

23/04/2024

CODE-A



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

AIM - 720

(Advanced **INTENSIVE** Mastery for **720**)

MM : 720

CST-13

Time : 3 Hrs. 20 Min.

Answers

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

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AIM - 720*(Advanced INTENSIVE Mastery for 720)*

MM : 720

CST-13

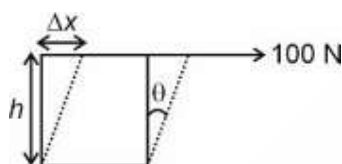
Time : 3 Hrs. 20 Min.

Answers & Solutions**PHYSICS**

TG :- @RAJHARSH77

SECTION-A

1. Answer (4)



$$\text{Shearing strain} = \text{Angle of shear} = \frac{\Delta x}{h}$$

$$= \frac{0.002 \times 10^{-2}}{0.1}$$

$$= 0.002$$

2. Answer (2)

We know,

$$\text{K.E.} = \frac{GMm}{2r}$$

$$\text{K.E.} \propto \frac{1}{r}$$

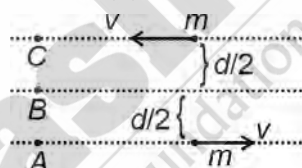
 \therefore when r is tripled

$$\text{K.E. becomes } \frac{K}{3}$$

3. Answer (3)

A rigid body does not deform under the action of applied force, thus there is no relative motion of any two particles on it, as the distance between them remain fixed.

4. Answer (3)



Angular momentum of system:

$$\text{About C } \vec{L}_C = mvd \hat{k}$$

$$\text{About B } \vec{L}_B = mv \left(\frac{d}{2} \right) \hat{k} + mv \left(\frac{d}{2} \right) \hat{k} = mvd \hat{k}$$

$$\text{About A } \vec{L}_A = mvd \hat{k}$$

$$\therefore \vec{L} (\text{about any point}) = mvd \hat{k} [\text{constant}]$$

5. Answer (2)

Convection is only possible in fluids.

6. Answer (2)

Work done in blowing a soap bubble of radius r is $8\pi r^2 T$

7. Answer (3)

Specific heat capacity of an ideal gas in polytropic process is given by

$$C = C_V + \frac{R}{1-n}; \text{ if } PV^n = \text{const.}$$

Here $n = -a$

$$0 = \frac{3}{2}R + \frac{R}{1+a} \Rightarrow a = \frac{-5}{3}$$

8. Answer (2)

Iy ideal gas equation

$$PV = \mu RT$$

And $VP^2 = \text{constant}$

$$P = \frac{A}{\sqrt{V}}$$

$$\text{So; } \frac{A}{\sqrt{V}} \times V = \mu RT$$

$$\text{So; } \sqrt{\frac{V_1}{V_2}} = \frac{T_1}{T_2}$$

$$T_2 = \sqrt{2} T$$

9. Answer (4)

$$\text{Maximum \% error in } Q = 2 \times 1\% + 1 \times 2\% + \frac{1}{2} \times 3\%$$

$$= \frac{11}{2}\%$$

$$= 5.5\%$$

$$\therefore \text{Error} \leq 5.5\%$$

10. Answer (2)

$$\frac{1}{2}mv^2 = mg\ell - mg\ell \cos 60^\circ$$

$$\frac{1}{2}mv^2 = \frac{mg\ell}{2}$$

$$v = \sqrt{g\ell}$$

$$\frac{mv^2}{\ell} = T - mg \cos 60^\circ$$

$$T = \frac{mv^2}{\ell} + mg \cos 60^\circ$$

$$T = mg + \frac{mg}{2} = \frac{3}{2}mg$$

11. Answer (4)

$$mgx = \frac{1}{2}Kx^2$$

$$x = \frac{2mg}{K}$$

For M to just lift off

$$Mg = Kx$$

$$x = Mg$$

$$\frac{Mg}{K} = \frac{2mg}{K} \Rightarrow m = \frac{M}{2} = \frac{10}{2} = 5 \text{ kg}$$

12. Answer (2)

Ferromagnetic material is made into thin sheets to reduce eddy current loss.

13. Answer (2)

$$\text{Let } V = V_0 \sin \omega t \text{ and } I = I_0 \sin(\omega t + \phi)$$

$$\text{Then } P = VI$$

$$P = V_0 I_0 (\sin \omega t - \sin(\omega t + \phi))$$

Solving this we get

$$P = A + B \cos 2\omega t + C \sin 2\omega t$$

Hence power varies with twice the frequency of the source.

14. Answer (2)

$$\sin \theta_c = \frac{1}{\mu}$$

$$\sin 37^\circ = \frac{1}{\mu}$$

$$\Rightarrow \frac{3}{5} = \frac{1}{\mu}$$

$$\Rightarrow \mu = \frac{5}{3}$$

15. Answer (3)

$$\text{Minimum magnifying power} = \frac{f_0}{f_e} = Y$$

$$\text{Now, } f'_e = \frac{f_e}{2}$$

$$Y' = \frac{f_0}{f'_e} = 2 \frac{f_0}{f_e} = 2Y$$

16. Answer (2)

The direction of wave propagation is given by

$$\vec{X} \parallel \vec{E} \times \vec{B}$$

17. Answer (3)

According to Brewster's law:

$$\tan \theta_p = \mu$$

$$\theta_p = \tan^{-1}(\mu)$$

18. Answer (4)

$$Kx \leftarrow \boxed{B} \rightarrow F \Rightarrow \vec{a}_B = \frac{F - Kx}{m} \hat{i} \text{ and } \boxed{A} \rightarrow Kx$$

$$\vec{a}_A = \frac{Kx}{m} \hat{i}$$

$$\vec{a}_{B,A} = \vec{a}_B - \vec{a}_A = \frac{F}{m} \hat{i} - \frac{Kx}{m} \hat{i} - \frac{Kx}{m} \hat{i} = \frac{F - 2Kx}{m} \hat{i}$$

19. Answer (2)

$$\vec{V}_{B,A} = \vec{V}_B - \vec{V}_A = 2\hat{i} + \hat{j} - 3\hat{i} - 2\hat{j} = -\hat{i} - \hat{j}$$

20. Answer (2)

$$T_{\text{Flight}} = \frac{2 \times u}{g} = \frac{2 \times 120}{10} = 24 \text{ s}$$

21. Answer (4)

Distance travelled = Area under curve

$$= \frac{1}{2} \times 10 \times 2 + 2 \times 10$$

$$= 10 + 20$$

$$= 30 \text{ m}$$

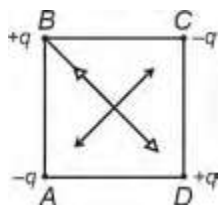
22. Answer (3)

Internal energy of an ideal gas is a function of its temperature.

