in the same direction as the resultant dipole moment of N – H bonds where as in NF_3 the orbital dipole is in the direction opposite to the resultant dipole moment of the three N – F bonds



62. Answer (2)

$$X_{urea} = \frac{n_{urea}}{n_{urea} + n_{H_2O}} = \frac{1}{1 + 55.55} = 0.018$$

63. Answer (4)

$$\Delta T_b \propto i$$

Salt	Van't Hoff factor
Glucose	1
Sucrose	1
Sodium chloride	2
Calcium chloride	3

64. Answer (3)

$$\text{Number of molecules} = \frac{w(g)}{M} \times N_A$$

$$= \frac{2 \times 10^{-3}}{16} \times 6.02 \times 10^{23}$$

$$\therefore \text{Number of H atoms} = \frac{6.02 \times 10^{20}}{8} \times 4 \\ = 3.01 \times 10^{20}$$

65. Answer (4)

$$M = \frac{W \times 1000}{MW \times V_{mL}}$$

$$0.25 = \frac{W \times 1000}{40 \times 100}$$

$$W = 1 \text{ g}$$

66. Answer (2)

Unit of rate of reaction is $\text{mol L}^{-1}\text{s}^{-1}$.

67. Answer (2)

On addition of dil. H_2SO_4 in CO_3^{2-} solution CO_2 gas will be evolved that will turn lime water milky.

68. Answer (1)

Group	Cations*	Group Reagent
Group zero	NH_4^+	None
Group-I	Pb^{2+}	Dilute HCl
Group-II	Pb^{2+} , Cu^{2+} , As^{3+}	H_2S gas in presence of dil. HCl
Group-III	Al^{3+} , Fe^{3+}	NH_4OH in presence of NH_4Cl
Group-IV	Co^{2+} , Ni^{2+} , Mn^{2+} , Zn^{2+}	H_2S in presence of NH_4OH

69. Answer (1)

X is silicon, element which is below silicon is germanium ($Z = 32$)

70. Answer (3)

Oxides	Nature
Al_2O_3	Amphoteric
Cl_2O_7	Acidic
CO	Neutral
Na_2O	Basic

71. Answer (4)

$$Q = 19.3 \times 100 = 1930 \text{ C} = 0.02 \text{ F}$$

$$\text{Moles of Al formed} = \frac{0.02}{3}$$

$$\text{Mass of Al formed} = \frac{0.02}{3} \times 27 = 0.18 \text{ g}$$

72. Answer (1)

For d electron $\ell = 2$

$$\text{Orbital angular momentum} = \frac{\hbar}{2\pi} \sqrt{\ell(\ell+1)}$$

$$= \frac{\hbar}{2\pi} \sqrt{2(2+1)}$$

$$= \frac{\hbar}{2\pi} \sqrt{6} = \frac{\hbar}{\pi} \sqrt{\frac{6}{4}}$$

$$= \sqrt{\frac{3}{2}} \frac{\hbar}{\pi}$$

73. Answer (2)

Presence of unpaired electrons and $d-d$ transition results in the colour in the aqueous solution of Mn^{2+} ion.

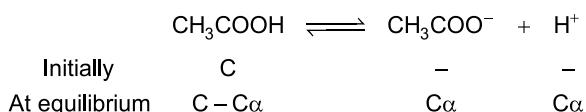
$Zn^{2+} = [Ar] 3d^{10}$ No unpaired electrons

$Ti^{4+} = [Ar]$ No unpaired electrons

$Sc^{3+} = [Ar]$ No unpaired electrons

$Mn^{2+} = [Ar] 3d^5$ Five unpaired electrons and $d-d$ transition is possible.

