All India Aakash Test Series for NEET - 2027

OPEN MOCK TEST - I

Click here for Code-J Sol.

Test Date : 22/03/2026

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

1. Answer (3)

Hint: Use principle of homogeneity

Sol.: Only those physical quantities which are having same dimensional formula can be added or subtracted, therefore $[a] = [t^2]$

$$[F] = \frac{[t^2]}{[b]} \Rightarrow [b] = \left[\frac{t^2}{F}\right]$$

$$\therefore \frac{[a^2]}{[b]} = [t^2]^2 \times \left[\frac{F}{t^2}\right] = [F][t^2]$$

$$\left[\frac{a^2}{b}\right] = [MLT^{-2}][T^2] = [ML]$$

2. Answer (4)

Hint: Orbital speed, $v_0 = \sqrt{\frac{GM}{R}}$

Sol.: • Since both the satellites are orbiting in same orbit, their orbital speeds must be equal.

• Kinetic energy = $\frac{1}{2}m \times v_0^2$

If mass of both satellites is same, then the kinetic energy would be equal.

• Potential energy = $\frac{-GMm}{R}$

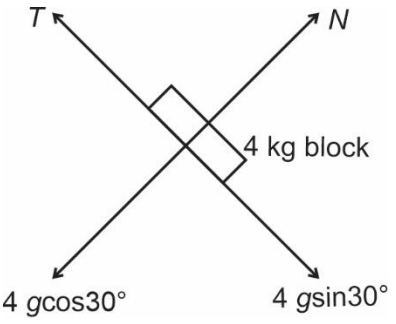
Since, it is not given that both the satellites are of same mass, hence their potential energy could be same or different.

3. Answer (1)

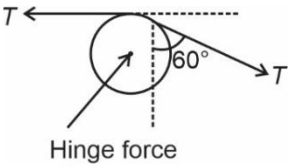
Hint: Net force on the pulley is zero.

Sol.: $T = 4\,g\sin30°$

$$T = 4 \times 10 \times \frac{1}{2} = 20 \text{ N}$$



FBD of pulley:



Net force due to tension = Hinge force

Net force due to tension

$$= \sqrt{T^2 + T^2 + 2T^2\cos(90° + 60°)}$$

$$T_{net} = \sqrt{T^2 + T^2 + 2T^2 \times \left(\frac{-\sqrt{3}}{2}\right)}$$

$$= \sqrt{2T^2 - \sqrt{3}T^2} = T\sqrt{2 - \sqrt{3}}$$

$\therefore$ Hinge force = $20\sqrt{2 - \sqrt{3}}$ N

4. Answer (3)

Hint & Sol.: Property of standing wave : amplitudes of different particles are different in a standing wave.

5. Answer (1)

Hint: First law of thermodynamics $\Delta Q = W + \Delta U$

Sol.: Under constant pressure,

Heat supplied $Q = \Delta U + P\Delta V$

Given $Q_x = Q_y$

$\Delta U_x = \Delta U_y$

$P_x = P_y$

$\therefore P_x\Delta V_x = P_y\Delta V_y \Rightarrow \Delta V_x = \Delta V_y$

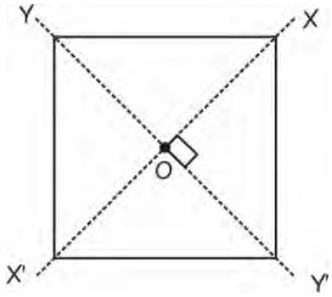
$$\pi r_x^2 \Delta h_x = \pi r_y^2 \Delta h_y$$

$$\frac{r_x^2}{r_y^2} = \frac{\Delta h_y}{\Delta h_x} = \frac{10}{20} \Rightarrow \frac{r_x}{r_y} = \frac{1}{\sqrt{2}}$$

6. Answer (2)

Hint: Use perpendicular and parallel axis theorems.

Sol.: Complete this sheet to form a square of side a and mass $2M$



Assume z-axis is perpendicular to the plane of sheet.

Moment of inertia about z-axis passing through point O is $\frac{(2M)(a^2+a^2)}{12}=\frac{Ma^2}{3}$

Due to symmetry $I_{xx'}=I_{yy'}$

From perpendicular axis theorem:

$I_{xx'}+I_{yy'}=I_{zz'}$

$$2I_{xx'}=I_{zz'} \Rightarrow I_{xx'}=\frac{Ma^2}{3}\times\frac{1}{2}=\frac{Ma^2}{6}$$

Take out the half sheet which was introduced earlier.

$$\therefore \quad (I_{xx'})_{\text{net}}=\frac{Ma^2}{6}\times\frac{1}{2}=\frac{Ma^2}{12}$$

7. Answer (1)

Hint: Use work energy theorem

Sol.: $W_{\text{net}}=\Delta\text{KE}$

$$W_{\text{net}}=\int_{x_0}^{2x_0}F\cdot dx=\int_{x_0}^{2x_0}2\sqrt{x}dx$$

$$W_{\text{net}}=\left[2\frac{x^{3/2}}{3/2}\right]_{x_0}^{2x_0}=\frac{4}{3}[(2x_0)^{3/2}-(x_0)^{3/2}]$$

$$\therefore \Delta\text{KE}=\frac{4}{3}\left(2\sqrt{2}-1\right)x_0^{3/2}$$

8. Answer (4)

Hint: Use formula : $\left(\frac{C_p}{C_v}\right)_{\text{mix}}=\frac{n_1C_{p_1}+n_2C_{p_2}}{n_1C_{v_1}+n_2C_{v2}}$

Sol.: $(C_v)_{\text{diatomic}}=\frac{5}{2}R;(C_p)_{\text{diatomic}}=\frac{7}{2}R$

$(C_v)_{\text{monoatomic}}=\frac{3}{2}R;(C_p)_{\text{monoatomic}}=\frac{5}{2}R$

$$\therefore \quad \gamma_{\text{mix}}=\frac{3\times\frac{7}{2}R+2\times\frac{5}{2}R}{3\times\frac{5}{2}R+2\times\frac{3}{2}R}=\frac{21+10}{15+6}=\frac{31}{21}$$

9. Answer (3)

Hint & Sol.: In SHM, total mechanical energy of the system remain conserved.

10. Answer (1)

Hint & Sol.: Area under acceleration-time graph is equal to change in velocity.

11. Answer (1)

Hint: Young's modulus, $Y=\frac{\text{Thermal stress}}{\text{Thermal strain}}$

Sol.: Stress = $Y\times$ strain ...(i)

$\Delta L=L_0\,\alpha\,\Delta T$

$\frac{\Delta L}{L_0}$ = strain = $\alpha\,\Delta T$

$\therefore\ \sigma=Y\times\alpha\Delta T$

$$\frac{\sigma_1}{\sigma_2}=\frac{\Delta T_1}{\Delta T_2}=1$$

12. Answer (1)

Hint: For uniform acceleration, average velocity is given by

$$<\vec{v}>=\frac{\vec{u}+\vec{v}}{2}$$

Sol.: Initial velocity, $\vec{u}=u\cos\theta\hat{i}+u\sin\theta\hat{j}$

Final velocity, $\vec{v}=u\cos\theta\hat{i}-u\sin\theta\hat{j}$

$$<\vec{v}>=\frac{\vec{u}+\vec{v}}{2}=\frac{2u\cos\theta\hat{i}}{2}=u\cos\theta\hat{i}$$

$u\cos\theta=10\sqrt{3}$ m/s

$20\cos\theta=10\sqrt{3} \Rightarrow \theta=30^\circ$

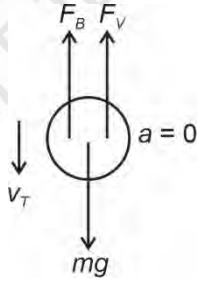
$$\therefore\ T=\frac{2u\sin\theta}{g}=\frac{2\times20\times\sin30^\circ}{10}=2\text{ s}$$

13. Answer (2)

Hint: At terminal velocity, net force on the ball will be zero.

Sol.: Volume of the ball

$$V=\frac{4}{3}\pi r^3=\frac{4}{3}\times\pi\times(5\times10^{-3})^3$$



Mass = $\rho_{\text{ball}}\times\frac{V}{2}$

= 3000 × $\frac{1}{2}\times\frac{4}{3}\pi\times125\times10^{-9}$

= 250 $\pi\times10^{-6}$ kg

Viscous force on ball $F_v=6\pi\eta r v_T$

$=6\pi\times10^{-3}\times5\times10^{-3}\times v_T$

$=30\pi\times10^{-6}\times v_T$

Buoyant force on ball

$F_B = \rho Vg = 10^3 \times \frac{4}{3}\pi \times 125 \times 10^{-9} \times 10$

$= \frac{4}{3}\pi \times 125 \times 10^{-5}$

At terminal velocity :

$F_B + F_V = mg$

$\frac{4}{3}\pi \times 125 \times 10^{-5} + 30\pi \times 10^{-6} \times v_T$

$= 250\pi \times 10^{-6} \times 10$

$\frac{3v_T}{100} = \frac{25}{10} - \frac{5}{3}$

$v_T = \frac{250}{9}$ m/s

14. Answer (4)

Hint: In series combination, rate of flow of heat remains same.

Sol.: $\frac{dQ}{dt} = kA\frac{dT}{dx}$

For the given condition : $\frac{dT}{dx} \propto \frac{1}{k}$

Slope of graph for 1st rod > slope of graph for 2nd rod.

15. Answer (2)

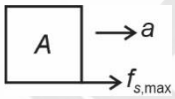
Hint: To get maximum value of m, take friction force between blocks A and B equal to $f_{s,\max}$.

Sol.: Maximum value of friction on block A is

$f_{s,\max} = \mu \times N = \frac{1}{2} \times 3\,g = 15$ N

$f_{s,\max} = m \times a$

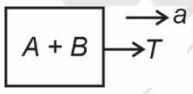
$15 = 3 \times a \Rightarrow a = 5$ m/s^2



Assuming block A and B to be one system:

$T = m_T \times a$

$T = (3 + 5) \times 5 = 40$ N

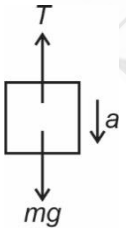


For block of mass m

$mg - T = m \times a$

$m \times (10 - 5) = T$

$m = \frac{40}{5} = 8$ kg



16. Answer (1)

Hint: Frequency of air column : $f \propto v \propto \sqrt{T}$

Sol.: Frequency of air column : $f = k\sqrt{T}$

Beat frequency, $\Delta f = f_1 - f_2$

$4 = k\sqrt{324} - f_T$ ...(i)

$1 = k\sqrt{289} - f_T$ ...(ii)

$\frac{4 + f_T}{1 + f_T} = \frac{k\sqrt{324}}{k\sqrt{289}} = \frac{18}{17}$

$17(4 + f_T) = 18(1 + f_T)$

On solving

$f_T = 50$ Hz

17. Answer (3)

Hint & Sol.: When a drop of liquid splits into number of smaller drops, then total surface area increases which results in increase of surface energy. Increase in surface energy means the original liquid has to absorb energy from the surrounding.

18. Answer (2)

Hint & Sol.: Centre of mass of a rod will lie towards the heavier side. Hence $x_{cm} > 50$ cm.

19. Answer (4)

Hint: Use equation : $\tau_{ext} = \frac{\Delta L}{\Delta t}$

Sol.: $\tau_{ext} = \frac{\Delta L}{\Delta t} \Rightarrow \tau = \frac{5L_0 - L_0}{4} = L_0$

20. Answer (3)

Hint: Use method of dimensional analysis.

Sol.: Linear momentum = kg m s^{-1}

$\Rightarrow [P] = [MLT^{-1}]$

Density = kg m^{-3} $\Rightarrow [D] = [ML^{-3}]$

Velocity = m s^{-1} $\Rightarrow [V] = [LT^{-1}]$

Area = m^2 $\Rightarrow [A] = [L^2]$

Let $[P] = [D]^x[V]^y[A]^z$

$[MLT^{-1}] = [ML^{-3}]^x[LT^{-1}]^y[L^2]^z$

$x = 1,\ -3x + y + 2z = 1,\ -y = -1$

On solving, we get

$x = 1, y = 1, z = \frac{3}{2}$

$\therefore\ [P] = [DVA^{3/2}]$

21. Answer (2)

Hint: Apply equations of uniformly accelerated motion.

Sol.: From $t = 0$ to $t = 3$ s ($a = 2$ m/s^2)

$v = u + at \Rightarrow v_3 = 0 + 2 \times 3 = 6$ m/s

$\Delta x = ut + \frac{1}{2}at^2 \Rightarrow \Delta x = 0 + \frac{1}{2} \times 2 \times 3^2 = 9$ m

At $t = 0$, $x_0 = 10$ m $\Rightarrow$ at $t = 3$ s, $x = 19$ m

For $t \geq 3$ s, $a = -2$ m/s^2

Displacement = Final position – initial position

$d = 3 - 19 = -16$ m

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

$-16 = 6t + \frac{1}{2}(-2) \times t^2$

$t^2 - 6t - 16 = 0 \Rightarrow t^2 - 8t + 2t - 16 = 0$

$t(t-8) + 2(t-8) = 0$

$t = 8$ s ($\because$ Time can't be negative)

Total time = 3 + 8 = 11 s

22. Answer (1)

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

Sol.: Given, $s = 3t^2 - 2$

$v = \frac{ds}{dt} = 6t$

$P = 5 \times (6 \times 3) = 5 \times 18 = 90$ W

23. Answer (3)

Hint & Sol.: In SHM, total mechanical energy remains conserved. At mean position, potential energy become minimum and therefore kinetic energy becomes maximum.

