All India Aakash Test Series for NEET - 2020

TEST - 6 (Code-A)

Test Date : 05/01/2020

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

1. Answer (1)

Hint : $|\vec{a}| = 0$ when $|\vec{F}| = \left|\frac{d\vec{p}}{dt}\right| = 0$

Sol. : $|\vec{F}| = \left|\frac{d\vec{p}}{dt}\right| = 2t - 2$

$\Rightarrow$ $2t - 2 = 0$

$\Rightarrow$ $t = 1$ s

2. Answer (4)

Hint : $T = m_A a$

Sol. : Acceleration of system,

$$a = \frac{F}{m_A + m_B} = \frac{106}{53} = 2 \text{ m s}^{-2}$$

Tension in the string,

$T = m_A a = 3 \times 2 = 6$ N

3. Answer (2)

Hint : $T = m(g - a)$, where a is downward acceleration.

Sol. : When person is descending with downward acceleration 'a', tension in the rope,

$\Rightarrow$ $T = m(g - a)$

If rope does not break,

$T \le T_{max}$

$\Rightarrow$ $m(g - a) \le 0.6\, mg$

$\Rightarrow$ $(g - a) \le 0.6\, g$

$\Rightarrow$ $a \ge 0.4\, g$

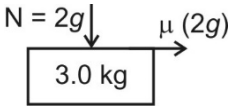
so, $a_{min} = \frac{2g}{5}$.

4. Answer (2)

Hint : $F < F_{max}$ for common acceleration.

Sol. : For lower block, frictional force is the driving force.

For maximum acceleration,



$$a_{max} = \frac{\mu(2g)}{3}$$

$$= \frac{1 \times 2 \times 10}{3} = \frac{20}{3} \text{ m/s}^2$$

Maximum force for common acceleration,

$$F_{max} = (2 + 3) \times \frac{20}{3} = \frac{100}{3} \text{ N}$$

As $F < F_{max}$, both blocks will move with common acceleration given by.

$$a = \frac{25}{5} = 5 \text{ m/s}^2$$

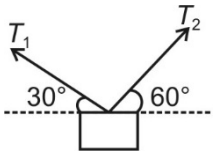
Frictional force between two blocks,

$f_s = 3 \times a = 15$ N.

5. Answer (2)

Hint : $\sum F_x = 0$; $\sum F_y = 0$.

Sol. : For equilibrium in x direction,



$T_1 \cos 30° = T_2 \cos 60°$

$\Rightarrow$ $T_2 = \sqrt{3}\, T_1$,

For equilibrium in y direction,

$T_1 \sin 30° + T_2 \sin 60° = 20$

$\Rightarrow$ $\frac{T_1}{2} + \frac{\sqrt{3}}{2}\left(\sqrt{3}\, T_1\right) = 20$

$\Rightarrow$ $2T_1 = 20$ N

$\Rightarrow$ $T_1 = 10$ N

6. Answer (1)

Hint : Contact force between two blocks is net force for 4 kg block.

Sol. : Acceleration of blocks,

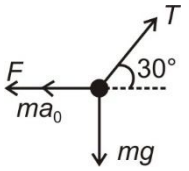
$$a = \frac{6}{4} = 1.5 \text{ m s}^{-2}$$

$F = (4 + 3) \times 1.5 = 10.5$ N

7. Answer (3)

Hint : Pseudo force = $-m\vec{a}_0$

Sol. : FBD of bob, In non-inertial frame, i.e. frame of trolley.



$T \sin 30° = mg$

$\Rightarrow$ $T \times \frac{1}{2} = 10$

$\Rightarrow$ $T = 20$ N

and, $T \cos 30° = F + ma_0$

$\Rightarrow$ $F = 10\sqrt{3} - 10$

$= 10\left(\sqrt{3} - 1\right)$ N

8. Answer (3)

Hint : Area under $F - t$ graph gives change in linear momentum.

Sol. : At $t = 6$ s, $F = -20$ N

Area under $F - t$ graph

$$\Delta\vec{p} = \frac{1}{2}\times 2\times 10 + \frac{1}{2}\times 4\times(-20)$$

$$\Delta\vec{p} = 10 - 40 = -30$$

$$\vec{p}_f - 20 = -30$$

$$\Rightarrow \quad \vec{p}_f = -10 \text{ N s}$$

so, $|\vec{p}_f| = 10$ N s

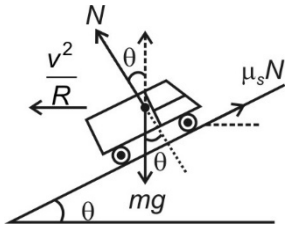
9. Answer (3)

Hint : Banking of road.

Sol. : In case of minimum speed, limiting friction acts up the plane.

In vertical direction

$N\cos\theta + \mu_s N\sin\theta = mg$



$$\Rightarrow \quad N = \frac{mg}{\cos\theta + \mu_s \sin\theta}$$

In horizontal direction,

$$N\sin\theta - \mu_s N\cos\theta = \frac{mv_{\min}^2}{R}$$

$$\Rightarrow \quad v_{\min}^2 = gR\left(\frac{\sin\theta - \mu_s\cos\theta}{\cos\theta + \mu_s\sin\theta}\right)$$

$$\Rightarrow \quad v_{\min} = \sqrt{\frac{gR(\tan\theta - \mu_s)}{1 + \mu_s\tan\theta}}$$

10. Answer (2)

Hint : $N = Ma$

Sol. : $a = \dfrac{F}{(M+m)}$

Normal contact force between two blocks,

$$N = Ma = \frac{MF}{(M+m)}$$

If block of mass m does not fall,

$mg \le \mu N$

$$\Rightarrow \quad mg \le \frac{\mu MF}{(M+m)}$$

$$\Rightarrow \quad F \ge \frac{(M+m)mg}{\mu M}$$

11. Answer (1)

Hint : $f_s = m\omega^2 R \le f_{\lim}$

Sol. : Static friction provides necessary centripetal force.

$f_s \le f_{\lim}$

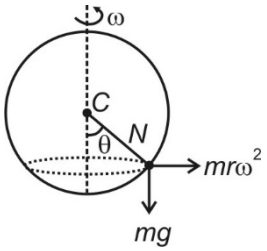
$m\omega^2 (2r) \le \mu$ mg

$$\Rightarrow \quad \omega \le \sqrt{\frac{\mu g}{2r}}\ .$$

12. Answer (1)

Hint : $\cos\theta = \dfrac{g}{\omega^2 R}$.

Sol. : $N\sin\theta = m\omega^2 R\sin\theta$



$$\Rightarrow \quad N = m\omega^2 R$$

$N\cos\theta = mg$

$$\Rightarrow \quad \cos\theta = \frac{g}{\omega^2 R} = \frac{g}{(5g/4)} = \frac{4}{5}$$

$$\Rightarrow \quad \theta = 37°$$

13. Answer (1)

Hint : $W = \int \vec{F}\cdot\overrightarrow{dx}$.

Sol. : $W = \int_{x_1}^{x_2} F\,dx$

$$= 10\int_{-0.5}^{1} dx + 20\int_{-0.5}^{1} x\,dx$$

$$= 10\left[x\right]_{-0.5}^{1} + 10\left[x^2\right]_{-0.5}^{1}$$

$= 10\ (1.5) + 10(1 - 0.25)$

$= 15 + 7.5 = 22.5$ J.

14. Answer (2)

Hint : $W_{all} = \Delta KE$.

Sol. : $W_{gravity} + W_f = \Delta KE$

$$\Rightarrow \quad 2.0\times 10^{-3}\times 10\times 2\times 10^3 + W_f = \frac{1}{2} \times 2.0\times 10^{-3}\,(50.0)^2.$$

$$\Rightarrow \quad 40 + W_f = 2.5$$

$$\Rightarrow \quad W_f = -37.5 \text{ J}$$

15. Answer (2)

Hint : $e = \frac{v}{u}$

Sol. : Speed of ball just before collision,

$u = \sqrt{(20)^2 + 2\times 10\times 20} = 20\sqrt{2}\ \text{m s}^{-1}$

Speed of ball just after the collision,

$v = \sqrt{2\times 10\times 20} = 20\ \text{m s}^{-1}$

$e = \frac{v}{u} = \frac{1}{\sqrt{2}}$

16. Answer (3)

Hint : $|\vec{p}_{\text{gun}}| = |\vec{p}_{\text{shell}}|$ after the firing.

Sol. : From conservation of linear momentum,

$\vec{p}_{\text{gun}} + \vec{p}_{\text{shell}} = \vec{0}$

$\Rightarrow \quad |\vec{p}_{\text{gun}}| = |\vec{p}_{\text{shell}}| = p \ \ (\text{say})$

Now, $\frac{p^2}{2M_{\text{gun}}} + \frac{p^2}{2M_{\text{shell}}} = KE$

$\Rightarrow \quad \frac{p^2}{2}\left[\frac{1}{2} + \frac{1}{0.1}\right] = 8.4\times 10^3$

$\Rightarrow \quad p^2 = \frac{8.4\times 10^3 \times 2}{10.5} = 1600$

$\Rightarrow \quad p = 40$ N s

17. Answer (3)

Hint : $P = Fv$

Sol. : $W = \int_0^t P\,dt$

$\Rightarrow \quad \frac{1}{2}mv^2 = \int_0^t kt\,dt$

$\Rightarrow \quad \frac{1}{2}mv^2 = \frac{kt^2}{2}$

$\Rightarrow \quad v = \sqrt{\frac{k}{m}}\,t$

now, $F = \frac{P}{v} = \frac{kt}{\sqrt{\frac{k}{m}}\,t} = \sqrt{km}$.

18. Answer (4)

Hint & Sol. : For neutral equilibrium,

$\frac{dU}{dx} = 0$ and $\frac{d^2U}{dx^2} = \left|\frac{dF}{dx}\right| = 0$

At points, P and Q, $\left|\frac{dF}{dx}\right| \neq 0$

At point R, $F \neq 0$

19. Answer (2)

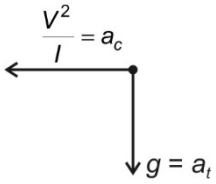
Hint : $a = \sqrt{a_c^2 + a_t^2}$

Sol. : Let speed of point mass is v, when string becomes horizontal. Then, from conservation of mechanical energy.

$v^2 = u^2 - 2gh$, we get

$v^2 = 4gl - 2gl$

$= 2gl$



So, $a_c = \frac{v^2}{l} = 2g$

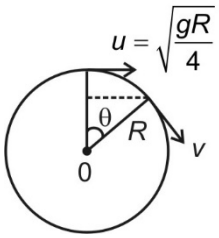
And $a_t = g$

So, $a = \sqrt{a_c^2 + a_t^2} = \sqrt{5}\,g$.

20. Answer (1)

Hint : Normal contact force is zero at the time of losing the contact.

Sol. : Let speed of particle is v, when it loses the contact with the sphere.



From conservation of mechanical energy.

$v^2 = u^2 + 2gh$

we get, $v^2 = \frac{gR}{4} + 2gR(1-\cos\theta)$ …(i)

$mg\cos\theta - N = \frac{mv^2}{R}$

when, it loses contact, N = 0,

we get $v^2 = Rg\cos\theta$ …(ii)

From equations (i) and (ii),

$Rg\cos\theta = \frac{Rg}{4} + 2gR(1-\cos\theta)$

$\Rightarrow \quad 3Rg\cos\theta = \frac{9Rg}{4} \Rightarrow \cos\theta = \frac{3}{4}$.

$\Rightarrow \quad \theta = \cos^{-1}\left(\frac{3}{4}\right)$

21. Answer (3)

Hint : $P = \vec{F} \cdot \vec{v}$

Sol. : $\Delta\vec{p} = \int_0^t \vec{F}\,dt = \hat{i}\int_0^t 2\,dt + \hat{j}\int_0^t 4t\,dt$

$m\vec{v} = 2t\,\hat{i} + 2t^2\hat{j}$

$\Rightarrow \quad \vec{v} = 2t\hat{i} + 2t^2\hat{j} \quad (\because m = 1\text{kg})$

$P = \vec{F} \cdot \vec{v} = \left(2\hat{i} + 4t\,\hat{j}\right) \cdot \left(2t\,\hat{i} + 2t^2\hat{j}\right)$

$= 4t + 8t^3$

$= 4 \times 2 + 8\,(2)^3$

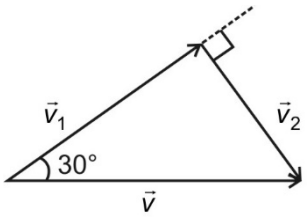
$= 72$ W

22. Answer (4)

Hint : In oblique elastic collision of two equal masses, angle between the final velocity vectors is 90°, when one mass is at rest.

Sol. : $m\vec{v} = m\vec{v}_1 + m\vec{v}_2$

$\Rightarrow \quad \vec{v} = \vec{v}_1 + \vec{v}_2$



According to problem,

$v_2 = v\sin 30° = \frac{v}{2} \quad \Rightarrow K_2 = \frac{1}{2}m\left(\frac{v}{2}\right)^2 = \frac{1}{8}mv^2$

23. Answer (3)

Hint : $W = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$. (work energy theorem)

Sol. : $s = \frac{1}{3}t^3$

$\Rightarrow \quad v = \frac{ds}{dt} = t^2$

At $t = 0$, $v = 0$

At $t = 2$ s, $v_f = 4$ m/s

$W = \frac{1}{2}m\left(v_f^2 - v_i^2\right)$

$= \frac{1}{2} \times 2 \times 16 = 16$ J

24. Answer (4)

Hint : $\Delta U = \frac{1}{2}k\left(x_2^2 - x_1^2\right)$.

Sol. : $U_1 = \frac{1}{2}k\left[\left(2\times10^{-2}\right)^2 - 0^2\right]$

$= 2k \times 10^{-4}$

$\Delta U = \frac{1}{2}k\left[\left(6\times10^{-2}\right)^2 - \left(2\times10^{-2}\right)^2\right]$

$= 16\text{ k} \times 10^{-4} = 8U$.