74. Answer (3)



$$[\text{H}^+] = \text{Cα} = (0.2 \text{ M}) \times (0.02) = 0.004 \text{ M}$$

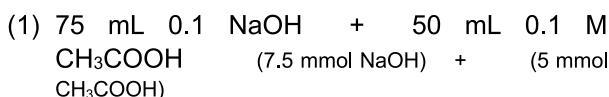
$$\text{pH} = -\log [\text{H}^+]$$

$$= -\log (4 \times 10^{-3})$$

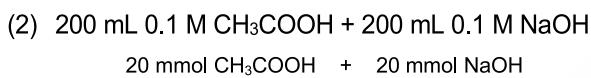
$$= 2.4$$

75. Answer (3)

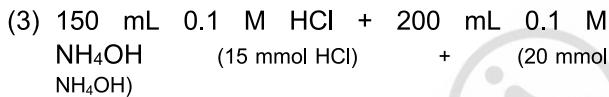
During neutralisation of weak base with a strong acid, if base is in excess then basic buffer is formed.



Strong base is in excess so, no buffer is formed.

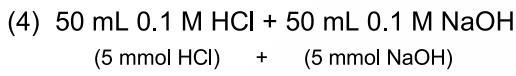


No buffer is formed



Weak base is in excess so weak base and its salt with strong acid (NH₄Cl) will be in solution.

Hence, it is a basic buffer



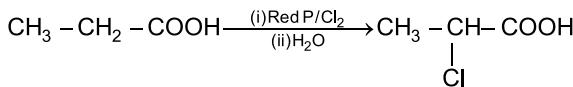
No buffer is formed.

76. Answer (4)

For aldol condensation reaction, at least two α hydrogen atoms, are present in carbonyl compound.

	-	no α - Hydrogen
	-	3 α - Hydrogen atoms
	-	no α - Hydrogen
	-	1 α Hydrogen atom is present so aldol condensation will not occur

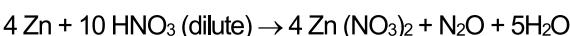
77. Answer (3)



78. Answer (4)

Sucrose is a non-reducing sugar. It does not reduce Tollens' reagent.

79. Answer (1)



80. Answer (3)

1. Hypophosphorous acid - H₃PO₂

2. Hypophosphoric acid - H₄P₂O₆

3. Pyrophosphorus acid - H₄P₂O₅

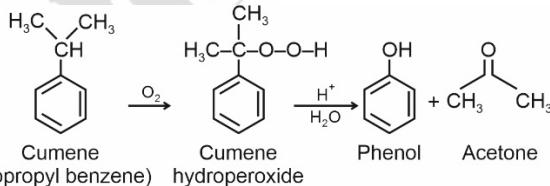
4. Pyrophosphoric acid - H₄P₂O₇

81. Answer (1)

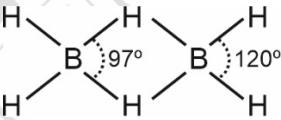
HI bond has lowest bond dissociation enthalpy and I⁻ has high nucleophilicity followed by HBr and HCl. So, the correct order of reactivity is



82. Answer (2)

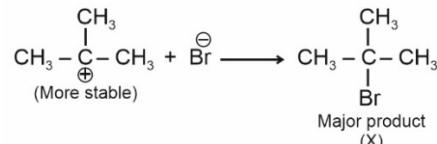
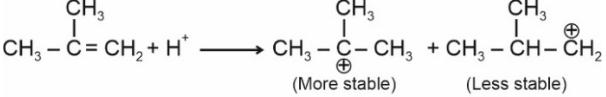


83. Answer (3)



In B₂H₆, the two H – B – H bond angles are 97° and 120°.

