

All India Aakash Test Series for NEET - 2026

TEST - 5 (Code-A)[Click here for Code-B Sol.](#)

Test Date : 28/12/2025

ANSWERS

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

HINTS & SOLUTIONS**[PHYSICS]**

1. Answer (2)

Hint: $\vec{A} \times \vec{B} = AB \sin \theta \hat{n}$

$$\text{Sol.: } \vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 3 & -5 \\ 3 & -2 & 5 \end{vmatrix}$$

$$= \hat{i}(15 - 10) - \hat{j}(10 + 15) + \hat{k}(-4 - 9)$$

$$= 5\hat{i} - 25\hat{j} - 13\hat{k}$$

$$|\vec{A} \times \vec{B}| = \sqrt{819} \text{ units}$$

2. Answer (4)

Hint: a_t is along tangent and a_r is along radius.**Sol.:** When the particle is moving in a vertical circle with the help of a string, the force towards the centre and the force along the tangent, vary from point to point and so both its radial and tangential acceleration also vary.

3. Answer (3)

Hint: $R^2 = P^2 + Q^2 + 2PQ \cos \theta$ **Sol.:** $P = (F_1 + F_2)$, $Q = (F_1 - F_2)$

$$R = \sqrt{F_1^2 + F_2^2}$$

$$\cos \theta = \frac{R^2 - P^2 - Q^2}{2PQ}$$

$$= \frac{(F_1^2 + F_2^2) - (F_1 + F_2)^2 - (F_1 - F_2)^2}{2(F_1 + F_2)(F_1 - F_2)}$$

$$= - \left[\frac{(F_1^2 + F_2^2)}{2(F_1^2 - F_2^2)} \right] \Rightarrow \theta = \cos^{-1} \left[- \frac{(F_1^2 + F_2^2)}{2(F_1^2 - F_2^2)} \right]$$

4. Answer (1)

Hint: $P = \vec{F} \cdot \vec{v}$, $a = v \frac{dv}{dx}$ **Sol.:** $P = mav$ and $a = v \frac{dv}{dx}$

$$v^2 dv = \frac{P}{m} dx$$

$$\int_u^v v^2 dv = \frac{P}{m} \int_0^x dx$$

$$P = \frac{m(v^3 - u^3)}{3x} = \frac{2500(216 - 64)}{3 \times 250}$$

$$= \frac{2500 \times 152}{3 \times 250} = 506.67 \text{ W} \approx 507 \text{ W}$$

5. Answer (4)

Hint: $W_{\text{cons}} = -\Delta U$ **Sol.:** Potential energy is defined for conservative force field. Work done by system against conservative force results in increase in potential energy.

6. Answer (2)

Hint: $\alpha = \frac{\omega_f - \omega_i}{t}$ & $\theta = \omega_0 t + \frac{1}{2} \alpha t^2$ **Sol.:** $f_0 = 420 \text{ rev/min}$

$$\omega_0 = 2\pi \times 7 = 14\pi \text{ rad/s}$$

At $t = 10 \text{ s}$, $\omega = 0$

$$\alpha = -\frac{14\pi}{10} = -\frac{7\pi}{5} \text{ rad/s}^2$$

$$\theta = \omega_0 t + \frac{1}{2} \alpha t^2$$

$$= 14\pi \times 10 - \frac{1}{2} \times \frac{7\pi}{5} \times 100$$

$$\theta = 70\pi \text{ rad}$$

$$\text{Number of revolutions} = \frac{\theta}{2\pi}$$

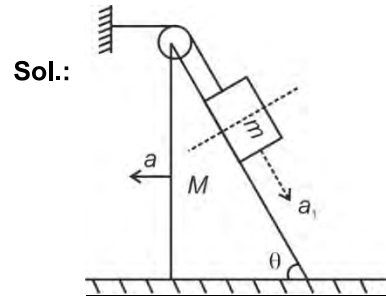
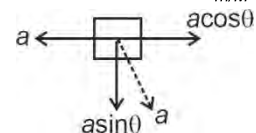
$$= \frac{70\pi}{2\pi} = 35 \text{ revolutions}$$

7. Answer (3)

Hint: Wedge constraint

(i) Along common normal, there is no relative motion.

(ii) Perpendicular to common normal, motion is always relative.

**Sol.:** $a_1 = a =$ acceleration of M w.r.t. ground = 2 m/s^2 acceleration of m w.r.t. $M = a_{m/M} = a = 2 \text{ m/s}^2$ 

$$\vec{a}_{m/g} = \vec{a}_{m/M} + \vec{a}_M$$

$$|\vec{a}_{m/g}| = \sqrt{(a - a \cos \theta)^2 + (a \sin \theta)^2}$$

$$= 2a \sin \frac{\theta}{2}$$

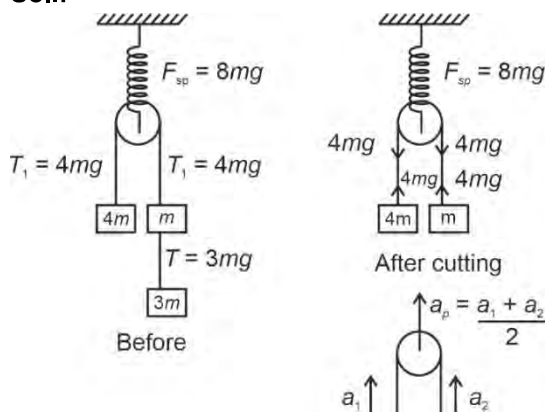
$$= 2 \times 2 \times \frac{1}{2} = 2 \text{ m/s}^2$$

8. Answer (2)

Hint: Initially system was at rest
Just after string is cut:

$$a_{\text{pulley}} = \frac{a_1 + a_2}{2}$$

Sol.:



Spring force, $F_{sp} = 8mg$

$$a_1 = a_{4m} = 0$$

$$a_2 = a_m = \frac{4mg - mg}{m} = 3g$$

$$a_p = \frac{0 + 3g}{2} = \frac{3g}{2}$$

9. Answer (3)

Hint : Use $m_1 r_1 = m_2 r_2$

Sol.: C.O.M. will be in IV quadrant

10. Answer (4)

Hint: Conservative force $F = -\frac{\partial U}{\partial r}$

$$\text{Sol.} : F_x = -\frac{\partial U}{\partial x} = -3$$

$$F_y = -\frac{\partial U}{\partial y} = -4$$

$$\vec{F} = F_x \hat{i} + F_y \hat{j}$$

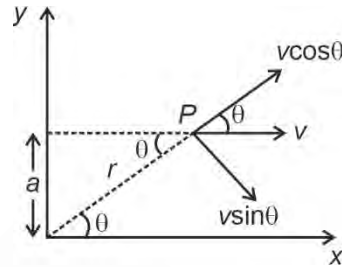
$$= -(3\hat{i} + 4\hat{j}) \text{ N}$$

$$|\vec{a}| = \frac{|\vec{F}|}{m} = \frac{\sqrt{9+16}}{5} = 1 \text{ m/s}^2$$

11. Answer (1)

Hint: Angular velocity $\omega = \frac{v_{\perp}}{r}$

$$\text{Sol.} : \omega = \frac{v_{\perp}}{r} = \frac{v \sin \theta}{r}$$



$$\frac{a}{r} = \sin \theta$$

$$r = \frac{a}{\sin \theta}$$

$$\omega = \frac{v \sin^2 \theta}{a} = 2 \times \frac{1}{4 \times 2} = \frac{1}{4} \text{ rad/s}$$

12. Answer (2)

Hint & Sol: Potential energy of a system can be positive, negative or zero.

- In circular motion, tension is perpendicular to velocity of block.

$$\text{Small work done, } dW = T dx \cos 90^\circ = 0$$

\Rightarrow Work done is zero

- Also, work done $= \int F \cdot dx$

\therefore Statement C is false

13. Answer (2)

Hint: In perfectly elastic head-on collision, kinetic energy transfer is maximum for $m_1 = m_2$

$$\text{Sol.} : v_1 = \left(\frac{m_1 - m_2}{m_1 + m_2} \right) u_1, v_2 = \frac{2m_1}{(m_1 + m_2)} u_1$$

Fraction of kinetic energy transferred

$$= \frac{(K_B)_{\text{final}}}{(K_A)_{\text{initial}}} = \frac{4m_1 m_2}{(m_1 + m_2)^2}$$

This expression is maximum when

$$m_1 = m_2$$

14. Answer (2)

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

$$\text{Sol.} : P = (2\hat{i} - 3\hat{j} + 4\hat{k}) \cdot (2\hat{i} + 3\hat{j} + 5\hat{k})$$

$$= 4 - 9 + 20 = 15 \text{ W}$$

15. Answer (1)

Hint: Total acceleration is given by

$$a_{\text{total}}^2 = a_t^2 + a_c^2$$

Sol.: Since the tangential acceleration is constant:

$$S = \frac{1}{4} \times 2\pi r = \frac{\pi r}{2}$$

$$S = ut + \frac{1}{2}at^2$$

$$\frac{\pi r}{2} = \frac{1}{2}at^2$$

$$t^2 = \frac{\pi r}{a}$$

$$v = a\sqrt{t^2} = a\sqrt{\frac{\pi r}{a}}$$

$$v = \sqrt{a\pi r}$$

$$a_c = \frac{v^2}{r} = \frac{a\pi r}{r} = a\pi$$

$$a_t = a$$

$$a_{\text{total}} = \sqrt{a_t^2 + a_c^2} = \sqrt{a^2 + a^2\pi^2}$$

$$= a\sqrt{1 + \pi^2} = 2\sqrt{1 + \pi^2}$$

16. Answer (1)

Hint & Sol.: Under Newton's 3rd law, action and reaction are always equal and opposite. They always act on different bodies.

17. Answer (1)

Hint: $F \times t = \text{impulse}$

& Impulse = change in momentum

Sol.:

$$(i) \text{ Impulse} = \frac{1}{2} \times 20 \times 20 = 200 \text{ N-s}$$

$$(ii) \text{ Impulse} = P_f - P_i \Rightarrow 200 = P_f - 10$$

$$P_f = 210 \text{ kg-m/s}$$

18. Answer (3)

$$\text{Hint: Force } \vec{F} = \frac{d\vec{p}}{dt}$$

$$\text{Sol.: } F = \frac{2mu \cos \theta}{t}$$

$$= \frac{2 \times 500 \times 10^{-3} \times 40 \times 1}{0.4 \times 2} = 50 \text{ N}$$

19. Answer (2)

Hint: To loop-the-loop body should not lose contact with the track anywhere, so velocity $v \geq \sqrt{gr}$ at the topmost point of circular loop.**Sol.:** By conservation of mechanical energy,

$$\frac{1}{2}mv_{\text{min}}^2 = mg(h_{\text{min}} - 2r)$$

$$\frac{1}{2}m(gr) = mg(h_{\text{min}} - 2r)$$

$$\frac{1}{2}r = h_{\text{min}} - 2r$$

$$\therefore h_{\text{min}} = \frac{r}{2} + 2r = \frac{5r}{2} = 2.5 \text{ m}$$

20. Answer (4)

Hint: For crossing the bridge in minimum time, it has to travel with maximum acceleration.**Sol.:** $a = \text{maximum acceleration produced in car}$
 $ma = \mu R$ (if acceleration is more than this, then tyres will slip)

$$ma = \mu mg$$

$$a = \mu g = 10 \text{ m/s}^2$$

$$u = 0, s = 500 \text{ m}, a = 10 \text{ m/s}^2$$

$$500 = \frac{1}{2} \times 10 \times t^2$$

$$t = 10 \text{ s}$$

21. Answer (3)

Hint: Work done $(W) = \Delta K \cdot E$

$$\text{Sol.: } x^2 = 25t^3$$

$$x = 5t^{3/2}$$

$$v = \frac{dx}{dt} = 5 \times \frac{3}{2} t^{1/2}$$

$$\text{At } t = 0, v = 0$$

 \Rightarrow Particle is at rest

$$W = \frac{1}{2}mv_t^2 - \frac{1}{2}mv_{t=0}^2$$

$$W = \frac{1}{2}mv_t^2$$

$$= \frac{1}{2} \times 5 \times \left(\frac{15}{2} t^{1/2} \right)^2 = \frac{5 \times 225}{2 \times 4} \times t$$

$$\therefore W \propto t$$

22. Answer (1)

Hint: Work done $W = \vec{F} \cdot d\vec{s}$, $\hat{i} \cdot \hat{j} = 0$

$$\text{Sol.: } W = \vec{F} \cdot \Delta \vec{x}$$

$$\Delta \vec{x} = (-3\hat{i}) \text{ m}$$

$$(a) W = -15 \text{ J}$$

$$(b) W = \text{zero}$$

$$(c) W = (-5\hat{i}) \cdot (-3\hat{j}) = 15 \text{ J}$$

$$(d) W = (-8\hat{i} + 5\hat{j}) \cdot (-3\hat{i}) = 24 \text{ J}$$

23. Answer (2)

Hint: Use conservation of momentum and change in total kinetic energy to find work done by internal forces.

Sol.: $\vec{P}_i = \text{zero}$

$$\vec{P}_f = m_1\vec{u} + m_2\vec{v}$$

$$\vec{P}_i = \vec{P}_f$$

$$0 = m_1\vec{u} + m_2\vec{v}$$

$$\vec{v} = \frac{-m_1\vec{u}}{m_2}$$

$$K.E_i = 0$$

$$K.E_f = \frac{1}{2}m_1u^2 + \frac{1}{2}m_2v^2$$

$$K.E_f = \frac{1}{2}m_1u^2 + \frac{1}{2}m_2\left(\frac{m_1u}{m_2}\right)^2$$

$$= \frac{1}{2}m_1u^2 + \frac{1}{2}\frac{m_1^2u^2}{m_2}$$

$$K.E_f = \frac{1}{2}\left(\frac{m_1m_2 + m_1^2}{m_2}\right)u^2$$

$$\Delta K.E = \frac{1}{2}m_1u^2 \left[1 + \frac{m_1}{m_2}\right]$$

$$= \frac{1}{2} \times 1 \times 4 \left[1 + \frac{1}{6}\right]$$

$$= 2 \times \frac{7}{6} = \frac{7}{3} \text{ J}$$

24. Answer (4)

Hint : Use momentum and energy conservation laws to verify post-collision velocities in each option.

Sol.: For elastic collision in option (3), $m_1 \gg m_2$

for $u_1 \neq 0, u_2 = 0$

$$\text{then, } v_1 = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)u_1 \approx u_1$$

$$v_2 = \frac{2m_1u_1}{(m_1 + m_2)} \approx 2u_1$$

For elastic collision in option (4), $m_1 = m_2$

for $u_1 \neq 0, u_2 = 0,$

then, $v_1 = 0, v_2 = u_1$

25. Answer (3)

Hint: Velocity of C.O.M. $\vec{v}_{cm} = \frac{m_1\vec{v}_1 + m_2\vec{v}_2}{m_1 + m_2}$

$$\text{Sol.} \vec{v}_{cm} = \frac{0.2 \times 5\hat{i} + 0.5(10\hat{i} + 10\hat{j})}{0.2 + 0.5}$$

$$= \frac{\hat{i} + 5\hat{i} + 5\hat{j}}{0.7}$$

$$= \frac{6\hat{i} + 5\hat{j}}{0.7} = \frac{60\hat{i} + 50\hat{j}}{7} \text{ m/s}$$

26. Answer (3)

Hint : Power due to a force in rotational motion is given by dot product of torque and angular velocity.

Sol.: $\vec{\tau} = \vec{r} \times \vec{F}$

$$P = \vec{\tau} \cdot \vec{\omega}$$

$$P = (\vec{r} \times \vec{F}) \cdot \vec{\omega}$$

27. Answer (1)

Hint: Use conservation of angular momentum

Sol.: By conservation of angular momentum,

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

$$\omega = \frac{2 \times 4 + 4 \times 2}{6} = \frac{16}{6} = \frac{8}{3} \text{ rad/s}$$

$$\text{Rotational kinetic energy} = \frac{1}{2}(I_1 + I_2)\omega^2$$

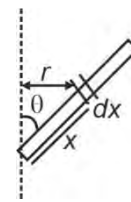
$$= \frac{1}{2} \times 6 \times \frac{64}{9} = \frac{64}{3} \text{ J}$$

28. Answer (3)

Hint: Moment of inertia, $I = \int r^2 dm$

Sol.: $r = x \sin\theta$

$$I = \int r^2 dm = \int_0^L x^2 \sin^2\theta \left(\frac{M}{L}\right) dx$$



$$= \frac{ML^2 \sin^2\theta}{3} = \frac{5 \times 25 \times 3}{4 \times 3} = \frac{125}{4} \text{ kg m}^2$$

29. Answer (4)

Hint: Torque $\vec{\tau} = \vec{r} \times \vec{F}$

Sol.: Torque is an axial vector and its direction is perpendicular to the plane containing \vec{r} & \vec{F} .

$$\vec{\omega}_{A/B} = \vec{\omega}_{B/A} = \vec{\omega}_{\text{body}}$$

Angular velocity is property of entire rigid body.

$$k_{\text{annular disc}} = \sqrt{\frac{1}{2}(R_1^2 + R_2^2)}$$

30. Answer (3)

Hint: Angular impulse = change in angular momentum

Sol.: $\tau t = I\omega - 0$

$$\omega = \frac{\tau t}{I} = \frac{FRt}{I} = \frac{40 \times 1 \times 5}{4} = 50 \text{ rad/s}$$

31. Answer (2)

Hint: $\vec{F}_{\text{net}} = m\vec{a}$

$$\vec{\tau} = \vec{r} \times \vec{F}$$

Sol.: $F_{\text{net}} = -20 + 30 - 10 + 40 - 40 = \text{Zero}$

\therefore No translatory motion.