23. Answer (3)

Potential decreases in the direction of electric field.

24. Answer (4)

Since $E_{\text{net}} = 0$, therefore

$$\vec{F}_{\text{net}} = 0$$

25. Answer (3)

Velocity of sound and depth of ocean can be determined by phenomenon of echo.

26. Answer (2)

$$y = 10 \sin\left(2\pi t + \frac{\pi}{3}\right)$$

$$v = \frac{dy}{dt}$$

$$v = 20\pi \cos\left(2\pi t + \frac{\pi}{3}\right)$$

At $t = 0$,

$$v = 20\pi \cos \frac{\pi}{3}$$

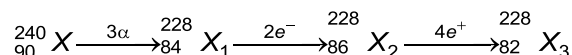
$$v = 10\pi \text{ m/s}$$

27. Answer (4)

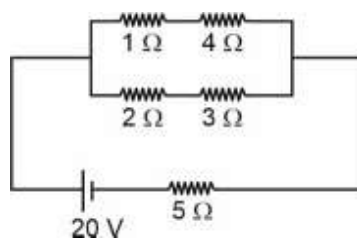
For photoelectric effect:

Frequency of incident light \geq threshold frequency

28. Answer (4)



29. Answer (4)

In the circuit D_1 is reverse biased and D_2 is forward biased, hence the equivalent circuit will become

$$i = \frac{20}{\left(\frac{5 \times 5}{5 + 5}\right) + 5} = \frac{8}{3} \text{ A}$$

30. Answer (4)

Zener diode will ON for $V_{1.5 \text{ k}\Omega} > 10 \text{ V}$

Suppose diode is not ON

$$R_L' = \frac{3 \times \frac{3}{2}}{3 + \frac{3}{2}} = 1 \text{ k}\Omega$$

$$V_L = \frac{1}{1 + 0.5} \times 12 \text{ V}$$

$$V_L = 8 \text{ V}$$

$$V_L < 10 \text{ V}$$

So, Zener diode will not work

$$I_z = 0$$

31. Answer (1)

$$R = \frac{\rho l}{A}, \quad V = I \times A$$

$$R = \frac{\rho V}{A^2} \Rightarrow R \propto \frac{1}{A^2}$$

$$\frac{81}{R'} = \frac{(3A)^2}{A^2} \Rightarrow R' = \frac{81}{9} = 9 \Omega$$

32. Answer (4)

Power rating:

$$P = \frac{V^2}{R_h} \Rightarrow R_h = \frac{V^2}{P} = \frac{100 \times 100}{1000} = 10 \Omega$$

$$\text{Using } P = i^2 R_h \Rightarrow 810 = i^2 \times 10 \Rightarrow i = 9 \text{ A}$$

$$i = \frac{V}{R_{eq}} \Rightarrow 9 = \frac{100}{R_h + 10} \Rightarrow R_h + 10 = \frac{100}{9}$$

$$R = \frac{100 - 90}{9} = \frac{10}{9} \Omega$$

33. Answer (1)

$$\vec{\tau} = \vec{\mu} \times \vec{B}$$

$$\vec{\mu} = i\vec{A} = ia^2\hat{k}$$

$$\vec{\tau} = (ia^2\hat{k}) \times B_0\hat{j} = ia^2B_0\hat{i}$$

34. Answer (3)

In the formula $\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{\text{enclosed}}$ the magnetic field (\vec{B}) is due to current elements which are inside as well as outside the loop.

35. Answer (2)

$$\chi = \frac{I}{H} \Rightarrow I = \chi H$$

where H is magnetising field intensity, I is intensity of magnetisation and χ is magnetic susceptibility.

SECTION-B

36. Answer (4)

Using principle of homogeneity, we can conclude that equation (4) is dimensionally incorrect.

37. Answer (1)

$$Q = \frac{\omega_0 L}{R}$$

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{0.4 \times 40 \times 10^{-6}}} \text{ rad/s}$$

$$\omega_0 = \frac{1000}{4} \text{ rad/s}$$

$$\omega_0 = 250 \text{ rad/s}$$

$$Q = \frac{250 \times 0.4}{50} = 2$$

38. Answer (3)

$$\varepsilon = \frac{\Delta \phi}{\Delta t} = 0.01 \times \frac{(4 \text{ T} - 2 \text{ T})}{10^{-3}} = 20 \text{ V}$$

$$P = \frac{\varepsilon^2}{R} = \frac{20 \times 20}{10} \text{ W}$$

$$= 40 \text{ W}$$

39. Answer (4)

Equivalent focal length of lenses does not depend on orientation of lenses.