25. Answer (1)

Hint & Sol. : When conservative forces do positive work, potential energy decreases.

26. Answer (3)

Hint : Conservation of linear momentum.

Sol. : Let velocity of block m be u. Then from conservation of linear momentum,

$mu = Mv$ where v is velocity of mass M after collision

and, $v = eu$

or, $v = 0.4u$

so, $M = \frac{mu}{v} = \frac{mu}{0.4u}$

$= 2.5m$

27. Answer (2)

Hint : $\tau\Delta\theta = \Delta K_{rot}$.

Sol. : Rotational kinetic energy of sphere,

$K_{rot} = \frac{1}{2}I\omega^2 = \frac{1}{2} \times \frac{2}{5} \times 1 \times \left(5\times10^{-2}\right)^2 \times \left(\frac{\pi}{10}\right)^2$

$= 5\pi^2 \times 10^{-6}$ J

If the retarding torque be τ, then

$\tau\Delta\theta = \Delta K_{rot}$

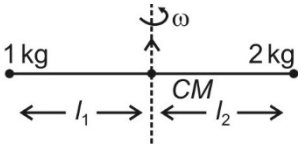
$\Rightarrow \quad \tau \times 2\pi^2 = 5\pi^2 \times 10^{-6} \qquad [\because \Delta\theta = \pi(2\pi) = 2\pi^2]$

$\Rightarrow \quad \tau = 2.5 \times 10^{-6}$ N m.

28. Answer (2)

Hint : $I_{cm} = \frac{m_1m_2}{m_1 + m_2}l^2$.

Sol. :



$I_{cm} = \frac{m_1m_2}{m_1 + m_2}\ell^2$

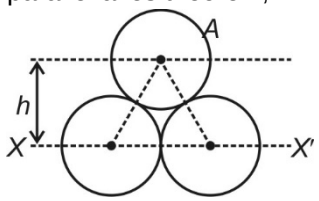
$= \frac{1\times2}{1+2} \times 4$

$= \frac{8}{3}\text{ kg m}^2$

29. Answer (3)

Hint : Parallel axes theorem.

Sol. : Moment of inertia of solid sphere A about axis *XX′* using parallel axes theorem,



$(I_A)_{XX'} = I_{CM} + M h^2$

$= \frac{2}{5}MR^2 + M(2R\sin 60°)^2$

$= \frac{2}{5}MR^2 + 3MR^2$

$= \frac{17}{5}MR^2$

Moment of inertia about *XX′*,

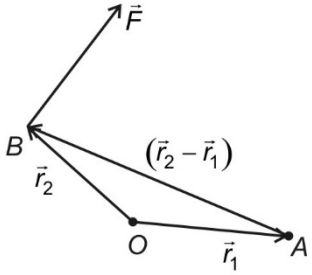
$I_{XX'} = 2\times\frac{2}{5}MR^2 + \frac{17}{5}MR^2$

$= \frac{21}{5}MR^2$

30. Answer (4)

Hint : $\vec{\tau} = (\vec{r}_2 - \vec{r}_1)\times\vec{F}$.

Sol. : Position vector of B w.r.t. A,



$\vec{r}_2 - \vec{r}_1 = (-\hat{i} + \hat{j} + 3\hat{k}) - (2\hat{i} - \hat{j} + \hat{k})$

$\vec{r}_2 - \vec{r}_1 = -3\hat{i} + 2\hat{j} + 2\hat{k}$

Torque of force about A

$\vec{\tau} = (\vec{r}_2 - \vec{r}_1)\times\vec{F}$

$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -3 & 2 & 2 \\ 2 & 4 & -8 \end{vmatrix}$

$= \hat{i}(-16-8) - \hat{j}(24-4) + \hat{k}(-12-4)$

$= (-24\hat{i} - 20\hat{j} - 16\hat{k})$

31. Answer (4)

Hint : $\frac{K_{rot}}{K_{total}} = \frac{k^2}{R^2+k^2} = \frac{I_{CM}}{mR^2 + I_{CM}}$.

Sol. : Rotational kinetic energy of spherical shell,

$K_{rot} = \frac{1}{2}I\omega^2 = \frac{1}{2}\times\frac{2}{3}mR^2\times\omega^2$

$= \frac{1}{3}mv^2$

$K_{total} = K_{rot} + K_{trans}$

$= \frac{1}{3}mv^2 + \frac{1}{2}mv^2$

$= \frac{5}{6}mv^2$

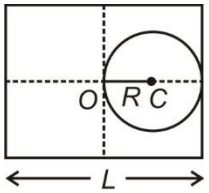
so, $\frac{K_{rot}}{K_{total}} = \frac{\frac{1}{3}mv^2}{\frac{5}{6}mv^2} = \frac{2}{5}$.

32. Answer (1)

Hint : Parallel axes theorem.

Sol. : Mass of removed disc

$m = \frac{M}{L^2}\times\pi\left(\frac{L^2}{16}\right)$



$R = \frac{L}{4}$

$= \frac{\pi M}{16}$

Moment of inertia of removed disc about given axis

$= \frac{3}{2}mR^2 = \frac{3}{2}\left(\frac{\pi M}{16}\right)\left(\frac{L^2}{16}\right)$

$= \frac{3\pi ML^2}{512}$.

From superposition principle, moment of inertia of remaining part,

$I = \frac{ML^2}{6} - \frac{3\pi ML^2}{512}$

$= \frac{(256-9\pi)ML^2}{1536}$.

33. Answer (3)

Hint : Conservation of angular momentum.

Sol. : From conservation of angular momentum,

$I_1\,\omega_1 = I_2\,\omega_2$

$\frac{1}{2}MR^2\omega = \left(\frac{1}{2}MR^2 + 2mR^2\right)\times 0.8\,\omega$

$\Rightarrow M = (M + 4m)\times 0.8$

$\Rightarrow 0.2M = 3.2m$

$\Rightarrow m = \frac{M}{16}$.

34. Answer (4)

Hint & Sol. : In the absence of external force, centre of mass of a system does not shift if initially at rest.

35. Answer (4)

Hint : Body having maximum kinetic energy attains maximum height.

Sol. : For same speed, total kinetic energy

$$K_{ring} = \frac{1}{2}mv^2 + \frac{1}{2}\left(mR^2\right)\left(\frac{v}{R}\right)^2 = mv^2$$

$$K_{sphere} = \frac{7}{10}mv^2$$

$$K_{disc} = \frac{3}{4}mv^2$$

Also, retardation in pure rolling

$$a_{ring} = \frac{g\sin\theta}{1+\frac{I_{cm}}{mR^2}} = \frac{g\sin\theta}{2}$$

$$a_{sphere} = \frac{5}{7}g\sin\theta$$

$$a_{disc} = \frac{2}{3}g\sin\theta$$

Kinetic energy of ring is maximum and retardation is minimum so, ring will reach maximum height in maximum time.

36. Answer (2)

Hint : $\Delta K = \frac{1}{2}\frac{I_1 I_2}{I_1 + I_2}\left(\omega_1 - \omega_2\right)^2$. Or use conservation of angular momentum.

Sol. : From conservation of angular momentum,

$I_1\omega_1 + I_2\omega_2 = (I_1 + I_2)\omega$

$$\Rightarrow \omega = \frac{I_1\omega_1 + I_2\omega_2}{I_1 + I_2}$$

$$= \frac{2\times 4 + 1\times 2}{3} = \frac{10}{3}\text{ rad/s}$$

Loss of kinetic energy,

$$\Delta K = \frac{1}{2}I_1\omega_1^2 + \frac{1}{2}I_2\omega_2^2 - \frac{1}{2}\left(I_1 + I_2\right)\omega^2$$

$$= \frac{1}{2}\times 2\times 16 + \frac{1}{2}\times 1\times 4 - \frac{1}{2}\times 3\times\frac{100}{9}$$

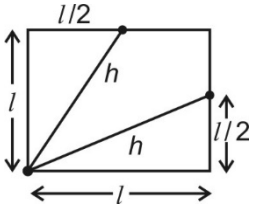
$$= 16 + 2 - \frac{50}{3}$$

$$= \frac{54-50}{3} = \frac{4}{3}\text{ J}.$$

37. Answer (3)

Hint : Moment of inertia of thin rod and parallel axes theorem.

Sol. : *Ml* of each rod, which are not adjacent, about given axis,



$I' = I_{cm} + Mh^2$

$$= \frac{1}{12}Ml^2 + M\left(l^2 + \frac{l^2}{4}\right)$$

$$= \frac{1}{12}Ml^2 + \frac{5Ml^2}{4}$$

$$= \frac{16Ml^2}{12} = \frac{4}{3}Ml^2$$

Ml of the frame about given axis,

$$I = 2\times\frac{1}{3}Ml^2 + 2\times\frac{4}{3}Ml^2$$

$$= \frac{10}{3}Ml^2$$

38. Answer (3)

Hint : $\vec{r}_{cm} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2}{m_1 + m_2}$.

Sol. : $\left(m_1 + m_2\right)\vec{r}_{cm} = m_1\vec{r}_1 + m_2\vec{r}_2$

$$\Rightarrow (1+4)\,\vec{0} = 1\times\left(\hat{i} - 2\hat{j} + 4\hat{k}\right) + 4\vec{r}_2$$

$$\Rightarrow 4\vec{r}_2 = -\hat{i} + 2\hat{j} - 4\hat{k}$$

$$\Rightarrow \vec{r}_2 = \frac{-\hat{i}}{4} + \frac{\hat{j}}{2} - \hat{k}.$$

39. Answer (4)

Hint & Sol. : As particle is moving with constant velocity parallel to *x*-axis, so its angular momentum about the origin remains constant both in magnitude and direction.

40. Answer (2)

Hint : At the time of collision, distance between the centres is 3*R*.

Sol. : Total distance covered by both bodies before collision is (13*R* – 3*R*) = 10*R*.

From conservation of linear momentum,

$4M \times d_1 = M(10R - d_1)$

$\Rightarrow 5d_1 = 10R$

$\Rightarrow d_1 = 2R$

41. Answer (1)

Hint : $\tau = 0$ when $\alpha = 0$

Sol. : $\theta = 3t^3 - 2t^2$

$\omega = \frac{d\theta}{dt} = 9t^2 - 4t$

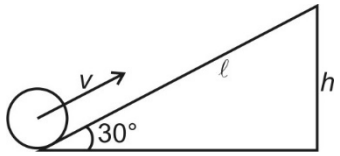
$\alpha = 18t - 4 = 0$

$t = \frac{2}{9}$ s .

42. Answer (4)

Hint : Conservation of mechanical energy.

Sol. :



From conservation of mechanical energy,

$K_{total} = mgh$

$\Rightarrow \frac{3}{4}mv^2 = mgl\sin\theta$

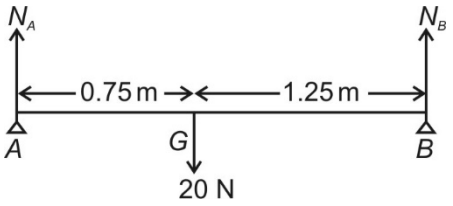
$\Rightarrow \frac{3}{4}(8)^2 = 10 \times l \times \frac{1}{2}$

$\Rightarrow l = 9.6$ m

43. Answer (1)

Hint : In rotational equilibrium, net torque = 0

Sol. : $\sum \tau_A = 0$



$\Rightarrow N_B \times 2 = 20 \times 0.75$

$\Rightarrow N_B = 7.5$ N

44. Answer (2)

Hint : $\alpha = \frac{\tau}{I}$

Sol. : Moment of inertia about given axis

$I = \frac{3}{2}MR^2$

Initial torque,

$\tau = mg \times R$

$\alpha = \frac{\tau}{I} = \frac{MgR}{\frac{3}{2}MR^2}$

$= \frac{2g}{3R}$.

45. Answer (2)

Hint : $\tau = mg \times \frac{R}{2}$; where R is horizontal range.

Sol. : Torque of weight about point of projection, when particle is at maximum height,

$\tau = mg \times r_{\perp} = mg \times \frac{R}{2} = mg \times \frac{u^2 \sin 2\theta}{2g} = \frac{mu^2 \sin 2\theta}{2}$

[CHEMISTRY]

46. Answer (2)

Hint : Partial pressure = Total pressure × Mole fraction.

Sol. : $n_{CH_4} = \frac{32}{16} = 2$ mol

$n_{O_2} = \frac{32}{32} = 1$ mol

Fraction of total pressure exerted by $O_2 = x_{O_2}$

$x_{O_2} = \frac{n_{O_2}}{n_{O_2} + n_{CH_4}} = \frac{1}{1+2} = \frac{1}{3}$

47. Answer (4)

Hint : Use Graham's law of diffusion.

Sol. : $\frac{r_{H_2}}{r_{gas}} = \sqrt{\frac{M_{gas}}{M_{H_2}}}$

$\frac{4}{1} = \sqrt{\frac{M_{gas}}{2}}$

$M_{gas} = 32$ u

48. Answer (3)

Hint : At high temperature, effect of interparticle attraction becomes negligible.

Sol. : At low pressure, volume of gas particles become negligible as compared to the total volume occupied by the gas.

49. Answer (3)

Hint : In H_2O and Ne, dipole-induced dipole forces take place.

Sol. : HCl and H_2O both are polar molecules so dipole-dipole interaction takes place.

50. Answer (2)

Hint : $U_{MPS} = \sqrt{\frac{2RT}{M}}$

Sol. : $\frac{U_1}{U_2} = \frac{\sqrt{\frac{2RT_1}{M}}}{\sqrt{\frac{2RT_2}{M}}} = \sqrt{\frac{T_1}{T_2}} = \sqrt{\frac{T}{4T}} = \frac{1}{2}$

So most probable velocity gets doubled if the temperature is quadrupled.

51. Answer (2)

Hint : $d = \frac{PM}{RT}$

Sol. : $d = \frac{8.21 \times 100}{0.0821 \times 300} = \frac{100}{3}$ g/L

52. Answer (2)

Hint : Viscosity $\propto$ inter particle attraction

Sol. : Due to more H–bonding, $HOCH_2CH_2OH$ is more viscous.