84. Answer (4)

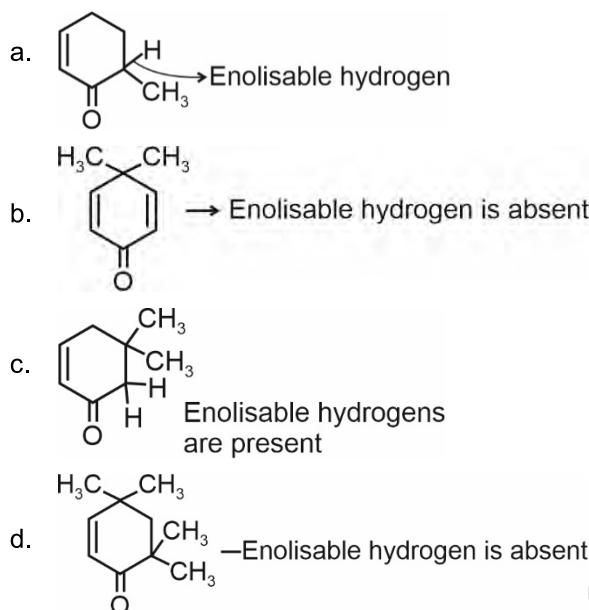


85. Answer (1)

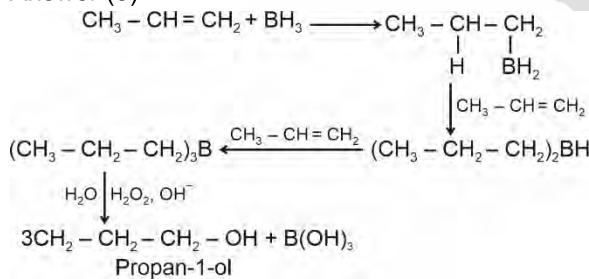
CH₃ - C - CH₃ follow S_N1 reaction due to the formation of stable CH₃ - C - CH₃ carbocation which contains 9α H and get stabilized by hyperconjugation and inductive effect.

SECTION-B**86. Answer (2)**

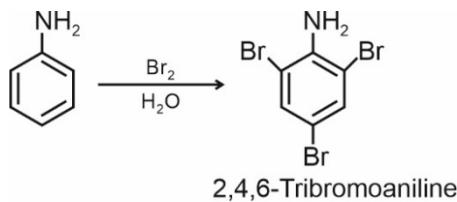
Species with enolisable hydrogen will show tautomerism

**87. Answer (4)**

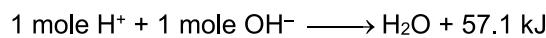
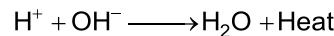
Due to high bond dissociation enthalpy H_2O does not possess reducing property while other hydrides of group 16 possess reducing property.

88. Answer (3)**89. Answer (2)**

More is the surface area, more is the van der Waals force of attraction and more is the boiling point. Boiling point of pentane is more than 2-Methylbutane. Melting point of 2,2-Dimethylpropane is higher than that of 2-Methylbutane.

90. Answer (3)**91. Answer (3)**

Vitamins	Deficiency Disease
Riboflavin	→ Digestive disorders and burning sensation of the skin
Thiamine	→ Loss of appetite
Pyridoxine	→ Convulsions
Ascorbic acid	→ Bleeding gums

92. Answer (3)**Moles of H^+ ions in H_2SO_4**

$$\text{M}_{\text{H}_2\text{SO}_4} = \frac{\text{N}}{\text{basicity of acid}} = \frac{1}{10} \times \frac{1}{2}$$

$$\text{Moles of } \text{H}_2\text{SO}_4 = \text{M} \times \text{V} = \frac{1}{10} \times \frac{1}{2} \times \frac{500}{1000} = [0.025]$$

$$\text{Moles of } \text{H}^+ \text{ ions} = 0.025 \times 2 = [0.05]$$

Moles of OH^- ions in NaOH

$$\text{M} = \frac{\text{N}}{\text{acidity of base}} = \frac{1}{20} \times 1 = \frac{1}{20}$$

Moles of OH^- ions

$$= \frac{1}{2} \times \frac{500}{100}$$

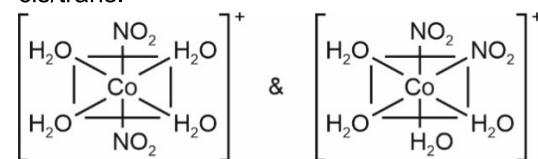
$$= 0.025$$

for neutralisations of 1 mol H^+ ions using 1 mol of OH^- ions 57.1 kJ heat is released