Taking torque of these forces about centre of mass of the rod,

$$|\vec{\tau}| = 30 \times 10 + 10 \times 10 + 40 \times 50 - (20 \times 30) - (40 \times 30)$$

$$= 2400 - 1800 = 600$$

$\therefore \vec{\tau}_{\text{net}}$ is non-zero

32. Answer (3)

Hint: $I_{xx'} = I_0 + MR^2$ & $M = \lambda L$

Sol.: $I_{xx'} = \frac{1}{2}MR^2 + MR^2 = \frac{3}{2}MR^2$

$$= \frac{3}{2}(\lambda L) \left(\frac{L}{2\pi}\right)^2 = \frac{3\lambda L^3}{8\pi^2}$$

$$= \frac{3 \times 3 \times 10^{-3} \times 8}{8\pi^2} = 9 \times 10^{-4} \text{ kg-m}^2$$

33. Answer (3)

Hint: Torque $\vec{\tau}_{\text{net}} = \frac{d\vec{L}}{dt}$

$$K_{\text{rotational}} = \frac{L^2}{2I}$$

Sol.: $\tau = 0$

$$\frac{dL}{dt} = 0 \Rightarrow L = \text{constant}$$

$$L = I\omega$$

If we decrease its radius, then I decreases

$\Rightarrow \omega$ increases.

$$\& K_r = \frac{L^2}{2I}$$

K_r increases as I decreases

34. Answer (4)

Hint & Sol.: Since the belt does not slide on the pulleys, magnitudes of velocity and acceleration of any point on the belt is same as that of any point on the periphery of either of the two pulleys.

$$a_c = \alpha_A r_A = \alpha_B r_B$$

$$r_A = 0.25 \text{ m}, r_B = 0.5 \text{ m and } \alpha_A = 0.2 \text{ rad/s}^2$$

$$a_c = 0.2 \times 0.25 = 0.05 \text{ m/s}^2$$

$$\alpha_B = \frac{a_c}{r_B} = \frac{0.05}{0.5} = 0.1 \text{ rad/s}^2$$

35. Answer (1)

Hint: Power output, $P = \tau\omega$

Sol.: $P = 200 \text{ H.P}$

$$= 200 \times 746 = 1.492 \times 10^5 \text{ W}$$

& $\omega = 6000 \text{ rev/min} = 628 \text{ rad/s}$

$$\tau = \frac{P}{\omega} = \frac{1.49 \times 10^5}{628} = 237.58 \text{ N-m}$$

36. Answer (3)

Hint: Coefficient of static friction,

$$\mu = \tan\theta$$

$$\text{Sol.} \quad \frac{1}{\sqrt{3}} = \tan\theta$$

$$\theta = \tan^{-1}\left(\frac{1}{\sqrt{3}}\right)$$

$$\theta = 30^\circ$$

37. Answer (2)

Hint: Retardation of block $a = \mu g$

Sol.: Use equation of motion,

$$v^2 = u^2 + 2as$$

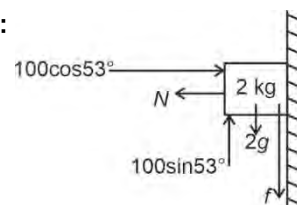
$$0 = u^2 - 2\mu gs$$

$$s = \frac{u^2}{2\mu g} = \frac{4 \times 4}{2 \times 3 \times 10} = \frac{16}{60} = \frac{4}{15} \text{ m}$$

38. Answer (4)

Hint: Net force, $\vec{F}_{\text{net}} = m\vec{a}$

Sol.:



$$N = 100 \cos 53^\circ = 100 \times \frac{3}{5} = 60 \text{ N}$$

If there is no friction, then net vertical force on the block:

$$R' = 100 \sin 53^\circ - mg = 80 - 20 = 60 \text{ N}$$

$$(f_s)_{\text{max}} = \mu_s N = 0.5 \times 60 = 30 \text{ N} < R'$$

\therefore Block moves and kinetic friction acts on it

$$f_k = \mu_k N = 0.4 \times 60 = 24 \text{ N}$$

$$a = \frac{R' - f_k}{m} = \frac{60 - 24}{2} = \frac{36}{2} = 18 \text{ m/s}^2$$

39. Answer (4)

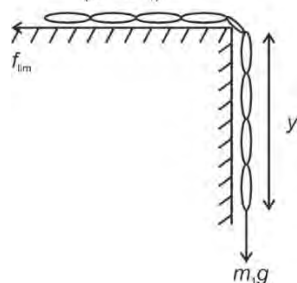
Hint: Force on block, $F = v \frac{dm}{dt}$

Sol.: $F = 5 \times 2 = 10 \text{ N}$

$$\Rightarrow a = \frac{F}{m} = \frac{10}{3} \text{ m/s}^2$$

40. Answer (2)

Hint: At equilibrium, $f_{\text{lim}} = m_1 g$
($M - m_1$)



Sol.: $\mu N = m_1 g$

$$\mu(M - m_1)g = m_1 g$$

$$y = \frac{\mu L}{(1 + \mu)} = \frac{0.1 \times 4}{1.1} = 0.36 \text{ m}$$

41. Answer (1)

Hint: $\tan \theta = \frac{v^2}{rg}$

Sol.: As v increases, θ would also increase to maintain balance. If turn is sharp, then r is small and θ increases.

42. Answer (4)

Hint: Work done, $W = \int_{x_1}^{x_2} F \cdot dx$

$$\begin{aligned} \text{Sol.} \quad W &= \int_2^5 (6 + 2x) dx = (6x + x^2) \Big|_2^5 \\ &= [30 + 25] - [12 + 4] = 55 - 16 = 39 \text{ J} \end{aligned}$$

46. Answer (4)

Hint: C_p and C_v are molar heat capacity at constant pressure and constant volume respectively. These are intensive properties.

Sol.: $C_p - C_v = R$; irrespective of the moles of an ideal gas.

47. Answer (1)

Hint: For irreversible isothermal process,

$$W = -P_2(V_2 - V_1)$$

Sol.: $W = -P_2(V_2 - V_1)$

43. Answer (4)

Hint: Work done by gravity, $W_g = -mg(h_2 - h_1)$

Work done on the ball by all the forces = $\Delta \text{K.E.}$

Sol.: $W_g + W_{\text{air}} = \Delta \text{K.E.}$

$$-mg(h_2 - h_1) + W_{\text{air}} = \frac{1}{2}m(v_2^2 - v_1^2)$$

$$-40 + W_{\text{air}} = -50$$

$$W_{\text{air}} = -10 \text{ J}$$

44. Answer (4)

Hint & Sol: A force is said to be conservative if work done by or against the force in moving a body from one position to another does not depend on path followed between these two positions.

Force of friction is a non-conservative force.

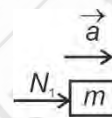
45. Answer (1)

Hint: Net force, $\vec{F}_{\text{net}} = M\vec{a}$

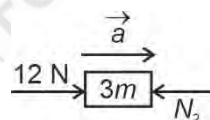
Sol.: Acceleration of the system of three masses = a

$$= \frac{12}{6m} = \frac{2}{m} \text{ m/s}^2$$

$$N_1 = ma = 2 \text{ N}$$



$$12 - N_2 = 3ma$$



$$N_2 = 6 \text{ N}$$

$$\frac{N_1}{N_2} = \frac{1}{3}$$

[CHEMISTRY]

46. Answer (4)

Hint: C_p and C_v are molar heat capacity at constant pressure and constant volume respectively. These are intensive properties.

Sol.: $C_p - C_v = R$; irrespective of the moles of an ideal gas.

47. Answer (1)

Hint: For irreversible isothermal process,

$$W = -P_2(V_2 - V_1)$$

Sol.: $W = -P_2(V_2 - V_1)$

$$= -P_2 \left(\frac{nRT}{P_2} - \frac{nRT}{P_1} \right)$$

$$= -nRT P_2 \left(\frac{1}{P_2} - \frac{1}{P_1} \right)$$

$$= -2 \times 8.314 \times 298 \times 4 \left(\frac{1}{4} - \frac{1}{1} \right) = 14.865 \text{ kJ}$$

48. Answer (4)

Hint: In expansion against vacuum,

$$P_{\text{ext}} = 0$$

Sol.: $\therefore w = -P_{\text{ext}}(\Delta V) = 0$

49. Answer (2)

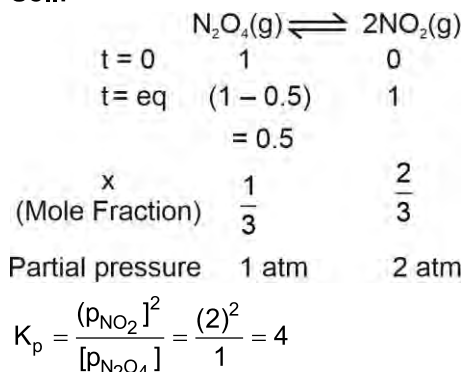
Hint: The functions which depend only on the path of the process are termed as path functions.

Sol.: Only heat and work are path functions.

50. Answer (1)

Hint: $\Delta G^\circ = -RT \ln K$

Sol.:



$$\begin{aligned} \Delta G^\circ &= -RT \ln K \\ &= -2.303 RT \log 4 \\ &= -3.84 \text{ kJ/mol} \end{aligned}$$

51. Answer (2)

Hint: ΔU does not discriminate between reversible and irreversible process, whereas ΔS_{total} does.

Sol.: Both for reversible and irreversible expansion of an ideal gas, under isothermal conditions,

$$\Delta U = 0$$

But $\Delta S_{\text{total}} = 0$, only for reversible process.

52. Answer (2)

Hint: $\Delta_r G^\ominus = \Delta_r H^\ominus - T \Delta_r S^\ominus$

$\Delta_r G^\ominus < 0$; reaction is spontaneous

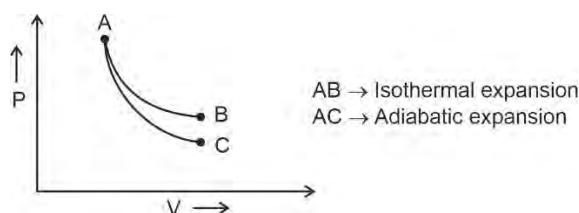
Sol.: $\Delta_r H^\ominus > 0$ and $\Delta_r S^\ominus < 0$

Hence $\Delta_r G^\ominus > 0$ at all temperature

53. Answer (3)

Hint: Cooling takes place upon adiabatic expansion of an ideal gas.

Sol.:

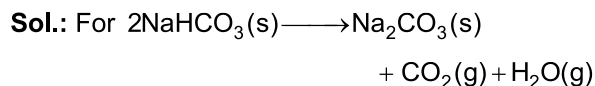


$$\therefore T_A > T_C$$

$$T_A = T_B$$

54. Answer (1)

Hint: Number of moles of gaseous product increases, entropy also increases.



$$\Delta n_g = 2 - 0 = 2$$

55. Answer (2)

Hint: Those properties which do not depend on the quantity or size of matter present are known as intensive properties

Sol.: Heat capacity is an extensive property while temperature is an intensive property.

Element	$\Delta_r H^\ominus / (\text{kJ mol}^{-1})$
S(s), rhombic	0
P(s), white	0

56. Answer (2)

Hint: For free expansion ($P_{\text{ex}} = 0$) $w = 0$

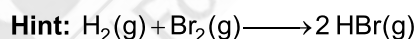
Sol.: For adiabatic process

$$q = 0.$$

$$\Delta U = q + w$$

$$\Delta U = 0$$

57. Answer (3)



$$\Delta_r H = \sum B.E_{\text{reactants}} - \sum B.E_{\text{products}}$$

Sol.: $-109 = B.E_{\text{H}_2} + B.E_{\text{Br}_2} - 2 \times B.E_{\text{HBr}}$

$$-109 = x + 192 - 2(368)$$

$$-109 + 2(368) = x + 192$$

$$736 - 109 = x + 192$$

$$627 = x + 192$$

$$627 - 192 = x$$

$$435 = x$$

58. Answer (1)

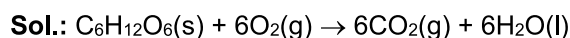
Hint: $\Delta S = nR \ln \frac{P_1}{P_2}$

Sol.: $\Delta S = 1 \times 8.314 \times 2.303 \log 2$

$$= 5.74 \text{ J K}^{-1} \text{ mol}^{-1}$$

59. Answer (4)

Hint: Due to better alignment of polymers, upon stretching of rubber entropy decreases.



$$\Delta_c H^\ominus = 6 \times (-400) + 6 \times (-300) - (-1300)$$

$$= -2900 \text{ kJ mol}^{-1}$$

Combustion of 180 gm of glucose, heat released

$$\text{is} = \frac{2900}{18} = 16.11 \text{ kJ g}^{-1}$$

60. Answer (3)

Hint: $\gamma = \frac{C_p}{C_v}$

Sol.: For diatomic gas,

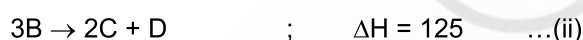
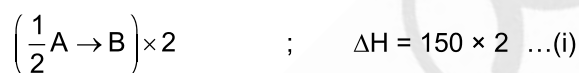
$$C_p = \frac{7}{2}R$$

$$C_v = \frac{5}{2}R$$

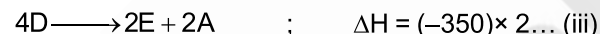
$$\gamma = \frac{C_p}{C_v} = 1.40$$

61. Answer (3)

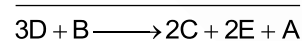
Hint & Sol.:



Reverse of $E + A \rightarrow 2D$ and multiplying by 2 we get



add eq. (i), (ii) and (iii) we get

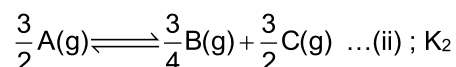
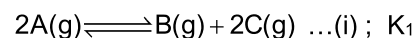


$$\therefore \Delta H = 300 + 125 - 350 \times 2$$

$$= 425 - 700 = -275 \text{ kJ mol}^{-1}$$

62. Answer (4)

Hint & Sol.:



Equation (ii) is $\frac{3}{4}$ times of equation (i)

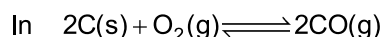
$$\therefore K_2 = (K_1)^{\frac{3}{4}}$$

63. Answer (2)

Hint: $K_p = K_c(RT)^{\Delta n_g}$

Sol.: For $K_p = K_c$

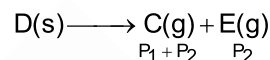
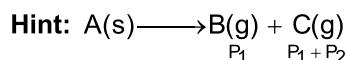
$$\therefore \Delta n_g = 0$$



$$\Delta n_g \neq 0$$

$$\therefore K_p \neq K_c$$

64. Answer (4)



Sol.: $x = (P_1) (P_1 + P_2)$

$$y = (P_2) (P_1 + P_2)$$

$$P_T = P_C + P_B + P_E$$

$$= P_1 + P_2 + P_1 + P_2 = 2(P_1 + P_2)$$

$$x + y = P_1^2 + P_1P_2 + P_2^2 + P_1P_2$$

$$x + y = (P_1 + P_2)^2$$

$$\therefore \boxed{2\sqrt{x+y} = P_T}$$

65. Answer (1)



$$Q_c = \frac{[B][C]}{[A]^2} = \frac{(2)(2)}{\left(\frac{1}{2}\right)^2} = \frac{4}{\frac{1}{4}} = 4 \times 4 = 16$$

Sol.: $\log K_c = \frac{-\Delta G^\ominus}{2.303 \times RT} = \frac{-2500}{2.303 \times 8.314 \times 300}$

$$= -\frac{2500}{5744} = -0.436$$

$$K_c = 0.36$$

Since $Q_c > K_c$; Backward direction

66. Answer (1)

Hint & Sol.:

Volumes increases, number of moles decreases then

\therefore Reaction shifts to a direction where number of gaseous moles increase

67. Answer (2)

Hint: Change in concentration of solid compounds do not affect the equilibrium

Sol.: No change in equilibrium is observed upon addition of an inert gas at constant volume because there is no change the partial pressure or the molar concentration of the substance involved in the reaction.

68. Answer (3)

Hint & Sol.: Volume gets halved and pressure gets doubled.So to keep K_p constant, α decreases.

69. Answer (2)

Hint & Sol.: $H_2C_2O_4$ reacts with Fe^{3+} ions to form a stable complex $[Fe(C_2O_4)_3]^{3-}$ and $HgCl_2$ reacts with SCN^- ions to form $[Hg(SCN)_4]^{2-}$ and shifts reactions in backward direction.