40. Answer (1)

$$\text{Shift} = \frac{\Delta \times D}{d}$$

$$= \frac{(\mu - 1)tD}{d}$$

$$= \frac{(2 - 1) \times tD}{d}$$

$$S = \frac{tD}{d}$$

$$\text{and } \beta = \frac{\lambda D}{d}$$

$$S = \frac{t\beta}{\lambda}$$

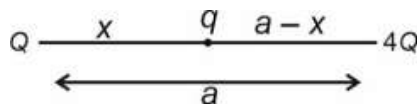
$$S = \frac{t\beta}{\lambda} = \frac{2 \times 10^{-6}}{4 \times 10^{-7}} \beta = 5\beta$$

41. Answer (2)

Magnitude of pseudo force acting on mass $m = m \times \text{acceleration of frame}$

$$= \frac{m \times F}{M + m}$$

42. Answer (1)



$$\frac{KQ}{x^2} = \frac{K4Q}{(a-x)^2}$$

$$x = \frac{a}{3}$$

For $4Q$ to be in equilibrium

$$\frac{KQ}{a^2} = \frac{kq}{\left(\frac{2a}{3}\right)^2}$$

$$\Rightarrow q = \frac{4Q}{9}$$

$$\text{Hence } q = \frac{-4Q}{9}$$

43. Answer (4)

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

$$q = CV$$

$$F = \frac{C^2 V^2 d}{2\varepsilon_0 A d}$$

$$F = \frac{CV^2}{2d}$$

44. Answer (4)

For last line of Paschen Series

$$n_1 = 3, n_2 = \infty$$

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

$$\frac{1}{\lambda} = \frac{R}{9} = 1.11 \times 10^6 \text{ m}^{-1}$$

45. Answer (4)

Maximum wavelength

$$\lambda_{\text{max}} = \frac{12400}{3.2} \text{ \AA} = 3875 \text{ \AA}$$

So, it can detect a signal of wavelength 3000 \AA.

46. Answer (3)

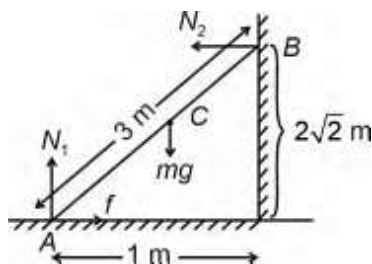
According to conservation of energy

$$(K.E. + P.E.)_i = (K.E. + P.E.)_f$$

$$\frac{1}{2}mv_i^2 - \frac{GM_E m}{5R_E} = \frac{1}{2}mv_f^2 - \frac{GM_E m}{R_E}$$

$$\text{Thus, } v_f^2 = v_i^2 + \frac{2GM_E}{R_E} \left(1 - \frac{1}{5}\right)$$

47. Answer (1)



From the FBD of ladder:

For translational equilibrium

$$N_1 = mg = 200 \text{ N}$$

$$\text{And } f = N_2$$

For rotational equilibrium (About A)

$$mg \left(\frac{1}{2}\right) = N_2 (2\sqrt{2})$$

$$\frac{200}{4\sqrt{2}} = N_2$$

$$\therefore N_2 = 35.25 \text{ N}$$

$$\text{and } N_1 = 200 \text{ N}$$

48. Answer (4)

At the junction, the sum of heat currents should be zero.

$$\left(\frac{dQ}{dt}\right)_1 + \left(\frac{dQ}{dt}\right)_2 + \left(\frac{dQ}{dt}\right)_3 = 0$$

$$KA \left(\frac{T-100}{l}\right) + 2KA \left(\frac{T-30}{l}\right) + 3KA \left(\frac{T-50}{l}\right) = 0$$

$$T = \frac{155}{3} ^\circ\text{C}$$

49. Answer (3)

$$V_T \propto r^2$$

$$\text{Mass} \propto r^3$$

$$r^2 \propto m^{2/3}$$

$$v \propto m^{2/3}$$

$$\frac{v_1}{v_2} = \left(\frac{m_1}{m_2}\right)^{2/3}$$

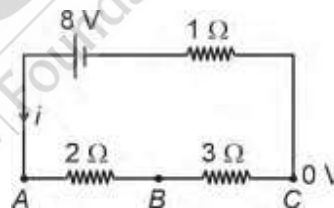
$$\frac{v_1}{v_2} = \left(\frac{3}{4}\right)^{2/3}$$

$$v_2 = \left(\frac{4}{3}\right)^{2/3} v_1$$

$$\Rightarrow v_2 = \left(\frac{4}{3}\right)^{2/3} v$$

50. Answer (3)

Earthing means the potential of point C is zero.



$$i = \frac{V}{R_{eq}} = \frac{8}{1+2+3} = \frac{8}{6} = \frac{4}{3} \text{ A}$$

$$V_A - (2 \times i) - (3 \times i) = V_C$$

$$V_A - 5 \times \frac{4}{3} = 0 \Rightarrow V_A = \frac{20}{3} \text{ V}$$

CHEMISTRY

SECTION-A

51. Answer (3)

\wedge_m increases with dilution because the total volume of solution containing one mole of electrolyte also increases.

$$\wedge_m \propto V$$

52. Answer (4)

NO: Neutral oxide

53. Answer (1)

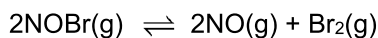
Boron can have maximum covalency of 4 as it has only four valence orbitals (2s and 2p) available for bonding.

Whereas Al have nine valence orbitals (3s, 3p, 3d). Due to small size and more electronegativity of 1st member of p-block forms $p\pi - p\pi$ bonds.

Eg. C = C, C \equiv C, N = N,

N \equiv N, C = O, C = N etc.

54. Answer (3)



$$t = 0 \quad P_0$$

$$t = t_{\text{eq}} \quad P_0 - 2x \qquad 2x \qquad x$$

$$2x = \frac{2P}{5}$$

$$x = \frac{P}{5}$$

$$P_0 + x = P$$

$$P_0 = P - x$$

$$P_0 = \frac{4P}{5}$$

$$P[\text{NOBr}]_{\text{eq}} = \frac{4P}{5} - \frac{2P}{5}$$

$$= \frac{2P}{5}$$

$$P[\text{NO}]_{\text{eq}} = \frac{2P}{5}$$

$$P[\text{Br}_2]_{\text{eq}} = \frac{P}{5}$$

$$K_p = \frac{\frac{P}{5} \times \left(\frac{2P}{5}\right)^2}{\left(\frac{2P}{5}\right)^2}$$

$$K_p = \frac{P}{5}$$

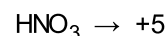
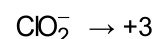
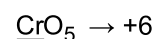
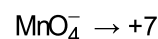
55. Answer (3)

Activity of solid is taken unity so, it does not affect the equilibrium.