∴ For 0.025 moles ≡ $57.1 \times 0.025 = [1.43 \text{ kJ}]$ heat is released

93. Answer (3)

- Complex will not exhibit coordination isomerism as there are no cationic and anionic coordination spheres separately.
- It will exhibit linkage isomerism as ambidentate ligand (NO_2) can have different linkages with central metal atom as follows.
 $[\text{Co}(\text{H}_2\text{O})_4(\text{NO}_2)_2]\text{Cl}$ and $[\text{Co}(\text{H}_2\text{O})_4(\text{ONO})_2]\text{Cl}$
- Complex will exhibit ionization isomerism by giving different ions in solution or in molten state as
 $[\text{Co}(\text{H}_2\text{O})_4(\text{NO}_2)_2]\text{Cl}$ and $[\text{Co}(\text{H}_2\text{O})_4(\text{NO}_2)(\text{Cl})]\text{NO}_2$
- Complex will exhibit geometrical isomerism as cis/trans.



trans-isomer

cis-isomer

No enantiomeric pairs possible, so there is no optical isomerism.

94. Answer (4)

$\text{PCl}_5 \Rightarrow$		Trigonal bipyramidal
$\text{XeF}_2 \Rightarrow$		Linear

95. Answer (1)

$$\begin{aligned} t_{75\%} &= 2 \times t_{50\%} \\ &= 2 \times 4 \\ &= 8 \text{ hours} \end{aligned}$$

96. Answer (4)

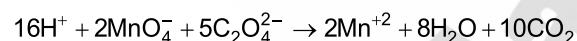
$$\text{Reducing power} \propto \frac{1}{\text{SRP}}$$

So, A is the best reducing agent among the given species followed by C and then B.

97. Answer (1)



Adding eqn (1) & (2)



1 mole of $\text{C}_2\text{O}_4^{2-}$ is oxidised by $\frac{2}{5}$ moles of MnO_4^-

↓

$= 0.4 \text{ moles of MnO}_4^-$

98. Answer (3)

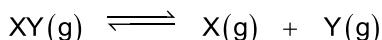
For $3d$ orbital, $n = 3$ and $l = 2$

Number of angular nodes $= l = 2$

Number of radial nodes $= (n - l - 1)$

$$= (3 - 2 - 1) = 0$$

99. Answer (3)



Initially $1 \quad 0 \quad 0$

At equilibrium $1 - \alpha \quad \alpha \quad \alpha$

$$\text{Total pressure} = [1 - \alpha] + [\alpha] + [\alpha] = 1 + \alpha$$

- Partial pressure of $\text{X} = \left[\frac{\alpha}{1 + \alpha} \right] \text{P}$

- Partial pressure of $\text{Y} = \left[\frac{\alpha}{1 + \alpha} \right] \text{P}$

- Partial pressure of $\text{XY} = \left[\frac{1 - \alpha}{1 + \alpha} \right] \text{P}$

$$K_p = \frac{(p_x)(p_y)}{(p_{xy})}$$

$$K_p = \frac{\left[\frac{\alpha}{1 + \alpha} \text{P} \right]^2}{\left[\frac{1 - \alpha}{1 + \alpha} \text{P} \right]}$$

$$K_p = \frac{\frac{\alpha^2}{(1 + \alpha)^2} \text{P}^2}{\frac{1 - \alpha}{1 + \alpha} \text{P}}$$

$$K_p = \frac{\alpha^2}{1^2 - \alpha^2} \text{P}$$

$$K_p = 2 \times \text{total pressure} = 2\text{P}$$

$$2\text{P} = \frac{\alpha^2}{1 - \alpha^2} \text{P}$$

$$2(1 - \alpha^2) = \alpha^2$$

$$2 - 2\alpha^2 = \alpha^2$$

$$2 = 3\alpha^2$$

$$\alpha = \sqrt{2/3}$$

100. Answer (3)

- In the given reaction LiAlH_4 reduces aldehyde into 1° alcohol
- LiAlH_4 cannot reduce double bonds.

BOTANY

SECTION-A

101. Answer (4)

$\text{Lac } i$ gene exhibits the constitutive expression of repressor protein. The $\text{lac } y$ gene codes for permease, which increases permeability of the cell

to β -galactosides. The $\text{lac } z$ gene codes for β -galactosidase which is primarily responsible for the hydrolysis of the disaccharide. The $\text{lac } a$ gene codes for transacetylase which can transfer acetyl group to β -galactoside.