70. Answer (2)

Hint: According to Bronsted-Lowry theory, acid is a substance that is capable of donating a hydrogen ion H^+ only.**Sol.:** Conjugate base of $HN_3 = N_3^-$

71. Answer (4)

Hint: Bronsted bases are capable of accepting of proton**Sol.:** Bronsted base are $C_2O_4^{2-}$ and PO_4^{3-}

72. Answer (4)

Hint: $\Delta G = \Delta H - T\Delta S$ **Sol.:** $\Delta H = \Delta U + \Delta n_g RT$

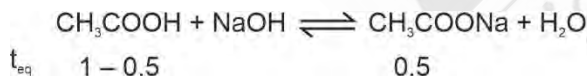
$$\Delta H = 1.1 + \frac{2 \times 8.314 \times 300}{1000}$$

$$= 1.1 + 4.98 = 6.08 \text{ kJ}$$

$$\Delta G = 6.08 - \frac{300 \times 11}{1000}$$

$$= 6.08 - 3.3 = 2.78 \text{ kJ}$$

73. Answer (4)

Hint: Solution of weak acid with its salt of strong base is an acidic buffer**Sol.:**

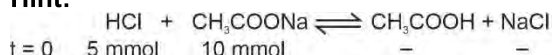
$$t_{eq} \quad 1 - 0.5$$

$$0.5$$

$$pH = pK_a + \log \frac{[Salt]}{[Acid]}$$

$$pH = pK_a$$

74. Answer (1)

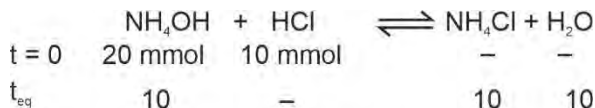
Hint:

$$t = 0 \quad 5 \text{ mmol} \quad 10 \text{ mmol} \quad - \quad -$$

$$t_{eq} \quad - \quad 5 \text{ mmol} \quad 5 \text{ mmol} \quad 5 \text{ mmol}$$

$$pH = pK_a + \log \frac{[Salt]}{[Acid]}$$

$$pH = 4.76, \text{ acidic buffer}$$

Sol.:

$$t = 0 \quad 20 \text{ mmol} \quad 10 \text{ mmol} \quad - \quad -$$

$$t_{eq} \quad 10 \quad - \quad 10 \quad 10$$

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

$$= 4.75, \text{ basic buffer}$$

75. Answer (3)

$$\text{Hint \& Sol.}: K_a = \frac{[H^+][A^-]}{[HA]}$$

$$10^{-5} = \frac{[H^+][3HA]}{[HA]} ; [H^+] = 3.3 \times 10^{-6}$$

$$pH = -\log(3.3 \times 10^{-6}) = 5.48$$

76. Answer (4)

Hint: Salt of strong base and weak acid is basic in nature.**Sol.:** Calcium cyanide is a salt of strong base and weak acid.

77. Answer (1)

$$\text{Hint : } C_m = \frac{q}{n\Delta T}$$

$$\text{Sol: } q = \frac{24 \times 54}{27} \times 20 = 960 \text{ J}$$

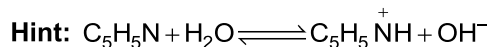
78. Answer (4)

Hint & Sol: pH for the salt of weak acid and weak base :

$$pH = 7 + \frac{pK_a}{2} - \frac{pK_b}{2}$$

$$= 7 + \frac{4.77}{2} - \frac{3.27}{2} = 7.75$$

79. Answer (2)



$$\text{Sol. : } \alpha = \sqrt{\frac{K_b}{C}}$$

$$= \sqrt{\frac{1.7}{2} \times 10^{-8}}$$

$$\alpha = 0.92 \times 10^{-4}$$

$$\% \alpha = 0.0092\%$$

80. Answer (4)

Hint & Sol.: For a polyprotic acid, it is more difficult to remove a positively charged proton from a negative ion.

81. Answer (1)

$$\text{Hint: } \text{pOH} = \text{pK}_b + \log \frac{[\text{NH}_4^+]}{[\text{NH}_3]}$$

$$\text{Sol.: } \text{pH} + \text{pOH} = 14$$

$$\text{pOH} = 14 - 8.26 = 5.74$$

$$5.74 = 4.74 + \log \frac{[\text{NH}_4^+]}{0.2}$$

$$[\text{NH}_4^+] = 2 \text{ M}$$

Moles of $\text{NH}_4\text{Cl} = 2$ molesAmount = $2 \times 53.5 \text{ g mol}^{-1} = 107 \text{ g}$

82. Answer (2)

Hint: Higher the solubility, lower will be the precipitation

$$\text{Sol.: } K_{\text{sp}} [\text{AgI}] = [\text{Ag}^+] [\text{I}^-]$$

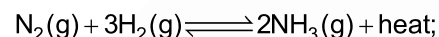
$$[\text{I}^-] = 8.5 \times 10^{-16} \text{ M}$$

$$K_{\text{sp}} [\text{Hg}_2\text{I}_2] = [[\text{Hg}_2^{2+}] [\text{I}^-]^2]$$

$$[\text{I}^-] = 5 \times 10^{-13} \text{ M}$$

 $[\text{I}^-]$ for AgI is smaller than for Hg_2I_2
 \therefore At $5 \times 10^{-13} \text{ M}$ almost complete precipitation of AgI takes place

83. Answer (2)

Hint : An acid is a species which accepts electron pair.**Sol.:** BF_3 is a Lewis acid but CH_4 is not a Lewis acid

The equilibrium shift in backward direction by increasing temperature.

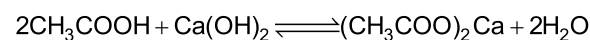
84. Answer (1)

Hint & Sol.: NaCl won't undergo hydrolysis as both ions comes from strong acid and strong base. Hence, the solution will be neutral

85. Answer (4)

Hint & Sol.: Cations which react with water to give weak base undergo cationic hydrolysis

86. Answer (2)

Hint:

$$[\text{CH}_3\text{COO}^-] = 2 \times 0.05 = 0.1$$

Sol.:

$$\text{pH} = 7 + \frac{\text{pK}_a}{2} + \frac{\log C}{2}$$

$$= 7 + \frac{4.74}{2} + \frac{1}{2} \log(10^{-1})$$

$$\text{pH} = 7 + 2.37 - 0.5 = 8.87$$

87. Answer (3)

Hint

$$\text{Sol.: } K_h = \frac{K_w}{K_b}$$

$$10^{-14} = 5.5 \times 10^{-10} \times K_b$$

$$K_b = \frac{10^{-14}}{5.5 \times 10^{-10}}$$

$$= 0.18 \times 10^{-4} = 1.8 \times 10^{-5}$$

88. Answer (3)

$$\text{Hint: For HCN, } h = \sqrt{\frac{K_h}{C}}$$

$$\text{Sol.: } \text{pH} = 7 + \frac{1}{2} [\text{pK}_a + \log C]$$

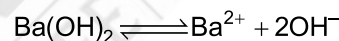
89. Answer (2)



$$\text{pH} = 11$$

$$\text{pOH} = 3$$

$$[\text{OH}^-] = 10^{-3}$$

Sol.:

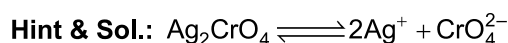
$$\frac{10^{-3}}{2} \quad \quad \quad 10^{-3}$$

$$K_{\text{sp}} = 0.5 \times 10^{-3} \times 10^{-6}$$

$$= 0.5 \times 10^{-9}$$

$$= 5 \times 10^{-10}$$

90. Answer (1)



Solubility higher, lower will be the precipitation.

Order of solubility is

 $\text{AgI} < \text{AgBr} < \text{AgCl} < \text{Ag}_2\text{CrO}_4$ **[BOTANY]**

91. Answer (2)

Hint: Basidiomycetes, produce sexual spores exogenously**Sol.:** *Agaricus* belongs to basidiomycetes.

92. Answer (3)

Hint: Two kingdom classification was given by C. Linnaeus.**Sol.:** Five kingdom classification was given by R.H Whittaker.

93. Answer (3)
Hint: Methanogens are responsible for production of biogas.
Sol.: Archaeobacteria differ from other bacteria in having a different cell wall structure. Methanogens are capable of converting CO₂, methanol and formic acid into methane.
94. Answer (3)
Hint: Mycoplasma is the smallest living cell.
Sol.: Mycoplasma do not have cell wall. Cell membranes are not made of peptidoglycan.
95. Answer (4)
Hint: Deuteromycetes are also known as imperfect fungi.
Sol.: *Agaricus* (Mushroom) belongs to basidiomycetes.
96. Answer (2)
Hint: Viruses — Mosaic formation in plants
Sol.: Bacteria — Citrus canker
 Viroids — Potato spindle tuber disease
 Prions — Mad cow disease in cattle
97. Answer (1)
Hint: Viruses are non-cellular organisms.
Sol.: Viruses did not find a place in classification since they are not considered truly 'living'.
98. Answer (3)
Hint: Cyanobacteria have chlorophyll a similar to higher plants.
Sol.: Euglenoids have pigments identical to higher plants. Except chlorophyll a, other pigments of cyanobacteria differ from higher plants.
99. Answer (2)
Hint: The given diagram is of *Paramecium*.
Sol.: *Paramecium* possess cilia instead of pseudopodia. Dinoflagellates possess cell wall having cellulose plates on the outer surface.
100. Answer (1)
Hint: Asexual spores are generally not found in the members of basidiomycetes.
Sol.: Asexual spores found in *Penicillium* is conidia. Zygosporangium is a sexual spore and it is formed by fusion of gametes.
101. Answer (1)
Hint: Yeast belongs to Ascomycetes.
Sol.: Yeast unicellular member of ascomycetes and do not form ascocarp. Dinoflagellates are mostly marine.
102. Answer (1)
Hint: In racemose type of inflorescence, the main axis continues to grow.
Sol.: Belladonna shows cymose inflorescence rest all of the examples showing racemose inflorescence.
103. Answer (4)
Hint: Members of Solanaceae have actinomorphic flowers.
Sol.: Ashwagandha being Solanaceae member has actinomorphic flowers.
104. Answer (2)
Hint: Root hairs are present in the zone of maturation
Sol.: Some cells from the region of maturation form very fine and delicate thread like structures called root hair.
105. Answer (3)
Hint: Sunflower and China rose show alternate phyllotaxy.
Sol.: Opposite phyllotaxy is seen in *Calotropis*.
106. Answer (3)
Hint: This type of aestivation is found in *Cassia*.
Sol.: In imbricate aestivation, margin of petals or sepals overlap each other but not in a particular direction.
107. Answer (1)
Hint:
 • Monoadelphous stamens — China rose
Sol.:
 • Diadelphous stamens – Pea
 • Polyadelphous stamens – Citrus
 • Polyandrous stamens – Mustard
108. Answer (3)
Hint: *Aspergillus* being a sac fungus has septate hyphae.
Sol.: *Mucor* – produce sexual spores by meiosis.
Colletotrichum – Lacks sexual reproduction and fruiting bodies, it asexually reproduce by conidia.
 Puffballs – Lacks asexual reproduction
109. Answer (3)
Hint: Fumigatory plant, tobacco is included in Solanaceae family.
Sol.: Fruit type is capsule or berry. They have five sepals that are persistent.
110. Answer (3)
Hint: Phyllotaxy is the pattern of leaves on stem
Sol.: The arrangement of veins and veinlets in the lamina or leaf blade is termed as venation.

111. Answer (4)

Hint: Root provides anchorage to the plant parts.

Sol.: Stem bears and support leaves, flowers and fruits.

112. Answer (3)

Hint: Mustard is a member of Brassicaceae while *Solanum* is a member of Solanaceae family.

Sol.:

Features	Mustard	<i>Solanum</i>
Phyllotaxy	Alternate	Alternate
Floral symmetry	Actinomorphic	Actinomorphic
Type of flower based on position of gynoecium	Hypogynous	Hypogynous
Type of placentation	Parietal	Axile

In mustard stamens have different length of filaments.

113. Answer (4)

Hint: In basal placentation, the placenta develops at the base of the ovary

Sol.: Marigold have basal placentation.

114. Answer (3)

Hint: In mango and coconut, the fruit is known as a drupe

Sol.: Mango and coconut develop from monocarpellary superior ovaries.

115. Answer (2)

Hint: In epipetalous condition stamens are attached to petals.

Sol.: $\overset{C}{\curvearrowright} A$ represents epipetalous stamens.

116. Answer (2)

Hint: Dinoflagellates are mostly marine and photosynthetic

Sol.: The cell wall of dinoflagellates has stiff cellulose plates on the outer surface.

117. Answer (2)

Hint: Kingdom Plantae show autotrophic mode of nutrition.

Sol.: Multicellular organism with loose tissue organisation having heterotrophic mode of nutrition is fungi.

118. Answer (3)

Hint: *Agaricus* (mushroom) is an edible fungi

Sol.: *Ustilago* and *Puccinia* are smut and rust fungi respectively.

119. Answer (4)

Hint: Sexual reproduction occurs by ascospores in ascomycetes class of fungi.

Sol.: Asexual reproduction in fungi occurs by asexual spores called conidia or sporangiospores.

120. Answer (3)

Hint: Viruses are inert outside their specific host cell.

Sol.: W.M. Stanley showed that viruses could be crystallised and crystals consist largely of protein. Viruses are obligate parasites.

121. Answer (3)

Hint: Epiphyllous condition of stamens is found in members of Liliaceae.

Sol.: When stamens are attached to the petals, they are called epipetalous as in brinjal or epiphyllous when attached to the perianth as in flower of lily.

122. Answer (1)

Hint: Pea is a leguminous plant.

Sol.: Leaf base becomes swollen in Pea Tricarpellary and syncarpous gynoecium – (*Asparagus*)

Presence of persistent sepal – Ashwagandha
Parietal placentation – *Argemone*

123. Answer (2)

Hint: The seed coat has two layers, the outer testa and inner tegmen

Sol.: A large shield shaped cotyledon found in maize seeds is known as scutellum. Above the hilum is a small pore called the micropyle.

124. Answer (1)

Hint: In non-endospermic seed, endosperm is not present in the mature seed

Sol.: Pea, Bean and Gram are examples of non-endospermic seeds.

125. Answer (2)

Hint: Marginal placentation is seen in pea

Sol.: Axile placentation is seen in China rose, tomato and lemon. *Primrose* has free central placentation.

126. Answer (4)

Hint: Spine is a modification of leaf.

Sol.: Spines in cactus are modified leaves.

127. Answer (4)

Hint: Mustard belongs to Brassicaceae family while China rose belongs to malvaceae family

Sol.:

	Feature	Mustard	China Rose
a.	Placentation	Parietal	Axile
b.	Floral symmetry	Actinomorphic	Actinomorphic
c.	Adhesion of stamen	Free stamens	Epipetalous
d.	Aestivation of corolla	Valvate	Twisted
e.	Union of carpels	Syncarpous	Syncarpous
f.	Type of fruit	Siliqua	Capsule
g.	Number of carpels	Two	Five

128. Answer (3)

Hint: Heterotrophic bacteria are helpful in making curd from milk and fixing nitrogen in legume**Sol.:** Some of cyanobacteria can fix atmospheric nitrogen in specialised cells called heterocysts. They lack flagella.

129. Answer (3)

Hint: Six Kingdom classification was given by Carl Woese**Sol.:** In six Kingdom classification, kingdom fungi and animalia have organisms with heterotrophic mode of nutrition only.

130. Answer (2)

Hint: T.O. Diener discovered a new infectious agent that was smaller than viruses known as viroid.**Sol.:** Pseudopodia are locomotory and feeding structure in amoeboid protozoans.

131. Answer (2)

Hint: Hypogynous flowers have superior ovary.**Sol.:** Plum, peach and rose – Half inferior ovary
Guava, cucumber, ray florets of sunflower – Inferior ovary. Rest all have superior ovary.

132. Answer (2)

Hint: Bicarpellary and bilocular ovary is seen in the members of solanaceae family**Sol.:** Epipetalous stamens and axile placentation are seen in tomato.

133. Answer (2)

Hint: Testa is the outer protective covering of seed**Sol.:** Coleoptile is a sheath enclosing plumule in monocot seed. The outer covering of endosperm separates the embryo by a proteinaceous layer called aleurone layer.

134. Answer (3)

Hint: *Entamoeba* is an amoeboid protozoan.**Sol.:** Amoeboid protozoans have pseudopodia for movement and capturing the prey. Marine forms of amoeboid protozoans have silica shells on their surface.

135. Answer (3)

Hint: A bud is present in the axil of petiole in both simple and compound leaf**Sol.:** In pinnately compound leaves, a number of leaflets are present on rachis.

[ZOOLOGY]

136. Answer (4)

Hint: Secretion of sebaceous gland**Sol.:** Sweat produced by the sweat glands is a watery fluid containing NaCl, small amounts of urea, lactic acid, etc. Though the primary function of sweat is to facilitate a cooling effect on body surface, it also helps to remove some of the wastes.