53. Answer (1)

Hint : 'b' depends on size of particles

54. Answer (2)

Hint : Volume of 1 mol ideal gas at S.T.P. = 22.4 L

Sol. : Since molar volume of the gas at S.T.P. is greater than 22.4 L so repulsive forces are dominating hence Z > 1.

55. Answer (3)

Hint : 'a' is attraction coefficient.

56. Answer (4)

Hint : For isothermal process, $\Delta U = 0$.

Sol. : $w = -P_{ext}(V_f - V_i)$

$= -2(4-1) = -6$ L atm

$= -6 \times 100 = -600$ J

$q = -w = -(-600) = 600$ J

57. Answer (3)

Hint : Decrease in gaseous moles decrease the entropy.

58. Answer (4)

Hint : $\frac{1}{2}A_2 + \frac{1}{2}B_2 \rightarrow AB$

Sol. : $\Delta H = \sum (BE)_R - \sum (BE)_P$

$\Delta H = \frac{1}{2} \times BE_{A-A} + \frac{1}{2}BE_{B-B} - BE_{A-B}$

$-50 = \frac{10}{2} + \frac{20}{2} - BE_{A-B}$

$\Rightarrow$ $BE_{A-B} = 65$ kJ/mol

59. Answer (3)

Hint : $dS = \frac{dq}{T}$

Sol. : For reversible isothermal process

$\Delta S = \frac{q}{T} = \frac{nRT\ln\frac{V_f}{V_i}}{T} = nR\ln\frac{V_f}{V_i}$

60. Answer (3)

Hint : For spontaneous process, $\Delta G < 0$.

Sol. : If $\Delta H > 0$ and $\Delta S < 0$ then the ΔG is always positive so process is always non spontaneous.

61. Answer (2)

Hint : Heat of formation of carbon dioxide and heat of combustion of carbon are same.

Sol. : $C(s) + O_2(g) \rightarrow CO_2(g)$, $\Delta H = -400$ kJ mol^{-1}

$\because$ Formation of 44 g CO_2 gives 400 kJ heat

$\therefore$ Formation of 22 g CO_2 gives 200 kJ heat

62. Answer (2)

Hint : $\Delta H = \Delta U + \Delta n_g RT$

Sol. : $\Delta H = 2 + (4)(2 \times 10^{-3})(300)$

$= 4.4$ kcal

$\Delta G = \Delta H - T\Delta S$

$= 4.4 - 300 \times \frac{10}{1000}$

$= 1.4$ kcal

63. Answer (2)

Hint : Intensive properties do not depend upon the quantity of the substance.

64. Answer (4)

Hint : $\Delta H = \Delta U$ if $\Delta n_g = 0$

Sol. : $C(s) + O_2(g) \rightarrow CO_2(g)$

$\because$ $\Delta n_g = n_P - n_R = 1 - 1 = 0$

$\therefore$ $\Delta H = \Delta U$

65. Answer (3)

Hint : $\Delta S_{system} + \Delta S_{surrounding} = \Delta S_{total}$

Sol. : For spontaneous process

$\Delta S_{total} > 0$

$\Delta S_{system} + \Delta S_{surrounding} > 0$

66. Answer (1)

Hint : Born Haber cycle is based on Hess's law.

Sol. : $Na(s) + \frac{1}{2}Cl_2(g) \rightarrow NaCl(s)$

$\Delta_f H°NaCl = \Delta_{sub}H°(Na) + \Delta_i H°(Na)$

$+\frac{1}{2}\Delta_{bond}H°(Cl_2) + \Delta_{eg}H°(Cl) - \Delta_{lattice}H°(NaCl)$

$\Delta_{lattice}H°(NaCl(s)) = 788$ kJ mol^{-1}

67. Answer (2)

Hint : Burning of hydrocarbon is a spontaneous process.

Sol. :

- Burning of C_2H_6 is exothermic therefore $\Delta H < 0$
- Number of gaseous moles is increasing therefore $\Delta S > 0$
- Burning of C_2H_6 is spontaneous therefore $\Delta G < 0$

68. Answer (3)

Hint : On adding the reaction the value of equilibrium constant gets multiplied.

Sol. : $A + 2B \rightleftharpoons C;\ K_1$ ...(i)

$2C \rightleftharpoons F_2 + 2E;\ K_2$

$C \rightleftharpoons \frac{1}{2} F_2 + E,\ \sqrt{K_2}$ ...(ii)

Adding (i) and (ii)

$$A + 2B \rightleftharpoons \frac{1}{2}F_2 + E;\ K_{eq} = K_1\sqrt{K_2}$$

69. Answer (3)

Hint : Common ion effect decreases the solubility.

Sol. :

	$AgCl(s) \rightleftharpoons$	$Ag^+(aq)$ +	$Cl^-(aq)$
(i)	–	0	0.2
(eq)	–	s	s + 0.2
			$\simeq$ 0.2

$K_{sp} = [Ag^+]\,[Cl^-] = (s)\,(0.2)$

$$s = \frac{K_{sp}}{0.2} = \frac{1.6\times10^{-10}}{0.2} = 8\times10^{-10}\ M$$

70. Answer (4)

Hint : In boric acid, boron has vacant *p*-orbital.

71. Answer (4)

Hint : Lewis bases are electron pair donor.

72. Answer (2)

Hint : Solution of weak acid and its salt with strong base is known as acidic buffer.

73. Answer (2)

Hint : Anionic hydrolysis takes place in CH_3COONa

Sol. : Salt of strong base and weak acid are basic due to anionic hydrolysis.

74. Answer (4)

Hint : Removing gaseous product from equilibrium, shifts the equilibrium in forward direction.

75. Answer (1)

Hint : $N_3V_3 = N_1V_1 – N_2V_2$

Sol. : Suppose 1 L each is taken

$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

t = 0, 0.1mol 0.1 mol 0

final, 0 $\frac{0.1}{2}$ mol $\frac{0.1}{2}$ mol

Moles of H_2SO_4 left = $\frac{0.1}{2}$

Molarity of H_2SO_4 left = $\frac{0.1}{4}$ M

Molarity of $H^+ = 2\times\frac{0.1}{4} = \frac{0.1}{2}$ M

$$pH = -\log[H^+] = -\log\frac{0.1}{2} = 1.3$$

76. Answer (2)

Hint : $Al_2(SO_4)_3 \rightleftharpoons 2Al^{3+}(aq.) + 3SO_4^{2-}(aq.)$

77. Answer (1)

Hint : At equilibrium, $\Delta G = 0$

Sol. : $\Delta G = \Delta G° + RT\ln Q$

$\because$ At equilibrium, K = Q, $\Delta G = 0$

$\therefore$ $\Delta G° = – RT\ln K$

$= – 2.303\ RT\ \log K = 2.303\ RT\ \log\left(\frac{1}{K}\right)$

78. Answer (4)

Hint : Equilibrium constant is a function of temperature only.

79. Answer (2)

Hint : $pH = 7 + \frac{pK_a}{2} - \frac{pK_b}{2}$ for the salt of weak acid and weak base.

Sol. : 100 ml 0.1 CH_3COOH + 100 ml 0.1 NH_4OH

$\equiv$ 0.05 M CH_3COONH_4

$$pH = 7 + \frac{4.76}{2} - \frac{4.75}{2} = 7.005$$

80. Answer (2)

Hint : $K_P = K_C(RT)^{\Delta n_g}$

Sol. : $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$

$\Delta n_g = (2 + 1) – (2) = 1$

$K_P = K_C(RT) = 2 \times 10^{10}\ RT$

81. Answer (3)

Hint : $M_1V_1 = M_2V_2$

Sol. : Concentration of H^+ at pH 3 = 10^{-3} M

Concentration of H^+ at pH 4 = 10^{-4} M

Now, $M_1V_1 = M_2V_2$

$10^{-3} \times 100 = 10^{-4} \times V_2$

V_2 = 1000 ml

$\therefore$ H_2O added = 900 ml

82. Answer (2)

Hint : For of pure water, $pK_w = 2$ pH

Sol. : For pure water

pH = pOH = 5

pK_w = pH + pOH = 10

$K_w = 10^{-10}$

83. Answer (3)

Hint : For precipitation, ionic product should be greater than solublity product.

Sol. : Salt for which CO_3^{2-} ion required for saturation are minimum, will give precipitate first.

$[CO_3^{2-}]$ for $Ag_2CO_3 \Rightarrow 8.1 \times 10^{-10}$

$[CO_3^{2-}]$ for $CuCO_3 \Rightarrow 1.4 \times 10^{-9}$

$[CO_3^{2-}]$ for $MnCO_3 \Rightarrow 1.8 \times 10^{-10}$

$[CO_3^{2-}]$ for $SrCO_3 \Rightarrow 1.1 \times 10^{-9}$

84. Answer (1)

Hint : Conjugate base = Acid – H^+

85. Answer (1)

Hint : NH_4^+ is conjugate acid of NH_3

Sol. : $K_a \times K_b = K_w$ (for conjugate acid base pair)

$$K_a = \frac{K_w}{K_b} = \frac{10^{-14}}{2\times10^{-5}} = 5\times10^{-10}$$

86. Answer (1)

Hint : Unit of $K_P = (atm)^{\Delta n_g}$

87. Answer (4)

Hint : K_{sp} of $Ba(OH)_2 = [Ba^{2+}]\,[OH^-]^2$

Sol. : pOH = 14 – pH = 14 – 8 = 6

$[OH^-] = 10^{-6}$

$$K_{sp} = \left(\frac{10^{-6}}{2}\right)(10^{-6})^2 = 5 \times 10^{-19}$$

88. Answer (1)

Hint : Solubility increases with temperature.

89. Answer (1)

Hint : Addition of inert gas at constant pressure increase the volume of container.

90. Answer (3)

Hint : For basic buffer

$$pOH = pK_b + \log\frac{[Salt]}{[Base]}$$

Sol. : For maximum buffer capacity

[Salt] = [Base]

$\therefore$ $pOH = pK_b$

[BIOLOGY]

91. Answer (1)

Hint : Members of kingdom Fungi and Animalia include heterotrophs only.

Sol. : Out of five, four kingdoms monera, protista, fungi and animalia include members with heterotrophic mode of nutrition.

92. Answer (2)

Hint : Archaebacteria lack peptidoglycan in their cell wall.

Sol. : Archaebacteria and eubacteria have different sequences of 16S rRNA gene. Archaebacteria have branched chain lipids in their membrane.

93. Answer (4)

Hint : Green and purple sulphur bacteria do not use water as electron donor in photosynthesis.

Sol. : *Anabaena* (cyanobacteria), *Gonyaulax* (dinoflagellate) and diatoms show oxygenic photosynthesis. Purple sulphur bacteria show anoxygenic photosynthesis.

94. Answer (2)

Hint : Methanogens are found in the gut of ruminants.

Sol. : Methanogens are obligate anaerobes, contain cell wall and convert CO_2, methanol and formic acid into methane.

95. Answer (3)

Hint : *Nostoc* is a cyanobacterium.

Sol. : *Nostoc* has heterocyst, trichome and chlorophyll a. It lacks flagella throughout the life.

96. Answer (1)

Sol. : *Mycoplasma* lack cell wall and popularly known as 'bacteria with their coats off'.

97. Answer (1)

Hint : Organisms called chief producers of ocean have silicious cell wall.

Sol. : Diatoms have silicious cell wall.

98. Answer (2)

Hint : Cyanobacteria, euglenoids and deuteromycetes do not reproduce by sexual means.

Sol. :

Anabaena – Cyanobacteria reproduce asexually only.

Euglena – Protist, sexual reproduction is not known

Alternaria and *Trichoderma* – Fungi that do not reproduce sexually

99. Answer (2)

Hint : Slime moulds are consumer decomposer protists.

Sol. : Slime moulds are saprophytic protists that form spores under unfavourable conditions. Their spores contain cellulosic cell wall.

100. Answer (4)

Hint : Sporozoans lack any locomotory structure.

Sol. : *Plasmodium* – Lack locomotory structure

Amoeba – Pseudopodia

Paramoecium – Cilia

Trypanosoma – Flagella

101. Answer (4)

Hint : Members of deuteromycetes, oomycetes and zygomycetes lack fruiting bodies.

Sol. : Deuteromycetes – Have septate hyphae, asexual spore as conidia.

Zygomycetes – Have aseptate hyphae, asexual spore as sporangiospores.

102. Answer (4)

Hint : *Albugo candida* causes white rust of crucifers.

Sol. : *Albugo* is a member of phycomycetes and has aseptate hyphae. It lacks dikaryophase in its life.

103. Answer (3)

Hint : *Saccharomyces* (yeast) is a unicellular fungus.

Sol. : Yeast does not produce fruiting body while *Agaricus,* morels and truffles produce edible fruiting bodies.

104. Answer (3)

Hint : *Claviceps* is a sac fungus.

Sol. : *Claviceps* shows dikaryophase in its life cycle *i.e*. karyogamy is delayed after plasmogamy.

Gonyaulax (red dinoflagellate) causes red tide.

Alternaria asexually reproduces through conidia.

105. Answer (4)

Hint : Viroids are infectious RNA particles.

Sol. : Viroids lack protein coat. They have ssRNA as their genetic material. Both viruses and viroids are pathogenic and have possibilities of mutation in their genetic meterial.

106. Answer (1)

Hint : Cr-Jacob disease is caused by prions.

Sol. : Prions are abnormally folded proteins, similar in size to viruses and lack any nucleic acid Prions cause disease in humans as well as cattles.

107. Answer (3)

Hint : Ascospores are sexual spores.

Sol. : Zoospores, sporangiospores and conidia are asexual spores. Ascospores are sexual spores produced by members of ascomycetes.

108. Answer (4)

Hint : *Puccinia graminis tritici* causes rust disease.

Sol. : *Puccinia* is a member of basidiomycetes in which asexual spores are generally not found. It lacks dolipore septum in its hyphae and has chitinous cell wall.

109. Answer (3)

Hint : Yeast *sp*. are used in baking and brewing industries.