102. Answer (3)

Polymorphism in DNA sequence is the basis of DNA fingerprinting. If an inheritable mutation is observed in a population at high frequency it is referred to as DNA polymorphism.

103. Answer (2)

DNA of *E. coli* has 4.6×10^6 base pairs. Scientists have identified about 1.4 million locations where single base DNA differences (SNPs) occur in humans.

104. Answer (1)

A translational unit on mRNA is the sequence of RNA that is flanked by the start codon (AUG) and the stop codon.

105. Answer (2)

In the bundle sheath cells of C₄ plants, Calvin pathway is carried out for the synthesis of carbohydrates.

106. Answer (3)

The primary CO₂ acceptor in C₄ plants is phosphoenolpyruvate (PEP).

107. Answer (3)

In one turn of citric acid cycle, one molecule of ATP, three NADH₂, one FADH₂ and along with two molecules of CO₂ are released. One substrate level phosphorylation reaction occurs in one turn of TCA cycle.

108. Answer (4)

The symbol  shows parents with female child affected with disease.

109. Answer (2)

T.H. Morgan coined the term linkage to describe the physical association of genes on a chromosome.

110. Answer (2)

Female heterogamety is shown by birds, two different sex chromosomes of a female bird have been designated to be the Z and W chromosomes. In these organisms the females have one Z and one W chromosomes, whereas males have a pair of Z chromosomes, besides the autosomes.

111. Answer (1)

β thalassemia is controlled by a single gene HBB on chromosome 11.

The family pedigree of Queen Victoria shows a number of haemophilia descendants as she was a carrier of the disease.

112. Answer (4)

In species area relationship given by Alexander von Humboldt $\log S = \log C + Z \log A$, Z stands for slope of line or regression coefficient.

113. Answer (3)

Western Ghats regions of Karnataka and Maharashtra have sacred groves.

114. Answer (3)

Biological names are either from Latin language or Latinised.

Dogs, mammals and animals are different taxa at different levels.

115. Answer (3)

Archaeabacteria differ from other bacteria in having different cell wall structure and this feature is responsible for their survival in extreme conditions.

116. Answer (3)

Instead of cell wall, euglenoids have protein rich layer called pellicle.

117. Answer (2)

The apex of root consists of root cap. Proximal to root cap is region of meristematic activity (cell division zone) and proximal to it, is region of elongation. Region of maturation is present towards the base of the stem.

118. Answer (2)

In opposite phyllotaxy a pair of leaves arise at each node and lie opposite to each other, e.g., *Calotropis* and *Guava*.

If more than two leaves arise at a node and form a whorl, it is called whorled phyllotaxy, as in *Alstonia*.

119. Answer (4)

Sesbania, *Trifolium*, *Lupin*, *Asparagus*, *Cabbage*, *Belladonna*, *Soyabean* have hypogynous flower (superior ovary).

120. Answer (4)

Sometimes, a few chromosomes have non-staining secondary constriction at a constant location which gives the appearance of a small fragment called the satellite.

121. Answer (2)

Cell membrane of prokaryotes is similar to that of eukaryotes.

122. Answer (2)

Cells of prokaryotic organisms do not have nucleus. Robert Brown discovered nucleus. Ribosomes are non-membrane bound organelle.

123. Answer (3)

G₁-phase corresponds to the interval between mitosis and initiation of DNA replication.

124. Answer (4)

The complex formed by a pair of synapsed homologous chromosomes is called a bivalent or a tetrad. These are more clearly visible in pachytene stage. Bivalents are formed in zygotene stage.

143. Answer (3)

Amitosis is a direct cell division in which no spindle fibre formation occurs.

144. Answer (1)

Gymnosperms also show secondary growth in stems and roots.

Narrow sieve tubes are found in protophloem which is first formed primary phloem and bigger in metaphloem which appears later.

Mature sieve tube has large vacuole and peripheral cytoplasm but lacks nucleus.

145. Answer (2)

Auxin is composed of indole compounds. It is responsible for initiation and promotion of cell division in cambium and it also controls xylem differentiation.