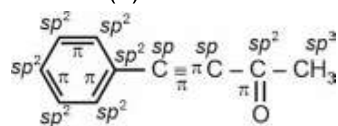
56. Answer (4)

A negative value of E^\ominus means that the redox couple is stronger reducing agent than the H^+/H_2 couple.

57. Answer (3)



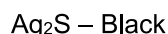
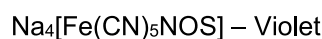
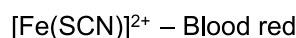
58. Answer (3)



sp^2 hybridised carbon = 7

Total π bonds = 6

59. Answer (4)



60. Answer (3)

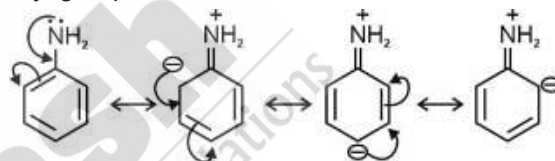
Element	Electronegativity (on Pauling scale)
1. C	2.5
2. Si	1.8
3. Ge	1.8
4. Sn	1.8

So, the correct order of electronegativity:

$\text{C} > \text{Si} = \text{Ge} = \text{Sn}$

61. Answer (3)

• Aromatic amines are weaker bases than ammonia due to electron withdrawing nature of the aryl group.



• Tertiary amines do not show intermolecular H-bonding.

62. Answer (4)

Alkyl halides react with sodium (in dry ether) to give hydrocarbons containing double the number of carbon atoms present in the halide.

$\therefore \text{CH}_4$ cannot be prepared using Wurtz reaction.

63. Answer (4)

The presence of electron donating group ($-\text{OH}$) at ortho and para-position decreases the reactivity of haloarenes, towards nucleophilic substitution reaction.

64. Answer (3)

$[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_2$ and $[\text{Fe}(\text{H}_2\text{O})_6]\text{Cl}_2$ have Cr^{2+} and Fe^{2+} metal ions.

Both Cr^{2+} and Fe^{2+} have four unpaired electrons with spin only magnetic moment value = 4.8 BM

65. Answer (2)

$$\text{Number of mole(s) in 1 g of } \text{N}_2 = \frac{1}{28}$$

$$\text{Number of mole(s) in 1 g of } \text{H}_2 = \frac{1}{2}$$

\therefore Number of atoms in 1 g of N_2 and 1 g of H_2 are different.

66. Answer (4)

Element	No. of moles	Simplest ratio of moles
C	$\frac{24.27}{12} = 2.02$	$\frac{2.02}{2.02} = 1$
H	$\frac{4.07}{1} = 4.07$	$\frac{4.07}{2.02} = 2$
Cl	$\frac{71.65}{35.5} = 2.02$	$\frac{2.02}{2.02} = 1$

∴ The empirical formula of given compound is CH_2Cl .

67. Answer (4)

$$\%N = \frac{1.4 \times M \times 2 \left(V - \frac{V_1}{2} \right)}{w}$$

$$= \frac{1.4 \times 1 \times 2(20)}{1.23}$$

$$= \frac{56}{1.23} = 45.52\%$$

68. Answer (4)

Among the acid derivatives only acid halide get reduced by NaBH_4 .

69. Answer (2)

$$\log \left(\frac{k_2}{k_1} \right) = \frac{E_a}{2.303R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$$

$$\log \left(\frac{2k}{k} \right) = \frac{E_a}{2.303R} \left(\frac{1}{300} - \frac{1}{310} \right)$$

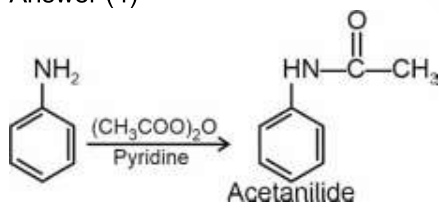
$$\log 2 = \frac{E_a}{2.303R} \left[\frac{10}{300 \times 310} \right]$$

$$E_a = 53.59 \text{ kJ}$$

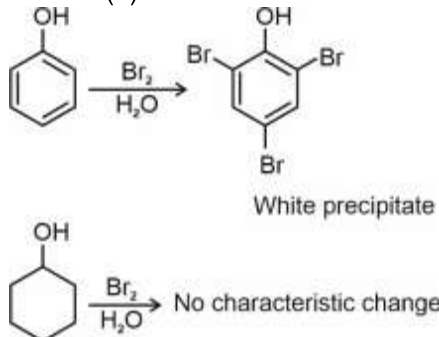
70. Answer (1)

Mohr's salt is $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$

71. Answer (4)



72. Answer (3)



73. Answer (1)

DNA contains four bases adenine, guanine, cytosine and thymine.

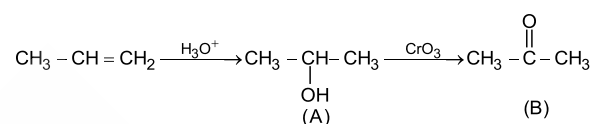
74. Answer (2)

$-\text{NH}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$ is o/p directing group, $-\text{CN}$ is m-directing.

75. Answer (3)

The cyclic species which contain $(4n + 2)\pi$ electrons in resonance are aromatic in nature.

76. Answer (4)



Ketone does not react with Tollens' reagent.