Sol. : Yeast is a fungus. Rest all activities are due to prokaryotes.

Making of curd from milk – *Lactobacillus*

N_2 fixation in beans – *Rhizobium*

Biogas production – Methanogens.

110. Answer (4)

Hint : *Paramoecium* is a ciliated protozoan.

Sol. : *Paramoecium* has thousands of cilia for locomotion.

111. Answer (3)

Sol. : *Rhizopus* is commonly called bread mould.

112. Answer (4)

Hint : Envelope is the outermost covering of some viruses.

Sol. : Bacteriophage generally have DNA as its genetic material covered in proteinaceous capsid but they lack envelope.

113. Answer (2)

Hint : Sporangiospores are produced inside sporangium

Sol. : Sporangiospores are endogenously produced aplanospores.

Zoospores – Planospores

Basidiospores – Sexual spores, exogenously formed.

Conidia – Non motile, exogenous, asexual spores.

114. Answer (4)

Hint : Ascomycetes is a class of fungi.

Sol. : Ascomycetes include heterotrophs only thus a phycobiont partner of lichen can never belong to ascomycetes. However unicellular BGA can be a phycobiont.

115. Answer (2)

Hint : Adventitious roots arise from the parts of plant other than radicle.

Sol. : Still roots of sugarcane arise from lower nodes of stem. Rest all are tap root modifications.

116. Answer (1)

Sol. : In radish and sweet potato, roots store food while in ginger, underground stem stores food. *Eichhornia* has offset which is not a modification of stem to store food.

117. Answer (1)

Hint : Axillary buds may modify into thorns or tendrils to protect or support the plants.

Sol. :

Tendril of grape vine, Thorns of *Bougainvillea* } Modified axillary buds

Spines of *Aloe* and *Opuntia* and tendrils of pea } Modified leaves

118. Answer (3)

Hint : Such type of stem modification is called phylloclade.

Sol. : Phylloclade is found in plants of arid regions like *Opuntia*, *Euphorbia* etc.

Opuntia – Flattened phylloclade

Euphorbia – Fleshy cylindrical phylloclade

119. Answer (1)

Sol. : In palmately compound leaf, all the leaflets are attached to a common point i.e. at tip of petiole eg. silk cotton.

120. Answer (3)

Hint : Mustard has racemose inflorescence.

Sol. : Mustard – flowers borne in acropetal order.

China rose – Alternate phyllotaxy

Calotropis – Opposite phyllotaxy

Solanum – Cymose inflorescence

121. Answer (4)

Hint : Pea flowers can be divided into equal halves by one plane only.

Sol. : Pea flowers are zygomorphic (bilateral symmetry.

122. Answer (1)

Sol. : Stamens are united into more than two bundles in *Citrus* i.e. polyadelphous stamens.

123. Answer (4)

Hint : Plants of Fabaceae and Brassicaceae family have superior ovary with marginal and parietal placentation respectively.

Sol. : Tomato, Tulip, *Petunia* } Superior ovary with axile placentation

Gram – Superior ovary, marginal placentation

Mustard – Superior ovary, parietal placentation

124. Answer (4)

Hint : Aestivation of petals or sepals as well placentation of ovary are not shown in floral formula.

Sol. : Given floral formula is of Liliaceae family. Type of placentation i.e. axile placentation is not shown in floral formula.

125. Answer (4)

Hint : Plants of Fabaceae family have non endospermic seeds and monocarpellary ovary.

Sol. : Pea has monocarpellary ovary. Rest all are correctly matched.

126. Answer (1)

Hint : Maize is a monocot seed in which food is stored in endosperm.

Sol. : In maize, radicle is covered with coleorhiza, perisperm is absent and proteinaceous aleurone layer is found.

127. Answer (1)

Hint : Mango is drupe type of fruit.

Sol. : In mango, fleshy mesocarp is edible. Drupe fruits arise from monocarpellary superior ovary.

128. Answer (2)

Sol. : In cereals, seed coat is thin and membranous and fused with pericarp e.g. maize.

129. Answer (4)

Hint : In offset, branch of leaves and roots are present at each node.

Sol. : *Chrysanthemum* shows sucker type of stem in which underground part of main stem form lateral branches that come out from soil surface.

130. Answer (1)

Sol. : Region of maturation bears root hairs which increase area of absorption of water and minerals.

131. Answer (1)

Hint : In cymose inflorescence, main axis terminates in a flower.

Sol. : Main axis show limited growth in cymose inflorescence

132. Answer (1)

Sol. : In *Calotropis*, petals show valvate aestivation.

133. Answer (1)

Hint : Solanaceae and Liliaceae show axile placentation.

Sol. : Given features are of Solanaceae family therefore plant 'X' should belong to Solanaceae.

134. Answer (3)

Sol. : Apple is a false fruit as it is formed by ovary and thalamus together.

135. Answer (1)

Sol. : In sunflower, basal placentation is found.

136. Answer (1)

Hint : Voice box of man

Sol. : The structure marked as 'X' represents the larynx which is responsible for sound production in man.

137. Answer (4)

Hint : Urea is synthesized in liver.

Sol. : Hepatic vein exits the liver therefore, carries the maximum amount of urea.

138. Answer (4)

Hint : Each polypeptide chain can bind to 1 molecule of oxygen.

Sol. : Haemoglobin comprises two pairs of polypeptide chains, known as α-chains and β-chains with each chain folded to provide a binding site for a heme group.

139. Answer (2)

Hint : These granulocytes have bilobed nucleus.

Sol. : Eosinophilia is an increase in number of eosinophils from 1-3% to about 14-16% in circulating blood. Its most common causes are allergic helminthic infections.

140. Answer (1)

Hint : A net force producing acceleration of the fluid.

Sol. : The pressure difference between post caval region and right atrium causes blood to flow into the atria.

141. Answer (4)

Hint : Man is ureotelic.

Sol. : Uric acid is excreted by reptiles, birds and terrestrial insects.

142. Answer (1)

Hint : Anti-diuretic hormone is released in response to altered osmolarity of CSF.

Sol. : Stored ADH is released by posterior pituitary and stimulates reabsorption of water and electrolytes by kidneys.

143. Answer (3)

Hint : Maximum reabsorption occurs in PCT.

Sol. : PCT is lined by brush bordered simple cuboidal epithelium. Presence of microvilli increases the absorptive surface area.

144. Answer (3)

Hint : Urethra has an internal and an external sphincter.

Sol. : Internal sphincter of males is supplied by both sympathetic and parasympathetic nervous system. External sphincter is supplied by somatic nerve.

145. Answer (1)

Hint : Identify the salt retaining hormone.

Sol. : Aldosterone is secreted by zona glomerulosa of adrenal cortex and increases sodium reabsorption by the distal convoluted tubules.

146. Answer (1)

Hint : Maximum reabsorption of water and electrolytes takes place here.

Sol. : Removal of PCT results in more dilute urine as fluid from filtrate will not be reabsorbed into the peritubular capillaries. Cardiac output is approximately 5 litres.

147. Answer (3)

Hint : This part is not involved in reabsorption and secretion.

Sol. : Glomerular filtration occurs in Bowman's capsule. Therefore, insufficient filtration will increase the levels of urea in blood.

148. Answer (3)

Hint : The curve represents oxygen dissociation curve (ODC).

Sol. : Increase in pCO_2, temperature and H^+ ion concentration will shift the ODC towards the right side, while increase in pO_2 will shift the curve to left side.

149. Answer (1)

Hint : These ions cause acidity.

Sol. : pH of urine varies between 4.6 and 8.0. Tubular secretion involves the removal of urea, uric acid, hippuric acid, creatinine, K^+ and H^+.

150. Answer (1)

Hint : Coagulation is a process where blood forms a clot.

Sol. : Plasma protein fibrinogen is a clotting factor which is converted to fibrin to form a clot.

Albumin maintains osmolarity of blood. Heparin is anti-coagulant.

151. Answer (3)

Hint : Individuals with blood group O^{-ve} are universal donors.

Sol. : The RBCs of individuals with O^{-ve} blood group have no antigens on their surface. AB^{+ve} is a universal recipient as they have both A and B antigens on RBC surface but no anti-A or anti-B antibody in the plasma.

152. Answer (3)

Hint : Wilhelm His Jr discovered this specialised tissue.

Sol. : Bundle of His is an important part of the electrical conduction system of the heart as it transmits impulses from atrioventricular node located at the inferior end of the interatrial septum to the ventricles of the heart.

153. Answer (2)

Hint : These are glycoproteins.

Sol. : Immunoglobulins that are gamma globulins help attack viruses and bacteria. Alpha and beta globulins transport iron, lipids and fat-soluble vitamins. RBCs contain haemoglobin.

154. Answer (4)

Hint : Lymph appears colourless.

Sol. : Lymph consists of plasma and leukocytes. It contains fewer plasma proteins and lower calcium and phosphorous than blood.

155. Answer (1)

Hint : This wave is a small upward deflection in the ECG.

Sol. : P-wave represents atrial depolarization or excitation which spreads from SA node through conducting fibres in both atria. T wave marks the end of ventricular systole. R wave represents spread of electrical impulse towards ventricles.

156. Answer (2)

Hint : Tricuspid valve guards the opening between right atrium and right ventricle.

Sol. : If due to the injury, bicuspid valves of the human heart become partially non-functional, the flow of blood into aorta is reduced because backflow of blood takes place into left atrium.

157. Answer (1)

Hint : Normal blood pressure is 120/80 mmHg.

Sol. : Hypertension or repeated high blood pressure is a condition in which pressure of blood is raised in arteries. High blood pressure of 200/100 mmHg may harm various organs of the body such as kidneys and brain to a great extent.

158. Answer (1)

Hint : Parasympathetic nerve fibres release acetylcholine.

Sol. : Parasympathetic nerve impulses reach the heart via right and left vagus nerves. They release acetylcholine which decreases heart rate by slowing the rate of spontaneous depolarization in autorhythmic fibres.

159. Answer (3)

Hint : Blood leaves the heart through the aorta.

Sol. : Blood pressure is maximum in the aorta when blood leaves the heart. Contraction causes blood pressure to rise to its highest point and relaxation brings it down to the lowest point.

160. Answer (4)

Hint : This fluid is plasma without clotting factors.

Sol. : Blood is a highly specialized connective tissue mainly composed of RBCs, WBCs, platelets and plasma.

161. Answer (4)

Hint : Second heart sound is shorter and high pitched.

Sol. : Second heart sound is called dub and is caused by blood turbulence associated with closure of the semilunar valves at the beginning of ventricular diastole.

162. Answer (4)

Hint : Erythropoiesis means production of RBCs.

Sol. : Erythropoiesis occurs by yolk sac in early embryonic life and by liver and spleen in late embryonic life. In adults, erythropoiesis occurs in red bone marrow.

163. Answer (2)

Hint : CO_2 is end product of metabolism in tissues.

Sol. : If a person holds his breath, fresh air is not inhaled so fresh supply of O_2 is arrested. Concentration of CO_2 however continues to rise in blood producing an urge to breathe.

164. Answer (1)

Hint : 70% CO_2 is transported in this form.

Sol. : CO_2 enters RBCs and reacts with water in the presence of enzyme carbonic anhydrase to form carbonic acid which dissociates into H^+ and HCO_3^-. About 20-25% of CO_2 is transported as carbaminohaemoglobin.

165. Answer (4)

Hint : It is the hunger and satiety centre.

Sol. : Normal respiratory rhythm is primarily maintained by medulla oblongata.

166. Answer (3)

Hint : This disorder is caused due to excessive cigarette smoking.

Sol. : Emphysema is a disorder characterized by destruction of walls of alveoli producing abnormally large air spaces that remain filled with air ever after exhalation.

167. Answer (2)

Hint : Physiological demand for oxygen rises during muscular work.

Sol. : Leftover oxygen is used as a reserve during muscular exercise to compensate for increased oxygen demand.

168. Answer (4)

Hint : BPG stands for 2, 3-bisphosphoglycerate.

Sol. : BPG combines with haemoglobin which makes the haemoglobin bind less tightly at the heme group sites. Greater the level of BPG, more is the O_2 unloaded from haemoglobin.

169. Answer (3)

Hint : In foetus, foramen ovale allows flow of oxygenated blood from right to left atrium.

Sol. : Ductus arteriosus closes after birth leaving a remnant known as ligamentum arteriosum.

170. Answer (2)

Hint : This phase is of shortest duration.

Sol. : Atrial systole enables approximately 30% filling of ventricles while 70% filling of ventricles occurs during joint diastole.

171. Answer (3)

Hint : This forms outermost covering of oesophagus.

Sol. : The outermost, middle and innermost layer of artery are tunica externa, media and interna respectively.

172. Answer (2)

Hint : Stroke volume is the amount of blood ejected by a ventricle during each systole.

Sol. : Cardiac output (mL/min) = Stroke volume × Heart rate.

173. Answer (4)

Hint : This promotes formation of red blood cells.

Sol. : Erythropoietin released by JG cells of kidney stimulates formation of RBCs. Aldosterone targets DCT of nephrons but is produced by adrenal cortex. Rennin is a digestive enzyme.

174. Answer (3)

Hint : This structure is associated with vasa recta.

Sol. : In cortical nephrons, the loop of Henle penetrates only outer region of renal medulla whereas in juxtamedullary nephrons it extends deep into medulla.

175. Answer (2)

Hint : External and internal oblique are abdominal muscles.

Sol. : Detrusor muscle is present in wall of urinary bladder and facilitates micturition.

176. Answer (1)

Hint : Tidal volume.

Sol. : Tidal volume represents the volume of air inhaled in a normal inhalation which is approximately 500 ml.

177. Answer (1)

Hint : These glands secrete lysozyme.

Sol. : Sweat glands are sudoriferous glands in the skin which help eliminate excess heat, water and carbon dioxide.

178. Answer (2)

Hint : Instrument that cannot measure RV.

Sol. : The maximum amount of air a person can expel from the lungs after maximum inhalation can be measured by a spirometer.

179. Answer (1)

Hint : Cockroach has tracheal tubes.

Sol. : Insects have a network of tracheal tubes to transfer atmospheric air into the body.