Abscisic acid stimulates closure of stomata. During desiccation, concentration of ABA increases. As a result, stomata closes and prevent transpiration.

146. Answer (1)

Yucca and *Pronuba* (moth) cannot complete their life cycle without each other.

Cleistogamous flowers produce assured seed set.

Water hyacinth and water lily are pollinated by insects or wind.

147. Answer (4)

Phylogeny/evolutionary relationships takes into account in systematics and not in taxonomy.

148. Answer (3)

Standing state: Amount of nutrients present in the soil at a given time.

Standing crop is expressed as the biomass of organism present at different trophic levels at a given time.

149. Answer (4)

Desert lizards lack the physiological ability that mammals have to deal with the high temperatures of their habitat, but manage to keep their body temperature fairly constant by behavioural means.

150. Answer (3)

Toddy is fermented product obtained from sap of palm by fermenting process of naturally occurring yeast.

ZOOLOGY

SECTION - A

151. Answer (3)

Flatworms (*Fasciola*) are bilaterally symmetrical. *Pennatula*, *Meandrina* and *Hydra* are radially symmetrical.

152. Answer (2)

Gap junctions facilitate the cells to communicate with each other by connecting the cytoplasm of adjoining cells, for rapid transfer of ions, small molecules and sometimes big molecules.

153. Answer (1)

In 1951, India initiated 'Family Planning Programmes' at a national level to attain total reproductive health as a social goal. Improved programmes covering wider reproduction-related areas are currently in operation under the popular name 'Reproductive and Child Health Care (RCH) programmes'.

154. Answer (4)

Coca alkaloid or cocaine is obtained from coca plant *Erythroxylum coca*, native to South America.

155. Answer (2)

- Amoebiasis is caused by a protozoan parasite in the large intestine of human, not small intestine.

- Drinking water and food contaminated by the faecal matter are the main source of infection.
- Houseflies act as mechanical carriers for the parasite. Its symptoms include constipation, abdominal pain and cramps, stools with excess mucous and blood clots.

156. Answer (3)

Systemic veins carry deoxygenated blood having 40 mm Hg pO₂ and 45 mm Hg pCO₂.

157. Answer (2)

Bt toxin is coded by a gene named *cry*. Proteins encoded by genes *CryIAc* and *CryIAb* control the cotton bollworms and that of *CryIAb* controls corn borer.

158. Answer (2)

In humans, based on the location, three types of muscles are identified, i.e.,

- | | |
|---------------|---------------|
| (i) Skeletal | (ii) Visceral |
| (iii) Cardiac | |

159. Answer (1)

The process through which two or more organs interact and complement the functions of one another is called coordination. Brain acts as the command and control system of the body. Antagonism is to oppose the functions of each other.

160. Answer (2)

Filtrate is acid-soluble pool and retentate is acid-insoluble fraction.

The acid-insoluble fraction has only four types of organic compounds i.e., proteins, nucleic acids, polysaccharides and lipids.

Nucleosides, amino acids, nitrogenous bases come under the category of acid-soluble pool/filtrate/biomicromolecules.

161. Answer (2)

Bioprocess engineering: Maintenance of sterile ambience in chemical engineering processes to enable growth of only the desired microbe/eukaryotic cell in large quantities for the manufacture of biotechnological products like antibiotics, vaccines, enzymes, etc.

DNA spooling is a method of obtaining DNA in the form of spool over a glass rod.

162. Answer (1)

The first restriction endonuclease enzyme isolated, whose functioning depends on a specific DNA nucleotide sequence is *Hind II*.

163. Answer (3)

Angiotensin-II activates the adrenal cortex to release aldosterone.

Aldosterone causes reabsorption of Na^+ and water from the distal parts of renal tubules.

164. Answer (4)

On the basis of their chemical nature, hormones can be divided into groups like peptide/protein hormones (e.g., insulin, glucagon, pituitary hormones), steroids (e.g., cortisol, testosterone, estradiol, progesterone) and iodothyronines (thyroxine).

Steroid hormones and iodothyronines interact with intracellular receptors and mostly regulate gene expression or chromosome function by the interaction of hormone-receptor complex with the genome.