24. Answer (2)

Hint: Apply energy conservation principle

Sol.: Orbital speed $v_0 = \sqrt{\frac{GM}{r}} = \sqrt{\frac{GM}{2R}}$

Energy conservation : $U_i + K_i = U_f + K_f$

$$\frac{-GMm}{R} + E = \frac{-GMm}{2R} + \frac{1}{2}m \times \left(\sqrt{\frac{GM}{2R}}\right)^2$$

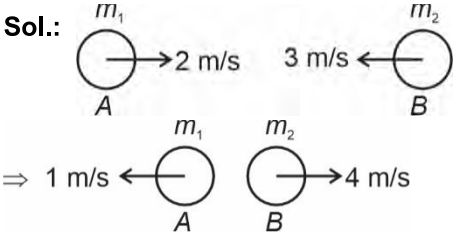
$$\frac{-GMm}{R} + E = \frac{-GMm}{2R} + \frac{1}{2}m \times \frac{GM}{2R}$$

$$E = \frac{GMm}{2R} + \frac{GMm}{4R} = \frac{3}{4}\frac{GMm}{R}$$

25. Answer (4)

Hint: Apply momentum conservation to find masses. Also use formula of coefficient of restitution.

Sol.:



Momentum conservation :

$m_1 \times 2 + m_2(-3) = m_1(-1) + m_2 \times 4$

Take $m_1 = 2$ kg

$4 - 3m_2 = -2 + 4m_2$

$7m_2 = 6 \Rightarrow m_2 = \frac{6}{7}$kg

Coefficient of restitution :

$$e = \left|\frac{v_2 - v_1}{u_2 - u_1}\right| = \frac{4-(-1)}{2-(-3)} = \frac{5}{5}$$

$e = 1 \Rightarrow$ Collision is perfectly elastic.

26. Answer (3)

Hint: Dot product of two perpendicular vectors is zero.

Sol.: $\vec{A} \cdot \vec{B} = 0 \Rightarrow \vec{A} \perp \vec{B}$

$\vec{A} \cdot \vec{C} = 0 \Rightarrow \vec{A} \perp \vec{C}$

Let $\vec{R} = \vec{A} \times \vec{C}$, then $\vec{R} \perp \vec{A}$ and $\vec{R} \perp \vec{C}$

$\therefore$ $\vec{A} \times \vec{C}$ is perpendicular to $\vec{A}$

Since $\vec{B}$ and $\vec{C}$ are perpendicular to $\vec{A}$, therefore $\vec{B} + \vec{C}$ will also be perpendicular to $\vec{A}$

Take dot product of $\vec{A}$ and $(\vec{A} + \vec{C})$:

$\vec{A} \cdot (\vec{A} + \vec{C}) = \vec{A} \cdot \vec{A} + \vec{A} \cdot \vec{C} = A^2 + 0 \neq 0$

$\therefore$ $\vec{A}$ and $\vec{A} + \vec{C}$ are not perpendicular.

27. Answer (2)

Hint: Use equation :

Energy supplied = $mL_f + ms\Delta T$

Sol.: Energy supplied = 0.25 × 3600 = 900 J

1 cal = 4.2 J

$\therefore$ 900 J = 214.3 cal

Energy needed to melt ice completely

$Q = mL_f = 10\text{ g} \times 80\ \frac{\text{cal}}{\text{g}} = 800$ cal

Since energy supplied is less than 800 cal, hence ice will not melt completely. In fact, the given energy is not enough to melt even half of the ice block.

28. Answer (1)

Hint & Sol.: Stress = $Y \times$ strain

$\frac{Mg}{A} = Y \times \frac{l}{l_0} \Rightarrow Y = \frac{Mgl_0}{A \times l}$

29. Answer (2)

Hint: Area under P - V graph gives work done.

Sol.: First law of thermodynamics :

$Q = \Delta U + W$

$W = \int PdV$ = Area under P - V graph

$$W = \frac{1}{2}(2P_0 + P_0)(3V_0 - V_0) = 3P_0V_0 \quad \ldots(i)$$

$$\Delta U = nC_v\Delta T = n \times \frac{3}{2}R\Delta T = \frac{3}{2}nR\Delta T \quad \ldots(ii)$$

For an ideal gas $PV = nRT$

$P_fV_f - P_iV_i = nR\Delta T$

$\Rightarrow nR\Delta T = 3P_0V_0 - 2P_0V_0 = P_0V_0 \quad \ldots(iii)$

$$\Delta U = \frac{3}{2}P_0V_0$$

$$\therefore Q = \frac{3}{2}P_0V_0 + 3P_0V_0 = \frac{9}{2}P_0V_0$$

30. Answer (3)

Hint & Sol.: SI unit of pressure is pascal.

31. Answer (4)

Hint & Sol.: Kinetic energy and root mean square speed of an ideal gas is a function of temperature only.

32. Answer (3)

Hint: Gravitational force is always attractive in nature.

Sol.: • Potential energy, $U = \frac{-Gm_1m_2}{r}$

$\therefore$ Potential energy of three-point mass system cannot become zero.

• Three-point masses can be arranged in a line such that one mass in the middle can remain in equilibrium.

33. Answer (1)

Hint: Draw FBD of both the blocks.

Sol.: It can easily be concluded that $a_1 = a_2 = g\sin\theta$.

34. Answer (2)

Hint & Sol.: First resonance, $l_1 = \frac{\lambda}{4}$

Second resonance, $l_2 = \frac{3\lambda}{4}$

If l_1 = 20 cm, then $l_2 = 3 \times 20 = 60$ cm

35. Answer (4)

Hint & Sol.: • PV = constant $\Rightarrow$ Isothermal process

When $\Delta T = 0 \Rightarrow \Delta U = nC_v\Delta T = 0$

• $C = C_v \Rightarrow$ Isochoric process $\Rightarrow W = 0$

• $C = C_v + R \Rightarrow$ Isobaric process

$\therefore Q = \Delta U + P\Delta V$

• PV^γ = constant $\Rightarrow$ Adiabatic process $\Rightarrow Q = 0$

36. Answer (4)

Hint: Apply formula $\vec{R}_{cm} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2 + m_3\vec{r}_3}{m_1 + m_2 + m_3}$

Sol.: $\vec{r}_1 = a\hat{i}, \quad \vec{r}_2 = 2a\hat{i}$

$$\vec{r}_3 = (a + a\cos 60^\circ)\hat{i} + (a\sin 60^\circ)\hat{j} = \frac{3a}{2}\hat{i} + \frac{\sqrt{3}a}{2}\hat{j}$$

$$\vec{R}_{cm} = \frac{ma\hat{i} + m2a\hat{i} + m\left(\frac{3a}{2}\hat{i} + \frac{\sqrt{3}a}{2}\hat{j}\right)}{3m}$$

$$\vec{R}_{cm} = \frac{m\left(a + 2a + \frac{3a}{2}\right)\hat{i} + m\left(0 + 0 + \frac{\sqrt{3}a}{2}\right)\hat{j}}{3m}$$

$$\vec{R}_{cm} = \frac{\frac{9a}{2}m\hat{i} + \frac{\sqrt{3}a}{2}m\hat{j}}{3m}$$

$$R_{cm} = \left(\frac{3a}{2}, \frac{a}{2\sqrt{3}}\right)$$

37. Answer (4)

Hint: v_{rms}, v_{avg} and v_{mp} are all dependent on temperature.

Sol.: $v_{rms} = \sqrt{\frac{3RT}{M}} \Rightarrow v_{rms} \propto \sqrt{T}$

$v_{mp} = \sqrt{\frac{2RT}{M}} \Rightarrow v_{mp} \propto \sqrt{T}$

$v_{avg} = \sqrt{\frac{8RT}{\pi M}} \Rightarrow v_{avg} \propto \sqrt{T}$

38. Answer (1)

Hint: Take LCM of time period of both the motions

Sol.: $x_1 = A\sin\omega t$

$T_1 = \frac{2\pi}{\omega}$

$x_2 = A\sin(2\omega t)$

$T_2 = \frac{2\pi}{2\omega} = \frac{\pi}{\omega}$

LCM of T_1 and T_2 is $\frac{2\pi}{\omega}$

39. Answer (4)

Hint: Use equation $2as = v^2 - u^2$

Sol.: Given, $v_i = v$, $v_f = 2\sqrt{2}v$

$2as = v^2 - u^2$

$2\times(-g)\times(-h) = (2\sqrt{2}v)^2 - v^2$

$h = \frac{7v^2}{2g}$

40. Answer (3)

Hint & Sol.: In small droplets, the gravitational force is lesser and hence less distortion of shape take place.

41. Answer (1)

Hint: $\vec{v}_{\text{rain/man}} = \vec{v}_{\text{rain/}g} - \vec{v}_{\text{man/}g}$

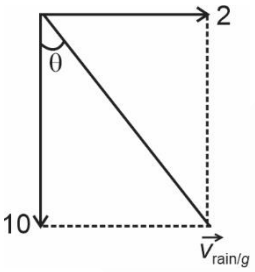
Sol.: Given, $\vec{v}_{\text{man/}g} = 2\hat{i}$ m/s

$\vec{v}_{\text{rain/man}} = -10\hat{j}$ m/s

$\vec{v}_{\text{rain/}g} = \vec{v}_{\text{rain/man}} + \vec{v}_{\text{man/}g}$

$\vec{v}_{\text{rain/}g} = (-10\hat{j} + 2\hat{i})$ m/s

$\tan\theta = \frac{2}{10} \Rightarrow \theta = \tan^{-1}\left(\frac{1}{5}\right)$



42. Answer (2)

Hint: Formula of $H_{max} = \frac{u_y^2}{2g}$

Sol.: $H_{max} = \frac{u_y^2}{2g}$ and $H_1 = H_2$

$\therefore$ Vertical component of velocity is same for both projectiles.

Time of flight, $T = \frac{2u\sin\theta}{g} = \frac{2u_y}{g}$

$\therefore\ T_1 = T_2$

43. Answer (4)

Hint: Maximum horizontal range is achieved at $h = \frac{H}{2}$

Sol.: Range $R = v\sqrt{\frac{2(H-h)}{g}} = \sqrt{2gh}\sqrt{\frac{2(H-h)}{g}}$

Put $h = \frac{H}{2}$ for maximum horizontal range

$R_{max} = \sqrt{2g\times\frac{H}{2}}\sqrt{\frac{2\times\frac{H}{2}}{g}} = \frac{2\times H}{2} = H$

44. Answer (2)

Hint & Sol.: A blackbody has emissivity $e = 1$, the maximum possible, while metals have lower emissivity than a blackbody.

$\left(\frac{dQ}{dt}\right)_{\text{radiation}} = eA\sigma T^4$

Therefore, blackbody radiates more energy at same temperature.

45. Answer (2)

Hint: Metallic scale would expand according to the formula $L = L_0(1 + \alpha\Delta T)$

Sol.: Let the new reading of the metallic scale is L_0 at 80°C.

Portion of metallic scale of actual length L_0 at 20°C, expands to length 100 cm at 80°C.

$L_i = L_0$ and $L_f = 100$ cm

$L_f = L_i(1 + \alpha\Delta T)$

$100 = L_0[1 + 10^{-3}\times(80 - 20)]$

$100 = L_0(1 + 0.06)$

$\Rightarrow L_0 = 94.34$ cm

[CHEMISTRY]

46. Answer (1)

Hint: Time taken for one complete revolution of electrons in an orbit $\propto \frac{n^3}{z^2}$

Sol.: $\frac{(t_2)_{He^+}}{(t_3)_H} = \left(\frac{2}{3}\right)^3\times\left(\frac{1}{2}\right)^2$

$= \frac{2}{27}$

47. Answer (3)

Hint: Given graph in the question is drawn for 2*s* orbital.

Sol.: For plots of radial probability function vs r number of peaks are given by n – l.

48. Answer (4)

Hint: 13th electron of Ca enters into 3p subshell.

Sol.: Ca(Z = 20) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

3p subshell, n = 3

l = 1

m = 1, 0 – 1

s = +1/2

49. Answer (1)

Hint: Total number of spectral lines $= \frac{\Delta n(\Delta n+1)}{2}$

$\Delta n = n_2 - n_1$

Sol.:

5 to 2	$\Delta n = 3$	number of spectral lines $= \frac{3\times4}{2} = 6$
6 to 1	$\Delta n = 5$	number of spectral lines $= \frac{5\times6}{2} = 15$
4 to 3	$\Delta n = 1$	number of spectral lines $= \frac{1\times2}{2} = 1$
3 to 1	$\Delta n = 2$	number of spectral lines $= \frac{2\times3}{2} = 3$

50. Answer (1)

Hint: Lewis acids are electron pair acceptor species.

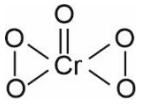
Sol.: As the size of halide ion increases, back bond strength decreases. Therefore Lewis acidic nature increases.

51. Answer (2)

Hint: Water gas is a mixture of CO and H_2.

Sol.: $C(s) + H_2O(g) \xrightarrow[473-1273\,K]{} CO(g) + H_2(g)$

52. Answer (3)

Hint: CrO_5;  Cr is in +6 oxidation state.

Sol.: • $CaOCl_2 \rightarrow Ca^{2+} + Cl^- + OCl^-$

• $Cr_2O_7^{2-}$ 2x + 7(–2) = –2

x = oxidation number of Cr in $Cr_2O_7^{2-}$

x = +6

53. Answer (1)

Hint: Equimolar species of highest n-factor will require maximum amount of $KMnO_4$

Sol.: • For $KMnO_4$

MnO_4^- changes to Mn^{2+}

Species	n-factor
$Fe_2(C_2O_4)_3$	6
$NaNO_2$	2
$Fe(OH)_2$	1
Cu_2Cl_2	2

54. Answer (2)

Hint: $E^\circ_{cell} = \left(E^\circ_R\right)_c - \left(E^\circ_R\right)_a$

Sol.: $E^\circ_{cell} = 0.34 + 0.25$

$E^\circ_{cell} = 0.59$ V

Since, in the given cell, Cu is taken as cathode which has more tendency to gain electrons and Ni is taken as anode which has less tendency to gain electrons, so, the reaction would be feasible.

55. Answer (1)

Hint: n-factor is the number of electron lost or gained per mol of substance.

Sol.: FeC_2O_4 contains Fe^{+2} ions and $C_2O_4^{2-}$ ions which changes to Fe^{+3} and CO_2 respectively in acidic medium with $KMnO_4$.

$Fe^{2+} \rightarrow Fe^{+3} + e^-$ n-factor = 1

$C_2O_4^{2-} \rightarrow CO_2 + 2e^-$ n-factor = 2

n-factor for FeC_2O_4 = 2 + 1 = 3

56. Answer (4)

Hint: Enthalpy of neutralization is the amount of heat evolved when 1 gram equivalent of an acid is neutralized by 1 gram equivalent of base.