180. Answer (3)

Hint : Pericardium is covering of heart.

Sol. : Pleura or pleural membranes form covering of lungs.

❑ ❑ ❑

All India Aakash Test Series for NEET - 2020

TEST - 6 (Code-B)

Test Date : 05/01/2020

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

1. Answer (2)

Hint : $\tau = mg \times \frac{R}{2}$; where R is horizontal range.

Sol. : Torque of weight about point of projection, when particle is at maximum height,

$$\tau = mg \times r_{\perp} = mg \times \frac{R}{2} = mg \times \frac{u^2 \sin 2\theta}{2g} = \frac{mu^2 \sin 2\theta}{2}$$

2. Answer (2)

Hint : $\alpha = \frac{\tau}{I}$

Sol. : Moment of inertia about given axis

$I = \frac{3}{2}MR^2$

Initial torque,

$\tau = mg \times R$

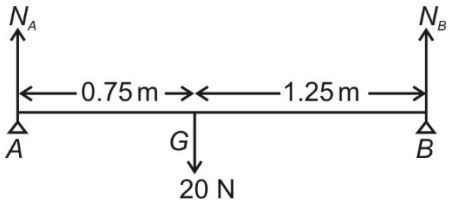
$\alpha = \frac{\tau}{I} = \frac{MgR}{\frac{3}{2}MR^2}$

$= \frac{2g}{3R}$.

3. Answer (1)

Hint : In rotational equilibrium, net torque = 0

Sol. : $\sum \tau_A = 0$



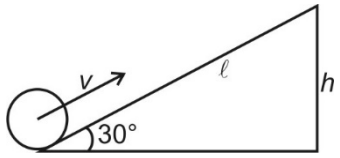
$\Rightarrow N_B \times 2 = 20 \times 0.75$

$\Rightarrow N_B = 7.5$ N

4. Answer (4)

Hint : Conservation of mechanical energy.

Sol. :



From conservation of mechanical energy,

$K_{total} = mgh$

$\Rightarrow \frac{3}{4}mv^2 = mgl\sin\theta$

$\Rightarrow \frac{3}{4}(8)^2 = 10 \times l \times \frac{1}{2}$

$\Rightarrow l = 9.6$ m

5. Answer (1)

Hint : $\tau = 0$ when $\alpha = 0$

Sol. : $\theta = 3t^3 - 2t^2$

$\omega = \frac{d\theta}{dt} = 9t^2 - 4t$

$\alpha = 18t - 4 = 0$

$t = \frac{2}{9}$ s .

6. Answer (2)

Hint : At the time of collision, distance between the centres is $3R$.

Sol. : Total distance covered by both bodies before collision is $(13R - 3R) = 10R$.

From conservation of linear momentum,

$4M \times d_1 = M(10R - d_1)$

$\Rightarrow 5d_1 = 10R$

$\Rightarrow d_1 = 2R$

7. Answer (4)

Hint & Sol. : As particle is moving with constant velocity parallel to x-axis, so its angular momentum about the origin remains constant both in magnitude and direction.

8. Answer (3)

Hint : $\vec{r}_{cm} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2}{m_1 + m_2}$.

Sol. : $(m_1 + m_2)\vec{r}_{cm} = m_1\vec{r}_1 + m_2\vec{r}_2$

$\Rightarrow (1 + 4)\ \vec{0} = 1 \times (\hat{i} - 2\hat{j} + 4\hat{k}) + 4\vec{r}_2$

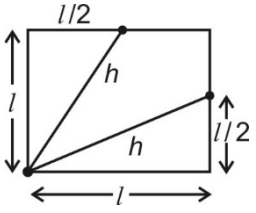
$\Rightarrow 4\vec{r}_2 = -\hat{i} + 2\hat{j} - 4\hat{k}$

$\Rightarrow \vec{r}_2 = \frac{-\hat{i}}{4} + \frac{\hat{j}}{2} - \hat{k}$.

9. Answer (3)

Hint : Moment of inertia of thin rod and parallel axes theorem.

Sol. : MI of each rod, which are not adjacent, about given axis,



$I' = I_{cm} + Mh^2$

$= \frac{1}{12}Ml^2 + M\left(l^2 + \frac{l^2}{4}\right)$

$= \frac{1}{12}Ml^2 + \frac{5Ml^2}{4}$

$= \frac{16Ml^2}{12} = \frac{4}{3}Ml^2$

MI of the frame about given axis,

$I = 2\times\frac{1}{3}Ml^2 + 2\times\frac{4}{3}Ml^2$

$= \frac{10}{3}Ml^2$

10. Answer (2)

Hint : $\Delta K = \frac{1}{2}\frac{I_1 I_2}{I_1 + I_2}(\omega_1 - \omega_2)^2$. Or use conservation of angular momentum.

Sol. : From conservation of angular momentum,

$I_1\,\omega_1 + I_2\,\omega_2 = (I_1 + I_2)\,\omega$

$\Rightarrow \omega = \frac{I_1\omega_1 + I_2\omega_2}{I_1 + I_2}$

$= \frac{2\times4 + 1\times2}{3} = \frac{10}{3}$ rad/s

Loss of kinetic energy,

$\Delta K = \frac{1}{2}I_1\omega_1^2 + \frac{1}{2}I_2\omega_2^2 - \frac{1}{2}(I_1 + I_2)\,\omega^2$

$= \frac{1}{2}\times2\times16 + \frac{1}{2}\times1\times4 - \frac{1}{2}\times3\times\frac{100}{9}$

$= 16 + 2 - \frac{50}{3}$

$= \frac{54 - 50}{3} = \frac{4}{3}$ J.

11. Answer (4)

Hint : Body having maximum kinetic energy attains maximum height.

Sol. : For same speed, total kinetic energy

$K_{ring} = \frac{1}{2}mv^2 + \frac{1}{2}\left(mR^2\right)\left(\frac{v}{R}\right)^2 = mv^2$

$K_{sphere} = \frac{7}{10}mv^2$

$K_{disc} = \frac{3}{4}mv^2$

Also, retardation in pure rolling

$a_{ring} = \frac{g\sin\theta}{1 + \frac{I_{cm}}{mR^2}} = \frac{g\sin\theta}{2}$

$a_{sphere} = \frac{5}{7}g\sin\theta$

$a_{disc} = \frac{2}{3}g\sin\theta$

Kinetic energy of ring is maximum and retardation is minimum so, ring will reach maximum height in maximum time.

12. Answer (4)

Hint & Sol. : In the absence of external force, centre of mass of a system does not shift if initially at rest.

13. Answer (3)

Hint : Conservation of angular momentum.

Sol. : From conservation of angular momentum,

$I_1\,\omega_1 = I_2\,\omega_2$

$\frac{1}{2}MR^2\omega = \left(\frac{1}{2}MR^2 + 2mR^2\right)\times0.8\,\omega$

$\Rightarrow M = (M + 4m)\times0.8$

$\Rightarrow 0.2M = 3.2m$

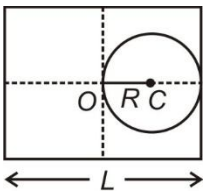
$\Rightarrow m = \frac{M}{16}$.

14. Answer (1)

Hint : Parallel axes theorem.

Sol. : Mass of removed disc

$m = \frac{M}{L^2}\times\pi\left(\frac{L^2}{16}\right)$



$R = \frac{L}{4}$

$= \frac{\pi M}{16}$

Moment of inertia of removed disc about given axis

$= \frac{3}{2}mR^2 = \frac{3}{2}\left(\frac{\pi M}{16}\right)\left(\frac{L^2}{16}\right)$

$= \frac{3\pi ML^2}{512}$.

From superposition principle, moment of inertia of remaining part,

$I = \frac{ML^2}{6} - \frac{3\pi ML^2}{512}$

$= \frac{(256 - 9\pi)ML^2}{1536}$.

15. Answer (4)

Hint : $\frac{K_{rot}}{K_{total}} = \frac{k^2}{R^2 + k^2} = \frac{I_{CM}}{mR^2 + I_{CM}}$.

Sol. : Rotational kinetic energy of spherical shell,

$K_{rot} = \frac{1}{2}I\omega^2 = \frac{1}{2}\times\frac{2}{3}mR^2\times\omega^2$

$= \frac{1}{3}mv^2$

$K_{total} = K_{rot} + K_{trans}$

$= \frac{1}{3}mv^2 + \frac{1}{2}mv^2$

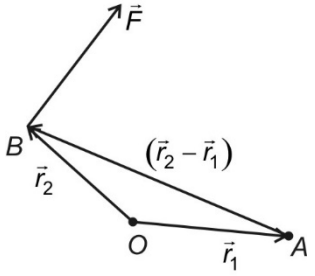
$= \frac{5}{6}mv^2$

so, $\frac{K_{rot}}{K_{total}} = \frac{\frac{1}{3}mv^2}{\frac{5}{6}mv^2} = \frac{2}{5}$.

16. Answer (4)

Hint : $\vec{\tau} = (\vec{r}_2 - \vec{r}_1) \times \vec{F}$.

Sol. : Position vector of B w.r.t. A,



$\vec{r}_2 - \vec{r}_1 = (-\hat{i} + \hat{j} + 3\hat{k}) - (2\hat{i} - \hat{j} + \hat{k})$

$\vec{r}_2 - \vec{r}_1 = -3\hat{i} + 2\hat{j} + 2\hat{k}$

Torque of force about A

$\vec{\tau} = (\vec{r}_2 - \vec{r}_1) \times \vec{F}$

$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -3 & 2 & 2 \\ 2 & 4 & -8 \end{vmatrix}$

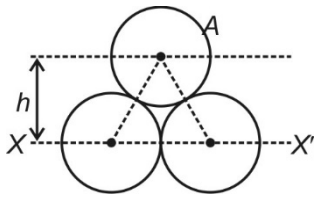
$= \hat{i}(-16-8) - \hat{j}(24-4) + \hat{k}(-12-4)$

$= (-24\hat{i} - 20\hat{j} - 16\hat{k})$

17. Answer (3)

Hint : Parallel axes theorem.

Sol. : Moment of inertia of solid sphere A about axis XX' using parallel axes theorem,



$(I_A)_{XX'} = I_{CM} + M h^2$

$= \frac{2}{5}MR^2 + M(2R\sin 60°)^2$

$= \frac{2}{5}MR^2 + 3MR^2$

$= \frac{17}{5}MR^2$

Moment of inertia about XX',

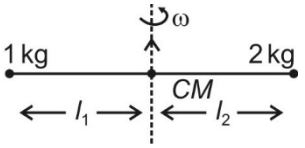
$I_{XX'} = 2 \times \frac{2}{5}MR^2 + \frac{17}{5}MR^2$

$= \frac{21}{5}MR^2$

18. Answer (2)

Hint : $I_{cm} = \frac{m_1 m_2}{m_1 + m_2} l^2$.

Sol. :



$I_{cm} = \frac{m_1 m_2}{m_1 + m_2}\ell^2$

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

$= \frac{8}{3}$ kg m^2

19. Answer (2)

Hint : $\tau\Delta\theta = \Delta K_{rot}$.

Sol. : Rotational kinetic energy of sphere,

$K_{rot} = \frac{1}{2}I\omega^2 = \frac{1}{2} \times \frac{2}{5} \times 1 \times \left(5 \times 10^{-2}\right)^2 \times \left(\frac{\pi}{10}\right)^2$

$= 5\pi^2 \times 10^{-6}$ J

If the retarding torque be τ, then

$\tau\Delta\theta = \Delta K_{rot}$

$\Rightarrow \tau \times 2\pi^2 = 5\pi^2 \times 10^{-6}$ [$\because \Delta\theta = \pi(2\pi) = 2\pi^2$]

$\Rightarrow \tau = 2.5 \times 10^{-6}$ N m.

20. Answer (3)

Hint : Conservation of linear momentum.

Sol. : Let velocity of block m be u. Then from conservation of linear momentum,

$mu = Mv$ where v is velocity of mass M after collision

and, $v = eu$

or, $v = 0.4u$

so, $M = \frac{mu}{v} = \frac{mu}{0.4u}$

$= 2.5m$

21. Answer (1)

Hint & Sol. : When conservative forces do positive work, potential energy decreases.

22. Answer (4)

Hint : $\Delta U = \frac{1}{2}k\left(x_2^2 - x_1^2\right)$.

Sol. : $U_1 = \frac{1}{2}k\left[\left(2\times10^{-2}\right)^2 - 0^2\right]$

$= 2k \times 10^{-4}$

$\Delta U = \frac{1}{2}k\left[\left(6\times10^{-2}\right)^2 - \left(2\times10^{-2}\right)^2\right]$

$= 16\ k \times 10^{-4} = 8U.$

23. Answer (3)

Hint : $W = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$. (work energy theorem)

Sol. : $s = \frac{1}{3}t^3$

$\Rightarrow \quad v = \frac{ds}{dt} = t^2$

At $t = 0$, $v = 0$

At $t = 2$ s, $v_f = 4$ m/s

$W = \frac{1}{2}m\left(v_f^2 - v_i^2\right)$

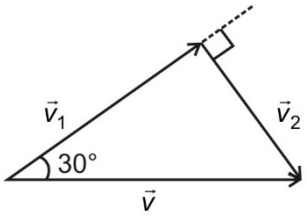
$= \frac{1}{2}\times 2\times 16 = 16$ J

24. Answer (4)

Hint : In oblique elastic collision of two equal masses, angle between the final velocity vectors is 90°, when one mass is at rest.