77. Answer (2)

1 molal aq. solution means 1 mole of solute in

$$1000 \text{ g of H}_2\text{O. Number of moles of water} = \frac{1000}{18}$$

$$= 55.55$$

$$X = \frac{n_2}{n_1 + n_2} = \frac{1}{1 + 55.55} = \frac{1}{56.55} = 0.0177$$

78. Answer (2)

$$n_{\text{Total}} = \frac{0.6}{60} + \frac{3.42}{342} = 0.02$$

$$\pi = i \left(\frac{n_{\text{total}}}{V} \right) RT$$

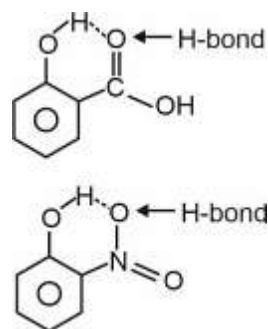
$$= \frac{1 \times 0.02 \times 1000 \times 0.0821 \times 300}{100}$$

$$= 4.92 \text{ atm}$$

79. Answer (1)

sp^3d^2 hybridisation has $d_{x^2-y^2}$, d_{z^2}

80. Answer (3)



81. Answer (2)

$$n\lambda = 2\pi r$$

$$\text{So, } \lambda = \frac{2\pi r}{n} \quad \dots(1)$$

$$r_n = a_0 \frac{n^2}{Z}$$

$$r_2 = \frac{a_0 \cdot (2)^2}{3} = \frac{52.9 \times 4}{3} \quad \dots(2)$$

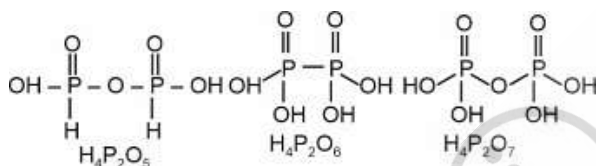
Putting (2) in (1)

$$\lambda = \frac{2\pi \times 52.9 \times 4}{3 \times 2} = 70.5\pi \text{ pm}$$

82. Answer (1)

At elevated temperatures, S_2 is the dominant species and is paramagnetic like O_2 .

83. Answer (4)



84. Answer (3)

(1) Heat is an extensive property.

 (2) If the gas expands, ($v_f > v_i$), work is done by the system and 'W' is negative.

(3) Internal energy of gas decreases during adiabatic expansion of a gas.

 (4) $\Delta U = 0$ for isothermal expansion as ($T = \text{constant}$).

85. Answer (2)



Unpaired electrons = 0 = Diamagnetic

Diamagnetic species are repelled by the applied magnetic field.

SECTION-B

86. Answer (2)

 For Lyman series $n_1 = 1$

The largest wavelength is given by

$$\frac{1}{\lambda_1} = R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$

$$\frac{1}{\lambda_1} = R_H \left[\frac{1}{(1)^2} - \frac{1}{(2)^2} \right]$$

$$\frac{1}{\lambda_1} = R_H \left[\frac{3}{4} \right]$$

$$\lambda_1 = \frac{4}{3R_H} = x$$

The wavelength of the second line of Balmer series of H atom is given by

$$\frac{1}{\lambda_2} = R_H \left[\frac{1}{(2)^2} - \frac{1}{(4)^2} \right]$$

$$= R_H \left[\frac{1}{4} - \frac{1}{16} \right] = R_H \left[\frac{3}{16} \right]$$

$$\lambda_2 = \frac{16}{3R_H} = 4x$$

87. Answer (3)

Interhalogen compounds are covalent, diamagnetic molecules and are more reactive than halogens (except fluorine).

88. Answer (4)

 500 cm³ of 0.5 M H_2SO_4

$$\text{Moles of } H^+ \text{ ions} = \left(\frac{500 \times 0.5}{1000} \right) \times 2$$

$$= 0.5 = 0.5 \text{ mol } H^+ \text{ ions}$$

 * 500 cm³ of 0.2 M NaOH

$$= \frac{500 \times 0.2}{1000} \times 1$$

$$= \frac{0.2}{2} = 0.1 \text{ mol } OH^- \text{ ions}$$

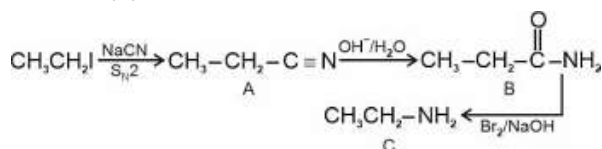
Amount of water formed = 0.1 mol

$$\text{Amount of heat evolved} = 0.1 \times 57.1 \text{ kJ} = 5.71 \text{ kJ}$$

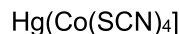
89. Answer (3)



90. Answer (4)



91. Answer (3)

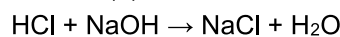


Cobalt is in +3 oxidation state

IUPAC name : Mercury

Tetrathiocyanatocobaltate (III)

92. Answer (3)

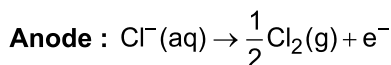
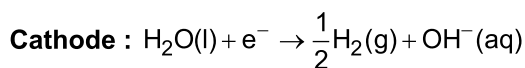
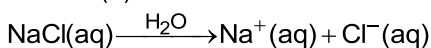


$$\frac{7.3}{36.5} = \frac{8}{40}$$

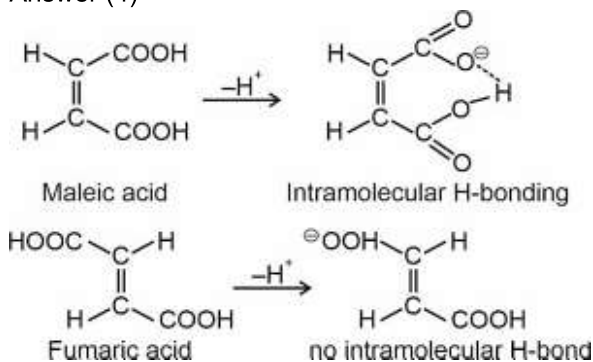
$$= 0.2 \quad 0.2$$

As moles of acid and base are equal and both are strong so salt formed will have pH = 7 (neutral)

93. Answer (4)



94. Answer (4)



95. Answer (1)

For zero order

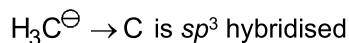
$$t_{1/2} = \frac{a_0}{2k}$$

$$t_{75\%} = \frac{3a_0}{4k}$$

$$\frac{t_{75\%}}{t_{1/2}} = \frac{3}{2}$$

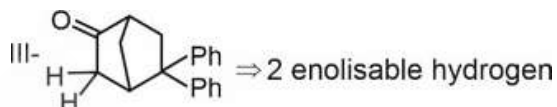
$$t_{75\%} = \frac{3}{2} \times 20 = 30 \text{ min}$$

96. Answer (1)



97. Answer (3)

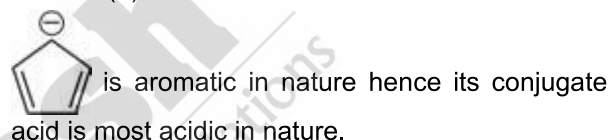
Hydrogen atoms at bridgehead carbon are not enolisable.