Sebaceous glands eliminate certain substances like sterols, hydrocarbons and waxes through sebum.

137. Answer (1)

Hint: Close proximity between Henle's loop and vasa recta**Sol.:** NaCl transported by the ascending limb of Henle's loop is exchanged with the descending limb of vasa recta. NaCl is returned to the interstitium by the ascending portion of vasa recta. The proximity between Henle's loop and vasa recta as well as counter current in them help in maintaining an increasing osmolarity towards inner medullaryinterstitium *i.e.*, from 300 mOsmol L⁻¹ to 1200 mOsmol L⁻¹. This gradient is mainly caused by NaCl and urea.

138. Answer (1)

Hint: The ascending limb is impermeable to water**Sol.:** The ascending limb of loop of Henle is impermeable to water but allows transport of electrolytes actively or passively. Therefore, as the concentrated filtrate pass upward, it gets diluted due to the passage of electrolytes to the medullary fluid.

139. Answer (3)

Hint: Renin stimulates glomerular blood flow**Sol.:** A fall in GFR can activate JG cells to release renin which converts angiotensinogen in blood to angiotensin I and further to angiotensin II. Angiotensin II, being a powerful vasoconstrictor, increases the glomerular blood pressure and thereby bring the GFR back to normal.

140. Answer (3)

Hint: Glomerular filtrate is proteinless plasma

Sol.: Blood is filtered so finely through filtration slits that almost all the constituents of the plasma except the proteins pass onto the lumen of the Bowman's capsule. Therefore, it is considered as a process of ultra filtration.

Globulins and fibrinogens are proteins.

141. Answer (1)

Hint: 70-80 per cent of electrolytes and water are reabsorbed by PCT.

Sol.: Glomerular filtrate in PCT is isotonic to blood plasma. Nearly all of the essential nutrients and 70-80 per cent of electrolytes and water are reabsorbed by this segment. Fluid present in descending limb of loop of Henle is hypertonic to the blood plasma.

142. Answer (2)

Hint: Concentrating segment.

Sol.: The ascending limb of loop of Henle is impermeable to water but allows transport of electrolytes actively or passively. Descending limb of loop of Henle is almost impermeable to electrolytes. Counter current mechanism operates in Henle's loop and vasa recta. DCT has hypotonic glomerular filtrate with respect to blood plasma. The epithelial cells of Bowman's capsule called podocytes are arranged in an intricate manner.

143. Answer (3)

Hint: Broad funnel shaped space

Sol.: The DCTs of many nephrons join to form a common collecting duct many of which converge and ultimately open into the renal pelvis through the medullary pyramids in the calyces. Inside the kidney, there are two zones, an outer cortex and an inner medulla. In humans, the excretory system consists of one pair of kidneys, a pair of ureters, a urinary bladder and a urethra. Renal columns are invagination of cortex into medulla.

144. Answer (2)

Hint: Part of nephron present in cortex of kidney

Sol.: Conditional reabsorption of Na^+ and water takes place in DCT. DCT is also capable of reabsorption of HCO_3^- and selective secretion of hydrogen and potassium ions and NH_3 to maintain the pH and sodium-potassium balance in blood.

145. Answer (1)

Hint: Osmolarity increases from renal cortex to renal medulla.

Sol.: The flow of filtrate in the two limbs of Henle's loop and vasa recta is in opposite direction and thus forms a counter current. The flow of blood through the two limbs of vasa recta is also in a counter current pattern. The proximity between the Henle's loop and vasa recta, as well as the counter current in them help in maintaining an increasing osmolarity towards the inner medullary interstitium.

146. Answer (2)

Hint: Counter current mechanism becomes impaired.

Sol.: Loop of Henle, along with vasa recta of juxtamedullary nephrons participates in counter current mechanism that leads to creation of concentration gradient in the medullary interstitium. So, more dilute urine will be produced upon removal of loop of Henle as less water is reabsorbed

147. Answer (3)

Hint: Exclude conditions associated with diabetes mellitus.

Sol.: Presence of glucose (glycosuria) and ketone bodies (ketonuria) in urine are indicative of diabetes mellitus. Malfunctioning of kidneys can lead to accumulation of urea in blood, a condition called uremia. An impairment affecting synthesis or release of ADH results in a diminished ability of the kidney to conserve water leading to water loss and dehydration (diuresis).

148. Answer (3)

Hint: Insects have Malpighian tubules.

Sol.: • Protonephridia or flame cells are excretory structures in platyhelminths. (Flatworms e.g. *Planaria*)

- Nephridia are tubular excretory structures of earthworms (*Pheretima*) and other annelids.
- Malpighian tubules are the excretory structures of most of the insects including cockroaches (*Periplaneta*).
- Antennal glands or green glands perform the excretory function in crustaceans like prawns (*Palaemon*).

149. Answer (2)

Hint: Blood vessel which carries blood away from heart.

Sol.: During the process of haemodialysis, the blood drained from a convenient artery is pumped into a dialysing unit called artificial kidney. Blood drained from convenient artery is pumped into a dialysing unit after adding an anticoagulant like heparin.

150. Answer (1)

Hint: Least toxic form of nitrogenous waste

Sol.: Land snails-Uricotelic.

Mammals, many terrestrial amphibians and marine fishes mainly excrete urea, hence are ureotelic animals.

151. Answer (1)

Hint: $\text{VC} = \text{ERV} + \text{TV} + \text{IRV}$

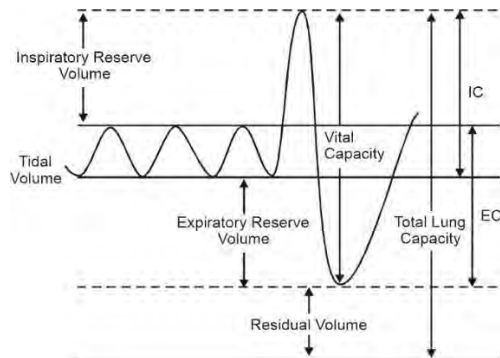
Sol.: $EC = TV + ERV$

$EC = FRC - RV + TV$

$TLC = RV + ERV + TV + IRV$

$VC = ERV + TV + IRV$

$IC = IRV + TV$



152. Answer (1)

Hint: Intra-pulmonary pressure is less than atmospheric pressure.

Sol.: Inspiration can occur if the pressure within the lungs *i.e.* intra-pulmonary pressure is less than the atmospheric pressure *i.e.*, there is a negative pressure in the lungs with respect to atmospheric pressure.

153. Answer (2)

Hint: Respiratory minute volume = Breathing rate \times tidal volume.

Sol.: A healthy human breathes 12-16 times/min in resting conditions. Tidal volume is approximately 500 mL.

$$\begin{aligned} \text{So, Respiratory minute volume (RMV)} &= \text{TV} \times \text{Respiratory rate} \\ &= 500 \times (12-16) \\ &= 6000-8000 \text{ mL per minute} \end{aligned}$$

Inspiratory reserve volume = 2500-3000 mL

Expiratory reserve volume = 1000-1100 mL

Residual volume = 1100-1200 mL

154. Answer (3)

Hint: Dome shaped structure

Sol.: Normal expiration is a passive process as relaxation of muscle occurs. The thoracic chamber is formed dorsally by vertebral column, ventrally by sternum, laterally by ribs and on the lower side by dome-shaped diaphragm.

155. Answer (4)

Hint: Spirometer do not measure residual volume

Sol.: The volume of air involved in breathing movements can be estimated by using a spirometer which helps in clinical assessment of pulmonary function. FRC, TLC and RV cannot be measured with the help of a simple spirometer.

156. Answer (4)

Hint: Carbonic anhydrase

Sol.: Enzyme 'X' is carbonic anhydrase which belongs to class IV category of enzymes. Carbonic anhydrase accelerates the reaction rate by about 10 million times. Carbonic anhydrase facilitates reaction in forward direction in tissue due to high $p\text{CO}_2$, low $p\text{O}_2$ and more H^+ . Reaction moves in backward direction at alveoli due to high $p\text{O}_2$, low $p\text{CO}_2$ and less H^+ . Carbonic anhydrase is not present in WBCs.

157. Answer (1)

Hint: Incomplete cartilaginous rings are absent in exchange part.

Sol.: The trachea, primary, secondary and tertiary bronchi and initial bronchioles are supported by incomplete cartilaginous rings. These are absent in terminal bronchioles, alveoli and their ducts (alveolar ducts).

158. Answer (1)

Hint: Inspiration and expiration is included in breathing

Sol.: Breathing involves two stages: inspiration of O_2 rich atmospheric air and expiration of CO_2 rich alveolar air.

Cellular respiration is defined as oxidation of food to form CO_2 , H_2O and energy.

159. Answer (1)

Hint: Venous blood is the deoxygenated blood.

Sol.: Venous blood has more CO_2 and more H^+ which leads to low pH as compared to arterial blood. Pulmonary vein carries oxygenated blood.

160. Answer (1)

Hint: Nasal chamber opens into pharynx

Sol.: The nasal chamber opens into the pharynx, a portion of which is the common passage for food and air. The pharynx opens through the larynx region into the trachea. Trachea divides at the level of 5th thoracic vertebra into a right and left primary bronchi. Each bronchi undergoes repeated division to form the secondary and tertiary bronchi and initial bronchioles ending up in very thin terminal bronchioles. Each terminal bronchiole gives rise to a number of very thin irregular-walled and vascularised bag-like structures called alveoli.

161. Answer (3)

Hint: Medulla oblongata regulates respiration.

Sol.: Aortic arch and carotid artery are peripheral chemoreceptors for regulation of breathing. They can recognise change in CO_2 and H^+ concentration and send necessary signals to the rhythm centre (Medulla oblongata).

162. Answer (2)

Hint: Observed during forceful expiration.

Sol.: Inspiration is initiated by the contraction of diaphragm which increases the volume of thoracic chamber in the antero-posterior axis. The contraction of external inter-costal muscles causes an increase in the volume of the thoracic chamber. We have the ability to increase the strength of inspiration and expiration with the help of additional muscles in abdomen. Contraction of internal inter-costal muscles occur during forceful expiration.

163. Answer (1)

Hint: Collects deoxygenated blood from upper parts of the body

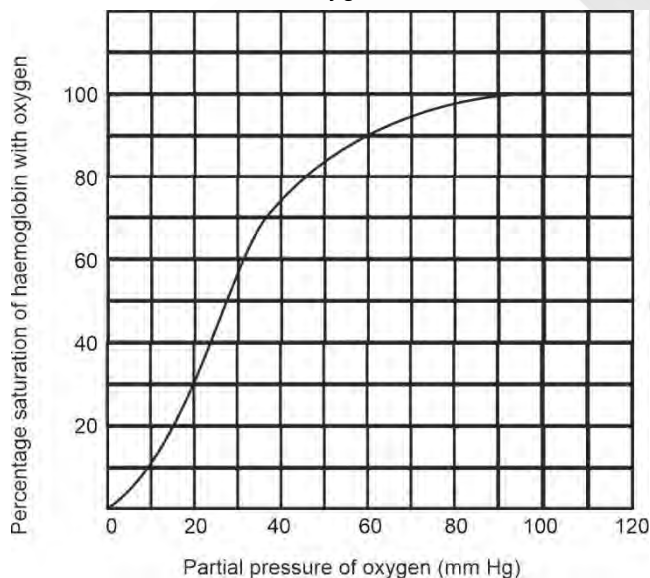
Sol.: Superior vena cava and inferior vena cava carry deoxygenated blood.

Respiratory Gas	Atmospheric Air	Alveoli	Blood (Deoxy-genated)	Blood (Oxygenated)	Tissues
O ₂	159	104	40	95	40
CO ₂	0.3	40	45	40	45

164. Answer (1)

Hint: Numerical value of urea excreted out per day.

Sol.: The partial pressure of oxygen is approximately 25-30 mm Hg when haemoglobin is 50% saturated with oxygen.



165. Answer (1)

Hint: Higher pCO₂ dissociates oxyhaemoglobin

Sol.: A sigmoid curve is obtained when percentage saturation of haemoglobin with O₂ is plotted against the pO₂. This curve is called the

oxygen dissociation curve. At the tissue site where low pO₂, high pCO₂, high H⁺ concentration and higher temperature exist, the conditions are favourable for dissociation of oxygen from the oxyhaemoglobin.

166. Answer (4)

Hint: It is more than 10

Sol.: A healthy human breathes 12-16 times per minute.

- A healthy individual has 12-16 gms of haemoglobin in every 100mL of blood.
- Neutrophils are the most abundant cell (60-65 per cent) of the total WBCs.
- Monocytes are 6-8 per cent of the total WBCs.
- 90-92 per cent of plasma is water and proteins contribute 6-8 per cent of it.

167. Answer (4)

Hint: CO₂ is more soluble than O₂

Sol.: Exchange of O₂ and CO₂ between blood and tissues is mainly based on pressure/concentration gradient.

Solubility of gases as well as the thickness of membranes involved in diffusion are some of the important factors that affect rate of diffusion of gases.

168. Answer (4)

Hint: Leucocytes have short life span

Sol.: In healthy human, heart rate is 72 times per 60 sec. If we reverse the ratio, we will get duration of cardiac cycle. Eosinophils (2-3 per cent) resist infections and they have bilobed nucleus. Leucocytes are also known as white blood cells (WBCs).

Leucocytes are generally short lived.

169. Answer (1)

Hint: Cardiac output = heart rate × stroke volume

Sol.: Stroke volume = end diastolic volume – end systolic volume

$$= 150 \text{ mL} - 50 \text{ mL}$$

$$\text{Stroke volume} = 100 \text{ mL}$$

Cardiac output = heart rate × stroke volume

$$\text{Heart rate} = \frac{\text{Cardiac output}}{\text{Stroke volume}} = \frac{7200 \text{ mL}}{100 \text{ mL}}$$

Heart rate = 72 beats per minute

170. Answer (1)

Hint: Pulmonary vein has oxygenated blood

Sol.: Tunica media is thicker in arteries as compared to veins, so their lumen is narrower. In arteries, blood flows always away from heart while in vein it flows towards the heart.

171. Answer (4)

Hint: Secreted from mast cells.

Sol.: Certain factors released by the tissue, at the site of injury can initiate coagulation. Ca^{+2} , fibrinogen and prothrombin are involved in the cascade that leads to blood clotting. Serotonin is a vasoconstrictor.

172. Answer (2)

Hint: Type of connective tissue

Sol.: The atrium and the ventricle of the same side are separated by a thick fibrous tissue called the atrio-ventricular septum. A thin, muscular wall called the inter-atrial septum separates the right and left atria.

173. Answer (1)

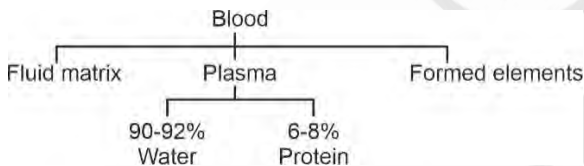
Hint: Universal recipient

Sol.: Persons with AB^{+ve} blood group do not have anti-A and anti-B antibodies in their plasma. They have A, B and Rh antigens on the RBC surface. Rh antigen will be absent on the RBCs of a AB^{-ve} individual.

174. Answer (1)

Hint: Fights pathogen

Sol.: Plasma without clotting factors is called serum.



Thus, formed elements do not constitute plasma.

175. Answer (4)

Hint: Smooth muscle fibres taper at the both ends

Sol.: Human heart has four chambers, two relatively small upper chambers called atria and two larger lower chambers called ventricles. A specialised cardiac musculature called the nodal tissue is also distributed in the heart.

Heart has cardiac muscle fibres.

Organ that stores urine is urinary bladder and it has smooth muscle fibres.

Cardiac muscle fibres	Smooth muscle fibres
• Branched	• Unbranched
• Cylindrical	• Fusiform
• Striated	• Non-striated

176. Answer (2)

Hint: First heart sound is produced at the beginning of ventricular systole.

Sol.: Lub is first heart sound which is associated with closure of atrio-ventricular valves. Dub is second heart sound which is associated with closure of semilunar valves. Increased blood flow into ventricles by about 30 per cent occurs during the atrial systole.

177. Answer (4)

Hint: Left ventricle pumps blood into aorta

Sol.: Blood pressure is high in arteries as compared to vein. A special coronary system of blood vessels is present in our body exclusively for the circulation of blood to and from the cardiac musculature.

178. Answer (3)

Hint: Angina is acute chest pain.

Sol.:

- Coronary artery disease, often referred to as atherosclerosis, affect the vessels that supply blood to the heart muscle.
- Angina is also called angina pectoris. A symptom of acute chest pain appears when not enough oxygen is reaching the heart muscle.
- Heart failure is sometimes called congestive heart failure because congestion of lungs is one of the main symptoms of this disease.
- In cardiac arrest, heart stops beating.

179. Answer (1)

Hint: Cardiac output = heart rate × stroke volume

Sol.: Athletes due to continuous training, have greater stroke volume than that of ordinary individuals. Human can alter the stroke volume and cardiac output. Athletes have higher stroke volume to maintain normal cardiac output. If repeated checks of blood pressure of an individual is 140/90 mm Hg or higher, it shows hypertension. Atherosclerosis affects the vessels that supply blood to the heart.