Sol.: Enthalpy of neutralization for CH_3COOH and NaOH in aqueous medium is less than 57.1 kJ mol^{-1} because some part of energy is used for dissociation of weak acid.

57. Answer (3)

Hint: In adiabatic process, no heat exchange between system and surrounding.

Sol.: • For adiabatic process,

q = 0

$\Delta U = q + w$

$\Delta U = w$

• For expansion process, w = (–)ve

ΔU = (–)ve = $nC_v\Delta T$

(–)ve = $nC_v(T_2 - T_1)$

$T_2 < T_1$

$T_2 < 300$ K

58. Answer (3)

Hint: $\Delta_r H = \sum$ B.E (Reactants) $- \sum$ B.E (products)

Sol.: $\Delta_r H = \sum$ B.E (Reactants) $- \sum$ B.E (products)

$= B.E_{H-H} + \frac{1}{2} B.E_{O=O} - 2 \times B.E_{O-H}$

$= x + \frac{1}{2} y - 2 \times z$

$= x + \frac{y}{2} - 2z$ kJ/mol

59. Answer (1)

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

If ΔG = (–)ve process is said to be spontaneous

Sol.: • ΔG = (–)ve spontaneous process

• ΔG = (+)ve, non-spontaneous process

• ΔH = (–)ve and ΔS = (–)ve, ΔG = (–)ve at low temperature

• ΔH = (+)ve and ΔS = (+)ve, ΔG = (+)ve at low temperature

60. Answer (1)

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

Sol.: • $\Delta n_g = 0 - 3 - \frac{1}{2}$

$= -\frac{7}{2}$

$\Delta H - \Delta U = \Delta n_g RT$

$= -\frac{7}{2} \times 300 \times 2$

= –2100 cal

61. Answer (4)

Hint: Zr is the element with atomic number 40.

Sol.: • The valence shell electronic configuration of Zr is $4d^2 5s^2$

• Last electron enters into d subshell, so, it is a *d*-block element.

• Highest value of principal quantum = Period number = 5

• Group number = electrons in (n – 1)*d* + electron in n*s*

= 2 + 2 = 4

62. Answer (4)

Hint: Due to stable configuration, Noble gases resist to gain electron(s)

Sol.: For Ne $\Delta_{eg}H$ = +116 kJ/mol

63. Answer (1)

Hint: In case of isoelectronic species, more the positive charge smaller will be the ionic radii.

Sol.: $Mg^{2+} < Na^{+} < N^{3-}$

Mg^{2+} would have high value of effective nuclear charge comparatively, so, has minimum radius.

64. Answer (1)

Hint: To exhibit tautomerism, carbonyl compound must have enolisable hydrogen.

Sol.: • Compound IV has enolisable hydrogen at γ-position.

• Compound II does not have alpha hydrogen.

65. Answer (2)

Hint: $[Fe(SCN)]^{2+}$ is blood red coloured species.

Sol.: • For the detection of N

$$Na_4[Fe(CN)_6] + Fe^{+3} \rightarrow \underset{\text{(Prussian blue)}}{Fe_4[Fe(CN)_6]_3}$$

• For the detection of both S and N

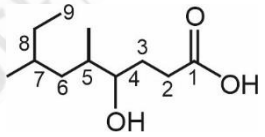
$$Fe^{+3} + SCN^{-} \rightarrow \underset{\text{(Blood red)}}{[Fe(SCN)]^{2+}}$$

• $[Fe(CN)_5NOS]^{4-}$: Violet

• $(NH_4)_3PO_4 \cdot 12MoO_3$: Yellow

66. Answer (4)

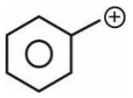
Hint: Parent chain must contain carboxylic acid and it must also contain maximum number of carbon atoms.

Sol.: 

4-Hydroxy-5, 7-dimethylnonanoic acid

67. Answer (2)

Hint: Electronic effects like resonance, hyperconjugation and inductive effect contribute to stability of carbocations.

Sol.: •  is stabilised by resonance

•  is stabilised by resonance

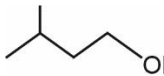
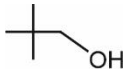
Benzyl carbocation is more stable than allyl carbocation.

•  is stabilised by 9 α – H bonds (hyperconjugation) and positive inductive effect.

• $CH_2 = \overset{\oplus}{C}H$ is the least stable carbocation.

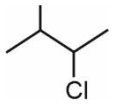
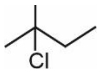
68. Answer (4)

Hint: Compounds having same molecular formula but different alkyl groups on either side of the functional group, are called metamers.

Sol.: •  and  are Chain isomers

• CH_3COOH and $HCOOCH_3$ are Functional group isomerism

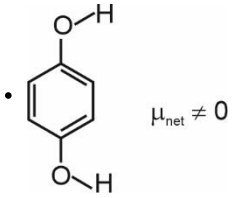
• $CH_3 - O - CH_2 - CH_2 - CH_3$ and $CH_3 - CH_2 - O - CH_2 - CH_3$ are Metamers

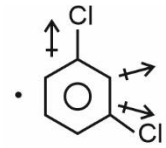
•  and  are Position isomers

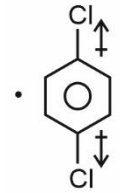
69. Answer (3)

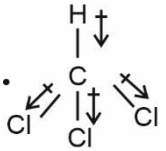
Hint: Symmetrical molecules tend to have zero dipole moment.

Sol.:

•  $\mu_{net} \neq 0$

•  $\mu_{net} \neq 0$

•  $\mu_{net} = 0$

•  $\mu_{net} \neq 0$

70. Answer (3)

Hint: Bond order $= \frac{1}{2}(N_b - N_a)$

N_b : Number of bonding electrons

N_a : Number of anti-bonding electrons

Sol.: Valence shell electronic configuration of molecules is as follows-

• C_2 KK $(\sigma_{2s})^2$ $(\sigma^*_{2s})^2$ $\left(\pi\, 2p_x^2 = \pi 2p_y^2\right)$, diamagnetic

• B_2 KK $(\sigma_{2s})^2$ $(\sigma^*_{2s})^2$ $\left(\pi\, 2p_x^1 = \pi 2p_y^1\right)$, paramagnetic

• N_2 KK $(\sigma_{2s})^2$ $(\sigma^*_{2s})^2$ $\left(\pi\, 2p_x^2 = \pi 2p_y^2\right)\left(\sigma 2p_z^2\right)$, diamagnetic

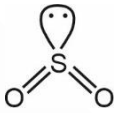
• Li_2 KK $(\sigma_{2s})^2$, diamagnetic

71. Answer (4)

Hint: Molecules with linear geometry would have bond angle 180° and molecules with trigonal planar arrangement with no lone pair of electrons would have bond angle 120°.

Sol.:

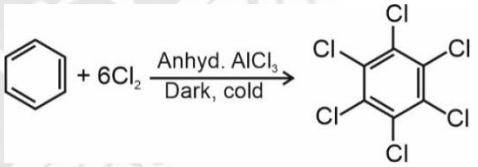
Molecule	Bond angle	Hybridisation
BF_3	120°	sp^2
BeF_2	180°	sp
$HgCl_2$	180°	sp
SO_2	119.5	sp^2



Because of the presence of lone pair of electron at S, bond angle becomes less than 120°.

72. Answer (3)

Hint: Under UV light, $3Cl_2$ molecules added to benzene to give gammaxane.

Sol.: 

73. Answer (3)

Hint: Strength of hydrogen bonding depends upon electronegativity of atom attached to hydrogen.

Sol.: The magnitude of H-bonding is maximum in the solid state and minimum in the gaseous state.

74. Answer (4)

Hint: The hybridisation of N is sp^2 in $N(SiH_3)_3$

Sol.: In $N(SiH_3)_3$, nitrogen donates its lone pair to vacant 3*d* orbital of Si.

75. Answer (2)

Hint: $Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O + CO_2$

Sol.: Number of mmoles of H_2SO_4 = Number of mmoles of Na_2CO_3

= 50 × 0.2

= 10 mmol

Mass of Na_2CO_3 = $10 \times 10^{-3} \times 106$

= 1.06 g

$\frac{\text{Mass of sample} \times 80}{100}$ = 1.06

Mass of sample = $\frac{1.06 \times 100}{80}$ = 1.325 g

76. Answer (1)

Hint: NaOH will neutralise H_2SO_4 to form salt and water.

Sol.: Number of mmoles of NaOH = 10 × 0.1

= 1 mmol

Number of mmoles of H_2SO_4 = 10 × 0.5

= 5 mmol

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

1 mmol 5 mmol

1 – 1 = 0 5 – 0.5 = 4.5

Number of mmoles left of H_2SO_4 = 5 – 0.5

= 4.5 mmol

77. Answer (4)

Hint: 1 molal solution means 1 mole of solute is present in 1 kg solvent.

Sol.: 2 molal = $\frac{0.5 \text{ mole solute}}{x \text{ (kg solvent)}}$

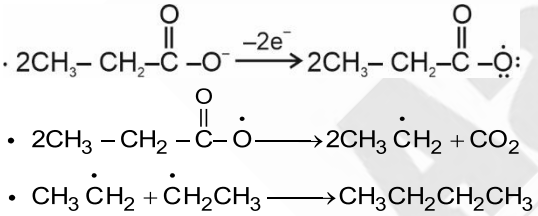
x = 0.25 kg

x = 250 g solvent

78. Answer (3)

Hint: An aqueous solution of sodium salt of a carboxylic acid on Kolbe's electrolysis gives alkane containing even number of carbon atoms at the anode.

Sol.: At anode :



79. Answer (2)

Hint: In presence of organic peroxide, HBr adds to alkene in accordance to Anti-Markovnikov rule.

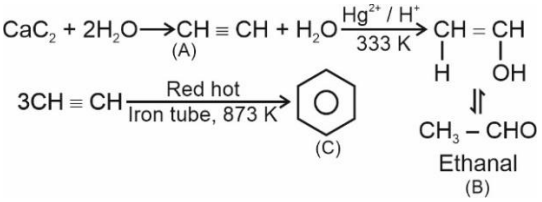
Sol.: X : $CH_3 - \underset{\underset{Br}{|}}{CH} - CH_3$

Y : $CH_3 - CH_2 - CH_2 - Br$

80. Answer (3)

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

Sol.:



81. Answer (4)

Hint: $K_p = \frac{(p_{NO_2})^2}{(p_{N_2O_4})}$

p_{NO_2} = partial pressure of NO_2

$p_{N_2O_4}$ = partial pressure of N_2O_4

Sol.: $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

t = 0 1 bar –

t = equilibrium 1-x 2x

Total pressure at equilibrium = 1.6 = 1 + x

x = 0.6

$p_{N_2O_4}$ = partial pressure of N_2O_4 = 1 – x

= 1 – 0.6

= 0.4 bar

p_{NO_2} = partial pressure of NO_2 = 2x

= 2 × 0.6

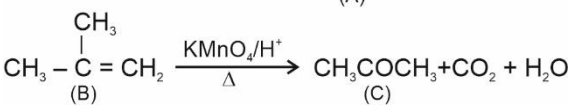
= 1.2 bar

$K_p = \frac{(p_{NO_2})^2}{p_{N_2O_4}} = \frac{(1.2)^2}{0.4} = 3.6$

82. Answer (2)

Hint: Alkanes with tertiary H atom can be oxidised to corresponding alcohols by $KMnO_4$.

Sol.:



83. Answer (2)

Hint: For A_xB_y salt, $K_{sp} = x^x y^y (s)^{x+y}$

Sol.: $Al(OH)_3 \rightleftharpoons \underset{s}{Al^{3+}} + \underset{3s}{3OH^-}$

$K_{sp} = [Al^{3+}][OH^-]^3$

$= S(3S)^3$

$K_{sp} = 27S^4$

$$S = \left(\frac{K_{sp}}{27}\right)^{1/4}$$

84. Answer (4)

Hint: According to Bronsted-Lowry theory, acid is a substance that is capable of donating a H^+ ion.

Sol.: Conjugate base of HSO_4^- is SO_4^{2-}

85. Answer (4)

Hint: Solution of a weak acid and a salt of this weak acid with a strong base is acidic buffer solution.

Sol.: • $\begin{matrix}COOH\\|\\COOH\end{matrix}$ and $\begin{matrix}COOK\\|\\COOK\end{matrix}$ is acidic buffer solution

H_2CO_3 and $NaHCO_3$ is acidic buffer solution

H_3PO_4 and NaH_2PO_4 is acidic buffer solution

86. Answer (3)

Hint: For m_l value to be zero, the value of l can be 0, 1, 2, 3

Sol.: Zn (Z = 30)

Electronic configuration is

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10}$

87. Answer (2)

Hint: SnO, PbO, SnO_2 and PbO_2 are amphoteric oxides.

Sol.: Graphite is thermodynamically most stable allotrope of carbon.

88. Answer (3)

Hint: Generally size increases on moving down the group.

Sol.: Size : C < Si < Ge < Sn < Pb

89. Answer (1)

Hint: Molarity = $\frac{\text{Number of moles of solute}}{\text{Volume of solution (L)}}$

Sol.: Molarity of $AlCl_3$ solution = $\frac{1.335 \times 1000}{133.5 \times 50}$

$= \frac{10^{-2} \times 10^3}{50}$

= 0.2 M

$\underset{0.2\,M}{AlCl_3} \longrightarrow \underset{0.2\,M}{Al^{3+}} + \underset{0.6\,M}{3Cl^-}$

90. Answer (2)

Hint: Presence of electron donating group increases rate of reactivity.

Sol.: • $-NO_2$ is a powerful deactivating group.

• $-CH_3$, $-NH_2$ and $-NHCOCH_3$ are activating groups.

[BIOLOGY]

91. Answer (4)

Hint: Man is classified under Order - Primata.

Sol.: Brinjal – Polymoniales.

Mango – Sapindales.

Wheat - Poales

92. Answer (3)

Hint: Body organization, mode of nutrition and cell wall was used by R.H. Whittaker for his five kingdom classification.