98. Answer (1)

Because of hydrogen bonding, boiling point of ethanol is maximum.

99. Answer (1)



100. Answer (2)

Cellulose is composed of β -D-glucose units.

BOTANY

SECTION-A

101. Answer (1)

Q represents H-bonds which confers stability to the double helical structure of DNA.

102. Answer (2)

Molecular structure of DNA is not identified by DNA fingerprinting. Rest all are the applications of DNA fingerprinting.

103. Answer (3)

In prokaryotes, DNA is held with some proteins (that have positive charges) in a region termed as 'nucleoid'; where DNA is organised in large loops. RNA functions as adapter, structural and in some cases as a catalytic molecule.

104. Answer (3)

RNA polymerase uses nucleoside triphosphates as substrate. It works in template dependent manner. It binds to the promoter region to initiate transcription.

105. Answer (2)

Antennae in photosystem has all the pigments.

106. Answer (1)

The use of radioactive ^{14}C by Melvin Calvin in algal photosynthesis studies led to the discovery that the first CO_2 fixation product was a 3-carbon organic acid.

107. Answer (3)

RER is frequently observed in the cells actively involved in protein synthesis and secretion. SER is the major site for synthesis of lipid. In animal cells lipid-like steroidal hormones are synthesised in SER. Chloroplast is involved in photosynthesis.

108. Answer (1)

In plants, the tonoplast facilitates the transport of a number of ions and other materials against concentration gradients into the vacuole, hence their concentration is significantly higher in the vacuole than in the cytoplasm.

109. Answer (1)
Lysosomes are known as suicidal bags. Lysosomes digest the old organelles that are no longer useful to the cells.
110. Answer (3)
In the S and G₂ phases the new DNA molecules formed are not distinct but intertwined.
111. Answer (4)
Prophase is the first stage of karyokinesis of mitosis. During prophase chromosomal material condenses to form compact mitotic chromosomes. The two asters together with spindle fibres forms mitotic apparatus. During anaphase chromatids move to opposite poles.
112. Answer (2)
The interphase lasts more than 95% of the duration of cell cycle, in rest part cell division takes place. M phase is the most dramatic period of the cell cycle, involving a major reorganisation of virtually all components of the cell.
113. Answer (1)
Gymnosperms lack sieve tubes and companion cells, instead they have sieve cells and albuminous cells.
114. Answer (3)
Cork cambium forms phellem or cork on its outer side. Heartwood does not conduct water but it gives mechanical support to the stem. Lenticels permit exchange of gases between outer atmosphere and the internal tissue of the stem.
115. Answer (3)
Large conspicuous nuclei is present in the cells of meristematic phase. Cell walls are primary in nature in this phase with abundant plasmodesmata. Increased vacuolation is a characteristic of cells of elongation phase.
116. Answer (1)
Opposite to the micropylar end is the chalaza, representing the basal part of anatropous ovule.
117. Answer (1)
Female flower have a very long pedicel. Pollen grains are released on to the surface of water.
118. Answer (4)
The second part of biological name consists of specific epithet.
119. Answer (3)
Ciliated protozoans have a cavity (gullet) that opens to the outside of the cell surface. The co-ordinated movement of rows of cilia causes the water laden with food to be stored into the gullet e.g., *Paramecium*.
120. Answer (2)
Most fungi are heterotrophic and absorb soluble organic matter from dead substrates and hence are called saprophytes.
121. Answer (3)
In some plants such as *Rhizophora* growing in swampy areas, many roots come out of the ground vertically upward to get oxygen for respiration. Such roots are called pneumatophores.
122. Answer (4)
In parietal placentation, the ovules develop on the inner wall of the ovary or on peripheral part.
123. Answer (2)
Cynodon dactylon is a grass which belongs to Gramineae family.
124. Answer (4)
In *Fucus* diplontic life cycle is observed.
125. Answer (2)
Male sex organ are present on antheridiophore. Pteridophytes are the first terrestrial plants to possess vascular tissue.
126. Answer (2)
Biocontrol refers to the use of biological methods for controlling plant diseases and pests. Dragonflies are used to control mosquitoes.
127. Answer (2)
Under unfavourable conditions many zooplankton species in lakes and ponds are known to enter diapause, a stage of suspended development.
128. Answer (1)
The successional series progress from hydric to mesic conditions. Phytoplankton is the pioneer community in hydrarch succession.
129. Answer (3)
Ubiquinone receives reducing equivalents via FADH₂ that is generated during oxidation of succinate in citric acid cycle.
130. Answer (4)
Alfred Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes and mapped their position on the chromosome.
131. Answer (1)
Honey bee show haplodiploid sex determination and has special characteristic features such as males produce sperms by mitosis.
132. Answer (4)
Gregor Mendel, conducted hybridisation experiment on garden peas for seven years (1856-1863) and proposed the laws of inheritance.

133. Answer (3)

Sixth mass extinction is anthropogenic in nature.

134. Answer (2)

Turner's syndrome afflicted female individual are sterile as their ovaries are rudimentary.

135. Answer (1)

Khasi and Jaintia hills are situated in Meghalaya.

SECTION-B

136. Answer (4)

DNA replication is semi-conservative in nature.

137. Answer (4)

Repressor is not a component of transcription unit.

138. Answer (3)

Bacterial flagellum is composed of three parts- filament, hook and basal body. Tubulin is found in eukaryotic flagella.

139. Answer (1)

The complete disintegration of the nuclear envelope marks the start of the metaphase. In metaphase, chromosomes move to spindle equator.