180. Answer (3)

Hint: Each artery and vein consists of three layers

Sol.: Basically, each artery and vein consists of three layers. Inner lining, the tunica intima, a middle layer tunica media and external layer tunica externa. The tunica media is comparatively thin in the veins. Pulmonary veins carries oxygenated blood while pulmonary artery carries deoxygenated blood. Partial pressure of O₂ in the pulmonary vein is 95 mm Hg.



All India Aakash Test Series for NEET - 2026

TEST - 5 (Code-B)[Click here for Code-A Sol.](#)

Test Date : 28/12/2025

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

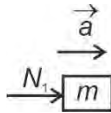
1. Answer (1)

Hint: Net force, $\vec{F}_{\text{net}} = M\vec{a}$

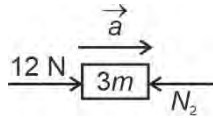
Sol.: Acceleration of the system of three masses = a

$$= \frac{12}{6m} = \frac{2}{m} \text{ m/s}^2$$

$$N_1 = ma = 2 \text{ N}$$



$$12 - N_2 = 3ma$$



$$N_2 = 6 \text{ N}$$

$$\frac{N_1}{N_2} = \frac{1}{3}$$

2. Answer (4)

Hint & Sol: A force is said to be conservative if work done by or against the force in moving a body from one position to another does not depend on path followed between these two positions.

Force of friction is a non-conservative force.

3. Answer (4)

Hint: Work done by gravity, $W_g = -mg(h_2 - h_1)$

Work done on the ball by all the forces = $\Delta\text{K.E.}$

Sol.: $W_g + W_{\text{air}} = \Delta\text{K.E.}$

$$-mg(h_2 - h_1) + W_{\text{air}} = \frac{1}{2}m(v_2^2 - v_1^2)$$

$$-40 + W_{\text{air}} = -50$$

$$W_{\text{air}} = -10 \text{ J}$$

4. Answer (4)

Hint: Work done, $W = \int_{x_1}^{x_2} F \cdot dx$

$$\text{Sol.} \quad W = \int_2^5 (6 + 2x) dx = (6x + x^2) \Big|_2^5$$

$$= [30 + 25] - [12 + 4] = 55 - 16 = 39 \text{ J}$$

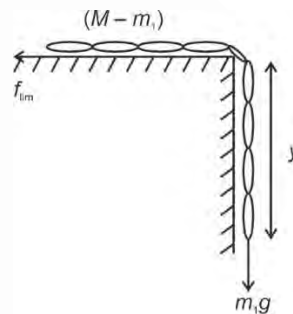
5. Answer (1)

$$\text{Hint: } \tan \theta = \frac{v^2}{rg}$$

Sol.: As v increases, θ would also increase to maintain balance. If turn is sharp, then r is small and θ increases

6. Answer (2)

Hint: At equilibrium, $f_{\text{lim}} = m_1g$



Sol.: $\mu N = m_1g$

$$\mu(M - m_1)g = m_1g$$

$$y = \frac{\mu L}{(1 + \mu)} = \frac{0.1 \times 4}{1.1} = 0.36 \text{ m}$$

7. Answer (4)

Hint: Force on block, $F = v \frac{dm}{dt}$

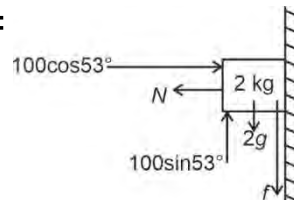
Sol.: $F = 5 \times 2 = 10 \text{ N}$

$$\Rightarrow a = \frac{F}{m} = \frac{10}{3} \text{ m/s}^2$$

8. Answer (4)

Hint: Net force, $\vec{F}_{\text{net}} = m\vec{a}$

Sol.:



$$N = 100 \cos 53^\circ = 100 \times \frac{3}{5} = 60 \text{ N}$$

If there is no friction, then net vertical force on the block:

$$R' = 100 \sin 53^\circ - mg = 80 - 20 = 60 \text{ N}$$

$$(f_s)_{\max} = \mu_s N = 0.5 \times 60 = 30 \text{ N} < R'$$

∴ Block moves and kinetic friction acts on it

$$f_k = \mu_k N = 0.4 \times 60 = 24 \text{ N}$$

$$a = \frac{R' - f_k}{m} = \frac{60 - 24}{2} = \frac{36}{2} = 18 \text{ m/s}^2$$

9. Answer (2)

Hint: Retardation of block $a = \mu g$

Sol.: Use equation of motion,

$$v^2 = u^2 + 2as$$

$$0 = u^2 - 2\mu gs$$

$$s = \frac{u^2}{2\mu g} = \frac{4 \times 4}{2 \times 3 \times 10} = \frac{16}{60} = \frac{4}{15} \text{ m}$$

10. Answer (3)

Hint: Coefficient of static friction,

$$\mu = \tan \theta$$

$$\text{Sol.} \frac{1}{\sqrt{3}} = \tan \theta$$

$$\theta = \tan^{-1} \left(\frac{1}{\sqrt{3}} \right)$$

$$\theta = 30^\circ$$

11. Answer (1)

Hint: Power output, $P = \tau \omega$

$$\text{Sol.} P = 200 \text{ H.P}$$

$$= 200 \times 746 = 1.492 \times 10^5 \text{ W}$$

$$\& \omega = 6000 \text{ rev/min} = 628 \text{ rad/s}$$

$$\tau = \frac{P}{\omega} = \frac{1.49 \times 10^5}{628} = 237.58 \text{ N-m}$$

12. Answer (4)

Hint & Sol.: Since the belt does not slide on the pulleys, magnitudes of velocity and acceleration of any point on the belt is same as that of any point on the periphery of either of the two pulleys

$$a_c = \alpha_A r_A = \alpha_B r_B$$

$$r_A = 0.25 \text{ m}, r_B = 0.5 \text{ m and } \alpha_A = 0.2 \text{ rad/s}^2$$

$$a_c = 0.2 \times 0.25 = 0.05 \text{ m/s}^2$$

$$\alpha_B = \frac{a_c}{r_B} = \frac{0.05}{0.5} = 0.1 \text{ rad/s}^2$$

13. Answer (3)

$$\text{Hint: Torque } \vec{\tau}_{\text{net}} = \frac{d\vec{L}}{dt}$$

$$K_{\text{rotational}} = \frac{L^2}{2I}$$

$$\text{Sol.} \tau = 0$$

$$\frac{dL}{dt} = 0 \Rightarrow L = \text{constant}$$

$$L = I\omega$$

If we decrease its radius, then I decreases

⇒ ω increases.

$$\& K_r = \frac{L^2}{2I}$$

K_r increases as I decreases

14. Answer (3)

$$\text{Hint: } I_{xx'} = I_0 + MR^2 \& M = \lambda L$$

$$\begin{aligned} \text{Sol.} I_{xx'} &= \frac{1}{2}MR^2 + MR^2 = \frac{3}{2}MR^2 \\ &= \frac{3}{2}(\lambda L) \left(\frac{L}{2\pi} \right)^2 = \frac{3\lambda L^3}{8\pi^2} \\ &= \frac{3 \times 3 \times 10^{-3} \times 8}{8\pi^2} = 9 \times 10^{-4} \text{ kg-m}^2 \end{aligned}$$

15. Answer (2)

$$\text{Hint: } \vec{F}_{\text{net}} = m\vec{a}$$

$$\vec{\tau} = \vec{r} \times \vec{F}$$

$$\text{Sol.} F_{\text{net}} = -20 + 30 - 10 + 40 - 40 = \text{Zero}$$

∴ No translatory motion.

Taking torque of these forces about centre of mass of the rod,

$$|\vec{\tau}| = 30 \times 10 + 10 \times 10 + 40 \times 50 - (20 \times 30) - (40 \times 30)$$

$$= 2400 - 1800 = 600$$

∴ $\vec{\tau}_{\text{net}}$ is non-zero

16. Answer (3)

Hint: Angular impulse = change in angular momentum

$$\text{Sol.} \tau t = I\omega - 0$$

$$\omega = \frac{\tau t}{I} = \frac{FRt}{I} = \frac{40 \times 1 \times 5}{4} = 50 \text{ rad/s}$$

17. Answer (4)

Hint: Torque $\vec{\tau} = \vec{r} \times \vec{F}$

Sol.: Torque is an axial vector and its direction is perpendicular to the plane containing \vec{r} & \vec{F} .

$$\vec{\omega}_{A/B} = \vec{\omega}_{B/A} = \vec{\omega}_{\text{body}}$$

Angular velocity is property of entire rigid body.

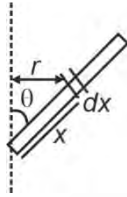
$$k_{\text{annular disc}} = \sqrt{\frac{1}{2}(R_1^2 + R_2^2)}$$

18. Answer (3)

Hint: Moment of inertia, $I = \int r^2 dm$

Sol.: $r = x \sin\theta$

$$I = \int r^2 dm = \int_0^L x^2 \sin^2 \theta \left(\frac{M}{L}\right) dx$$



$$= \frac{ML^2 \sin^2 \theta}{3} = \frac{5 \times 25 \times 3}{4 \times 3} = \frac{125}{4} \text{ kg m}^2$$

19. Answer (1)

Hint: Use conservation of angular momentum

Sol.: By conservation of angular momentum

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

$$\omega = \frac{2 \times 4 + 4 \times 2}{6} = \frac{16}{6} = \frac{8}{3} \text{ rad/s}$$

$$\text{Rotational kinetic energy} = \frac{1}{2} (I_1 + I_2) \omega^2$$

$$= \frac{1}{2} \times 6 \times \frac{64}{9} = \frac{64}{3} \text{ J}$$

20. Answer (3)

Hint : Power due to a force in rotational motion is given by dot product of torque and angular velocity.

Sol.: $\vec{\tau} = \vec{r} \times \vec{F}$

$$P = \vec{\tau} \cdot \vec{\omega}$$

$$P = (\vec{r} \times \vec{F}) \cdot \vec{\omega}$$

21. Answer (3)

Hint: Velocity of C.O.M. $\vec{v}_{\text{cm}} = \frac{m_1 \vec{v}_1 + m_2 \vec{v}_2}{m_1 + m_2}$

$$\text{Sol.} \vec{v}_{\text{cm}} = \frac{0.2 \times 5\hat{i} + 0.5(10\hat{i} + 10\hat{j})}{0.2 + 0.5}$$

$$= \frac{\hat{i} + 5\hat{i} + 5\hat{j}}{0.7}$$

$$= \frac{6\hat{i} + 5\hat{j}}{0.7} = \frac{60\hat{i} + 50\hat{j}}{7} \text{ m/s}$$

22. Answer (4)

Hint : Use momentum and energy conservation laws to verify post-collision velocities in each option.

Sol.: For elastic collision in option (3), $m_1 \gg m_2$ for $u_1 \neq 0, u_2 = 0$

$$\text{then, } v_1 = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) u_1 \approx u_1$$

$$v_2 = \frac{2m_1 u_1}{(m_1 + m_2)} \approx 2u_1$$

For elastic collision in option (4), $m_1 = m_2$

for $u_1 \neq 0, u_2 = 0,$

then, $v_1 = 0, v_2 = u_1$

23. Answer (2)

Hint: Use conservation of momentum and change in total kinetic energy to find work done by internal forces.

Sol.: $\vec{P}_i = \text{zero}$

$$\vec{P}_f = m_1 \vec{u} + m_2 \vec{v}$$

$$\vec{P}_i = \vec{P}_f$$

$$0 = m_1 \vec{u} + m_2 \vec{v}$$

$$\vec{v} = \frac{-m_1 \vec{u}}{m_2}$$

$$K.E_i = 0$$

$$K.E_f = \frac{1}{2} m_1 u^2 + \frac{1}{2} m_2 v^2$$

$$K.E_f = \frac{1}{2} m_1 u^2 + \frac{1}{2} m_2 \left(\frac{m_1 u}{m_2}\right)^2$$

$$= \frac{1}{2} m_1 u^2 + \frac{1}{2} \frac{m_1^2 u^2}{m_2}$$

$$K.E_f = \frac{1}{2} \left(\frac{m_1 m_2 + m_1^2}{m_2} \right) u^2$$

$$\begin{aligned} \Delta K.E &= \frac{1}{2} m_1 u^2 \left[1 + \frac{m_1}{m_2} \right] \\ &= \frac{1}{2} \times 1 \times 4 \left[1 + \frac{1}{6} \right] \\ &= 2 \times \frac{7}{6} = \frac{7}{3} \text{ J} \end{aligned}$$

24. Answer (1)

Hint: Work done $W = \vec{F} \cdot d\vec{s}$, $\hat{i} \cdot \hat{j} = 0$

Sol.: $W = \vec{F} \cdot \Delta \vec{x}$

$$\Delta \vec{x} = (-3\hat{i}) \text{ m}$$

(a) $W = -15 \text{ J}$

(b) $W = \text{zero}$

(c) $W = (-5\hat{i}) \cdot (-3\hat{j}) = 15 \text{ J}$

(d) $W = (-8\hat{i} + 5\hat{j}) \cdot (-3\hat{i}) = 24 \text{ J}$

25. Answer (3)

Hint: Work done (W) = $\Delta K \cdot E$

Sol.: $x^2 = 25t^3$

$$x = 5t^{3/2}$$

$$v = \frac{dx}{dt} = 5 \times \frac{3}{2} t^{1/2}$$

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

⇒ Particle is at rest

$$W = \frac{1}{2} m v_t^2 - \frac{1}{2} m v_{t=0}^2$$

$$W = \frac{1}{2} m v_t^2$$

$$= \frac{1}{2} \times 5 \times \left(\frac{15}{2} t^{1/2} \right)^2 = \frac{5 \times 225}{2 \times 4} \times t$$

∴ $W \propto t$

26. Answer (4)

Hint: For crossing the bridge in minimum time, it has to travel with maximum acceleration.

Sol.: $a =$ maximum acceleration produced in car

$ma = \mu R$ (if acceleration is more than this, then tyres will slip)

$$ma = \mu mg$$

$$a = \mu g = 10 \text{ m/s}^2$$

$$u = 0, s = 500 \text{ m}, a = 10 \text{ m/s}^2$$

$$500 = \frac{1}{2} \times 10 \times t^2$$

$$t = 10 \text{ s}$$

27. Answer (2)

Hint: To loop-the-loop body should not lose contact with the track anywhere, so velocity $v \geq \sqrt{gr}$ at the topmost point of circular loop.

Sol.: By conservation of mechanical energy,

$$\frac{1}{2} m v_{\min}^2 = mg(h_{\min} - 2r)$$

$$\frac{1}{2} m(gr) = mg(h_{\min} - 2r)$$

$$\frac{1}{2} r = h_{\min} - 2r$$

$$\therefore h_{\min} = \frac{r}{2} + 2r = \frac{5r}{2} = 2.5 \text{ m}$$

28. Answer (3)

Hint: Force $\vec{F} = \frac{d\vec{p}}{dt}$

$$\text{Sol.} \quad F = \frac{2mu \cos \theta}{t}$$

$$= \frac{2 \times 500 \times 10^{-3} \times 40 \times 1}{0.4 \times 2} = 50 \text{ N}$$

29. Answer (1)

Hint: $F \times t =$ impulse

& Impulse = change in momentum

Sol.:

(i) Impulse = $\frac{1}{2} \times 20 \times 20 = 200 \text{ N-s}$

(ii) Impulse = $P_f - P_i \Rightarrow 200 = P_f - 10$

$$P_f = 210 \text{ kg-m/s}$$

30. Answer (1)

Hint & Sol.: Under Newton's 3rd law, action and reaction are always equal and opposite. They always act on different bodies.

31. Answer (1)

Hint: Total acceleration is given by

$$a_{\text{total}}^2 = a_t^2 + a_c^2$$

Sol.: Since the tangential acceleration is constant:

$$S = \frac{1}{4} \times 2\pi r = \frac{\pi r}{2}$$

$$S = ut + \frac{1}{2}at^2$$

$$\frac{\pi r}{2} = \frac{1}{2}at^2$$

$$t^2 = \frac{\pi r}{a}$$

$$v = a\sqrt{t^2} = a\sqrt{\frac{\pi r}{a}}$$

$$v = \sqrt{a\pi r}$$

$$a_c = \frac{v^2}{r} = \frac{a\pi r}{r} = a\pi$$

$$a_t = a$$

$$a_{\text{total}} = \sqrt{a_t^2 + a_c^2} = \sqrt{a^2 + a^2\pi}$$

$$= a\sqrt{1 + \pi^2} = 2\sqrt{1 + \pi^2}$$

32. Answer (2)

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

$$\text{Sol.} : P = (2\hat{i} - 3\hat{j} + 4\hat{k}) \cdot (2\hat{i} + 3\hat{j} + 5\hat{k})$$

$$= 4 - 9 + 20 = 15 \text{ W}$$

33. Answer (2)

Hint: In perfectly elastic head-on collision, kinetic energy transfer is maximum for $m_1 = m_2$

$$\text{Sol.} : v_1 = \left(\frac{m_1 - m_2}{m_1 + m_2} \right) u_1, v_2 = \left(\frac{2m_1}{m_1 + m_2} \right) u_1$$

Fraction of kinetic energy transferred

$$= \frac{(K_B)_{\text{final}}}{(K_A)_{\text{initial}}} = \frac{4m_1 m_2}{(m_1 + m_2)^2}$$

This expression is maximum when

$$m_1 = m_2$$

34. Answer (2)

Hint & Sol: Potential energy of a system can be positive, negative or zero.