Sol. : $m\vec{v} = m\vec{v}_1 + m\vec{v}_2$

$\Rightarrow \quad \vec{v} = \vec{v}_1 + \vec{v}_2$



According to problem,

$v_2 = v\sin 30° = \frac{v}{2} \quad \Rightarrow K_2 = \frac{1}{2}m\left(\frac{v}{2}\right)^2 = \frac{1}{8}mv^2$

25. Answer (3)

Hint : $P = \vec{F}\cdot\vec{v}$

Sol. : $\Delta\vec{p} = \int_0^t \vec{F}\,dt = \hat{i}\int_0^t 2\,dt + \hat{j}\int_0^t 4t\,dt$

$m\vec{v} = 2t\,\hat{i} + 2t^2\hat{j}$

$\Rightarrow \quad \vec{v} = 2t\hat{i} + 2t^2\hat{j} \quad (\because m = 1\text{kg})$

$P = \vec{F}\cdot\vec{v} = \left(2\hat{i} + 4t\,\hat{j}\right)\cdot\left(2t\,\hat{i} + 2t^2\hat{j}\right)$

$= 4t + 8t^3$

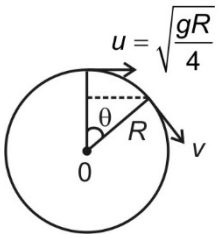
$= 4 \times 2 + 8\,(2)^3$

$= 72$ W

26. Answer (1)

Hint : Normal contact force is zero at the time of losing the contact.

Sol. : Let speed of particle is v, when it loses the contact with the sphere.



From conservation of mechanical energy.

$v^2 = u^2 + 2gh$

we get, $v^2 = \frac{gR}{4} + 2gR\left(1-\cos\theta\right)$ …(i)

$mg\cos\theta - N = \frac{mv^2}{R}$

when, it loses contact, N = 0,

we get $v^2 = Rg\cos\theta$ …(ii)

From equations (i) and (ii),

$Rg\cos\theta = \frac{Rg}{4} + 2gR\left(1-\cos\theta\right)$

$\Rightarrow \quad 3Rg\cos\theta = \frac{9Rg}{4} \Rightarrow \cos\theta = \frac{3}{4}.$

$\Rightarrow \quad \theta = \cos^{-1}\left(\frac{3}{4}\right)$

27. Answer (2)

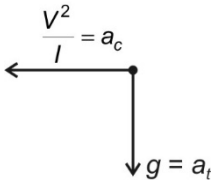
Hint : $a = \sqrt{a_c^2 + a_t^2}$

Sol. : Let speed of point mass is v, when string becomes horizontal. Then, from conservation of mechanical energy.

$v^2 = u^2 - 2gh$, we get

$v^2 = 4gl - 2gl$

$= 2gl$



So, $a_c = \frac{v^2}{l} = 2g$

And $a_t = g$

So, $a = \sqrt{a_c^2 + a_t^2} = \sqrt{5}\,g$.

28. Answer (4)

Hint & Sol. : For neutral equilibrium,

$\frac{dU}{dx} = 0$ and $\frac{d^2U}{dx^2} = \left|\frac{dF}{dx}\right| = 0$

At points, P and Q, $\left|\frac{dF}{dx}\right| \neq 0$

At point R, $F \neq 0$

29. Answer (3)

Hint : $P = Fv$

Sol. : $W = \int_0^t P dt$

$\Rightarrow \quad \frac{1}{2}mv^2 = \int_0^t kt\, dt$

$\Rightarrow \quad \frac{1}{2}mv^2 = \frac{kt^2}{2}$

$\Rightarrow \quad v = \sqrt{\frac{k}{m}}\, t$

now, $F = \frac{P}{v} = \frac{kt}{\sqrt{\frac{k}{m}}\, t} = \sqrt{km}$.

30. Answer (3)

Hint : $\left|\vec{p}_{gun}\right| = \left|\vec{p}_{shell}\right|$ after the firing.

Sol. : From conservation of linear momentum,

$\vec{p}_{gun} + \vec{p}_{shell} = \vec{0}$

$\Rightarrow \quad \left|\vec{p}_{gun}\right| = \left|\vec{p}_{shell}\right| = p \ \ (\text{say})$

Now, $\frac{p^2}{2M_{gun}} + \frac{p^2}{2M_{shell}} = KE$

$\Rightarrow \quad \frac{p^2}{2}\left[\frac{1}{2} + \frac{1}{0.1}\right] = 8.4 \times 10^3$

$\Rightarrow \quad p^2 = \frac{8.4 \times 10^3 \times 2}{10.5} = 1600$

$\Rightarrow \quad p = 40$ N s

31. Answer (2)

Hint : $e = \frac{v}{u}$

Sol. : Speed of ball just before collision,

$u = \sqrt{(20)^2 + 2 \times 10 \times 20} = 20\sqrt{2}\ \text{m s}^{-1}$

Speed of ball just after the collision,

$v = \sqrt{2 \times 10 \times 20} = 20\ \text{m s}^{-1}$

$e = \frac{v}{u} = \frac{1}{\sqrt{2}}$

32. Answer (2)

Hint : $W_{all} = \Delta KE$.

Sol. : $W_{gravity} + W_f = \Delta KE$

$\Rightarrow \quad 2.0 \times 10^{-3} \times 10 \times 2 \times 10^3 + W_f = \frac{1}{2} \times 2.0 \times 10^{-3} (50.0)^2$.

$\Rightarrow \quad 40 + W_f = 2.5$

$\Rightarrow \quad W_f = -37.5$ J

33. Answer (1)

Hint : $W = \int \vec{F} \cdot \overrightarrow{dx}$.

Sol. : $W = \int_{x_1}^{x_2} F\, dx$

$= 10 \int_{-0.5}^{1} dx + 20 \int_{-0.5}^{1} x\, dx$

$= 10\left[x\right]_{-0.5}^{1} + 10\left[x^2\right]_{-0.5}^{1}$

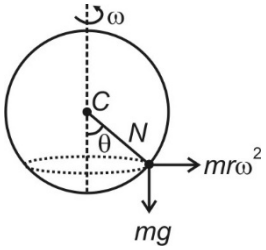
$= 10\ (1.5) + 10(1 - 0.25)$

$= 15 + 7.5 = 22.5$ J.

34. Answer (1)

Hint : $\cos\theta = \frac{g}{\omega^2 R}$.

Sol. : $N \sin\theta = m\omega^2 R \sin\theta$



$\Rightarrow \quad N = m\omega^2 R$

$N \cos\theta = mg$

$\Rightarrow \quad \cos\theta = \frac{g}{\omega^2 R} = \frac{g}{(5g/4)} = \frac{4}{5}$

$\Rightarrow \quad \theta = 37°$

35. Answer (1)

Hint : $f_s = m\omega^2 R \leq f_{lim}$

Sol. : Static friction provides necessary centripetal force.

$f_s \leq f_{lim}$

$m\omega^2 (2r) \leq \mu$ mg

$\Rightarrow \quad \omega \leq \sqrt{\frac{\mu g}{2r}}$.

36. Answer (2)

Hint : $N = Ma$

Sol. : $a = \dfrac{F}{(M+m)}$

Normal contact force between two blocks,

$N = Ma = \dfrac{MF}{(M+m)}$

If block of mass m does not fall,

$mg \le \mu N$

$\Rightarrow \quad mg \le \dfrac{\mu MF}{(M+m)}$

$\Rightarrow \quad F \ge \dfrac{(M+m)mg}{\mu M}$

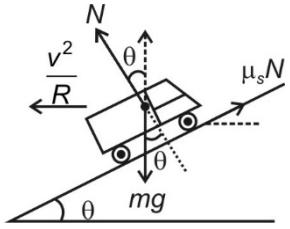
37. Answer (3)

Hint : Banking of road.

Sol. : In case of minimum speed, limiting friction acts up the plane.

In vertical direction

$N\cos\theta + \mu_s N\sin\theta = mg$



$\Rightarrow \quad N = \dfrac{mg}{\cos\theta + \mu_s \sin\theta}$

In horizontal direction,

$N\sin\theta - \mu_s N\cos\theta = \dfrac{mv_{\min}^2}{R}$

$\Rightarrow \quad v_{\min}^2 = gR\left(\dfrac{\sin\theta - \mu_s\cos\theta}{\cos\theta + \mu_s\sin\theta}\right)$

$\Rightarrow \quad v_{\min} = \sqrt{\dfrac{gR(\tan\theta - \mu_s)}{1+\mu_s\tan\theta}}$

38. Answer (3)

Hint : Area under $F - t$ graph gives change in linear momentum.

Sol. : At t = 6 s, F = – 20 N

Area under $F - t$ graph

$\Delta\vec{p} = \dfrac{1}{2}\times 2\times 10 + \dfrac{1}{2}\times 4\times(-20)$

$\Delta\vec{p} = 10 - 40 = -30$

$\vec{p}_f - 20 = -30$

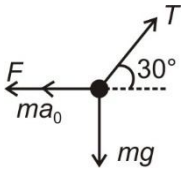
$\Rightarrow \quad \vec{p}_f = -10 \text{ N s}$

so, $|\vec{p}_f| = 10 \text{ N s}$

39. Answer (3)

Hint : Pseudo force = $-m\vec{a}_0$

Sol. : FBD of bob, In non-inertial frame, i.e. frame of trolley.



$T\sin30° = mg$

$\Rightarrow \quad T\times\dfrac{1}{2} = 10$

$\Rightarrow \quad T = 20$ N

and, $T\cos30° = F + ma_0$

$\Rightarrow F = 10\sqrt{3} - 10$

$= 10\left(\sqrt{3} - 1\right)$ N

40. Answer (1)

Hint : Contact force between two blocks is net force for 4 kg block.

Sol. : Acceleration of blocks,

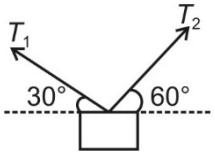
$a = \dfrac{6}{4} = 1.5 \text{ m s}^{-2}$

$F = (4 + 3) \times 1.5 = 10.5$ N

41. Answer (2)

Hint : $\sum F_x = 0 \quad ; \quad \sum F_y = 0$.

Sol. : For equilibrium in x direction,



$T_1\cos30° = T_2\cos60°$

$\Rightarrow \quad T_2 = \sqrt{3}\,T_1$,

For equilibrium in y direction,

$T_1\sin30° + T_2\sin60° = 20$

$\Rightarrow \quad \dfrac{T_1}{2} + \dfrac{\sqrt{3}}{2}\left(\sqrt{3}\,T_1\right) = 20$

$\Rightarrow \quad 2T_1 = 20$ N

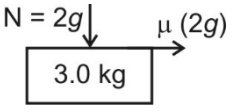
$\Rightarrow \quad T_1 = 10$ N

42. Answer (2)

Hint : $F < F_{\max}$ for common acceleration.

Sol. : For lower block, frictional force is the driving force.

For maximum acceleration,



$a_{max} = \frac{\mu(2g)}{3}$

$= \frac{1\times 2\times 10}{3} = \frac{20}{3}$ m/s^2

Maximum force for common acceleration,

$F_{max} = (2+3)\times\frac{20}{3} = \frac{100}{3}$ N

As $F < F_{max}$, both blocks will move with common acceleration given by.

$a = \frac{25}{5} = 5$ m/s^2

Frictional force between two blocks,

$f_s = 3 \times a = 15$ N.

43. Answer (2)

Hint : $T = m(g - a)$, where a is downward acceleration.

Sol. : When person is descending with downward acceleration 'a', tension in the rope,

$\Rightarrow$ $T = m(g - a)$

If rope does not break,

$T \le T_{max}$

$\Rightarrow$ $m(g - a) \le 0.6\, mg$

$\Rightarrow$ $(g - a) \le 0.6\, g$

$\Rightarrow$ $a \ge 0.4\, g$

so, $a_{min} = \frac{2g}{5}$.

44. Answer (4)

Hint : $T = m_A a$

Sol. : Acceleration of system,

$a = \frac{F}{m_A + m_B} = \frac{106}{53} = 2$ m s^{-2}

Tension in the string,

$T = m_A a = 3 \times 2 = 6$ N

45. Answer (1)

Hint : $|\vec{a}| = 0$ when $|\vec{F}| = \left|\frac{d\vec{p}}{dt}\right| = 0$

Sol. : $|\vec{F}| = \left|\frac{d\vec{p}}{dt}\right| = 2t - 2$

$\Rightarrow$ $2t - 2 = 0$

$\Rightarrow$ $t = 1$ s

[CHEMISTRY]

46. Answer (3)

Hint : For basic buffer

$$pOH = pK_b + \log\frac{[Salt]}{[Base]}$$

Sol. : For maximum buffer capacity

[Salt] = [Base]

$\therefore$ pOH = pK_b

47. Answer (1)

Hint : Addition of inert gas at constant pressure increase the volume of container.

48. Answer (1)

Hint : Solubility increases with temperature.

49. Answer (4)

Hint : K_{sp} of $Ba(OH)_2 = [Ba^{2+}]\,[OH^-]^2$

Sol. : pOH = 14 – pH = 14 – 8 = 6

$[OH^-] = 10^{-6}$

$K_{sp} = \left(\frac{10^{-6}}{2}\right)(10^{-6})^2 = 5 \times 10^{-19}$

50. Answer (1)

Hint : Unit of $K_P = (atm)^{\Delta n_g}$

51. Answer (1)

Hint : NH_4^+ is conjugate acid of NH_3

Sol. : $K_a \times K_b = K_w$ (for conjugate acid base pair)

$K_a = \frac{K_w}{K_b} = \frac{10^{-14}}{2\times 10^{-5}} = 5\times 10^{-10}$

52. Answer (1)

Hint : Conjugate base = Acid – H^+

53. Answer (3)

Hint : For precipitation, ionic product should be greater than solublity product.

Sol. : Salt for which CO_3^{2-} ion required for saturation are minimum, will give precipitate first.