140. Answer (1)

- In dicot root, parenchymatous cells which lie between xylem and phloem are called conjunctive tissue.
- Conjoint open vascular bundles have the capability to form secondary tissues.
- In exarch condition, protoxylem lies towards periphery and metaxylem lies towards the centre.

141. Answer (2)

Ethylene helps leaves/upper parts of the deep-water rice plants remain above water.

142. Answer (2)

The portion of embryonal axis below the level of cotyledons is hypocotyl and above the level of cotyledons is epicotyl.

143. Answer (2)

Plant viruses generally have ssRNA as their genetic material.

144. Answer (2)

Calotropis, Tulip, *Asparagus*, Tobacco and *Gloriosa* show the valvate aestivation.

Lady's finger shows twisted aestivation. *Sesbania* shows vexillary aestivation.

145. Answer (3)

Angiosperm does not show the presence of archegonia.

146. Answer (3)

Cyclosporin A (*Trichoderma polysporum*), Statin (*Monascus purpureus*) and citric acid (*Aspergillus niger*) are fungal products. Streptokinase is produced by bacterium *Streptococcus*.

147. Answer (4)

Ectoparasites feed on the external surface of the host organism.

Cuckoo and crow are example of brood parasitism.

148. Answer (4)

Desert is natural terrestrial ecosystem.

149. Answer (3)

Pyruvate dehydrogenase requires Mg^{2+} as cofactor.

150. Answer (4)

Phenylketonuria afflicted individual lacks the enzyme that converts amino acid phenylalanine into tyrosine.

Thalassemia is an autosomal recessive trait.

ZOOLOGY**SECTION - A**

151. Answer (2)

Endocrine system in human body provides chemical integration through hormones called intercellular messengers.

152. Answer (4)

The axons transmit nerve impulses away from the cell body to a synapse or to a neuro-muscular junction. Impulse is carried by dendrites towards the cell body.

153. Answer (3)

Middle piece of sperm possesses numerous mitochondria which produce energy for movement of the tail.

154. Answer (4)

Within Graafian follicle, the secondary oocyte forms a new membrane called zona pellucida surrounding it. Cells present in corpus luteum are called luteal cells. Granulosa cells are present around follicles and secrete estrogen.

155. Answer (1)

In human females, oogenesis starts during embryonic development. The primary oocytes start division and enter into prophase-I of the meiotic division and get temporarily arrested at this stage. Each primary oocyte then gets surrounded by a layer of granulosa cells and is called the primary follicle.

156. Answer (4)

Ionising radiations like X-rays are physical carcinogens. Biological carcinogens include cancer causing genes called viral oncogenes.

α -interferons are helpful in the treatment of cancer.

157. Answer (2)

Drugs like barbiturates, amphetamines, benzodiazepines are normally used as medicines to help patients cope with mental illness like depression.

158. Answer (4)

Frog has different types of sense organs, namely organs of touch (sensory papillae), taste (taste buds), smell (nasal epithelium), vision (eyes) and hearing (tympanum with internal ears). They do not have external ears.

159. Answer (3)

When columnar or cuboidal cells bear cilia on their free surface, they are called ciliated epithelium and the main function of cilia is to move particles in a specific direction.

160. Answer (3)

Tendons and ligaments are examples of dense regular connective tissue. In connective tissue, the cells secrete modified polysaccharides which accumulate between cells and fibres and acts as a matrix.

161. Answer (2)

Bt toxin gene has been cloned from the bacteria and has been expressed in plants to provide resistance against insects without the need for insecticides; in effect created a bio-pesticide.

162. Answer (4)

Bt stands for *Bacillus thuringiensis* and the examples of Bt crops are Bt cotton, corn, rice, tomato, potato and soyabean, etc.

163. Answer (3)

The molecules in the acid-insoluble fraction with the exception of lipids are polymeric substances.

Lipids do not exceed 800 Da in molecular weight but still comes under acid-insoluble fraction because lipids are not water soluble and on disrupting the cell structure, they form vesicles and get separated along with acid-insoluble pool.

164. Answer (1)

K_m also known as the Michaelis constant, is the substrate concentration at which the reaction reaches half of the maximum velocity [V_{max}].

165. Answer (2)

Enzyme catalysts differ from inorganic catalysts. The inorganic catalysts work efficiently at high temperatures and high pressures, while enzymes get damaged at high temperatures (say above 40°C). However, thermostable enzymes isolated from thermophilic organisms are stable and retain their catalytic power even at high temperatures.

166. Answer (1)

Neurohypophysis stores and releases two hormones called oxytocin and vasopressin which are actually synthesised by hypothalamus and are transported axonally to neurohypophysis.

167. Answer (2)

Person with blood group A can donate blood to people with blood group 'A' and 'AB'.

168. Answer (3)

To obtain a standard ECG, a patient is connected to the machine with three electrical leads (one to each wrist and to the left ankle) that continuously monitor the heart activity.

169. Answer (2)

In tubectomy, a small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through vagina.

In vasectomy, a small part of vas deferens is removed or tied up through a small incision on scrotum. IUDs are inserted by doctors or expert nurses in the uterus through vagina.

170. Answer (2)

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.

171. Answer (3)

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

172. Answer (1)

Trachea is a straight tube extending upto the mid-thoracic cavity, gets divided into a right and left primary bronchi at the level of 5th thoracic vertebra.

173. Answer (1)

The centre present in the pons region of the brain called pneumotaxic centre can moderate the functions of the respiratory rhythm centre. Neural signals from this centre reduce the duration of inspiration and alters the respiratory rate.

174. Answer (4)

Many bony fishes, aquatic amphibians and aquatic insects are ammonotelic in nature. They excrete ammonia as excretory waste.

Betta, *Clarias* and *Pterophyllum* are bony fishes. *Pristis* is a cartilaginous fish.