Sol.: Carl Woese used the sequence of 16S rRNA genes for dividing the kingdom Monera into two domains.

93. Answer (2)

Hint: Production of toxins and whirling whip motion is shown by dinoflagellates.

Sol.: None of the photosynthetic protists show formation of fruiting body.

94. Answer (3)

Hint: Pteridophytes require cool, damp and shady places to grow.

Sol.: Pteridophytes also require water for the process of fertilization.

95. Answer (4)

Hint: Gemmae are green, multicellular, asexual buds found in liverworts.

Sol.: *Porphyra* is a red alga. In angiosperms, ovary appeared for the first time.

96. Answer (4)

Hint: Rhizome is an underground stem, which grows parallel or horizontal to the soil surface.

Sol.: Pteridophytes, like *Equisetum* have rhizome.

97. Answer (3)

Hint: *Datura* belongs to Solanaceae family.

Sol.: Solanaceae members can have endospermic seed and berry or capsule fruits.

98. Answer (3)

Hint: Parenchyma is a simple, living tissue which is involved in storage of food.

Sol.: Conjunctive tissue is found in roots. It does not perform photosynthesis.

99. Answer (3)

Hint: Suberin depositions in endodermis is seen in the roots of the plant.

Sol.: Roots of sunflower have a pericycle. Sunflower is a dicot plant and roots of dicots have small or inconspicuous pith.

100. Answer (4)

Hint: Glycocalyx is composed of mucous and polysaccharides.

Sol.: Glycocalyx differs in composition and thickness in different bacteria.

101. Answer (4)

Hint: 9 + 2 arrangement of microtubules is found in cilia.

Sol.: Axoneme is the core of a cilium and a flagellum. They have a pair of microtubules present singly in the centre.

102. Answer (3)

Hint: Meiosis is a reductional division which is important in formation of gametes.

Sol.: Meiosis helps in the introduction of variations.

103. Answer (4)

Hint: Movement of centrioles to opposite poles takes place during prophase.

Sol.: Splitting of centromere occurs during anaphase. Complete disintegration of nuclear envelope marks the start of metaphase.

104. Answer (3)

Hint: Accessory pigments prevent the photooxidation of chlorophyll *a*.

Sol.: Splitting of water molecule is the function of water splitting complex which is associated with the photosystem II.

105. Answer (2)

Hint: Photosystems are embedded in the thylakoid membrane.

Sol.: PS II is involved in release of oxygen.

106. Answer (2)

Hint: Brush-border epithelium

Sol.: The epithelium of PCT of nephron in kidneys constitutes cuboidal cells with microvilli.

Squamous epithelium is present in the lining of air sacs of lungs and walls of blood vessels.

107. Answer (3)

Hint: Homopolysaccharide

Sol.: Inulin is a polysaccharide made up of fructose (hexose sugar) as its monomeric unit.

Proteins are heteropolymers.

108. Answer (2)

Hint: Respiratory structures of fishes

Sol.: Special vascularised structures like gills are used by most of the aquatic arthropods. Earthworms use their moist cuticle for respiration. Lungs are respiratory structures of reptiles, birds and mammals. Green glands are the excretory structures of prawns.

109. Answer (4)

Hint: Dense regular connective tissue.

Sol.: In the dense regular connective tissues, the collagen fibres are present in rows between many parallel bundles of fibres. Tendons, which attach skeletal muscles to bones and ligaments which attach one bone to another are examples of dense regular connective tissue.

Adipose tissue is specialised to store fats.

Areolar tissue serves as a support framework for epithelium. Bone marrow is the site of production of blood cells.

110. Answer (2)

Hint: Less than 3%

Sol.: Basophils are the least (0.5-1%) of the total WBCs. Basophils secrete histamine, serotonin, heparin, *etc.*, and are involved in inflammatory reactions. Neutrophils (phagocytes) constitute 60-65% of the total WBCs.

Monocytes (phagocytes) constitute 6-8% while eosinophils (resist infections) constitute 2-3% of the total WBCs.

111. Answer (4)

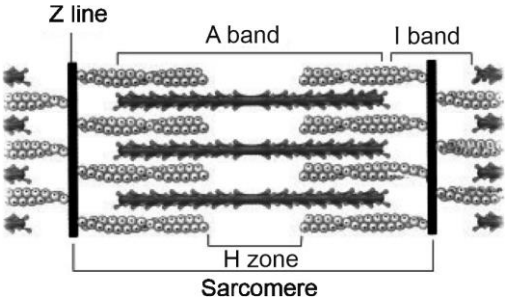
Hint: Renal corpuscle

Sol.: Blood is filtered finally through filtration membrane. The glomerular capillary blood pressure causes filtration of blood through 3 layers, *i.e.*, the endothelium of glomerular blood vessels, the epithelium of Bowman's capsule called podocytes and acellular basement membrane between these two layers.

112. Answer (4)

Hint: Zone comprising only myosin filaments.

Sol.:



The light bands contain actin whereas 'A' band contains both actin and myosin. The central part of thick filaments, not overlapped by thin filaments is called 'H' zone.

113. Answer (2)

Hint: Possesses corpora quadrigemina

Sol.: Midbrain, pons and medulla oblongata form brain stem. Medulla oblongata, pons and cerebellum form hindbrain.

114. Answer (3)

Hint: Functions of thyroid hormones

Sol.: Thyroxine plays an important role in the regulation of the basal metabolic rate. This hormone also supports the process of RBC formation as well as maintains water and electrolyte balance.

115. Answer (2)

Hint: Structure found in a male cockroach

Sol.: A pair of collaterial glands, a pair of spermathecae and a single common oviduct or vagina open in the genital pouch of female cockroaches. Mushroom-shaped gland is present in male cockroaches.

116. Answer (1)

Hint: 3 ATP are formed through substrate level phosphorylation.

Sol.: In glycolysis

1 NADH = 1 × 3 = 3 ATP

2 ATP in pay off phase

1 NADH from link reaction + 3 NADH from Krebs' cycle = 4 × 3 = 12 ATP

1 $FADH_2$ from Krebs' cycle = 1 × 2 = 2 ATP

1 GTP from Krebs' cycle = 1 ATP

Total = 15 ATP + 5 ATP = 20 ATP

117. Answer (4)

Hint: Gibberellins are responsible for foolish seedling disease in rice.

Sol.: Gibberellins induce bolting in certain rosette plants like cabbage and beet.

118. Answer (1)

Hint: *Albugo candida* causes white rust in mustard and it has coenocytic mycelium.

Sol.: Tobacco mosaic virus (TMV) has a single stranded RNA of approximately 6400 nucleotides in length.

119. Answer (2)

Hint: *Marchantia* is a bryophyte and it does not contain coralloid roots.

Sol.: Coralloid roots are found in *Cycas*.

120. Answer (2)

Hint: Solanaceae and Brassicaceae families show features like superior ovary and bicarpellary gynoecium in flowers.

Sol.: *Petunia*, Mustard, Makoi, Tomato, Brinjal and Chilli have bicarpellary gynoecium and superior ovary.

121. Answer (4)

Hint: Bulliform cells are large, empty and colourless cells of monocot leaves.

Sol.: When the bulliform cells in grass leaves absorb water, they become turgid and the leaf surface is exposed.

122. Answer (2)

Hint: Protein synthesis is performed by Rough ER.

Sol.: Smooth ER is involved in the synthesis of steroidal hormones.

123. Answer (3)

Hint: Pairing of homologous chromosomes takes place in the zygotene stage.

Sol.: The correct sequential order is

$c \rightarrow a \rightarrow b \rightarrow d$

124. Answer (3)

Hint: NADPH is not produced in the Krebs' cycle.

Sol.: $FADH_2$ is formed only once in a citric acid cycle and it gets oxidized during the oxidative phosphorylation.

125. Answer (3)

Hint: Cotton and Larkspur show developmental heterophylly.

Sol.: Buttercup shows environmental heterophylly in different habitats.

126. Answer (1)

Hint: Class includes related order, for example order Primata is placed in class Mammalia along with order Carnivora.

Sol.:

Canidae	Comprises a group of related genera

Felis	Comprises a group of related species
Chordata	This category includes related classes comprising animals
Carnivora	This is the assemblage of related families

127. Answer (2)

Hint: Vast majority of bacteria are dependent on other organisms or on dead organic matter for food.

Sol.: The vast majority of bacteria are heterotrophic.

128. Answer (3)

Hint: *Entamoeba* is a parasitic form of amoeboid protozoans.

Sol.: *Plasmodium* is a protozoan which causes malaria, a disease which has a staggering effect on human population.

Trypanosoma in a parasitic form of flagellated protozoans.

129. Answer (2)

Hint: Mannitol or laminarin are stored food in brown algae.

Sol.: *Dictyota* is a brown algae.

130. Answer (3)

Hint: *Cycas* has pinnately compound leaves persist for few years.

Sol.: The male or female cones or strobili may be borne on the same tree (*Pinus*). However, in *Cycas* male cones and megasporophylls are borne on different trees.

131. Answer (4)

Hint: Locust is an arthropod.

Sol.: Locusts have jointed appendages. They have organ system level of organisation and bilateral symmetry. *Pennatula* is a diploblastic organism. Aquatic arthropods have statocysts for balancing.

132. Answer (4)

Hint: Joint diastole

Sol.: The first heart sound (lub) is associated with the closure of the tricuspid and the bicuspid valves whereas the second heart sound (dub) is associated with the closure of semilunar valves.

133. Answer (3)

Hint: Cyclostomes lack jaws

Sol.: Cyclostomes have cartilaginous cranium and vertebral column. Bony fishes, reptiles, birds and mammals have bony vertebral column. Members of the phylum Chordata have closed circulatory system. Members of the class Chondrichthyes have powerful jaws and backwardly directed teeth.

134. Answer (3)

Hint: Body cavity lined by mesoderm

Sol.: Presence or absence of a cavity between the body wall and the gut wall is very important in classification. The body cavity which is lined by mesoderm is called coelom. Animals possessing coelom are called coelomates, *e.g.*, annelids, molluscs, arthropods, echinoderms, hemichordates and chordates. Annelids have body cavity lined by mesoderm.

135. Answer (4)

Hint: Most of the mammals have enucleated RBCs

Sol.: RBCs are nucleated in frogs and contain red coloured pigment namely haemoglobin. The hind-brain of frogs consists of cerebellum and medulla oblongata. Urethra is the common urinogenital duct in human males. Renal portal system is absent in humans.

136. Answer (1)

Hint: Exclude lipids

Sol.: Amino acids are substituted methanes.

Example: Valine, glutamic acid, phenylalanine
Lipids - Palmitic acid, arachidonic acid

137. Answer (2)

Hint: Exclude the numerical value of tidal volume

Sol.: Volume of air inspired or expired during each breathe is approx. 500 mL, *i.e.*, a healthy man can inspire or expire approximately 6000 to 8000 mL of air per minute.

ERV = 1000 – 1100 mL

IRV = 2500 – 3000 mL

138. Answer (2)

Hint: Cancer treatment drug

Sol.:

Pigments	Carotenoids, Anthocyanins, *etc.*
Alkaloids	Morphine, Codeine, *etc.*
Terpenoides	Monoterpenes, Diterpenes, *etc*.
Essential oils	Lemon grass oil, *etc.*
Toxins	Abrin, Ricin
Lectins	Concanavalin A
Drugs	Vinblastin, curcumin, *etc*.
Polymeric substances	Rubber, gums, cellulose

139. Answer (4)

Hint: 16 carbon fatty acid

Sol.:

- Sugar in a nucleotide can be ribose or 2′ deoxyribose.
- Triglyceride consists of 3 ester bonds.
- In serine, hydroxy methyl group is attached to α-carbon.

140. Answer (4)

Hint: Cockroach excretes uric acid.

Sol.: Katla (bony fish) - ammonotelic

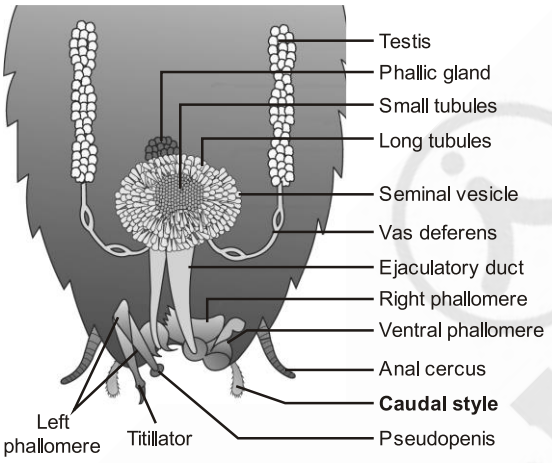
Cockroach (insect) - uricotelic

Vulture (bird) - uricotelic

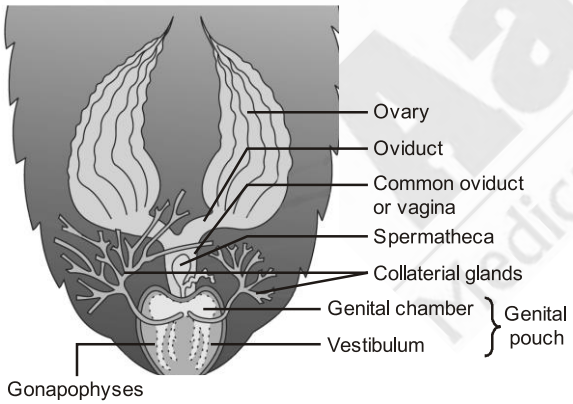
141. Answer (2)

Hint: Produce ova

Sol.: The female reproductive system consists of two large ovaries lying laterally in the 2nd to 6th abdominal segments.



A



B

142. Answer (3)

Hint: Function of hypothalamus

Sol.: Hypothalamus regulates body temperature. Medulla oblongata regulates cardiovascular reflexes. Hypothalamus secretes gonadotropin releasing hormones.

143. Answer (2)

Hint: Alteration of respiratory rate

Sol.: Neural signals from pneumotaxic centre can reduce the duration of inspiration and thereby alter the respiratory rate. Increase in respiratory rate will be seen as a result of activation of pneumotaxic centre.