$[CO_3^{2-}]$ for $Ag_2CO_3 \Rightarrow 8.1 \times 10^{-10}$

$[CO_3^{2-}]$ for $CuCO_3 \Rightarrow 1.4 \times 10^{-9}$

$[CO_3^{2-}]$ for $MnCO_3 \Rightarrow 1.8 \times 10^{-10}$

$[CO_3^{2-}]$ for $SrCO_3 \Rightarrow 1.1 \times 10^{-9}$

54. Answer (2)

Hint : For of pure water, pK_w = 2 pH

Sol. : For pure water

pH = pOH = 5

pK_w = pH + pOH = 10

$K_w = 10^{-10}$

55. Answer (3)

Hint : $M_1V_1 = M_2V_2$

Sol. : Concentration of H^+ at pH 3 = 10^{-3} M

Concentration of H^+ at pH 4 = 10^{-4} M

Now, $M_1V_1 = M_2V_2$

$10^{-3} \times 100 = 10^{-4} \times V_2$

$V_2 = 1000$ ml

$\therefore$ H_2O added = 900 ml

56. Answer (2)

Hint : $K_P = K_C(RT)^{\Delta n_g}$

Sol. : $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$

$\Delta n_g = (2 + 1) - (2) = 1$

$K_P = K_C(RT) = 2 \times 10^{10}$ RT

57. Answer (2)

Hint : $pH = 7 + \frac{pK_a}{2} - \frac{pK_b}{2}$ for the salt of weak acid and weak base.

Sol. : 100 ml 0.1 CH_3COOH + 100 ml 0.1 NH_4OH

$\equiv$ 0.05 M CH_3COONH_4

$$pH = 7 + \frac{4.76}{2} - \frac{4.75}{2} = 7.005$$

58. Answer (4)

Hint : Equilibrium constant is a function of temperature only.

59. Answer (1)

Hint : At equilibrium, $\Delta G = 0$

Sol. : $\Delta G = \Delta G° + RT\ln Q$

$\because$ At equilibrium, K = Q, $\Delta G = 0$

$\therefore$ $\Delta G° = -RT\ln K$

$= -2.303\ RT \log K = 2.303\ RT \log\left(\frac{1}{K}\right)$

60. Answer (2)

Hint : $Al_2(SO_4)_3 \rightleftharpoons 2Al^{3+}(aq.) + 3SO_4^{2-}(aq.)$

61. Answer (1)

Hint : $N_3V_3 = N_1V_1 - N_2V_2$

Sol. : Suppose 1 L each is taken

$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

t = 0, 0.1mol 0.1 mol 0

final, 0 $\frac{0.1}{2}$ mol $\frac{0.1}{2}$ mol

Moles of H_2SO_4 left = $\frac{0.1}{2}$

Molarity of H_2SO_4 left = $\frac{0.1}{4}$ M

Molarity of $H^+ = 2 \times \frac{0.1}{4} = \frac{0.1}{2}$ M

$$pH = -\log[H^+] = -\log\frac{0.1}{2} = 1.3$$

62. Answer (4)

Hint : Removing gaseous product from equilibrium, shifts the equilibrium in forward direction.

63. Answer (2)

Hint : Anionic hydrolysis takes place in CH_3COONa

Sol. : Salt of strong base and weak acid are basic due to anionic hydrolysis.

64. Answer (2)

Hint : Solution of weak acid and its salt with strong base is known as acidic buffer.

65. Answer (4)

Hint : Lewis bases are electron pair donor.

66. Answer (4)

Hint : In boric acid, boron has vacant *p*-orbital.

67. Answer (3)

Hint : Common ion effect decreases the solubility.

Sol. :

	$AgCl(s)$	$\rightleftharpoons$	$Ag^+(aq) + Cl^-(aq)$
(i)	–	0	0.2
(eq)	–	s	s + 0.2
			$\simeq$ 0.2

$K_{sp} = [Ag^+]\ [Cl^-] = (s)\ (0.2)$

$$s = \frac{K_{sp}}{0.2} = \frac{1.6 \times 10^{-10}}{0.2} = 8 \times 10^{-10}\ M$$

68. Answer (3)

Hint : On adding the reaction the value of equilibrium constant gets multiplied.

Sol. : $A + 2B \rightleftharpoons C;\ K_1$ ...(i)

$2C \rightleftharpoons F_2 + 2E;\ K_2$

$C \rightleftharpoons \frac{1}{2} F_2 + E,\ \sqrt{K_2}$ ...(ii)

Adding (i) and (ii)

$$A + 2B \rightleftharpoons \frac{1}{2}F_2 + E;\ K_{eq} = K_1\sqrt{K_2}$$

69. Answer (2)

Hint : Burning of hydrocarbon is a spontaneous process.

Sol. :

- Burning of C_2H_6 is exothermic therefore $\Delta H < 0$
- Number of gaseous moles is increasing therefore $\Delta S > 0$
- Burning of C_2H_6 is spontaneous therefore $\Delta G < 0$

70. Answer (1)

Hint : Born Haber cycle is based on Hess's law.

Sol. : $Na(s) + \frac{1}{2}Cl_2(g) \rightarrow NaCl(s)$

$\Delta_f H°NaCl = \Delta_{sub}H°(Na) + \Delta_i H°(Na)$

$+\frac{1}{2}\Delta_{bond}H°(Cl_2) + \Delta_{eg}H°(Cl) - \Delta_{lattice}H°(NaCl)$

$\Delta_{lattice}H°(NaCl(s)) = 788\ kJ\ mol^{-1}$

71. Answer (3)

Hint : $\Delta S_{system} + \Delta S_{surrounding} = \Delta S_{total}$

Sol. : For spontaneous process

$\Delta S_{total} > 0$

$\Delta S_{system} + \Delta S_{surrounding} > 0$

72. Answer (4)

Hint : $\Delta H = \Delta U$ if $\Delta n_g = 0$

Sol. : $C(s) + O_2(g) \rightarrow CO_2(g)$

$\because \quad \Delta n_g = n_P - n_R = 1 - 1 = 0$

$\therefore \quad \Delta H = \Delta U$

73. Answer (2)

Hint : Intensive properties do not depend upon the quantity of the substance.

74. Answer (2)

Hint : $\Delta H = \Delta U + \Delta n_g RT$

Sol. : $\Delta H = 2 + (4)\ (2 \times 10^{-3})\ (300)$

$= 4.4$ kcal

$\Delta G = \Delta H - T\Delta S$

$= 4.4 - 300 \times \frac{10}{1000}$

$= 1.4$ kcal

75. Answer (2)

Hint : Heat of formation of carbon dioxide and heat of combustion of carbon are same.

Sol. : $C(s) + O_2(g) \rightarrow CO_2(g),\ \Delta H = -400\ kJ\ mol^{-1}$

$\because$ Formation of 44 g CO_2 gives 400 kJ heat

$\therefore$ Formation of 22 g CO_2 gives 200 kJ heat

76. Answer (3)

Hint : For spontaneous process, $\Delta G < 0$.

Sol. : If $\Delta H > 0$ and $\Delta S < 0$ then the ΔG is always positive so process is always non spontaneous.

77. Answer (3)

Hint : $dS = \frac{dq}{T}$

Sol. : For reversible isothermal process

$$\Delta S = \frac{q}{T} = \frac{nRT\ln\frac{V_f}{V_i}}{T} = nR\ln\frac{V_f}{V_i}$$

78. Answer (4)

Hint : $\frac{1}{2}A_2 + \frac{1}{2}B_2 \rightarrow AB$

Sol. : $\Delta H = \sum(BE)_R - \sum(BE)_P$

$$\Delta H = \frac{1}{2} \times BE_{A-A} + \frac{1}{2}BE_{B-B} - BE_{A-B}$$

$$-50 = \frac{10}{2} + \frac{20}{2} - BE_{A-B}$$

$\Rightarrow \quad BE_{A-B} = 65$ kJ/mol

79. Answer (3)

Hint : Decrease in gaseous moles decrease the entropy.

80. Answer (4)

Hint : For isothermal process, $\Delta U = 0$.

Sol. : $w = -P_{ext}(V_f - V_i)$

$= -2\ (4 - 1) = -6$ L atm

$= -6 \times 100 = -600$ J

$q = -w = -(-600) = 600$ J

81. Answer (3)

Hint : 'a' is attraction coefficient.

82. Answer (2)

Hint : Volume of 1 mol ideal gas at S.T.P. = 22.4 L

Sol. : Since molar volume of the gas at S.T.P. is greater than 22.4 L so repulsive forces are dominating hence $Z > 1$.

83. Answer (1)

Hint : 'b' depends on size of particles

84. Answer (2)

Hint : Viscosity $\propto$ inter particle attraction.

Sol. : Due to more H–bonding, $HOCH_2CH_2OH$ is more viscous.

85. Answer (2)

Hint : $d = \frac{PM}{RT}$

Sol. : $d = \frac{8.21 \times 100}{0.0821 \times 300} = \frac{100}{3}$ g/L

86. Answer (2)

Hint : $U_{MPS} = \sqrt{\frac{2RT}{M}}$

Sol. : $\frac{U_1}{U_2} = \frac{\sqrt{\frac{2RT_1}{M}}}{\sqrt{\frac{2RT_2}{M}}} = \sqrt{\frac{T_1}{T_2}} = \sqrt{\frac{T}{4T}} = \frac{1}{2}$

So most probable velocity gets doubled if the temperature is quadrupled.

87. Answer (3)

Hint : In H_2O and Ne, dipole-induced dipole forces take place.

Sol. : HCl and H_2O both are polar molecules so dipole-dipole interaction takes place.

88. Answer (3)

Hint : At high temperature, effect of interparticle attraction becomes negligible.

Sol. : At low pressure, volume of gas particles become negligible as compared to the total volume occupied by the gas.

89. Answer (4)

Hint : Use Graham's law of diffusion.

Sol. : $\frac{r_{H_2}}{r_{gas}} = \sqrt{\frac{M_{gas}}{M_{H_2}}}$

$\frac{4}{1} = \sqrt{\frac{M_{gas}}{2}}$

M_{gas} = 32 u

90. Answer (2)

Hint : Partial pressure = Total pressure × Mole fraction.

Sol. : $n_{CH_4} = \frac{32}{16} = 2$ mol

$n_{O_2} = \frac{32}{32} = 1$ mol

Fraction of total pressure exerted by $O_2 = x_{O_2}$

$x_{O_2} = \frac{n_{O_2}}{n_{O_2} + n_{CH_4}} = \frac{1}{1+2} = \frac{1}{3}$

[BIOLOGY]

91. Answer (1)

Sol. : In sunflower, basal placentation is found.

92. Answer (3)

Sol. : Apple is a false fruit as it is formed by ovary and thalamus together.

93. Answer (1)

Hint : Solanaceae and Liliaceae show axile placentation.

Sol. : Given features are of Solanaceae family therefore plant 'X' should belong to Solanaceae.

94. Answer (1)

Sol. : In *Calotropis*, petals show valvate aestivation.

95. Answer (1)

Hint : In cymose inflorescence, main axis terminates in a flower.

Sol. : Main axis show limited growth in cymose inflorescence

96. Answer (1)

Sol. : Region of maturation bears root hairs which increase area of absorption of water and minerals.

97. Answer (4)

Hint : In offset, branch of leaves and roots are present at each node.

Sol. : *Chrysanthemum* shows sucker type of stem in which underground part of main stem form lateral branches that come out from soil surface.

98. Answer (2)

Sol. : In cereals, seed coat is thin and membranous and fused with pericarp e.g. maize.

99. Answer (1)

Hint : Mango is drupe type of fruit.

Sol. : In mango, fleshy mesocarp is edible. Drupe fruits arise from monocarpellary superior ovary.

100. Answer (1)

Hint : Maize is a monocot seed in which food is stored in endosperm.

Sol. : In maize, radicle is covered with coleorhiza, perisperm is absent and proteinaceous aleurone layer is found.

101. Answer (4)

Hint : Plants of Fabaceae family have non endospermic seeds and monocarpellary ovary.

Sol. : Pea has monocarpellary ovary. Rest all are correctly matched.

102. Answer (4)

Hint : Aestivation of petals or sepals as well placentation of ovary are not shown in floral formula.

Sol. : Given floral formula is of Liliaceae family. Type of placentation i.e. axile placentation is not shown in floral formula.

103. Answer (4)

Hint : Plants of Fabaceae and Brassicaceae family have superior ovary with marginal and parietal placentation respectively.

Sol. : Tomato, Tulip, *Petunia* } Superior ovary with axile placentation

Gram – Superior ovary, marginal placentation

Mustard – Superior ovary, parietal placentation

104. Answer (1)

Sol. : Stamens are united into more than two bundles in *Citrus* i.e. polyadelphous stamens.

105. Answer (4)

Hint : Pea flowers can be divided into equal halves by one plane only.

Sol. : Pea flowers are zygomorphic (bilateral symmetry.

106. Answer (3)

Hint : Mustard has racemose inflorescence.

Sol. : Mustard – flowers borne in acropetal order.

China rose – Alternate phyllotaxy

Calotropis – Opposite phyllotaxy

Solanum – Cymose inflorescence

107. Answer (1)

Sol. : In palmately compound leaf, all the leaflets are attached to a common point i.e. at tip of petiole eg. silk cotton.

108. Answer (3)

Hint : Such type of stem modification is called phylloclade.

Sol. : Phylloclade is found in plants of arid regions like *Opuntia*, *Euphorbia* etc.

Opuntia – Flattened phylloclade

Euphorbia – Fleshy cylindrical phylloclade

109. Answer (1)

Hint : Axillary buds may modify into thorns or tendrils to protect or support the plants.

Sol. :

Tendril of grape vine, Thorns of *Bougainvillea* } Modified axillary buds

Spines of *Aloe* and *Opuntia* and tendrils of pea } Modified leaves

110. Answer (1)

Sol. : In radish and sweet potato, roots store food while in ginger, underground stem stores food. *Eichhornia* has offset which is not a modification of stem to store food.

111. Answer (2)

Hint : Adventitious roots arise from the parts of plant other than radicle.

Sol. : Still roots of sugarcane arise from lower nodes of stem. Rest all are tap root modifications.

112. Answer (4)

Hint : Ascomycetes is a class of fungi.

Sol. : Ascomycetes include heterotrophs only thus a phycobiont partner of lichen can never belong to ascomycetes. However unicellular BGA can be a phycobiont.

113. Answer (2)

Hint : Sporangiospores are produced inside sporangium

Sol. : Sporangiospores are endogenously produced aplanospores.

Zoospores – Planospores

Basidiospores – Sexual spores, exogenously formed.

Conidia – Non motile, exogenous, asexual spores.

114. Answer (4)

Hint : Envelope is the outermost covering of some viruses.