175. Answer (1)

pO₂ in systemic veins = 40 mmHg

pCO₂ in systemic arteries = 40 mmHg

pO₂ in pulmonary veins = 95 mmHg

pCO₂ in pulmonary arteries = 45 mmHg

pCO₂ in systemic veins = 45 mmHg

176. Answer (4)

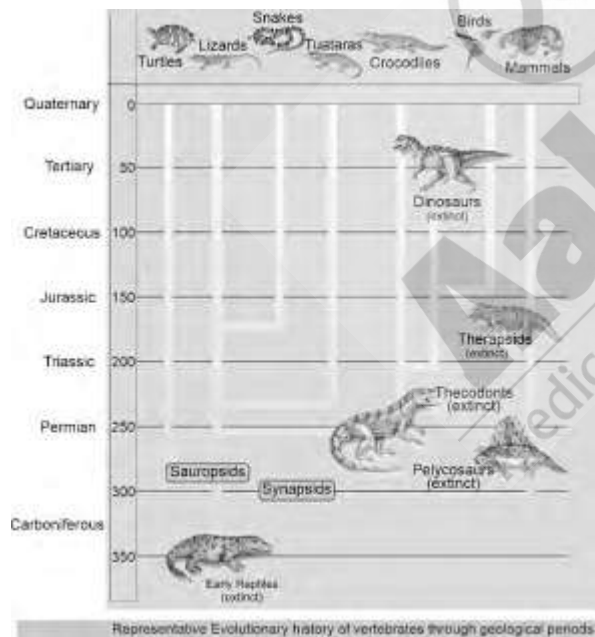
Walking, running, climbing, flying, swimming are some forms of locomotory movements.

Locomotion is actually a voluntary movement that results in a change of place or location.

177. Answer (2)

The thick filaments in the 'A' band are held together in the middle of this band by a thin fibrous membrane called 'M' line.

178. Answer (3)



179. Answer (1)

Two mya, *Australopithecus* probably lived in East African grasslands. Evidence shows they hunted with stone weapons but essentially ate fruit.

180. Answer (3)

Embryological support for evolution was proposed by Ernst Haeckel based upon the observation of certain features during embryonic stage common to all vertebrates that are absent in adult.

181. Answer (4)

Fasciola – Platyhelminthes

Wuchereria – Aschelminthes

Aplysia, *Dentalium* – Mollusca

Physalia, *Gorgonia* – Coelenterata

182. Answer (3)

Plasmids are autonomously replicating, circular, double stranded, extra chromosomal DNA.

183. Answer (3)

The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution.

184. Answer (2)

The order of steps involved in PCR is

Denaturation (94°C) → Annealing (50°C - 60°C) → Primer extension (72°C)

High temperature is responsible for denaturation and primer extension is responsible for addition of nucleotides on template DNA.

185. Answer (1)

Carcharodon belongs to the class Chondrichthyes and these animals lack air bladder, therefore they have to swim constantly to avoid sinking.

SECTION-B

186. Answer (3)

PNS is divided into two divisions called somatic neural system and autonomous neural system. The autonomous neural system is further classified into sympathetic neural system and parasympathetic neural system. Somatic neural system transmit impulses from the CNS to skeletal muscles.

187. Answer (3)

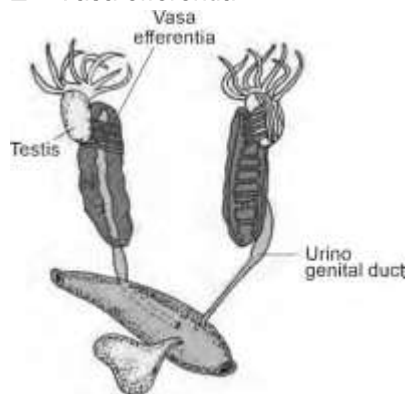
Embryonic development is also called gestation. Attachment of blastocyst to uterine wall is called implantation. First menstruation begins at puberty and is called menarche. Menstrual flow lasts for 3-5 days.

188. Answer (3)

X – Urinogenital duct

Y – Testis

Z – Vasa efferentia



189. Answer (3)

Metastasis is the most feared property of malignant tumors.

In malignant tumors, cells sloughed from tumors and reach distant sites through blood, and wherever they get lodged in the body, they start a new tumor there. This property called metastasis is the most feared property of malignant tumors.

190. Answer (4)

- *Rana tigrina* is a dioecious vertebrate.
- Spermatheca is present in a female cockroach.

191. Answer (2)

Plasma constitutes nearly 55% of the blood. It contains small amount of minerals. Clotting factors are present in plasma in an inactive form. 90-92% of plasma is water and 6-8% is proteins. Plasma without clotting factors is called serum.

192. Answer (1)

Inulin is the polymer of fructose.

Insulin is a peptide hormone and it is a heteropolymer of amino acids.

193. Answer (1)

- (a) Thymosins – Differentiation of T-lymphocytes
- (b) Insulin – Enhances the cellular glucose uptake and utilization
- (c) Cortisol – Suppresses the immune response
- (d) Androgens – Synthetic effects on protein and carbohydrate metabolism

194. Answer (3)

The Medical Termination (Amendment) Act, 2017 was enacted by the Government of India with the intention of reducing the incidence of illegal abortion and consequent maternal mortality and morbidity.

195. Answer (1)

Agrobacterium tumefaciens is the natural genetic engineer of plants.

Retroviruses are used for transformation of animal cells.

196. Answer (1)

Malpighian body or renal corpuscle is glomerulus along with Bowman's capsule. Blood from the glomerulus is carried away by an efferent arteriole.

197. Answer (2)

In stabilising selection, more individuals acquire mean character value while in directional selection, more individuals acquire value other than the mean character value.

198. Answer (2)

Our vertebral column is formed by 26 serially arranged units called vertebrae and is dorsally placed. Each vertebrae has a central hollow portion (neural canal).

199. Answer (1)

Adult echinoderms (sea cucumber) are radially symmetrical.

Sea anemone is a cnidarian.

200. Answer (3)

After completion of the biosynthetic stage, the product has to be formulated through a series of processes before it is ready for marketing as a finished product.

The processes which include separation and purification, are collectively referred to as downstream processing.