- In circular motion, tension is perpendicular to velocity of block.

Small work done, $dW = Tdx \cos 90^\circ = 0$

\Rightarrow Work done is zero

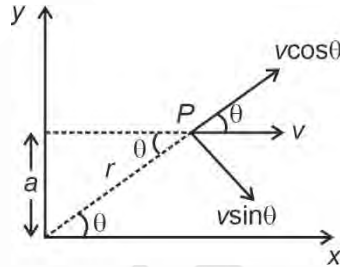
- Also, work done = $\int F \cdot dx$

\therefore Statement C is false

35. Answer (1)

Hint: Angular velocity $\omega = \frac{v_\perp}{r}$

$$\text{Sol.} : \omega = \frac{v_\perp}{r} = \frac{v \sin \theta}{r}$$



$$\frac{a}{r} = \sin \theta$$

$$r = \frac{a}{\sin \theta}$$

$$\omega = \frac{v \sin^2 \theta}{a} = 2 \times \frac{1}{4 \times 2} = \frac{1}{4} \text{ rad/s}$$

36. Answer (4)

Hint: Conservative force $F = -\frac{\partial U}{\partial r}$

$$\text{Sol.} : F_x = -\frac{\partial U}{\partial x} = -3$$

$$F_y = -\frac{\partial U}{\partial y} = -4$$

$$\vec{F} = F_x \hat{i} + F_y \hat{j}$$

$$= -(3\hat{i} + 4\hat{j}) \text{ N}$$

$$|\vec{a}| = \frac{|\vec{F}|}{m} = \frac{\sqrt{9+16}}{5} = 1 \text{ m/s}^2$$

37. Answer (3)

Hint : Use $m_1 r_1 = m_2 r_2$

Sol.: C.O.M. will be in IV quadrant

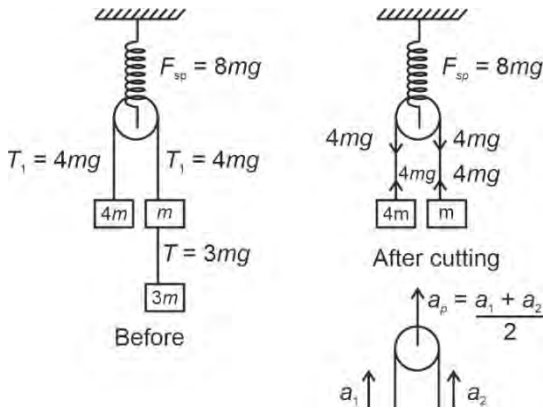
38. Answer (2)

Hint: Initially system was at rest

Just after string is cut:

$$a_{\text{pulley}} = \frac{a_1 + a_2}{2}$$

Sol.:



Spring force, $F_{sp} = 8mg$

$$a_1 = a_{4m} = 0$$

$$a_2 = a_m = \frac{4mg - mg}{m} = 3g$$

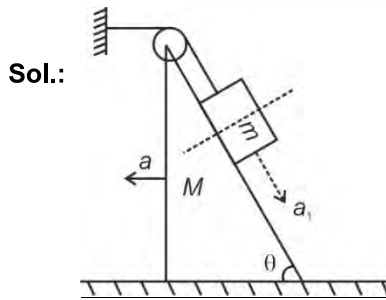
$$a_p = \frac{0 + 3g}{2} = \frac{3g}{2}$$

39. Answer (3)

Hint: Wedge constraint

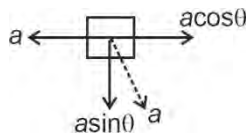
(i) Along common normal, there is no relative motion.

(ii) Perpendicular to common normal, motion is always relative.



$a_1 = a =$ acceleration of M w.r.t. ground $= 2 \text{ m/s}^2$

acceleration of m w.r.t. $M = a_{m/M} = a = 2 \text{ m/s}^2$



$$\vec{a}_{m/g} = \vec{a}_{m/M} + \vec{a}_M$$

$$|\vec{a}_{m/g}| = \sqrt{(a - a \cos \theta)^2 + (a \sin \theta)^2}$$

$$= 2a \sin \frac{\theta}{2}$$

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

40. Answer (2)

$$\text{Hint: } \alpha = \frac{\omega_f - \omega_i}{t} \text{ \& } \theta = \omega_0 t + \frac{1}{2} \alpha t^2$$

Sol.: $f_0 = 420 \text{ rev/min}$

$$\omega_0 = 2\pi \times 7 = 14\pi \text{ rad/s}$$

At $t = 10 \text{ s}$, $\omega = 0$

$$\alpha = -\frac{14\pi}{10} = -\frac{7\pi}{5} \text{ rad/s}^2$$

$$\theta = \omega_0 t + \frac{1}{2} \alpha t^2$$

$$= 14\pi \times 10 - \frac{1}{2} \times \frac{7\pi}{5} \times 100$$

$$\theta = 70\pi \text{ rad}$$

$$\text{Number of revolutions} = \frac{\theta}{2\pi}$$

$$= \frac{70\pi}{2\pi} = 35 \text{ revolutions}$$

41. Answer (4)

Hint: $W_{\text{cons}} = -\Delta U$

Sol.: Potential energy is defined for conservative force field. Work done by system against conservative force results in increase in potential energy.

42. Answer (1)

$$\text{Hint: } P = \vec{F} \cdot \vec{v}, a = v \frac{dv}{dx}$$

$$\text{Sol.: } P = mav \text{ and } a = v \frac{dv}{dx}$$

$$v^2 dv = \frac{P}{m} dx$$

$$\int_u^v v^2 dv = \frac{P}{m} \int_0^x dx$$

$$P = \frac{m(v^3 - u^3)}{3x} = \frac{2500(216 - 64)}{3 \times 250}$$

$$= \frac{2500 \times 152}{3 \times 250} = 506.67 \text{ W} \approx 507 \text{ W}$$

43. Answer (3)

Hint: $R^2 = P^2 + Q^2 + 2PQ \cos\theta$ **Sol.:** $P = (F_1 + F_2)$, $Q = (F_1 - F_2)$

$$R = \sqrt{F_1^2 + F_2^2}$$

$$\cos\theta = \frac{R^2 - P^2 - Q^2}{2PQ}$$

$$= \frac{(F_1^2 + F_2^2) - (F_1 + F_2)^2 - (F_1 - F_2)^2}{2(F_1 + F_2)(F_1 - F_2)}$$

$$= - \left[\frac{(F_1^2 + F_2^2)}{2(F_1^2 - F_2^2)} \right] \Rightarrow \theta = \cos^{-1} \left[- \frac{(F_1^2 + F_2^2)}{2(F_1^2 - F_2^2)} \right]$$

44. Answer (4)

Hint : a_t is along tangent and a_r is along radius.**Sol.:** When the particle is moving in a vertical circle with the help of a string, the force towards the centre and the force along the tangent, vary from point to point and so both its radial and tangential acceleration also vary.

45. Answer (2)

Hint: $\vec{A} \times \vec{B} = AB \sin\theta \hat{n}$

$$\text{Sol. : } \vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 3 & -5 \\ 3 & -2 & 5 \end{vmatrix}$$

$$= \hat{i}(15 - 10) - \hat{j}(10 + 15) + \hat{k}(-4 - 9)$$

$$= 5\hat{i} - 25\hat{j} - 13\hat{k}$$

$$|\vec{A} \times \vec{B}| = \sqrt{819} \text{ units}$$

[CHEMISTRY]

46. Answer (4)

Hint: C_p and C_v are molar heat capacity at constant pressure and constant volume respectively. These are intensive properties.**Sol.:** $C_p - C_v = R$; irrespective of the moles of an ideal gas.

47. Answer (1)

Hint: For irreversible isothermal process,

$$W = -P_2(V_2 - V_1)$$

$$\text{Sol. : } W = -P_2(V_2 - V_1)$$

$$= -P_2 \left(\frac{nRT}{P_2} - \frac{nRT}{P_1} \right)$$

$$= -nRT P_2 \left(\frac{1}{P_2} - \frac{1}{P_1} \right)$$

$$= -2 \times 8.314 \times 298 \times 4 \left(\frac{1}{4} - \frac{1}{1} \right) = 14.865 \text{ kJ}$$

48. Answer (4)

Hint: In expansion against vacuum,

$$P_{\text{ext}} = 0$$

$$\text{Sol. } \therefore w = -P_{\text{ext}}(\Delta V) = 0$$

49. Answer (2)

Hint: The functions which depend only on the path of the process are termed as path functions.**Sol.:** Only heat and work are path functions.

50. Answer (1)

Hint: $\Delta G^\circ = -RT \ln K$ **Sol.:**

	$\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$
t = 0	1 0
t = eq	(1 - 0.5) 1
	= 0.5
x	1 2
(Mole Fraction)	3 3
Partial pressure	1 atm 2 atm

$$K_p = \frac{(P_{\text{NO}_2})^2}{[P_{\text{N}_2\text{O}_4}]} = \frac{(2)^2}{1} = 4$$

$$\Delta G^\circ = -RT \ln K$$

$$= -2.303 RT \log 4$$

$$= -3.84 \text{ kJ/mol}$$

51. Answer (2)

Hint: ΔU does not discriminate between reversible and irreversible process, whereas ΔS_{total} does.**Sol.:** Both for reversible and irreversible expansion of an ideal gas, under isothermal conditions,

$$\Delta U = 0$$

But $\Delta S_{\text{total}} = 0$, only for reversible process.

52. Answer (2)

$$\text{Hint: } \Delta_r G^\ominus = \Delta_r H^\ominus - T \Delta_r S^\ominus$$

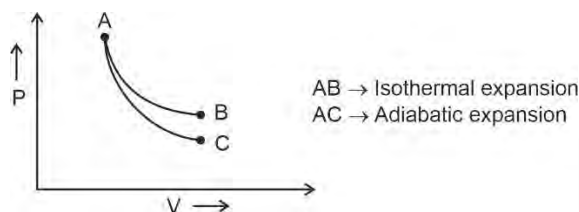
 $\Delta_r G^\ominus < 0$; reaction is spontaneous

$$\text{Sol.: } \Delta_r H^\ominus > 0 \text{ and } \Delta_r S^\ominus < 0$$

 Hence $\Delta_r G^\ominus > 0$ at all temperature

53. Answer (3)

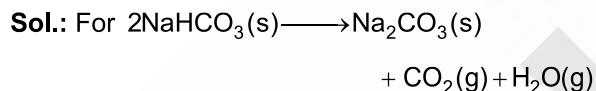
Hint: Cooling takes place upon adiabatic expansion of an ideal gas.

Sol.:


$$\therefore T_A > T_C$$

$$T_A = T_B$$

54. Answer (1)

Hint: Number of moles of gaseous product increases, entropy also increases.


$$\Delta n_g = 2 - 0 = 2$$

55. Answer (2)

Hint: Those properties which do not depend on the quantity or size of matter present are known as intensive properties

Sol.: Heat capacity is an extensive property while temperature is an intensive property.

Element	$\Delta_r H^\ominus / (\text{kJ mol}^{-1})$
S(s), rhombic	0
P(s), White	0

56. Answer (2)

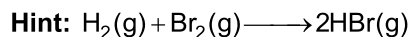
Hint: For free expansion ($P_{\text{ex}} = 0$) $w = 0$
Sol.: For adiabatic process

$$q = 0.$$

$$\Delta U = q + w$$

$$\Delta U = 0$$

57. Answer (3)



$$\Delta_r H = \sum B.E_{\text{reactants}} - \sum B.E_{\text{products}}$$

$$\text{Sol.: } -109 = B.E_{\text{H}_2} + B.E_{\text{Br}_2} - 2 \times B.E_{\text{HBr}}$$

$$-109 = x + 192 - 2(368)$$

$$-109 + 2(368) = x + 192$$

$$736 - 109 = x + 192$$

$$627 = x + 192$$

$$627 - 192 = x$$

$$435 = x$$

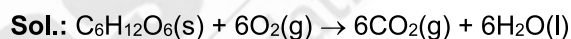
58. Answer (1)

$$\text{Hint: } \Delta S = nR \ln \frac{P_1}{P_2}$$

$$\text{Sol.: } \Delta S = 1 \times 8.314 \times 2.303 \log 2$$

$$= 5.74 \text{ J K}^{-1} \text{ mol}^{-1}$$

59. Answer (4)

Hint: Due to better alignment of polymers, upon stretching of rubber entropy decreases.


$$\Delta_r H^\ominus = 6 \times (-400) + 6 \times (-300) - (-1300)$$

$$= -2900 \text{ kJ mol}^{-1}$$

Combustion of 180 gm of glucose, heat released

$$\text{is } = \frac{2900}{18} = 16.11 \text{ kJ g}^{-1}$$

60. Answer (3)

$$\text{Hint: } \gamma = \frac{C_p}{C_v}$$

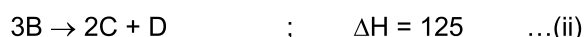
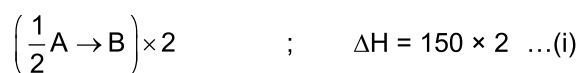
Sol.: For diatomic gas,

$$C_p = \frac{7}{2}R$$

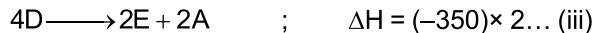
$$C_v = \frac{5}{2}R$$

$$\gamma = \frac{C_p}{C_v} = 1.40$$

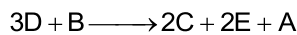
61. Answer (3)

Hint & Sol.:


Reverse of $E + A \longrightarrow 2D$ and multiplying by 2 we get



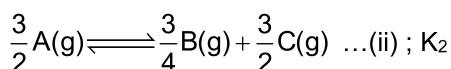
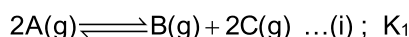
add eq. (i), (ii) and (iii) we get



$$\begin{aligned} \therefore \Delta H &= 300 + 125 - 350 \times 2 \\ &= 425 - 700 = -275 \text{ kJ mol}^{-1} \end{aligned}$$

62. Answer (4)

Hint & Sol.:



Equation (ii) is $\frac{3}{4}$ times of equation (i)

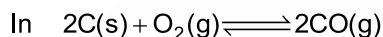
$$\therefore K_2 = (K_1)^{\frac{3}{4}}$$

63. Answer (2)

Hint: $K_p = K_c (RT)^{\Delta n_g}$

Sol.: For $K_p = K_c$

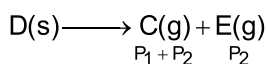
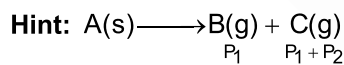
$$\therefore \Delta n_g = 0$$



$$\Delta n_g \neq 0$$

$$\therefore K_p \neq K_c$$

64. Answer (4)



$$\text{Sol.: } x = (P_1)(P_1 + P_2)$$

$$y = (P_2)(P_1 + P_2)$$

$$P_T = P_C + P_B + P_E$$

$$= P_1 + P_2 + P_1 + P_2 = 2(P_1 + P_2)$$

$$x + y = P_1^2 + P_1P_2 + P_2^2 + P_1P_2$$

$$x + y = (P_1 + P_2)^2$$

$$\therefore \boxed{2\sqrt{x+y} = P_T}$$

65. Answer (1)

Hint: $2A \rightleftharpoons B + C$

$$Q_c = \frac{[B][C]}{[A]^2} = \frac{(2)(2)}{\left(\frac{1}{2}\right)^2} = \frac{4}{\frac{1}{4}} = 4 \times 4 = 16$$

$$\begin{aligned} \text{Sol.: } \log K_c &= \frac{-\Delta G^\circ}{2.303 \times RT} = \frac{-2500}{2.303 \times 8.314 \times 300} \\ &= -\frac{2500}{5744} = -0.436 \end{aligned}$$

$$K_c = 0.36$$

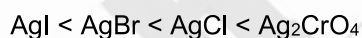
Since $Q_c > K_c$; Backward direction

66. Answer (1)

Hint & Sol.: $Ag_2CrO_4 \rightleftharpoons 2Ag^+ + CrO_4^{2-}$

Solubility higher, lower will be the precipitation.