144. Answer (4)

Hint: Complete separation of compartments

Sol.: In double circulation, blood passes through the heart twice in one complete circuit and is vital for efficient oxygen delivery as well as maintains a high metabolic rate in birds and mammals.

This separation of oxygenated and deoxygenated blood ensures a consistent rich supply of oxygen to the body tissues, crucial for active lifestyle.

Incomplete double circulation is seen in amphibians and reptiles.

145. Answer (2)

Hint: More than one

Sol.: Low temperature preserves the enzyme in a temporarily inactive state whereas high temperature destroys enzymatic activity because proteins are denatured by heat.

146. Answer (3)

Hint: Equal to 14

Sol.: False ribs = 6 in number

Phalanges = 14 in each limb

Tarsals = 7 in each lower limb

Lumbar vertebrae = 5 in number

True ribs = 14 in number

147. Answer (2)

Hint: Secreted from thyroid gland

Sol.: T_4 interacts with intracellular receptors and regulates gene expression. Epinephrine, somatostatin and thymosin interact with membrane bound receptors.

148. Answer (1)

Hint: Complex functions are controlled by association areas

Sol.: Cerebral cortex is thrown into prominent folds and it contains motor areas, sensory areas and large regions that are neither clearly sensory nor motor in function, named association areas.

149. Answer (3)

Hint: Identify an aschelminth.

Sol.: Protonephridia or flame cells are the excretory structures in platyhelminths (Flatworms,

e.g., Planaria), rotifers, some annelids and the cephalochordate – *Amphioxus*.

Renette cells are present in aschelminths (*Ascaris*).

150. Answer (3)

Hint: Knee joint

Sol.:

(1) Atlas and axis – Pivot joint

(2) Femur and acetabulum – Ball and socket joint

(3) Tibia and femur – Hinge joint

(4) Between carpal and metacarpal – Saddle joint

151. Answer (3)

Hint: Movement of K^+ occurs during repolarisation

Sol.: After depolarisation, within a fraction of a second, K^+ diffuses outside the membrane and restores the resting potential of the membrane at the site of excitation.

152. Answer (3)

Hint: Exclude the tessellated epithelium

Sol.: Some of the columnar or cuboidal cells get specialised for secretion and are called glandular epithelium.

153. Answer (4)

Hint: Choose a mammal.

Sol.:

Animal	Type of fertilisation	Type of development
Pleurobrachia	External	Indirect
Fasciola	Internal	Indirect
Hyla	External	Indirect
Macropus	Internal	Direct

154. Answer (2)

Hint: Trypsin is a proteolytic enzyme

Sol.:

Trypsin – Catalytic heteropolymer found in animals

Collagen – Structural heteropolymer found in animals

Cellulose – Polymer of hexose sugar (glucose) and found in cotton fibres

Chitin – Polymer of amino sugars (N-acetyl glucosamine) and found in arthropods

155. Answer (2)

Hint: Enzyme commission number starts with 2

Sol.: Transferases: Enzymes catalysing a transfer of a group, other than hydrogen between a pair of substrate, S and S′.

Hydrolases: Enzymes catalysing hydrolysis of ester, ether, peptide, glydosidic, C–C, C-halide or P–N bonds.

Lyases: Enzymes that catalyse removal of groups from substrates by mechanisms other than hydrolysis leaving double bonds.

Dehydrogenases: Enzymes which catalyse oxidoreduction between two substrates S and S′ *e.g.*, S reduced + S′ oxidised $\rightarrow$ S oxidized + S′ reduced

156. Answer (4)

Hint: Axile placentation is seen in Malvaceae family.

Sol.: In alternate type of phyllotaxy, a single leaf arises at each node in alternate manner, as in China rose, mustard and sun flower plants.

157. Answer (3)

Hint: Potato belongs to Solanaceae family.

Sol.: The floral diagram of potato family is follows:

158. Answer (4)

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

Sol.: Cymose inflorescence is observed in *Solanum.*

159. Answer (4)

Hint: Legume type of fruit may have one or many seeds.

Sol.: *Calotropis* shows valvate aestivation of petals.

Castor has endospermic seeds.

160. Answer (3)

Hint: Open vascular bundles possess the activity to form secondary xylem and phloem tissues.

Sol.: Monocots do not undergo secondary growth as they lack cambium in their vascular bundles.

161. Answer (4)

Hint: The ground tissue system of monocot stem is not well differentiated.

Sol.: Vascular bundles in dicot stem and monocot stem are endarch type.

162. Answer (2)

Hint: Phosphoglycolate is formed in C_3 plants during photorespiration.

Sol.:

Phosphoglycolate	Formed when RuBisCO binds with O_2 instead of CO_2 to convert RuBP
Phosphoenol pyruvate	Primary CO_2 acceptor; 3-carbon molecule which gets converted into 4-carbon molecule after carboxylation in mesophyll cell
3-phosphoglycerate	Primary stable product formed during the most crucial step of Calvin cycle in all photosynthetic plants
Oxaloacetic acid	Primary stable product of CO_2 fixation in the mesophyll cell of maize leaves

163. Answer (4)

Hint: Light is rarely a limiting factor in nature except for plants in shade.

Sol.: Current availability of CO_2 levels is limiting for the C_3 plants.

164. Answer (2)

Hint: Enzymes of TCA cycle require oxygenic conditions. Lactate dehydrogenase is required in lactic acid fermentation.

Sol.: Incomplete oxidation of glucose to form alcohol require enzymes involved in glycolysis and alcohol fermentation, *i.e.*, pyruvate decarboxylase and alcohol dehydrogenase.

165. Answer (4)

Hint: $FADH_2$ and NADH + H^+ are reduced coenzymes.

Sol.: During the TCA cycle following conversion reactions release reduced coenzymes.

- Malic acid $\rightarrow$ OAA
- Succinic acid $\rightarrow$ Fumaric acid
- α-ketoglutarate $\rightarrow$ Succinyl CoA

166. Answer (3)

Hint: Complex I refers to NADH dehydrogenase complex.

Sol.: Complex I transfers electrons to ubiquinone. Complex II (succinate dehydrogenase) does not transport H^+ from matrix to inter membrane space. Complex IV is referred as cytochrome *c* oxidase complex.

167. Answer (1)

Hint: RQ values of oxalic acid is 4.

Sol.: RQ value of organic acids is more than unity as organic acid contains high proportion of oxygen as compared to carbon and hydrogen, therefore, less oxygen is absorbed than CO_2 liberated.

168. Answer (4)

Hint: Adenine derivative PGR is N^6-furfuryl aminopurine, kinetin.

Sol.: Cytokinin promotes nutrient mobilisation which helps in the delay of leaf senescence.

169. Answer (2)

Hint: ABA is growth inhibitory hormone.

Sol.: ABA acts as an antagonist to GAs w.r.t. dormancy of seeds, buds and storage organs.

170. Answer (1)

Hint: Cytokinin along with auxin causes callus proliferation.

Sol.: Extract of vascular tissues, yeast extract, degraded product of autoclaved herring sperm DNA and coconut milk are source of cytokinin. They along with auxin can proliferate callus.

171. Answer (2)

Hint: Identify a cyclostome

Sol.: Cyclostomes have a sucking and circular mouth without jaws. Their body is devoid of scales and paired fins. Cranium and vertebral column are cartilaginous. *ex-Petromyzon*

Scoliodon $\rightarrow$ Cartilaginous fish

Devil fish, cuttlefish $\rightarrow$ Mollusc

172. Answer (4)

Hint: Right side shift of O_2-dissociation curve

Sol.: In tissues, where low pO_2, high pCO_2, high H^+ concentration and higher temperature exist, the conditions are favourable for dissociation of oxygen from oxyhaemoglobin.

173. Answer (3)

Hint: Hormone from pars nervosa

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

Somatostatin – Hypothalamus

Prolactin releasing hormone – Hypothalamus

ADH – Hypothalamus

Prolactin (Milk secreting hormone) - Pituitary gland

174. Answer (3)

Hint: Identify an aschelminth

Sol.: Hookworm (*Ancylostoma*) $\rightarrow$ Sexes are separate and complete digestive system is present

Earthworm (*Pheretima*) and leech (*Hirudinaria*) $\rightarrow$ Sexes are not separate.

Tapeworm (*Taenia*) $\rightarrow$ Hermaphrodite with no digestive system

175. Answer (1)

Hint: Synaptic delay

Sol.: Synaptic delay is significantly seen in chemical synapses compared to electrical synapses. Because former involves the release of chemical neurotransmitters from the pre-synaptic neuron which diffuse across the synaptic cleft to bind to receptors on the post-synaptic neuron.

176. Answer (4)

Hint: CO. = HR × SV

Sol.: Heart rate = 85 beats per minute

End diastolic volume = 120 mL

End systolic volume = 50 mL

Stroke volume = 120 – 50 = 70 mL

Cardiac output = 70 × 85 mL / min = 5.95 L / min

177. Answer (2)

Hint: No energy formation after death

Sol.: When a new ATP binds to the myosin head the cross-bridge is broken. After death, no new ATP is formed and thus rigor mortis occurs.

178. Answer (4)

Hint: Organ that also aids in hearing

Sol.: Frog has different types of sense organs, namely organs of touch (sensory papillae), taste (taste buds), smell (nasal epithelium), vision (eyes) and hearing (tympanum with internal ears). Out of these, eyes and internal ears are well organised sense structures.

179. Answer (2)

Hint: Characterised by enlargement of lower jaw

Sol.: Excess secretion of growth hormone in adults especially in middle age can result in severe disfigurement (especially of the face) called Acromegaly, which may lead to serious complications and premature death if unchecked. Addison's disease – Hyposecretion of adrenal cortical hormone

Cretinism – Hyposecretion of thyroxine

Diabetes mellitus – Hyposecretion of insulin

180. Answer (3)

Hint: Universal donor blood group

Sol.:

Blood Group	Antigens on RBCs	Antibodies in Plasma	Donor's Group
A	A	anti-B	A, O
B	B	anti-A	B, O
AB	A, B	nil	AB, A, B, O
O	nil	anti-A B	O

❑ ❑ ❑

All India Aakash Test Series for NEET - 2027

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Test Date : 22/03/2026

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

1. Answer (2)

Hint: Metallic scale would expand according to the formula $L = L_0 (1 + \alpha\Delta T)$

Sol.: Let the new reading of the metallic scale is L_0 at 80°C.

Portion of metallic scale of actual length L_0 at 20°C, expands to length 100 cm at 80°C.

$L_i = L_0$ and $L_f = 100$ cm

$L_f = L_i (1 + \alpha\Delta T)$

$100 = L_0 [1 + 10^{-3} \times (80 - 20)]$

$100 = L_0 (1 + 0.06)$

$\Rightarrow L_0 = 94.34$ cm

2. Answer (2)

Hint & Sol.: A blackbody has emissivity $e = 1$, the maximum possible, while metals have lower emissivity than a blackbody.

$$\left(\frac{dQ}{dt}\right)_{\text{radiation}} = eA\sigma T^4$$

Therefore, blackbody radiates more energy at same temperature.

3. Answer (4)

Hint: Maximum horizontal range is achieved at $h = \frac{H}{2}$

Sol.: Range $R = v\sqrt{\frac{2(H-h)}{g}} = \sqrt{2gh}\sqrt{\frac{2(H-h)}{g}}$

Put $h = \frac{H}{2}$ for maximum horizontal range

$$R_{\max} = \sqrt{2g \times \frac{H}{2}}\sqrt{\frac{2 \times \frac{H}{2}}{g}} = \frac{2 \times H}{2} = H$$

4. Answer (2)

Hint: Formula of $H_{\max} = \frac{u_y^2}{2g}$

Sol.: $H_{\max} = \frac{u_y^2}{2g}$ and $H_1 = H_2$

$\therefore$ Vertical component of velocity is same for both projectiles.

Time of flight, $T = \frac{2u\sin\theta}{g} = \frac{2u_y}{g}$

$\therefore T_1 = T_2$

5. Answer (1)

Hint: $\vec{v}_{\text{rain/man}} = \vec{v}_{\text{rain}/g} - \vec{v}_{\text{man}/g}$

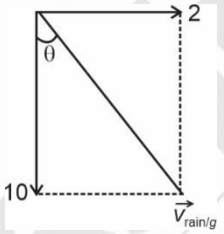
Sol.: Given, $\vec{v}_{\text{man}/g} = 2\hat{i}$ m/s

$\vec{v}_{\text{rain/man}} = -10\hat{j}$ m/s

$\vec{v}_{\text{rain}/g} = \vec{v}_{\text{rain/man}} + \vec{v}_{\text{man}/g}$

$\vec{v}_{\text{rain}/g} = (-10\hat{j} + 2\hat{i})$ m/s

$\tan\theta = \frac{2}{10} \Rightarrow \theta = \tan^{-1}\left(\frac{1}{5}\right)$



6. Answer (3)

Hint & Sol.: In small droplets, the gravitational force is lesser and hence less distortion of shape take place.

7. Answer (4)

Hint: Use equation $2as = v^2 - u^2$

Sol.: Given, $v_i = v$, $v_f = 2\sqrt{2}v$

$2as = v^2 - u^2$

$2 \times (-g) \times (-h) = (2\sqrt{2}v)^2 - v^2$

$h = \frac{7v^2}{2g}$

8. Answer (1)

Hint: Take LCM of time period of both the motions

Sol.: $x_1 = A\sin\omega t$

$T_1 = \frac{2\pi}{\omega}$

$x_2 = A\sin(2\omega t)$

$T_2 = \frac{2\pi}{2\omega} = \frac{\pi}{\omega}$

LCM of T_1 and T_2 is $\frac{2\pi}{\omega}$

9. Answer (4)

Hint: v_{rms}, v_{avg} and v_{mp} are all dependent on temperature.