165. Answer (3)

- The Big Bang theory attempts to explain to us the origin of Universe. It talks of a singular huge explosion unimaginable in physical terms.
- There was no atmosphere on early Earth and ozone layer was also absent in primitive Earth.

166. Answer (3)

- Exocrine glands secrete mucus, saliva, earwax, oil, milk and digestive enzymes like lipase, protease and amylase.
- Pancreas is a composite gland which acts as both exocrine and endocrine gland. The endocrine pancreas consists of 'Islets of Langerhans' which secrete hormone insulin and glucagon.

167. Answer (4)

The diffusion membrane is made up of three major layers; two are cellular and one is acellular. Cellular layers are thin squamous epithelium of alveoli and endothelium of alveolar capillaries. Acellular layer is the basement substance present in between them.

168. Answer (2)

The milk produced during the initial few days of lactation is called colostrum which contains several antibodies absolutely essential to develop resistance for the new-born babies against several diseases. Colostrum is not produced during pregnancy.

169. Answer (3)

Chelone, *Neophron*, *Macropus* and *Betta* belong to classes Reptilia, Aves, Mammalia and Osteichthyes respectively. They all possess ventral heart. *Betta* (fighting fish) is an aquarium fish. Only *Neophron* and *Macropus* are homeothermous and rest are poikilothermous animals.

170. Answer (3)

Human sperm consists of four parts from head to tail. These parts are

1. Head
2. Neck
3. Middle piece
4. Tail

171. Answer (1)

In a chromosome, there is a specific DNA sequence called the origin of replication, which is responsible for initiating replication.

Therefore, for the multiplication of an alien DNA in an organism it needs to be a part of a chromosome(s) which has a specific sequence i.e., 'ori' sequence.

172. Answer (3)

- Frog's hind limbs end in five digits and they are larger and muscular than fore limbs that end in four digits.
- Eyes are bulged and covered by a nictitating membrane that protects them while in water.
- They never drink water but absorb it through the skin.

173. Answer (3)

Most of the annelids and all vertebrates have a closed circulatory system in which blood pumped by heart is always circulated through a closed network of blood vessels. This is more advanced in comparison to open circulatory system as flow of fluid can be more precisely regulated.

174. Answer (2)

In a cardiac cycle, each ventricle pumps about 70 mL of blood which is known as stroke volume/beat volume.

175. Answer (1)

Primary structure – Positional information of amino acids in a protein.

Tertiary structure – 3-D view of a protein

Secondary structure – Only right-handed helices are observed

Quaternary structure – Assembly of more than one polypeptide or subunits.

176. Answer (1)

The sex organs which participate in gametogenesis are called primary sex organs. Testes in males and ovaries in females are considered as primary sex organs because they participate in spermatogenesis and oogenesis respectively.

177. Answer (3)

Based on number of amino and carboxyl groups, there are acidic (e.g., glutamic acid), basic (lysine) and neutral (valine) amino acids. Similarly, there are aromatic amino acids (tyrosine, phenylalanine, tryptophan). So, lysine is odd one w.r.t. aromatic amino acids.

178. Answer (2)

- (A) – *Triceratops* →
- 3 – horned face
 - Herbivore

- (B) – *Tyrannosaurus* →
- Carnivore
 - Bipedal
 - Biggest dinosaur having huge fearsome dagger like teeth.

179. Answer (2)

Hydra uses its tentacles for capturing its prey and also use them for locomotion.

In *Paramecium*, cilia helps in the movement of food through cytopharynx and in locomotion as well.

180. Answer (3)

During the formation of Earth, the UV rays from the sun broke up water into hydrogen and oxygen and the lighter H₂ escaped.

181. Answer (1)

Emphysema is a chronic disorder in which alveolar walls are damaged.

Fibrosis is seen in occupational respiratory disorder.

α-1-antitrypsin is used for the treatment of emphysema.

182. Answer (2)

The cerebrum wraps around a structure called thalamus, which is a major coordinating centre for sensory and motor signaling. Hypothalamus is the basal part of diencephalon.