Order of solubility is



67. Answer (2)

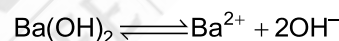
Hint: $Ba(OH)_2 \rightleftharpoons Ba^{2+} + 2OH^-$

$$pH = 11$$

$$pOH = 3$$

$$[OH^-] = 10^{-3}$$

Sol.:



$$\frac{10^{-3}}{2} \quad \quad \quad 10^{-3}$$

$$K_{sp} = 0.5 \times 10^{-3} \times 10^{-6}$$

$$= 0.5 \times 10^{-9}$$

$$= 5 \times 10^{-10}$$

68. Answer (3)

Hint: For HCN, $h = \sqrt{\frac{K_h}{C}}$

$$\text{Sol.: } pH = 7 + \frac{1}{2}[pK_a + \log C]$$

69. Answer (3)

Hint

$$\text{Sol.: } K_h = \frac{K_w}{K_b}$$

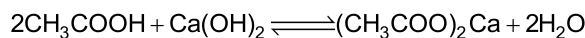
$$10^{-14} = 5.5 \times 10^{-10} \times K_b$$

$$K_b = \frac{10^{-14}}{5.5 \times 10^{-10}}$$

$$= 0.18 \times 10^{-4} = 1.8 \times 10^{-5}$$

70. Answer (2)

Hint:



$$[\text{CH}_3\text{COO}^-] = 2 \times 0.05 = 0.1$$

Sol.:

$$\text{pH} = 7 + \frac{\text{p}K_a}{2} + \frac{\log C}{2}$$

$$= 7 + \frac{4.74}{2} + \frac{1}{2} \log(10^{-1})$$

$$\text{pH} = 7 + 2.37 - 0.5 = 8.87$$

71. Answer (4)

Hint & Sol.: Cations which react with water to give weak base undergo cationic hydrolysis

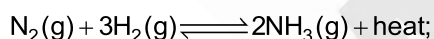
72. Answer (1)

Hint & Sol.: NaCl won't undergo hydrolysis as both ions come from strong acid and strong base. Hence, the solution will be neutral

73. Answer (2)

Hint : An acid is a species which accepts electron pair.

Sol.: BF_3 is a Lewis acid but CH_4 is not a Lewis acid



The equilibrium shifts in backward direction by increasing temperature.

74. Answer (2)

Hint: Higher the solubility, lower will be the precipitation

$$\text{Sol.}: K_{sp} [\text{AgI}] = [\text{Ag}^+] [\text{I}^-]$$

$$[\text{I}^-] = 8.5 \times 10^{-16} \text{ M}$$

$$K_{sp} [\text{Hg}_2\text{I}_2] = [[\text{Hg}_2^{2+}] [\text{I}^-]^2]$$

$$[\text{I}^-] = 5 \times 10^{-13} \text{ M}$$

$[\text{I}^-]$ for AgI is smaller than for Hg_2I_2

\therefore At $5 \times 10^{-13} \text{ M}$ almost complete precipitation of AgI takes place

75. Answer (1)

$$\text{Hint: } \text{pOH} = \text{p}K_b + \log \frac{[\text{NH}_4^+]}{[\text{NH}_3]}$$

$$\text{Sol.}: \text{pH} + \text{pOH} = 14$$

$$\text{pOH} = 14 - 8.26 = 5.74$$

$$5.74 = 4.74 + \log \frac{[\text{NH}_4^+]}{0.2}$$

$$[\text{NH}_4^+] = 2 \text{ M}$$

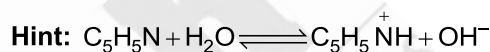
Moles of $\text{NH}_4\text{Cl} = 2$ moles

$$\text{Amount} = 2 \times 53.5 \text{ g mol}^{-1} = 107 \text{ g}$$

76. Answer (4)

Hint & Sol.: For a polyprotic acid, it is more difficult to remove a positively charged proton from a negative ion.

77. Answer (2)



$$\text{Sol.}: \alpha = \sqrt{\frac{K_b}{c}}$$

$$= \sqrt{\frac{1.7}{2} \times 10^{-8}}$$

$$\alpha = 0.92 \times 10^{-4}$$

$$\% \alpha = 0.0092\%$$

78. Answer (4)

Hint & Sol: pH for the salt of weak acid and weak base :

$$\text{pH} = 7 + \frac{\text{p}K_a}{2} - \frac{\text{p}K_b}{2}$$

$$= 7 + \frac{4.77}{2} - \frac{3.27}{2} = 7.75$$

79. Answer (1)

$$\text{Hint : } C_m = \frac{q}{n\Delta T}$$

$$\text{Sol: } q = \frac{24 \times 54}{27} \times 20 = 960 \text{ J}$$

80. Answer (4)

Hint: Salt of strong base and weak acid is basic in nature.

Sol.: Calcium cyanide is a salt of strong base and weak acid.

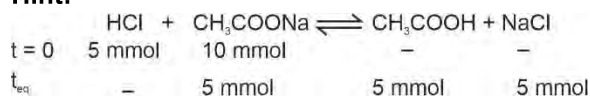
81. Answer (3)

$$\text{Hint \& Sol.: } K_a = \frac{[H^+][A^-]}{[HA]}$$

$$10^{-5} = \frac{[H^+][3HA]}{[HA]}; [H^+] = 3.3 \times 10^{-6}$$

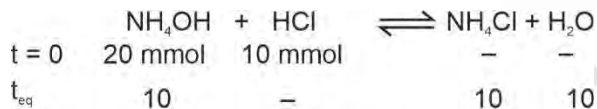
$$\text{pH} = -\log(3.3 \times 10^{-6}) = 5.48$$

82. Answer (1)

Hint:

$$\text{pH} = \text{p}K_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

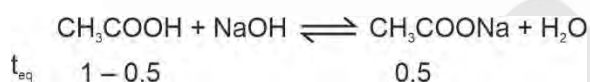
$$\text{pH} = 4.76, \text{ acidic buffer}$$

Sol.:

$$\text{pH} = \text{p}K_b + \log \frac{[\text{Salt}]}{[\text{Base}]}$$

$$= 4.75, \text{ basic buffer}$$

83. Answer (4)

Hint: Solution of weak acid with its salt of strong base is an acidic buffer**Sol.:**

$$\text{pH} = \text{p}K_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$\text{pH} = \text{p}K_a$$

84. Answer (4)

$$\text{Hint: } \Delta G = \Delta H - T\Delta S$$

$$\text{Sol.: } \Delta H = \Delta U + \Delta n_g RT$$

$$\Delta H = 1.1 + \frac{2 \times 8.314 \times 300}{1000}$$

$$= 1.1 + 4.98 = 6.08 \text{ kJ}$$

$$\Delta G = 6.08 - \frac{300 \times 11}{1000}$$

$$= 6.08 - 3.3 = 2.78 \text{ kJ}$$

85. Answer (4)

Hint: Bronsted bases are capable of accepting of proton**Sol.:** Bronsted base are C₂O₄²⁻ and PO₄³⁻

86. Answer (2)

Hint: According to Bronsted-Lowry theory, acid is a substance that is capable of donating a hydrogen ion H⁺ only.**Sol.:** Conjugate base of HN₃ = N₃⁻

87. Answer (2)

Hint & Sol.: H₂C₂O₄ reacts with Fe³⁺ ions to form a stable complex [Fe(C₂O₄)₃]³⁻ and HgCl₂ reacts with SCN⁻ ions to form [Hg(SCN)₄]²⁻ and shifts reactions in backward direction.

88. Answer (3)

Hint & Sol.: Volume gets halved and pressure gets doubled.So to keep K_p constant, α decreases.

89. Answer (2)

Hint: Change in concentration of solid compounds do not affect the equilibrium**Sol.:** No change in equilibrium is observed upon addition of an inert gas at constant volume because there is no change the partial pressure or the molar concentration of the substance involved in the reaction.

90. Answer (1)

Hint & Sol.:

Volumes increases, number of moles decreases then

∴ Reaction shifts to a direction where number of gaseous moles increase

[BOTANY]

91. Answer (3)

Hint: A bud is present in the axil of petiole in both simple and compound leaf**Sol.:** In pinnately compound leaves, a number of leaflets are present on rachis.

92. Answer (3)

Hint: *Entamoeba* is an amoeboid protozoan.**Sol.:** Amoeboid protozoans have pseudopodia for movement and capturing the prey. Marine forms of amoeboid protozoans have silica shells on their surface.

93. Answer (2)

Hint: Testa is the outer protective covering of seed

Sol.: Coleoptile is a sheath enclosing plumule in monocot seed. The outer covering of endosperm separates the embryo by a proteinaceous layer called aleurone layer.

94. Answer (2)

Hint: Bicarpellary and bilocular ovary is seen in the members of solanaceae family

Sol.: Epipetalous stamens and axile placentation are seen in tomato.

95. Answer (2)

Hint: Hypogynous flowers have superior ovary.

Sol.: Plum, peach and rose – Half inferior ovary
Guava, cucumber, ray florets of sunflower – Inferior ovary. Rest all have superior ovary.

96. Answer (2)

Hint: T.O. Diener discovered a new infectious agent that was smaller than viruses known as viroid.

Sol.: Pseudopodia are locomotory and feeding structure in amoeboid protozoans.

97. Answer (3)

Hint: Six Kingdom classification was given by Carl Woese

Sol.: In six Kingdom classification, kingdom fungi and animalia have organisms with heterotrophic mode of nutrition only.

98. Answer (3)

Hint: Heterotrophic bacteria are helpful in making curd from milk and fixing nitrogen in legume

Sol.: Some of cyanobacteria can fix atmospheric nitrogen in specialised cells called heterocysts. They lack flagella.

99. Answer (4)

Hint: Mustard belongs to Brassicaceae family while China rose belongs to malvaceae family

Sol.:

	Feature	Mustard	China Rose
a.	Placentation	Parietal	Axile
b.	Floral symmetry	Actinomorphic	Actinomorphic
c.	Adhesion of stamen	Free stamens	Epipetalous

d.	Aestivation of corolla	Valvate	Twisted
e.	Union of carpels	Syncarpous	Syncarpous
f.	Type of fruit	Silique	Capsule
g.	Number of carpels	Two	Five

100. Answer (4)

Hint: Spine is a modification of leaf.

Sol.: Spines in cactus are modified leaves.

101. Answer (2)

Hint: Marginal placentation is seen in pea

Sol.: Axile placentation is seen in China rose, tomato and lemon. *Primrose* has free central placentation.

102. Answer (1)

Hint: In non-endospermic seed, endosperm is not present in the mature seed

Sol.: Pea, Bean and Gram are examples of non-endospermic seeds.

103. Answer (2)

Hint: The seed coat has two layers, the outer testa and inner tegmen

Sol.: A large shield shaped cotyledon found in maize seeds is known as scutellum. Above the hilum is a small pore called the micropyle.

104. Answer (1)

Hint: Pea is a leguminous plant.

Sol.: Leaf base becomes swollen in Pea
Tricarpellary and syncarpous gynoecium – (*Asparagus*)

Presence of persistent sepal – Ashwagandha
Parietal placentation – *Argemone*

105. Answer (3)

Hint: Epiphyllous condition of stamens is found in members of Liliaceae.

Sol.: When stamens are attached to the petals, they are called epipetalous as in brinjal or epiphyllous when attached to the perianth as in flower of lily.

106. Answer (3)

Hint: Viruses are inert outside their specific host cell.

Sol.: W.M. Stanley showed that viruses could be crystallised and crystals consist largely of protein. Viruses are obligate parasites.

107. Answer (4)

Hint: Sexual reproduction occurs by ascospores in ascomycetes class of fungi.

Sol.: Asexual reproduction in fungi occurs by asexual spores called conidia or sporangiospores.

108. Answer (3)

Hint: *Agaricus* (mushroom) is an edible fungi

Sol.: *Ustilago* and *Puccinia* are smut and rust fungi respectively.

109. Answer (2)

Hint: Kingdom Plantae show autotrophic mode of nutrition.

Sol.: Multicellular organism with loose tissue organisation having heterotrophic mode of nutrition is fungi.

110. Answer (2)

Hint: Dinoflagellates are mostly marine and photosynthetic

Sol.: The cell wall of dinoflagellates has stiff cellulose plates on the outer surface.

111. Answer (2)

Hint: In epipetalous condition stamens are attached to petals.

Sol.: C A represents epipetalous stamens.

112. Answer (3)

Hint: In mango and coconut, the fruit is known as a drupe

Sol.: Mango and coconut develop from monocarpellary superior ovaries.

113. Answer (4)

Hint: In basal placentation, the placenta develops at the base of the ovary

Sol.: Marigold have basal placentation.

114. Answer (3)

Hint: Mustard is a member of Brassicaceae while *Solanum* is a member of Solanaceae family.

Sol.:

Features	Mustard	<i>Solanum</i>
Phyllotaxy	Alternate	Alternate
Floral symmetry	Actinomorphic	Actinomorphic
Type of flower based on position of gynoecium	Hypogynous	Hypogynous
Type of placentation	Parietal	Axile

In mustard stamens have different length of filaments.

115. Answer (4)

Hint: Root provides anchorage to the plant parts.

Sol.: Stem bears and support leaves, flowers and fruits.

116. Answer (3)

Hint: Phyllotaxy is the pattern of leaves on stem

Sol.: The arrangement of veins and veinlets in the lamina or leaf blade is termed as venation.

117. Answer (3)

Hint: Fumigatory plant, tobacco is included in Solanaceae family.

Sol.: Fruit type is capsule or berry. They have five sepals that are persistent.

118. Answer (3)

Hint: *Aspergillus* being a sac fungus has septate hyphae.

Sol.: *Mucor* – produce sexual spores by meiosis.

Colletotrichum – Lacks sexual reproduction and fruiting bodies, it asexually reproduce by conidia.

Puffballs – Lacks asexual reproduction

119. Answer (1)

Hint:

- Monoadelphous stamens — China rose

Sol.:

- Diadelphous stamens – Pea
- Polyadelphous stamens – Citrus
- Polyandrous stamens – Mustard

120. Answer (3)

Hint: This type of aestivation is found in *Cassia*.

Sol.: In imbricate aestivation, margin of petals or sepals overlap each other but not in a particular direction.

121. Answer (3)

Hint: Sunflower and China rose show alternate phyllotaxy.

Sol.: Opposite phyllotaxy is seen in *Calotropis*.

122. Answer (2)

Hint: Root hairs are present in the zone of maturation

Sol.: Some cells from the region of maturation form very fine and delicate thread like structures called root hair.

123. Answer (4)

Hint: Members of Solanaceae have actinomorphic flowers.

Sol.: Ashwagandha being Solanaceae member has actinomorphic flowers.

124. Answer (1)

Hint: In racemose type of inflorescence, the main axis continues to grow.

Sol.: Belladonna shows cymose inflorescence rest all of the examples showing racemose inflorescence.

125. Answer (1)

Hint: Yeast belongs to Ascomycetes.

Sol.: Yeast unicellular member of ascomycetes and do not form ascocarp. Dinoflagellates are mostly marine.

126. Answer (1)

Hint: Asexual spores are generally not found in the members of basidiomycetes.

Sol.: Asexual spores found in *Penicillium* is conidia. Zygosporangium is a sexual spore and it is formed by fusion of gametes.

127. Answer (2)

Hint: The above given diagram is of *Paramecium*.

Sol.: *Paramecium* possess cilia instead of pseudopodia. Dinoflagellates possess cell wall having cellulose plates on the outer surface.

128. Answer (3)

Hint: Cyanobacteria have chlorophyll a similar to higher plants.

Sol.: Euglenoids have pigments identical to higher plants. Except chlorophyll a, other pigments of cyanobacteria differ from higher plants.

129. Answer (1)

Hint: Viruses are non-cellular organisms.

Sol.: Viruses did not find a place in classification since they are not considered truly 'living'.

130. Answer (2)

Hint: Viruses — Mosaic formation in plants

Sol.: Bacteria — Citrus canker

Viroids — Potato spindle tuber disease

Prions — Mad cow disease in cattle

131. Answer (4)

Hint: Deuteromycetes are also known as imperfect fungi.

Sol.: *Agaricus* (Mushroom) belongs to basidiomycetes.

132. Answer (3)

Hint: Mycoplasma is the smallest living cell.

Sol.: Mycoplasma do not have cell wall. Cell membranes are not made of peptidoglycan.

133. Answer (3)

Hint: Methanogens are responsible for production of biogas.

Sol.: Archaeobacteria differ from other bacteria in having a different cell wall structure. Methanogens are capable of converting CO₂, methanol and formic acid into methane.

134. Answer (3)

Hint: Two kingdom classification was given by C. Linnaeus.

Sol.: Five kingdom classification was given by R.H Whittaker.

135. Answer (2)

Hint: Basidiomycetes, produce sexual spores exogenously

Sol.: *Agaricus* belongs to basidiomycetes.

[ZOOLOGY]

136. Answer (3)

Hint: Each artery and vein consists of three layers

Sol.: Basically, each artery and vein consists of three layers. Inner lining, the tunica intima, a middle layer tunica media and external layer tunica externa. The tunica media is comparatively thin in the veins. Pulmonary veins carries oxygenated blood while pulmonary artery carries deoxygenated blood. Partial pressure of O₂ in the pulmonary vein is 95 mm Hg.

137. Answer (1)

Hint: Cardiac output = heart rate × stroke volume

Sol.: Athletes due to continuous training, have greater stroke volume than that of ordinary individuals. Human can alter the stroke volume and cardiac output. Athletes have higher stroke volume to maintain normal cardiac output. If repeated checks of blood pressure of an individual is 140/90 mm Hg or higher, it shows hypertension. Atherosclerosis affects the vessels that supply blood to the heart.