Sol.: $v_{rms} = \sqrt{\frac{3RT}{M}} \Rightarrow v_{rms} \propto \sqrt{T}$

$v_{mp} = \sqrt{\frac{2RT}{M}} \Rightarrow v_{mp} \propto \sqrt{T}$

$v_{avg} = \sqrt{\frac{8RT}{\pi M}} \Rightarrow v_{avg} \propto \sqrt{T}$

10. Answer (4)

Hint: Apply formula $\vec{R}_{cm} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2 + m_3\vec{r}_3}{m_1 + m_2 + m_3}$

Sol.: $\vec{r}_1 = a\hat{i}, \quad \vec{r}_2 = 2a\hat{i}$

$\vec{r}_3 = (a + a\cos 60°)\hat{i} + (a\sin 60°)\hat{j} = \frac{3a}{2}\hat{i} + \frac{\sqrt{3}a}{2}\hat{j}$

$\vec{R}_{cm} = \frac{ma\hat{i} + m2a\hat{i} + m\left(\frac{3a}{2}\hat{i} + \frac{\sqrt{3}a}{2}\hat{j}\right)}{3m}$

$\vec{R}_{cm} = \frac{m\left(a + 2a + \frac{3a}{2}\right)\hat{i} + m\left(0 + 0 + \frac{\sqrt{3}a}{2}\right)\hat{j}}{3m}$

$\vec{R}_{cm} = \frac{\frac{9a}{2}m\hat{i} + \frac{\sqrt{3}a}{2}m\hat{j}}{3m}$

$R_{cm} = \left(\frac{3a}{2}, \frac{a}{2\sqrt{3}}\right)$

11. Answer (4)

Hint & Sol.: • PV = constant $\Rightarrow$ Isothermal process

When $\Delta T = 0 \Rightarrow \Delta U = nC_v\Delta T = 0$

• $C = C_v \Rightarrow$ Isochoric process $\Rightarrow W = 0$

• $C = C_v + R \Rightarrow$ Isobaric process

$\therefore Q = \Delta U + P\Delta V$

• PV^γ = constant $\Rightarrow$ Adiabatic process $\Rightarrow Q = 0$

12. Answer (2)

Hint & Sol.: First resonance, $l_1 = \frac{\lambda}{4}$

Second resonance, $l_2 = \frac{3\lambda}{4}$

If l_1 = 20 cm, then l_2 = 3 × 20 = 60 cm

13. Answer (1)

Hint: Draw FBD of both the blocks.

Sol.: It can easily be concluded that $a_1 = a_2 = g\sin\theta$.

14. Answer (3)

Hint: Gravitational force is always attractive in nature.

Sol.: • Potential energy, $U = \frac{-Gm_1m_2}{r}$

$\therefore$ Potential energy of three-point mass system cannot become zero.

• Three-point masses can be arranged in a line such that one mass in the middle can remain in equilibrium.

15. Answer (4)

Hint & Sol.: Kinetic energy and root mean square speed of an ideal gas is a function of temperature only.

16. Answer (3)

Hint & Sol.: SI unit of pressure is pascal.

17. Answer (2)

Hint: Area under P - V graph gives work done.

Sol.: First law of thermodynamics :

$Q = \Delta U + W$

$W = \int PdV$ = Area under P - V graph

$W = \frac{1}{2}(2P_0 + P_0)(3V_0 - V_0) = 3P_0V_0$ …(i)

$\Delta U = nC_v\Delta T = n \times \frac{3}{2}R\Delta T = \frac{3}{2}nR\Delta T$ …(ii)

For an ideal gas $PV = nRT$

$P_fV_f - P_iV_i = nR\Delta T$

$\Rightarrow nR\Delta T = 3P_0V_0 - 2P_0V_0 = P_0V_0$ …(iii)

$\Delta U = \frac{3}{2}P_0V_0$

$\therefore Q = \frac{3}{2}P_0V_0 + 3P_0V_0 = \frac{9}{2}P_0V_0$

18. Answer (1)

Hint & Sol.: Stress = Y × strain

$\frac{Mg}{A} = Y \times \frac{l}{l_0} \Rightarrow Y = \frac{Mgl_0}{A \times l}$

19. Answer (2)

Hint: Use equation :

Energy supplied = $mL_f + ms\Delta T$

Sol.: Energy supplied = 0.25 × 3600 = 900 J

1 cal = 4.2 J

$\therefore$ 900 J = 214.3 cal

Energy needed to melt ice completely

$Q = mL_f$ = 10 g × 80 $\frac{\text{cal}}{\text{g}}$ = 800 cal

Since energy supplied is less than 800 cal, hence ice will not melt completely. In fact, the given energy is not enough to melt even half of the ice block.

20. Answer (3)

Hint: Dot product of two perpendicular vectors is zero.

Sol.: $\vec{A}\cdot\vec{B}=0 \Rightarrow \vec{A}\perp\vec{B}$

$\vec{A}\cdot\vec{C}=0 \Rightarrow \vec{A}\perp\vec{C}$

Let $\vec{R}=\vec{A}\times\vec{C}$, then $\vec{R}\perp\vec{A}$ and $\vec{R}\perp\vec{C}$

$\therefore$ $\vec{A}\times\vec{C}$ is perpendicular to $\vec{A}$

Since $\vec{B}$ and $\vec{C}$ are perpendicular to $\vec{A}$, therefore $\vec{B}+\vec{C}$ will also be perpendicular to $\vec{A}$

Take dot product of $\vec{A}$ and $(\vec{A}+\vec{C})$:

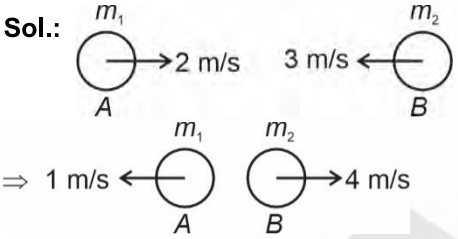
$\vec{A}\cdot(\vec{A}+\vec{C})=\vec{A}\cdot\vec{A}+\vec{A}\cdot\vec{C}=A^2+0\neq 0$

$\therefore$ $\vec{A}$ and $\vec{A}+\vec{C}$ are not perpendicular.

21. Answer (4)

Hint: Apply momentum conservation to find masses. Also use formula of coefficient of restitution.

Sol.:



Momentum conservation :

$m_1\times 2+m_2(-3)=m_1(-1)+m_2\times 4$

Take m_1 = 2 kg

$4-3m_2=-2+4m_2$

$7m_2=6 \Rightarrow m_2=\frac{6}{7}$kg

Coefficient of restitution :

$$e=\left|\frac{v_2-v_1}{u_2-u_1}\right|=\frac{4-(-1)}{2-(-3)}=\frac{5}{5}$$

$e=1 \Rightarrow$ Collision is perfectly elastic.

22. Answer (2)

Hint: Apply energy conservation principle

Sol.: Orbital speed $v_0=\sqrt{\frac{GM}{r}}=\sqrt{\frac{GM}{2R}}$

Energy conservation : $U_i+K_i=U_f+K_f$

$$\frac{-GMm}{R}+E=\frac{-GMm}{2R}+\frac{1}{2}m\times\left(\sqrt{\frac{GM}{2R}}\right)^2$$

$$\frac{-GMm}{R}+E=\frac{-GMm}{2R}+\frac{1}{2}m\times\frac{GM}{2R}$$

$$E=\frac{GMm}{2R}+\frac{GMm}{4R}=\frac{3}{4}\frac{GMm}{R}$$

23. Answer (3)

Hint & Sol.: In SHM, total mechanical energy remains conserved. At mean position, potential energy become minimum and therefore kinetic energy becomes maximum.

24. Answer (1)

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

Sol.: Given, $s=3t^2-2$

$v=\frac{ds}{dt}=6t$

$P=5\times(6\times 3)=5\times 18=90$ W

25. Answer (2)

Hint: Apply equations of uniformly accelerated motion.

Sol.: From $t=0$ to $t=3$ s ($a=2$ m/s^2)

$v=u+at \Rightarrow v_3=0+2\times 3=6$ m/s

$\Delta x=ut+\frac{1}{2}at^2 \Rightarrow \Delta x=0+\frac{1}{2}\times 2\times 3^2=9$ m

At $t=0$, $x_0=10$ m $\Rightarrow$ at $t=3$ s, $x=19$ m

For $t\geq 3$ s, $a=-2$ m/s^2

Displacement = Final position – initial position

$d=3-19=-16$ m

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

$-16=6t+\frac{1}{2}(-2)\times t^2$

$t^2-6t-16=0 \Rightarrow t^2-8t+2t-16=0$

$t(t-8)+2(t-8)=0$

$t=8$ s ($\because$ Time can't be negative)

Total time = 3 + 8 = 11 s

26. Answer (3)

Hint: Use method of dimensional analysis.

Sol.: Linear momentum = kg m s^{-1}

$\Rightarrow [P]=[MLT^{-1}]$

Density = kg m^{-3} $\Rightarrow [D]=[ML^{-3}]$

Velocity = $m\,s^{-1} \Rightarrow [V] = [LT^{-1}]$

Area = $m^2 \Rightarrow [A] = [L^2]$

Let $[P] = [D]^x[V]^y[A]^z$

$[MLT^{-1}] = [ML^{-3}]^x[LT^{-1}]^y[L^2]^z$

$x = 1,\ -3x + y + 2z = 1,\ -y = -1$

On solving, we get

$x = 1, y = 1, z = \frac{3}{2}$

$\therefore\ [P] = [DVA^{3/2}]$

27. Answer (4)

Hint: Use equation : $\tau_{ext} = \frac{\Delta L}{\Delta t}$

Sol.: $\tau_{ext} = \frac{\Delta L}{\Delta t} \Rightarrow \tau = \frac{5L_0 - L_0}{4} = L_0$

28. Answer (2)

Hint & Sol.: Centre of mass of a rod will lie towards the heavier side. Hence $x_{cm} > 50$ cm.

29. Answer (3)

Hint & Sol.: When a drop of liquid splits into number of smaller drops, then total surface area increases which results in increase of surface energy. Increase in surface energy means the original liquid has to absorb energy from the surrounding.

30. Answer (1)

Hint: Frequency of air column : $f \propto v \propto \sqrt{T}$

Sol.: Frequency of air column : $f = k\sqrt{T}$

Beat frequency, $\Delta f = f_1 - f_2$

$4 = k\sqrt{324} - f_T$ ...(i)

$1 = k\sqrt{289} - f_T$ ...(ii)

$\frac{4 + f_T}{1 + f_T} = \frac{k\sqrt{324}}{k\sqrt{289}} = \frac{18}{17}$

$17(4 + f_T) = 18(1 + f_T)$

On solving

$f_T = 50$ Hz

31. Answer (2)

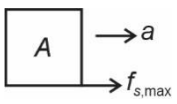
Hint: To get maximum value of m, take friction force between blocks A and B equal to $f_{s,max}$.

Sol.: Maximum value of friction on block A is

$f_{s,max} = \mu \times N = \frac{1}{2} \times 3\,g = 15$ N

$f_{s,max} = m \times a$

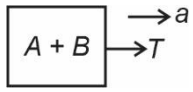
$15 = 3 \times a \Rightarrow a = 5$ m/s^2



Assuming block A and B to be one system:

$T = m_T \times a$

$T = (3 + 5) \times 5 = 40$ N

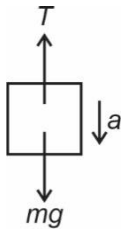


For block of mass m

$mg - T = m \times a$

$m \times (10 - 5) = T$

$m = \frac{40}{5} = 8$ kg



32. Answer (4)

Hint: In series combination, rate of flow of heat remains same.

Sol.: $\frac{dQ}{dt} = kA\frac{dT}{dx}$

For the given condition : $\frac{dT}{dx} \propto \frac{1}{k}$

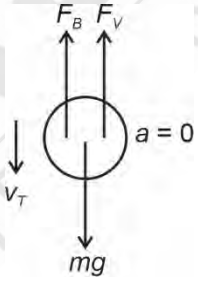
Slope of graph for 1st rod > slope of graph for 2nd rod.

33. Answer (2)

Hint: At terminal velocity, net force on the ball will be zero.

Sol.: Volume of the ball

$V = \frac{4}{3}\pi r^3 = \frac{4}{3} \times \pi \times (5 \times 10^{-3})^3$



Mass = $\rho_{ball} \times \frac{V}{2}$

= 3000 × $\frac{1}{2} \times \frac{4}{3}\pi$ × 125 × 10^{-9}

= 250 π × 10^{-6} kg

Viscous force on ball $F_v = 6\pi\eta r v_T$

$= 6\pi \times 10^{-3} \times 5 \times 10^{-3} \times v_T$

$= 30\pi \times 10^{-6} \times v_T$

Buoyant force on ball

$F_B = \rho V g = 10^3 \times \frac{4}{3}\pi \times 125 \times 10^{-9} \times 10$

$= \frac{4}{3}\pi \times 125 \times 10^{-5}$

At terminal velocity :

$F_B + F_V = mg$

$$\frac{4}{3}\pi\times125\times10^{-5}+30\pi\times10^{-6}\times v_T$$

$$=250\pi\times10^{-6}\times10$$

$$\frac{3v_T}{100}=\frac{25}{10}-\frac{5}{3}$$

$$v_T=\frac{250}{9}\text{m/s}$$

34. Answer (1)

Hint: For uniform acceleration, average velocity is given by

$$<\vec{v}>=\frac{\vec{u}+\vec{v}}{2}$$

Sol.: Initial velocity, $\vec{u}=u\cos\theta\hat{i}+u\sin\theta\hat{j}$

Final velocity, $\vec{v}=u\cos\theta\hat{i}-u\sin\theta\hat{j}$

$$<\vec{v}>=\frac{\vec{u}+\vec{v}}{2}=\frac{2u\cos\theta\hat{i}}{2}=u\cos\theta\hat{i}$$

$u\cos\theta=10\sqrt{3}$ m/s

$20\cos\theta=10\sqrt{3}\ \Rightarrow\theta=30°$

$$\therefore\ T=\frac{2u\sin\theta}{g}=\frac{2\times20\times\sin30°}{10}=2\text{ s}$$

35. Answer (1)

Hint: Young's modulus, $Y=\dfrac{\text{Thermal stress}}{\text{Thermal strain}}$

Sol.: Stress = Y × strain ...(i)

$\Delta L = L_0\,\alpha\,\Delta T$

$\dfrac{\Delta L}{L_0}$ = strain = $\alpha\,\Delta T$

$\therefore\ \sigma = Y\times\alpha\Delta T$

$$\frac{\sigma_1}{\sigma_2}=\frac{\Delta T_1}{\Delta T_2}=1$$

36. Answer (1)

Hint & Sol.: Area under acceleration-time graph is equal to change in velocity.