Sol. : Bacteriophage generally have DNA as its genetic material covered in proteinaceous capsid but they lack envelope.

115. Answer (3)

Sol. : *Rhizopus* is commonly called bread mould.

116. Answer (4)

Hint : *Paramoecium* is a ciliated protozoan.

Sol. : *Paramoecium* has thousands of cilia for locomotion.

117. Answer (3)

Hint : Yeast *sp*. are used in baking and brewing industries.

Sol. : Yeast is a fungus. Rest all activities are due to prokaryotes.

Making of curd from milk – *Lactobacillus*

N_2 fixation in beans – *Rhizobium*

Biogas production – Methanogens.

118. Answer (4)

Hint : *Puccinia graminis tritici* causes rust disease.

Sol. : *Puccinia* is a member of basidiomycetes in which asexual spores are generally not found. It lacks dolipore septum in its hyphae and has chitinous cell wall.

119. Answer (3)

Hint : Ascospores are sexual spores.

Sol. : Zoospores, sporangiospores and conidia are asexual spores. Ascospores are sexual spores produced by members of ascomycetes.

120. Answer (1)

Hint : Cr-Jacob disease is caused by prions.

Sol. : Prions are abnormally folded proteins, similar in size to viruses and lack any nucleic acid Prions cause disease in humans as well as cattles.

121. Answer (4)

Hint : Viroids are infectious RNA particles.

Sol. : Viroids lack protein coat. They have ssRNA as their genetic material. Both viruses and viroids are pathogenic and have possibilities of mutation in their genetic meterial.

122. Answer (3)

Hint : *Claviceps* is a sac fungus.

Sol. : *Claviceps* shows dikaryophase in its life cycle *i.e*. karyogamy is delayed after plasmogamy.

Gonyaulax (red dinoflagellate) causes red tide.

Alternaria asexually reproduces through conidia.

123. Answer (3)

Hint : *Saccharomyces* (yeast) is a unicellular fungus.

Sol. : Yeast does not produce fruiting body while *Agaricus,* morels and truffles produce edible fruiting bodies.

124. Answer (4)

Hint : *Albugo candida* causes white rust of crucifers.

Sol. : *Albugo* is a member of phycomycetes and has aseptate hyphae. It lacks dikaryophase in its life.

125. Answer (4)

Hint : Members of deuteromycetes, oomycetes and zygomycetes lack fruiting bodies.

Sol. : Deuteromycetes – Have septate hyphae, asexual spore as conidia.

Zygomycetes – Have aseptate hyphae, asexual spore as sporangiospores.

126. Answer (4)

Hint : Sporozoans lack any locomotory structure.

Sol. : *Plasmodium* – Lack locomotory structure

Amoeba – Pseudopodia

Paramoecium – Cilia

Trypanosoma – Flagella

127. Answer (2)

Hint : Slime moulds are consumer decomposer protists.

Sol. : Slime moulds are saprophytic protists that form spores under unfavourable conditions. Their spores contain cellulosic cell wall.

128. Answer (2)

Hint : Cyanobacteria, euglenoids and deuteromycetes do not reproduce by sexual means.

Sol. :

Anabaena – Cyanobacteria reproduce asexually only.

Euglena – Protist, sexual reproduction is not known

Alternaria and *Trichoderma* – Fungi that do not reproduce sexually

129. Answer (1)

Hint : Organisms called chief producers of ocean have silicious cell wall.

Sol. : Diatoms have silicious cell wall.

130. Answer (1)

Sol. : *Mycoplasma* lack cell wall and popularly known as 'bacteria with their coats off'.

131. Answer (3)

Hint : *Nostoc* is a cyanobacterium.

Sol. : *Nostoc* has heterocyst, trichome and chlorophyll a. It lacks flagella throughout the life.

132. Answer (2)

Hint : Methanogens are found in the gut of ruminants.

Sol. : Methanogens are obligate anaerobes, contain cell wall and convert CO_2, methanol and formic acid into methane.

133. Answer (4)

Hint : Green and purple sulphur bacteria do not use water as electron donor in photosynthesis.

Sol. : *Anabaena* (cyanobacteria), *Gonyaulax* (dinoflagellate) and diatoms show oxygenic photosynthesis. Purple sulphur bacteria show anoxygenic photosynthesis.

134. Answer (2)

Hint : Archaebacteria lack peptidoglycan in their cell wall.

Sol. : Archaebacteria and eubacteria have different sequences of 16S rRNA gene. Archaebacteria have branched chain lipids in their membrane.

135. Answer (1)

Hint : Members of kingdom Fungi and Animalia include heterotrophs only.

Sol. : Out of five, four kingdoms monera, protista, fungi and animalia include members with heterotrophic mode of nutrition.

136. Answer (3)

Hint : Pericardium is covering of heart.

Sol. : Pleura or pleural membranes form covering of lungs.

137. Answer (1)

Hint : Cockroach has tracheal tubes.

Sol. : Insects have a network of tracheal tubes to transfer atmospheric air into the body.

138. Answer (2)

Hint : Instrument that cannot measure RV.

Sol. : The maximum amount of air a person can expel from the lungs after maximum inhalation can be measured by a spirometer.

139. Answer (1)

Hint : These glands secrete lysozyme.

Sol. : Sweat glands are sudoriferous glands in the skin which help eliminate excess heat, water and carbon dioxide.

140. Answer (1)

Hint : Tidal volume.

Sol. : Tidal volume represents the volume of air inhaled in a normal inhalation which is approximately 500 ml.

141. Answer (2)

Hint : External and internal oblique are abdominal muscles.

Sol. : Detrusor muscle is present in wall of urinary bladder and facilitates micturition.

142. Answer (3)

Hint : This structure is associated with vasa recta.

Sol. : In cortical nephrons, the loop of Henle penetrates only outer region of renal medulla whereas in juxtamedullary nephrons it extends deep into medulla.

143. Answer (4)

Hint : This promotes formation of red blood cells.

Sol. : Erythropoietin released by JG cells of kidney stimulates formation of RBCs. Aldosterone targets DCT of nephrons but is produced by adrenal cortex. Rennin is a digestive enzyme.

144. Answer (2)

Hint : Stroke volume is the amount of blood ejected by a ventricle during each systole.

Sol. : Cardiac output (mL/min) = Stroke volume × Heart rate.

145. Answer (3)

Hint : This forms outermost covering of oesophagus.

Sol. : The outermost, middle and innermost layer of artery are tunica externa, media and interna respectively.

146. Answer (2)

Hint : This phase is of shortest duration.

Sol. : Atrial systole enables approximately 30% filling of ventricles while 70% filling of ventricles occurs during joint diastole.

147. Answer (3)

Hint : In foetus, foramen ovale allows flow of oxygenated blood from right to left atrium.

Sol. : Ductus arteriosus closes after birth leaving a remnant known as ligamentum arteriosum.

148. Answer (4)

Hint : BPG stands for 2, 3-bisphosphoglycerate.

Sol. : BPG combines with haemoglobin which makes the haemoglobin bind less tightly at the heme group sites. Greater the level of BPG, more is the O_2 unloaded from haemoglobin.

149. Answer (2)

Hint : Physiological demand for oxygen rises during muscular work.

Sol. : Leftover oxygen is used as a reserve during muscular exercise to compensate for increased oxygen demand.

150. Answer (3)

Hint : This disorder is caused due to excessive cigarette smoking.

Sol. : Emphysema is a disorder characterized by destruction of walls of alveoli producing abnormally large air spaces that remain filled with air ever after exhalation.

151. Answer (4)

Hint : It is the hunger and satiety centre.

Sol. : Normal respiratory rhythm is primarily maintained by medulla oblongata.

152. Answer (1)

Hint : 70% CO_2 is transported in this form.

Sol. : CO_2 enters RBCs and reacts with water in the presence of enzyme carbonic anhydrase to form carbonic acid which dissociates into H^+ and HCO_3^-. About 20-25% of CO_2 is transported as carbaminohaemoglobin.

153. Answer (2)

Hint : CO_2 is end product of metabolism in tissues.

Sol. : If a person holds his breath, fresh air is not inhaled so fresh supply of O_2 is arrested. Concentration of CO_2 however continues to rise in blood producing an urge to breathe.

154. Answer (4)

Hint : Erythropoiesis means production of RBCs.

Sol. : Erythropoiesis occurs by yolk sac in early embryonic life and by liver and spleen in late embryonic life. In adults, erythropoiesis occurs in red bone marrow.

155. Answer (4)

Hint : Second heart sound is shorter and high pitched.

Sol. : Second heart sound is called dub and is caused by blood turbulence associated with closure of the semilunar valves at the beginning of ventricular diastole.

156. Answer (4)

Hint : This fluid is plasma without clotting factors.

Sol. : Blood is a highly specialized connective tissue mainly composed of RBCs, WBCs, platelets and plasma.

157. Answer (3)

Hint : Blood leaves the heart through the aorta.

Sol. : Blood pressure is maximum in the aorta when blood leaves the heart. Contraction causes blood pressure to rise to its highest point and relaxation brings it down to the lowest point.

158. Answer (1)

Hint : Parasympathetic nerve fibres release acetylcholine.

Sol. : Parasympathetic nerve impulses reach the heart via right and left vagus nerves. They release acetylcholine which decreases heart rate by slowing the rate of spontaneous depolarization in autorhythmic fibres.

159. Answer (1)

Hint : Normal blood pressure is 120/80 mmHg.

Sol. : Hypertension or repeated high blood pressure is a condition in which pressure of blood is raised in arteries. High blood pressure of 200/100 mmHg may harm various organs of the body such as kidneys and brain to a great extent.

160. Answer (2)

Hint : Tricuspid valve guards the opening between right atrium and right ventricle.

Sol. : If due to the injury, bicuspid valves of the human heart become partially non-functional, the flow of blood into aorta is reduced because backflow of blood takes place into left atrium.

161. Answer (1)

Hint : This wave is a small upward deflection in the ECG.

Sol. : P-wave represents atrial depolarization or excitation which spreads from SA node through conducting fibres in both atria. T wave marks the end of ventricular systole. R wave represents spread of electrical impulse towards ventricles.

162. Answer (4)

Hint : Lymph appears colourless.

Sol. : Lymph consists of plasma and leukocytes. It contains fewer plasma proteins and lower calcium and phosphorous than blood.

163. Answer (2)

Hint : These are glycoproteins.

Sol. : Immunoglobulins that are gamma globulins help attack viruses and bacteria. Alpha and beta globulins transport iron, lipids and fat-soluble vitamins. RBCs contain haemoglobin.

164. Answer (3)

Hint : Wilhelm His Jr discovered this specialised tissue.

Sol. : Bundle of His is an important part of the electrical conduction system of the heart as it transmits impulses from atrioventricular node located at the inferior end of the interatrial septum to the ventricles of the heart.

165. Answer (3)

Hint : Individuals with blood group O^{-ve} are universal donors.

Sol. : The RBCs of individuals with O^{-ve} blood group have no antigens on their surface. AB^{+ve} is a universal recipient as they have both A and B antigens on RBC surface but no anti-A or anti-B antibody in the plasma.

166. Answer (1)

Hint : Coagulation is a process where blood forms a clot.

Sol. : Plasma protein fibrinogen is a clotting factor which is converted to fibrin to form a clot.

Albumin maintains osmolarity of blood. Heparin is anti-coagulant.

167. Answer (1)

Hint : These ions cause acidity.

Sol. : pH of urine varies between 4.6 and 8.0. Tubular secretion involves the removal of urea, uric acid, hippuric acid, creatinine, K^+ and H^+.

168. Answer (3)

Hint : The curve represents oxygen dissociation curve (ODC).

Sol. : Increase in pCO_2, temperature and H^+ ion concentration will shift the ODC towards the right side, while increase in pO_2 will shift the curve to left side.

169. Answer (3)

Hint : This part is not involved in reabsorption and secretion.

Sol. : Glomerular filtration occurs in Bowman's capsule. Therefore, insufficient filtration will increase the levels of urea in blood.

170. Answer (1)

Hint : Maximum reabsorption of water and electrolytes takes place here.

Sol. : Removal of PCT results in more dilute urine as fluid from filtrate will not be reabsorbed into the peritubular capillaries. Cardiac output is approximately 5 litres.

171. Answer (1)

Hint : Identify the salt retaining hormone.

Sol. : Aldosterone is secreted by zona glomerulosa of adrenal cortex and increases sodium reabsorption by the distal convoluted tubules.

172. Answer (3)

Hint : Urethra has an internal and an external sphincter.

Sol. : Internal sphincter of males is supplied by both sympathetic and parasympathetic nervous system. External sphincter is supplied by somatic nerve.

173. Answer (3)

Hint : Maximum reabsorption occurs in PCT.

Sol. : PCT is lined by brush bordered simple cuboidal epithelium. Presence of microvilli increases the absorptive surface area.

174. Answer (1)

Hint : Anti-diuretic hormone is released in response to altered osmolarity of CSF.

Sol. : Stored ADH is released by posterior pituitary and stimulates reabsorption of water and electrolytes by kidneys.

175. Answer (4)

Hint : Man is ureotelic.

Sol. : Uric acid is excreted by reptiles, birds and terrestrial insects.

176. Answer (1)

Hint : A net force producing acceleration of the fluid.

Sol. : The pressure difference between post caval region and right atrium causes blood to flow into the atria.

177. Answer (2)

Hint : These granulocytes have bilobed nucleus.

Sol. : Eosinophilia is an increase in number of eosinophils from 1-3% to about 14-16% in circulating blood. Its most common causes are allergic helminthic infections.

178. Answer (4)

Hint : Each polypeptide chain can bind to 1 molecule of oxygen.

Sol. : Haemoglobin comprises two pairs of polypeptide chains, known as α-chains and β-chains with each chain folded to provide a binding site for a heme group.

179. Answer (4)

Hint : Urea is synthesized in liver.

Sol. : Hepatic vein exits the liver therefore, carries the maximum amount of urea.

180. Answer (1)

Hint : Voice box of man

Sol. : The structure marked as 'X' represents the larynx which is responsible for sound production in man.

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