183. Answer (3)

'X' is *Escherichia coli*. *E.coli* is closely related to the genus *Salmonella*.

pBR322 of *E.coli* is used as a cloning vector.

184. Answer (2)

Atherosclerosis	Lumen of coronary arteries becomes narrower due to deposition of calcium, fat and cholesterol
Angina pectoris	Not enough oxygen reaching the heart muscle
Cardiac arrest	Heart stops beating
Heart failure	Heart fails to pump blood effectively enough to meet the needs of the body

185. Answer (2)

Steroidal oral contraceptive pills contain progestogens alone or in combination with estrogens. Pills inhibit ovulation and alter the quality of cervical mucus.

SECTION - B

186. Answer (2)

ZIFT (Zygote Intra Fallopian Transfer), ICSI (Intra Cytoplasmic Sperm Injection) and IUT (Intra Uterine Transfer) involve *in-vitro* fertilisation, while GIFT (Gamete Intra Fallopian Transfer) and IUI (Intra Uterine Insemination) involve *in-vivo* fertilisation.

187. Answer (4)

In humans, spermatogenesis starts at the age of puberty due to significant increase in the secretion of gonadotropin releasing hormone (GnRH).

188. Answer (3)

Amniocentesis is used to test for the presence of certain genetic disorders such as down syndrome, haemophilia, sickle-cell anemia, etc., to determine the survivability of the foetus. Cleft palate is not a genetic disorder.

189. Answer (2)

RNAi is a novel strategy which takes place in all eukaryotic organisms as a method of cellular defense. This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to prevent translation of mRNA. The source of complementary RNA could be transposons.

190. Answer (4)

Carbon dioxide which is harmful is released during the catabolic reactions.

Mechanism of breathing vary among different groups of animals depending mainly on their habitats and levels of organisation.

191. Answer (3)

Neurohypophysis (pars nervosa) also known as posterior pituitary, stores and releases two hormones called oxytocin and vasopressin which are actually synthesized by the hypothalamus and are transported axonally to neurohypophysis.

192. Answer (4)

Skeletal muscle fibres are present in biceps. They have a striped appearance under the microscope. They are under the voluntary control.

Heart consists of cardiac muscle fibres while stomach and iris of eye consists of smooth muscle fibres.

193. Answer (2)

Aschelminths (Hookworm) are pseudocoelomates. Annelids (Earthworm), arthropods (Cockroach) and molluscs (Sea-hare) are coelomates.

194. Answer (1)

Oparin of Russia and Haldane of England proposed that the first form of life could have come from pre-existing non-living organic molecules and that formation of life was preceded by chemical evolution, i.e., formation of diverse organic molecules from inorganic constituents.

195. Answer (4)

Male frogs can be distinguished by the presence of sound producing vocal sacs and also a copulatory pad on the first digit of the fore limbs which are absent in female frogs.

Bidder's canal is only present in male frogs. On either side of eyes, a membranous tympanum (ear) receives sound signals in both male and female frogs.

196. Answer (1)

Glomerulus is a tuft of capillaries formed by the afferent arteriole.

Each kidney has nearly one million complex tubular structures called nephrons. The medulla is divided into a few conical masses projecting into the calyces.

197. Answer (1)

Thymine is the nitrogenous base present only in DNA and not in RNA. The percentage of nitrogenous bases in above mentioned DNA will be

$$\text{Thymine} = 28\%$$

$$\text{Adenine} = 28\%$$

$$\text{Cytosine} = 22\%$$

$$\text{Guanine} = 22\%$$

Thymine forms complimentary base pair with Adenine.

198. Answer (3)

The genes encoding resistance to antibiotics such as ampicillin, chloramphenicol, tetracycline, etc., are considered useful selectable markers.

199. Answer (2)

The resting potential at the site of excitation is restored by rapid efflux of K^+ due to the rise in its permeability.

200. Answer (4)

- Many fungi belonging to the genera *Microsporum*, *Trichophyton* and *Epidermophyton* are responsible for ringworms.
- Tetanus – It is a bacterial disease
- Rheumatoid arthritis – It is an autoimmune disease.