37. Answer (3)

Hint & Sol.: In SHM, total mechanical energy of the system remain conserved.

38. Answer (4)

Hint: Use formula : $\left(\dfrac{C_p}{C_v}\right)_{\text{mix}}=\dfrac{n_1C_{p_1}+n_2C_{p_2}}{n_1C_{v_1}+n_2C_{v2}}$

Sol.: $(C_v)_{\text{diatomic}}=\dfrac{5}{2}R;(C_p)_{\text{diatomic}}=\dfrac{7}{2}R$

$$(C_v)_{\text{monoatomic}}=\frac{3}{2}R;(C_p)_{\text{monoatomic}}=\frac{5}{2}R$$

$$\therefore\ \gamma_{\text{mix}}=\frac{3\times\frac{7}{2}R+2\times\frac{5}{2}R}{3\times\frac{5}{2}R+2\times\frac{3}{2}R}=\frac{21+10}{15+6}=\frac{31}{21}$$

39. Answer (1)

Hint: Use work energy theorem

Sol.: $W_{\text{net}} = \Delta\text{KE}$

$$W_{\text{net}}=\int_{x_0}^{2x_0}F\cdot dx=\int_{x_0}^{2x_0}2\sqrt{x}dx$$

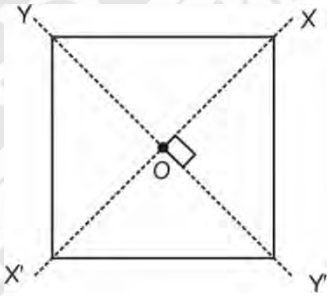
$$W_{\text{net}}=\left[2\frac{x^{3/2}}{3/2}\right]_{x_0}^{2x_0}=\frac{4}{3}[(2x_0)^{3/2}-(x_0)^{3/2}]$$

$$\therefore\ \Delta\text{KE}=\frac{4}{3}\left(2\sqrt{2}-1\right)x_0^{3/2}$$

40. Answer (2)

Hint: Use perpendicular and parallel axis theorems.

Sol.: Complete this sheet to form a square of side a and mass $2M$



Assume z-axis is perpendicular to the plane of sheet.

Moment of inertia about z-axis passing through point O is $\dfrac{(2M)(a^2+a^2)}{12}=\dfrac{Ma^2}{3}$

Due to symmetry $I_{xx'}=I_{yy'}$

From perpendicular axis theorem:

$I_{xx'}+I_{yy'}=I_{zz'}$

$$2I_{xx'}=I_{zz'}\ \Rightarrow\ I_{xx'}=\frac{Ma^2}{3}\times\frac{1}{2}=\frac{Ma^2}{6}$$

Take out the half sheet which was introduced earlier.

$$\therefore\ (I_{xx'})_{\text{net}}=\frac{Ma^2}{6}\times\frac{1}{2}=\frac{Ma^2}{12}$$

41. Answer (1)

Hint: First law of thermodynamics $\Delta Q = W + \Delta U$

Sol.: Under constant pressure,

Heat supplied $Q = \Delta U + P\Delta V$

Given $Q_x = Q_y$

$\Delta U_x = \Delta U_y$

$P_x = P_y$

$\therefore\ P_x\Delta V_x = P_y\Delta V_y \Rightarrow \Delta V_x = \Delta V_y$

$\pi r_x^2 \Delta h_x = \pi r_y^2 \Delta h_y$

$$\frac{r_x^2}{r_y^2} = \frac{\Delta h_y}{\Delta h_x} = \frac{10}{20} \Rightarrow \frac{r_x}{r_y} = \frac{1}{\sqrt{2}}$$

42. Answer (3)

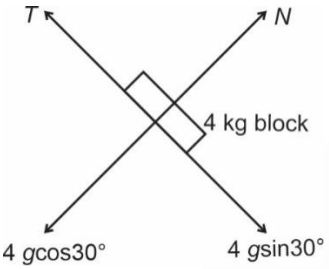
Hint & Sol.: Property of standing wave : amplitudes of different particles are different in a standing wave.

43. Answer (1)

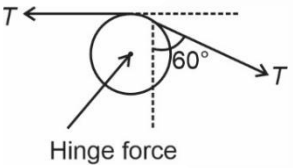
Hint: Net force on the pulley is zero.

Sol.: $T = 4\,g\sin30°$

$$T = 4 \times 10 \times \frac{1}{2} = 20\ \text{N}$$



FBD of pulley:



Net force due to tension = Hinge force

Net force due to tension

$$= \sqrt{T^2 + T^2 + 2T^2\cos(90° + 60°)}$$

$$T_{net} = \sqrt{T^2 + T^2 + 2T^2 \times \left(\frac{-\sqrt{3}}{2}\right)}$$

$$= \sqrt{2T^2 - \sqrt{3}T^2} = T\sqrt{2-\sqrt{3}}$$

$\therefore$ Hinge force = $20\sqrt{2-\sqrt{3}}$ N

44. Answer (4)

Hint: Orbital speed, $v_0 = \sqrt{\frac{GM}{R}}$

Sol.: • Since both the satellites are orbiting in same orbit, their orbital speeds must be equal.

• Kinetic energy = $\frac{1}{2}m \times v_0^2$

If mass of both satellites is same, then the kinetic energy would be equal.

• Potential energy = $\frac{-GMm}{R}$

Since, it is not given that both the satellites are of same mass, hence their potential energy could be same or different.

45. Answer (3)

Hint: Use principle of homogeneity

Sol.: Only those physical quantities which are having same dimensional formula can be added or subtracted, therefore $[a] = [t^2]$

$$[F] = \frac{[t^2]}{[b]} \Rightarrow [b] = \left[\frac{t^2}{F}\right]$$

$$\therefore\ \frac{[a^2]}{[b]} = [t^2]^2 \times \left[\frac{F}{t^2}\right] = [F][t^2]$$

$$\left[\frac{a^2}{b}\right] = [MLT^{-2}][T^2] = [ML]$$

[CHEMISTRY]

46. Answer (1)

Hint: Time taken for one complete revolution of electrons in an orbit $\propto \frac{n^3}{z^2}$

Sol.: $\frac{(t_2)_{He^+}}{(t_3)_H} = \left(\frac{2}{3}\right)^3 \times \left(\frac{1}{2}\right)^2 = \frac{2}{27}$

47. Answer (3)

Hint: Given graph in the question is drawn for 2*s* orbital.

Sol.: For plots of radial probability function vs r number of peaks are given by n – l.

48. Answer (4)

Hint: 13th electron of Ca enters into 3p subshell.

Sol.: Ca(Z = 20) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

3p subshell, n = 3

l = 1

m = 1, 0 – 1

s = +1/2

49. Answer (1)

Hint: Total number of spectral lines $= \frac{\Delta n(\Delta n+1)}{2}$

$\Delta n = n_2 - n_1$

Sol.:

5 to 2	$\Delta n = 3$	number of spectral lines $= \frac{3\times4}{2} = 6$
6 to 1	$\Delta n = 5$	number of spectral lines $= \frac{5\times6}{2} = 15$
4 to 3	$\Delta n = 1$	number of spectral lines $= \frac{1\times2}{2} = 1$
3 to 1	$\Delta n = 2$	number of spectral lines $= \frac{2\times3}{2} = 3$

50. Answer (1)

Hint: Lewis acids are electron pair acceptor species.

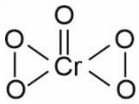
Sol.: As the size of halide ion increases, back bond strength decreases. Therefore Lewis acidic nature increases.

51. Answer (2)

Hint: Water gas is a mixture of CO and H_2.

Sol.: $C(s) + H_2O(g) \xrightarrow[473-1273\,K]{} CO(g) + H_2(g)$

52. Answer (3)

Hint: CrO_5;  Cr is in +6 oxidation state.

Sol.: • $CaOCl_2 \rightarrow Ca^{2+} + Cl^- + OCl^-$

• $Cr_2O_7^{2-}$ $2x + 7(-2) = -2$

x = oxidation number of Cr in $Cr_2O_7^{2-}$

x = +6

53. Answer (1)

Hint: Equimolar species of highest n-factor will require maximum amount of $KMnO_4$

Sol.: • For $KMnO_4$

MnO_4^- changes to Mn^{2+}

Species	n-factor
$Fe_2(C_2O_4)_3$	6
$NaNO_2$	2
$Fe(OH)_2$	1
Cu_2Cl_2	2

54. Answer (2)

Hint: $E^\circ_{cell} = \left(E^\circ_R\right)_c - \left(E^\circ_R\right)_a$

Sol.: $E^\circ_{cell} = 0.34 + 0.25$

$E^\circ_{cell} = 0.59$ V

Since, in the given cell, Cu is taken as cathode which has more tendency to gain electrons and Ni is taken as anode which has less tendency to gain electrons, so, the reaction would be feasible.

55. Answer (1)

Hint: n-factor is the number of electron lost or gained per mol of substance.

Sol.: FeC_2O_4 contains Fe^{+2} ions and $C_2O_4^{2-}$ ions which changes to Fe^{+3} and CO_2 respectively in acidic medium with $KMnO_4$.

$Fe^{2+} \rightarrow Fe^{+3} + e^-$ n-factor = 1

$C_2O_4^{2-} \rightarrow CO_2 + 2e^-$ n-factor = 2

n-factor for FeC_2O_4 = 2 + 1 = 3

56. Answer (4)

Hint: Enthalpy of neutralization is the amount of heat evolved when 1 gram equivalent of an acid is neutralized by 1 gram equivalent of base.

Sol.: Enthalpy of neutralization for CH_3COOH and NaOH in aqueous medium is less than 57.1 kJ mol^{-1} because some part of energy is used for dissociation of weak acid.

57. Answer (3)

Hint: In adiabatic process, no heat exchange between system and surrounding.

Sol.: • For adiabatic process,

q = 0

$\Delta U = q + w$

$\Delta U = w$

• For expansion process, w = (–)ve

ΔU = (–)ve = $nC_v\Delta T$

(–)ve = $nC_v(T_2 - T_1)$

$T_2 < T_1$

T_2 < 300 K

58. Answer (3)

Hint: $\Delta_r H = \sum$B.E (Reactants) $- \sum$B.E (products)

Sol.: $\Delta_r H = \sum$B.E (Reactants) $- \sum$B.E (products)

$= B.E_{H-H} + \frac{1}{2} B.E_{O=O} - 2 \times B.E_{O-H}$

$= x + \frac{1}{2}y - 2\times z$

$= x + \frac{y}{2} - 2z$ kJ/mol

59. Answer (1)

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

If ΔG = (–)ve process is said to be spontaneous

Sol.: • ΔG = (–)ve spontaneous process

• ΔG = (+)ve, non-spontaneous process

• ΔH = (–)ve and ΔS = (–)ve, ΔG = (–)ve at low temperature

• ΔH = (+)ve and ΔS = (+)ve, ΔG = (+)ve at low temperature

60. Answer (1)

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

Sol.: • $\Delta n_g = 0 - 3 - \frac{1}{2} = -\frac{7}{2}$

$\Delta H - \Delta U = \Delta n_g RT$

$= -\frac{7}{2} \times 300 \times 2 = -2100$ cal

61. Answer (4)

Hint: Zr is the element with atomic number 40.

Sol.: • The valence shell electronic configuration of Zr is $4d^2 5s^2$

• Last electron enters into d subshell, so, it is a *d*-block element.

• Highest value of principal quantum = Period number = 5

• Group number = electrons in (n – 1)*d* + electron in n*s*

= 2 + 2 = 4

62. Answer (4)

Hint: Due to stable configuration, Noble gases resist to gain electron(s)

Sol.: For Ne $\Delta_{eg}H$ = +116 kJ/mol

63. Answer (1)

Hint: In case of isoelectronic species, more the positive charge smaller will be the ionic radii.

Sol.: $Mg^{2+} < Na^{+} < N^{3-}$

Mg^{2+} would have high value of effective nuclear charge comparatively, so, has minimum radius.

64. Answer (1)

Hint: To exhibit tautomerism, carbonyl compound must have enolisable hydrogen.

Sol.: • Compound IV has enolisable hydrogen at γ-position.

• Compound II does not have alpha hydrogen.

65. Answer (2)

Hint: $[Fe(SCN)]^{2+}$ is blood red coloured species.

Sol.: • For the detection of N

$$Na_4[Fe(CN)_6] + Fe^{+3} \rightarrow \underset{\text{(Prussian blue)}}{Fe_4[Fe(CN)_6]_3}$$

• For the detection of both S and N

$$Fe^{+3} + SCN^{-} \rightarrow \underset{\text{(Blood red)}}{[Fe(SCN)]^{2+}}$$

• $[Fe(CN)_5NOS]^{4-}$: Violet

• $(NH_4)_3PO_4 \cdot 12MoO_3$: Yellow

66. Answer (2)

Hint: Presence of electron donating group increases rate of reactivity.

Sol.: • $-NO_2$ is a powerful deactivating group.

• $-CH_3$, $-NH_2$ and $-NHCOCH_3$ are activating groups.

67. Answer (1)

Hint: Molarity = $\frac{\text{Number of moles of solute}}{\text{Volume of solution (L)}}$

Sol.: Molarity of $AlCl_3$ solution = $\frac{1.335 \times 1000}{133.5 \times 50}$

$= \frac{10^{-2} \times 10^{3}}{50}$

= 0.2 M

$$\underset{0.2\,M}{AlCl_3} \longrightarrow \underset{0.2\,M}{Al^{3+}} + \underset{0.6\,M}{3Cl^{-}}$$

68. Answer (3)

Hint: Generally size increases on moving down the group.

Sol.: Size : C < Si < Ge < Sn < Pb

69. Answer (2)

Hint: SnO, PbO, SnO_2 and PbO_2 are amphoteric oxides.

Sol.: Graphite is thermodynamically most stable allotrope of carbon.

70. Answer (3)

Hint: For m_l value to be zero, the value of l can be 0, 1, 2, 3

Sol.: Zn (Z = 30)

Electronic configuration is

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10}$

71. Answer (4)

Hint: Solution of a weak acid and a salt of this weak acid with a strong base is acidic buffer solution.