138. Answer (3)

Hint: Angina is acute chest pain.

Sol.:

- Coronary artery disease, often referred to as atherosclerosis, affect the vessels that supply blood to the heart muscle.
- Angina is also called angina pectoris. A symptom of acute chest pain appears when not enough oxygen is reaching the heart muscle.
- Heart failure is sometimes called congestive heart failure because congestion of lungs is one of the main symptoms of this disease.
- In cardiac arrest, heart stops beating.

139. Answer (4)

Hint: Left ventricle pumps blood into aorta

Sol.: Blood pressure is high in arteries as compared to vein. A special coronary system of blood vessels is present in our body exclusively for the circulation of blood to and from the cardiac musculature.

140. Answer (2)

Hint: First heart sound is produced at the beginning of ventricular systole.

Sol.: Lub is first heart sound which is associated with closure of atrio-ventricular valves. Dub is second heart sound which is associated with closure of semilunar valves. Increased blood flow into ventricles by about 30 per cent occurs during the atrial systole.

141. Answer (4)

Hint: Smooth muscle fibres taper at the both ends

Sol.: Human heart has four chambers, two relatively small upper chambers called atria and two larger lower chambers called ventricles. A specialised cardiac musculature called the nodal tissue is also distributed in the heart.

Heart has cardiac muscle fibres.

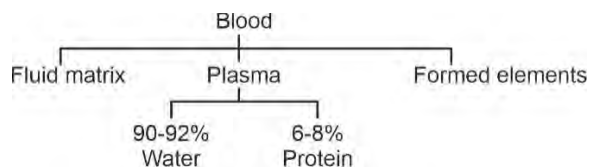
Organ that stores urine is urinary bladder and it has smooth muscle fibres.

Cardiac fibres	muscle	Smooth fibres	muscle
• Branched		• Unbranched	
• Cylindrical		• Fusiform	
• Striated		• Non-striated	

142. Answer (1)

Hint: Fights pathogen

Sol.: Plasma without clotting factors is called serum.



Thus, formed elements do not constitute plasma.

143. Answer (1)

Hint: Universal recipient

Sol.: Persons with AB⁺ blood group do not have anti-A and anti-B antibodies in their plasma. They have A, B and Rh antigens on the RBC surface. Rh antigen will be absent on the RBCs of a AB⁻ individual.

144. Answer (2)

Hint: Type of connective tissue

Sol.: The atrium and the ventricle of the same side are separated by a thick fibrous tissue called the atrio-ventricular septum. A thin, muscular wall called the inter-atrial septum separates the right and left atria.

145. Answer (4)

Hint: Secreted from mast cells.

Sol.: Certain factors released by the tissue, at the site of injury can initiate coagulation. Ca²⁺, fibrinogen and prothrombin are involved in the cascade that leads to blood clotting. Serotonin is a vasoconstrictor.

146. Answer (1)

Hint: Pulmonary vein has oxygenated blood

Sol.: Tunica media is thicker in arteries as compared to veins, so their lumen is narrower. In arteries, blood flows always away from heart while in vein it flows towards the heart.

147. Answer (1)

Hint: Cardiac output = heart rate X stroke volume

Sol.: Stroke volume = end diastolic volume – end systolic volume

$$= 150 \text{ mL} - 50 \text{ mL}$$

$$\text{Stroke volume} = 100 \text{ mL}$$

Cardiac output = heart rate × stroke volume

$$\text{Heart rate} = \frac{\text{Cardiac output}}{\text{Stroke volume}} = \frac{7200 \text{ mL}}{100 \text{ mL}}$$

Heart rate = 72 beats per minute

148. Answer (4)

Hint: Leucocytes have short life span

Sol.: In healthy human, heart rate is 72 times per 60 sec. If we reverse the ratio, we will get duration of cardiac cycle. Eosinophils (2-3 per cent) resist infections and they have bilobed nucleus. Leucocytes are also known as white blood cells (WBCs).

Leucocytes are generally short lived.

149. Answer (4)

Hint: CO₂ is more soluble than O₂

Sol.: Exchange of O₂ and CO₂ between blood and tissues is mainly based on pressure/concentration gradient.

Solubility of gases as well as the thickness of membranes involved in diffusion are some of the important factors that affect rate of diffusion of gases.

150. Answer (4)

Hint: It is more than 10

Sol.: A healthy human breathes 12-16 times per minute.

- A healthy individual has 12-16 gms of haemoglobin in every 100mL of blood.
- Neutrophils are the most abundant cell (60-65 per cent) of the total WBCs.
- Monocytes are 6-8 per cent of the total WBCs.
- 90-92 per cent of plasma is water and proteins contribute 6-8 per cent of it.

151. Answer (1)

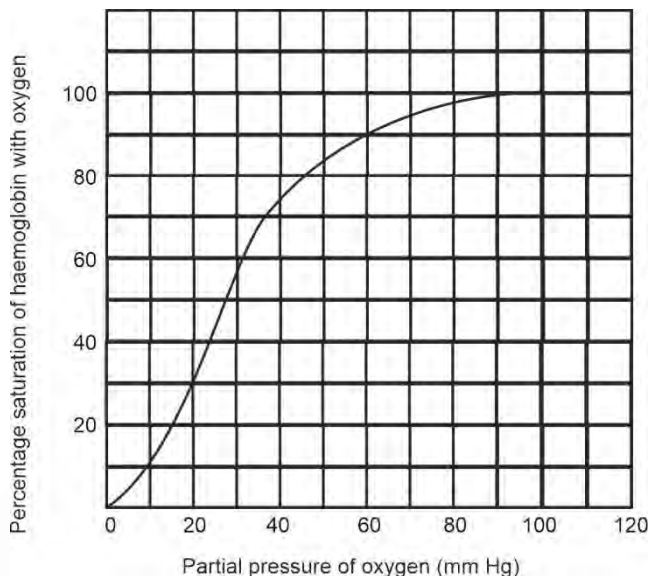
Hint: Higher pCO₂ dissociates oxyhaemoglobin

Sol.: A sigmoid curve is obtained when percentage saturation of haemoglobin with O₂ is plotted against the pO₂. This curve is called the oxygen dissociation curve. At the tissue site where low pO₂, high pCO₂, high H⁺ concentration and higher temperature exist, the conditions are favourable for dissociation of oxygen from the oxyhaemoglobin.

152. Answer (1)

Hint: Numerical value of urea excreted out per day.

Sol.: The partial pressure of oxygen is approximately 25-30 mm Hg when haemoglobin is 50% saturated with oxygen.



153. Answer (1)

Hint: Collects deoxygenated blood from upper parts of the body

Sol.: Superior vena cava and inferior vena cava carry deoxygenated blood.

Respiratory Gas	Atmospheric Air	Alveoli	Blood (Deoxy-genated)	Blood (Oxygenated)	Tissues
O ₂	159	104	40	95	40
CO ₂	0.3	40	45	40	45

154. Answer (2)

Hint: Observed during forceful expiration.

Sol.: Inspiration is initiated by the contraction of diaphragm which increases the volume of thoracic chamber in the antero-posterior axis. The contraction of external inter-costal muscles causes an increase in the volume of the thoracic chamber. We have the ability to increase the strength of inspiration and expiration with the help of additional muscles in abdomen. Contraction of internal inter-costal muscles occur during forceful expiration.

155. Answer (3)

Hint: Medulla oblongata regulates respiration.

Sol.: Aortic arch and carotid artery are peripheral chemoreceptors for regulation of breathing. They can recognise change in CO₂ and H⁺ concentration and send necessary signals to the rhythm centre (Medulla oblongata).

156. Answer (1)

Hint: Nasal chamber opens into pharynx**Sol.:** The nasal chamber opens into the pharynx, a portion of which is the common passage for food and air. The pharynx opens through the larynx region into the trachea. Trachea divides at the level of 5th thoracic vertebra into a right and left primary bronchi. Each bronchi undergoes repeated division to form the secondary and tertiary bronchi and initial bronchioles ending up in very thin terminal bronchioles. Each terminal bronchiole gives rise to a number of very thin irregular-walled and vascularised bag-like structures called alveoli.

157. Answer (1)

Hint: Venous blood is the deoxygenated blood.**Sol.:** Venous blood has more CO₂ and more H⁺ which leads to low pH as compared to arterial blood. Pulmonary vein carries oxygenated blood.

158. Answer (1)

Hint: Inspiration and expiration is included in breathing**Sol.:** Breathing involves two stages: inspiration of O₂ rich atmospheric air and expiration of CO₂ rich alveolar air.Cellular respiration is defined as oxidation of food to form CO₂, H₂O and energy.

159. Answer (1)

Hint: Incomplete cartilaginous rings are absent in exchange part.**Sol.:** The trachea, primary, secondary and tertiary bronchi and initial bronchioles are supported by incomplete cartilaginous rings. These are absent in terminal bronchioles, alveoli and their ducts (alveolar ducts).

160. Answer (4)

Hint: Carbonic anhydrase**Sol.:** Enzyme 'X' is carbonic anhydrase which belongs to class IV category of enzymes. Carbonic anhydrase accelerates the reaction rate by about 10 million times. Carbonic anhydrase facilitates reaction in forward direction in tissue due to high pCO₂, low pO₂ and more H⁺. Reaction moves in backward direction at alveoli due to high pO₂, low pCO₂ and less H⁺. Carbonic anhydrase is not present in WBCs.

161. Answer (4)

Hint: Spirometer do not measure residual volume**Sol.:** The volume of air involved in breathing movements can be estimated by using a spirometer which helps in clinical assessment of pulmonary function. FRC, TLC and RV cannot be measured with the help of a simple spirometer.

162. Answer (3)

Hint: Dome shaped structure**Sol.:** Normal expiration is a passive process as relaxation of muscle occurs. The thoracic chamber is formed dorsally by vertebral column, ventrally by sternum, laterally by ribs and on the lower side by dome-shaped diaphragm.

163. Answer (2)

Hint: Respiratory minute volume = Breathing rate × tidal volume.**Sol.:** A healthy human breathes 12-16 times/min in resting conditions. Tidal volume is approximately 500 mL.

So, Respiratory minute volume (RMV) =

TV × Respiratory rate

$$= 500 \times (12-16)$$

$$= 6000-8000 \text{ mL per}$$

minute

Inspiratory reserve volume = 2500-3000 mL

Expiratory reserve volume = 1000-1100 mL

Residual volume = 1100-1200 mL

164. Answer (1)

Hint: Intra-pulmonary pressure is less than atmospheric pressure.**Sol.:** Inspiration can occur if the pressure within the lungs *i.e.* intra-pulmonary pressure is less than the atmospheric pressure *i.e.*, there is a negative pressure in the lungs with respect to atmospheric pressure.

165. Answer (1)

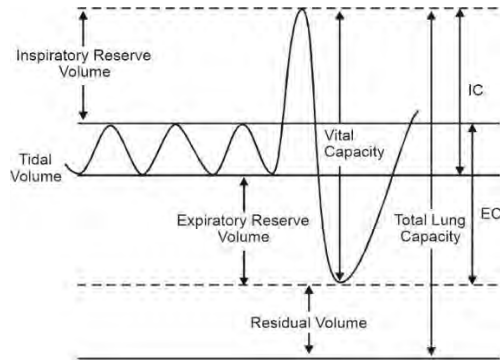
Hint: VC = ERV+TV+IRV**Sol.:** EC = TV+ ERV

EC = FRC-RV+TV

TLC = RV+ERV+TV+IRV

VC = ERV+TV+IRV

IC = IRV+TV



166. Answer (1)

Hint: Least toxic form of nitrogenous waste

Sol.: Land snails-Uricotelic.

Mammals, many terrestrial amphibians and marine fishes mainly excrete urea, hence are ureotelic animals.

167. Answer (2)

Hint: Blood vessel which carries blood away from heart.

Sol.: During the process of haemodialysis, the blood drained from a convenient artery is pumped into a dialysing unit called artificial kidney. Blood drained from convenient artery is pumped into a dialysing unit after adding an anticoagulant like heparin.

168. Answer (3)

Hint: Insects have Malpighian tubules.

Sol.: • Protonephridia or flame cells are excretory structures in platyhelminths. (Flatworms e.g. *Planaria*)

- Nephridia are tubular excretory structures of earthworms (*Pheretima*) and other annelids.
- Malpighian tubules are the excretory structures of most of the insects including cockroaches (*Periplaneta*).
- Antennal glands or green glands perform the excretory function in crustaceans like prawns (*Palaemon*).

169. Answer (3)

Hint: Exclude conditions associated with diabetes mellitus.

Sol.: Presence of glucose (glycosuria) and ketone bodies (ketonuria) in urine are indicative of diabetes mellitus. Malfunctioning of kidneys can lead to accumulation of urea in blood, a condition

called uremia. An impairment affecting synthesis or release of ADH results in a diminished ability of the kidney to conserve water leading to water loss and dehydration (diuresis).

170. Answer (2)

Hint: Counter current mechanism becomes impaired.

Sol.: Loop of Henle, along with vasa recta of juxtamedullary nephrons participates in counter current mechanism that leads to creation of concentration gradient in the medullary interstitium. So, more dilute urine will be produced upon removal of loop of Henle as less water is reabsorbed

171. Answer (1)

Hint: Osmolarity increases from renal cortex to renal medulla.

Sol.: The flow of filtrate in the two limbs of Henle's loop and vasa recta is in opposite direction and thus forms a counter current. The flow of blood through the two limbs of vasa recta is also in a counter current pattern. The proximity between the Henle's loop and vasa recta, as well as the counter current in them help in maintaining an increasing osmolarity towards the inner medullary interstitium.

172. Answer (2)

Hint: Part of nephron present in cortex of kidney

Sol.: Conditional reabsorption of Na^+ and water takes place in DCT. DCT is also capable of reabsorption of HCO_3^- and selective secretion of hydrogen and potassium ions and NH_3 to maintain the pH and sodium-potassium balance in blood.

173. Answer (3)

Hint: Broad funnel shaped space

Sol.: The DCTs of many nephrons join to form a common collecting duct many of which converge and ultimately open into the renal pelvis through the medullary pyramids in the calyces. Inside the kidney, there are two zones, an outer cortex and an inner medulla. In humans, the excretory system consists of one pair of kidneys, a pair of ureters, a urinary bladder and a urethra. Renal columns are invagination of cortex into medulla.

174. Answer (2)

Hint: Concentrating segment.

Sol.: The ascending limb of loop of Henle is impermeable to water but allows transport of electrolytes actively or passively. Descending limb of loop of Henle is almost impermeable to electrolytes. Counter current mechanism operates in Henle's loop and vasa recta. DCT has hypotonic glomerular filtrate with respect to blood plasma. The epithelial cells of Bowman's capsule called podocytes are arranged in an intricate manner.

175. Answer (1)

Hint: 70-80 per cent of electrolytes and water are reabsorbed by PCT.

Sol.: Glomerular filtrate in PCT is isotonic to blood plasma. Nearly all of the essential nutrients and 70-80 per cent of electrolytes and water are reabsorbed by this segment. Fluid present in descending limb of loop of Henle is hypertonic to the blood plasma.

176. Answer (3)

Hint: Glomerular filtrate is proteinless plasma

Sol.: Blood is filtered so finely through filtration slits that almost all the constituents of the plasma except the proteins pass onto the lumen of the Bowman's capsule. Therefore, it is considered as a process of ultra filtration.

Globulins and fibrinogens are proteins.

177. Answer (3)

Hint: Renin stimulates glomerular blood flow

Sol.: A fall in GFR can activate JG cells to release renin which converts angiotensinogen in blood to angiotensin I and further to angiotensin II. Angiotensin II, being a powerful vasoconstrictor, increases the glomerular blood pressure and thereby bring the GFR back to normal.

178. Answer (1)

Hint: The ascending limb is impermeable to water

Sol.: The ascending limb of loop of Henle is impermeable to water but allows transport of electrolytes actively or passively. Therefore, as the concentrated filtrate pass upward, it gets diluted due to the passage of electrolytes to the medullary fluid.

179. Answer (1)

Hint: Close proximity between Henle's loop and vasa recta

Sol.: NaCl transported by the ascending limb of Henle's loop is exchanged with the descending limb of vasa recta. NaCl is returned to the interstitium by the ascending portion of vasa recta. The proximity between Henle's loop and vasa recta as well as counter current in them help in maintaining an increasing osmolarity towards inner medullary interstitium *i.e.*, from 300 mOsmol L⁻¹ to 1200 mOsmol L⁻¹. This gradient is mainly caused by NaCl and urea.

180. Answer (4)

Hint: Secretion of sebaceous gland

Sol.: Sweat produced by the sweat glands is a watery fluid containing NaCl, small amounts of urea, lactic acid, *etc.* Though the primary function of sweat is to facilitate a cooling effect on body surface, it also helps to remove some of the wastes.

Sebaceous glands eliminate certain substances like sterols, hydrocarbons and waxes through sebum.