Sol.: • $\begin{matrix}COOH\\|\\COOH\end{matrix}$ and $\begin{matrix}COOK\\|\\COOK\end{matrix}$ is acidic buffer solution

H_2CO_3 and $NaHCO_3$ is acidic buffer solution

H_3PO_4 and NaH_2PO_4 is acidic buffer solution

72. Answer (4)

Hint: According to Bronsted-Lowry theory, acid is a substance that is capable of donating a H^+ ion.

Sol.: Conjugate base of HSO_4^- is SO_4^{2-}

73. Answer (2)

Hint: For A_xB_y salt, $K_{sp} = x^x y^y (s)^{x+y}$

Sol.: $Al(OH)_3 \rightleftharpoons \underset{s}{Al^{3+}} + \underset{3s}{3OH^-}$

$K_{sp} = [Al^{3+}][OH^-]^3$

$= S\,(3S)^3$

$K_{sp} = 27S^4$

$$S = \left(\frac{K_{sp}}{27}\right)^{1/4}$$

74. Answer (2)

Hint: Alkanes with tertiary H atom can be oxidised to corresponding alcohols by $KMnO_4$.

Sol.:

$$\text{2-Methylpropane} \xrightarrow{KMnO_4} \underset{(A)}{(CH_3)_3COH} \xrightarrow[\Delta]{\text{conc. } H_2SO_4} \underset{(B)}{CH_3-\overset{CH_3}{\overset{|}{C}}=CH_2} \xrightarrow[\Delta]{KMnO_4/H^+} \underset{(C)}{CH_3COCH_3} + CO_2 + H_2O$$

75. Answer (4)

Hint: $K_p = \dfrac{(p_{NO_2})^2}{(p_{N_2O_4})}$

p_{NO_2} = partial pressure of NO_2

$p_{N_2O_4}$ = partial pressure of N_2O_4

Sol.: $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

t = 0 1 bar –

t = equilibrium 1-x 2x

Total pressure at equilibrium = 1.6 = 1 + x

x = 0.6

$p_{N_2O_4}$ = partial pressure of N_2O_4 = 1 – x

= 1 – 0.6

= 0.4 bar

p_{NO_2} = partial pressure of NO_2 = 2x

= 2 × 0.6

= 1.2 bar

$$K_p = \frac{(p_{NO_2})^2}{p_{N_2O_4}} = \frac{(1.2)^2}{0.4} = 3.6$$

76. Answer (3)

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

Sol.:

$$CaC_2 + 2H_2O \longrightarrow \underset{(A)}{CH \equiv CH} + H_2O \xrightarrow[333\ K]{Hg^{2+}/H^+} CH_2=CH(OH) \rightleftharpoons CH_3-CHO$$

Ethanal (B)

$$3CH \equiv CH \xrightarrow[\text{Iron tube, 873 K}]{\text{Red hot}} \underset{(C)}{\text{benzene}}$$

77. Answer (2)

Hint: In presence of organic peroxide, HBr adds to alkene in accordance to Anti-Markovnikov rule.

Sol.: $X: CH_3-\underset{\underset{Br}{|}}{CH}-CH_3$

$Y: CH_3-CH_2-CH_2-Br$

78. Answer (3)

Hint: An aqueous solution of sodium salt of a carboxylic acid on Kolbe's electrolysis gives alkane containing even number of carbon atoms at the anode.

Sol.: At anode :

$$\cdot\ 2CH_3-CH_2-\overset{O}{\overset{\|}{C}}-O^- \xrightarrow{-2e^-} 2CH_3-CH_2-\overset{O}{\overset{\|}{C}}-\dot{O}:$$

$$\bullet\ 2CH_3-CH_2-\overset{O}{\overset{\|}{C}}-\dot{O} \longrightarrow 2CH_3\dot{C}H_2 + CO_2$$

$$\bullet\ CH_3\dot{C}H_2 + \dot{C}H_2CH_3 \longrightarrow CH_3CH_2CH_2CH_3$$

79. Answer (4)

Hint: 1 molal solution means 1 mole of solute is present in 1 kg solvent.

Sol.: 2 molal = $\dfrac{0.5 \text{ mole solute}}{x \text{ (kg solvent)}}$

x = 0.25 kg

x = 250 g solvent

80. Answer (1)

Hint: NaOH will neutralise H_2SO_4 to form salt and water.

Sol.: Number of mmoles of NaOH = 10 × 0.1

= 1 mmol

Number of mmoles of H_2SO_4 = 10 × 0.5

= 5 mmol

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

1 mmol 5 mmol

1 – 1 = 0 5 – 0.5 = 4.5

Number of mmoles left of H_2SO_4 = 5 – 0.5

= 4.5 mmol

81. Answer (2)

Hint: $Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O + CO_2$

Sol.: Number of mmoles of H_2SO_4 = Number of mmoles of Na_2CO_3

= 50 × 0.2 = 10 mmol

Mass of Na_2CO_3 = $10 \times 10^{-3} \times 106 = 1.06$ g

$\frac{\text{Mass of sample} \times 80}{100} = 1.06$

Mass of sample = $\frac{1.06 \times 100}{80} = 1.325$ g

82. Answer (4)

Hint: The hybridisation of N is sp^2 in $N(SiH_3)_3$

Sol.: In $N(SiH_3)_3$, nitrogen donates its lone pair to vacant 3*d* orbital of Si.

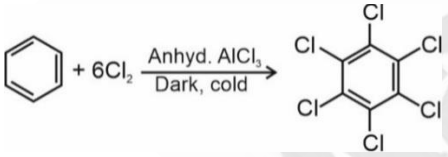
83. Answer (3)

Hint: Strength of hydrogen bonding depends upon electronegativity of atom attached to hydrogen.

Sol.: The magnitude of H-bonding is maximum in the solid state and minimum in the gaseous state.

84. Answer (3)

Hint: Under UV light, $3Cl_2$ molecules added to benzene to give gammaxane.

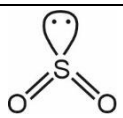
Sol.: 

85. Answer (4)

Hint: Molecules with linear geometry would have bond angle 180° and molecules with trigonal planar arrangement with no lone pair of electrons would have bond angle 120°.

Sol.:

Molecule	Bond angle	Hybridisation
BF_3	120°	sp^2
BeF_2	180°	*sp*
$HgCl_2$	180°	*sp*
SO_2	119.5	sp^2



Because of the presence of lone pair of electron at S, bond angle becomes less than 120°.

86. Answer (3)

Hint: Bond order $= \frac{1}{2}(N_b - N_a)$

N_b : Number of bonding electrons

N_a : Number of anti-bonding electrons

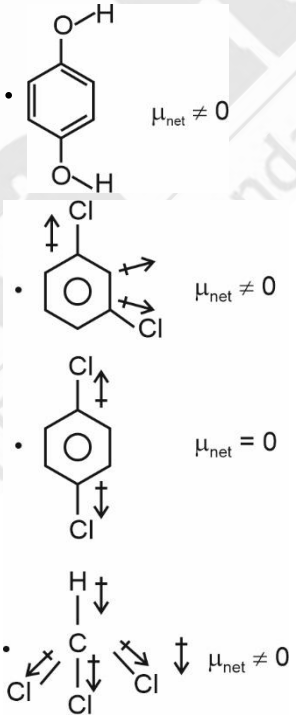
Sol.: Valence shell electronic configuration of molecules is as follows-

- C_2 KK $(\sigma_{2s})^2 (\sigma^*_{2s})^2 \left(\pi\, 2p_x^2 = \pi 2p_y^2\right)$, diamagnetic
- B_2 KK $(\sigma_{2s})^2 (\sigma^*_{2s})^2 \left(\pi\, 2p_x^1 = \pi 2p_y^1\right)$, paramagnetic
- N_2 KK $(\sigma_{2s})^2 (\sigma^*_{2s})^2 \left(\pi\, 2p_x^2 = \pi 2p_y^2\right) \left(\sigma 2p_z^2\right)$, diamagnetic
- Li_2 KK $(\sigma_{2s})^2$, diamagnetic

87. Answer (3)

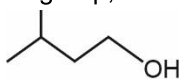
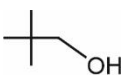
Hint: Symmetrical molecules tend to have zero dipole moment.

Sol.:



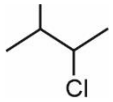
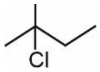
88. Answer (4)

Hint: Compounds having same molecular formula but different alkyl groups on either side of the functional group, are called metamers.

Sol.: •  and  are Chain isomers

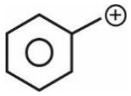
- CH_3COOH and $HCOOCH_3$ are Functional group isomerism

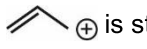
• $CH_3 - O - CH_2 - CH_2 - CH_3$ and $CH_3 - CH_2 - O - CH_2 - CH_3$ are Metamers

•  and  are Position isomers

89. Answer (2)

Hint: Electronic effects like resonance, hyperconjugation and inductive effect contribute to stability of carbocations.

Sol.: •  is stabilised by resonance

•  is stabilised by resonance

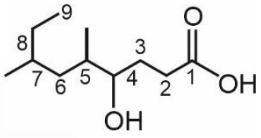
Benzyl carbocation is more stable than allyl carbocation.

•  is stabilised by 9 α – H bonds (hyperconjugation) and positive inductive effect.

• $CH_2 = \overset{\oplus}{C}H$ is the least stable carbocation.

90. Answer (4)

Hint: Parent chain must contain carboxylic acid and it must also contain maximum number of carbon atoms.

Sol.: 

4-Hydroxy-5, 7-dimethylnonanoic acid

[BIOLOGY]

91. Answer (2)

Hint: Photosystems are embedded in the thylakoid membrane.

Sol.: PS II is involved in release of oxygen.

92. Answer (3)

Hint: Accessory pigments prevent the photooxidation of chlorophyll *a*.

Sol.: Splitting of water molecule is the function of water splitting complex which is associated with the photosystem II.

93. Answer (4)

Hint: Movement of centrioles to opposite poles takes place during prophase.

Sol.: Splitting of centromere occurs during anaphase. Complete disintegration of nuclear envelope marks the start of metaphase.

94. Answer (3)

Hint: Meiosis is a reductional division which is important in formation of gametes.

Sol.: Meiosis helps in the introduction of variations.

95. Answer (4)

Hint: 9 + 2 arrangement of microtubules is found in cilia.

Sol.: Axoneme is the core of a cilium and a flagellum. They have a pair of microtubules present singly in the centre.

96. Answer (4)

Hint: Glycocalyx is composed of mucous and polysaccharides.

Sol.: Glycocalyx differs in composition and thickness in different bacteria.

97. Answer (3)

Hint: Suberin depositions in endodermis is seen in the roots of the plant.

Sol.: Roots of sunflower have a pericycle. Sunflower is a dicot plant and roots of dicots have small or inconspicuous pith.

98. Answer (3)

Hint: Parenchyma is a simple, living tissue which is involved in storage of food.

Sol.: Conjunctive tissue is found in roots. It does not perform photosynthesis.

99. Answer (3)

Hint: *Datura* belongs to Solanaceae family.

Sol.: Solanaceae members can have endospermic seed and berry or capsule fruits.

100. Answer (4)

Hint: Rhizome is an underground stem, which grows parallel or horizontal to the soil surface.

Sol.: Pteridophytes, like *Equisetum* have rhizome.

101. Answer (4)

Hint: Gemmae are green, multicellular, asexual buds found in liverworts.

Sol.: *Porphyra* is a red alga. In angiosperms, ovary appeared for the first time.

102. Answer (3)

Hint: Pteridophytes require cool, damp and shady places to grow.

Sol.: Pteridophytes also require water for the process of fertilization.

103. Answer (2)

Hint: Production of toxins and whirling whip motion is shown by dinoflagellates.

Sol.: None of the photosynthetic protists show formation of fruiting body.

104. Answer (3)

Hint: Body organization, mode of nutrition and cell wall was used by R.H. Whittaker for his five kingdom classification.

Sol.: Carl Woese used the sequence of 16S rRNA genes for dividing the kingdom Monera into two domains.

105. Answer (4)

Hint: Man is classified under Order - Primata.

Sol.: Brinjal – Polymoniales.

Mango – Sapindales.

Wheat - Poales

106. Answer (2)

Hint: Structure found in a male cockroach

Sol.: A pair of collaterial glands, a pair of spermathecae and a single common oviduct or vagina open in the genital pouch of female cockroaches. Mushroom-shaped gland is present in male cockroaches.

107. Answer (3)

Hint: Functions of thyroid hormones

Sol.: Thyroxine plays an important role in the regulation of the basal metabolic rate. This hormone also supports the process of RBC formation as well as maintains water and electrolyte balance.

108. Answer (2)

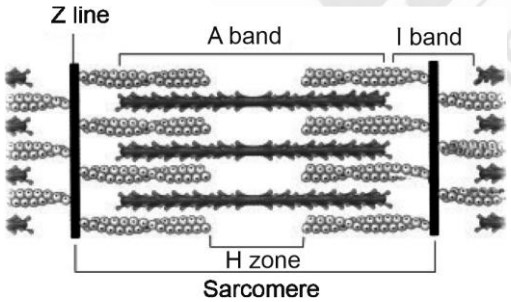
Hint: Possesses corpora quadrigemina

Sol.: Midbrain, pons and medulla oblongata form brain stem. Medulla oblongata, pons and cerebellum form hindbrain.

109. Answer (4)

Hint: Zone comprising only myosin filaments.

Sol.:



The light bands contain actin whereas 'A' band contains both actin and myosin. The central part of thick filaments, not overlapped by thin filaments is called 'H' zone.

110. Answer (4)

Hint: Renal corpuscle

Sol.: Blood is filtered finally through filtration membrane. The glomerular capillary blood pressure causes filtration of blood through 3 layers, *i.e.*, the endothelium of glomerular blood vessels, the epithelium of Bowman's capsule called podocytes and acellular basement membrane between these two layers.

111. Answer (2)

Hint: Less than 3%

Sol.: Basophils are the least (0.5-1%) of the total WBCs. Basophils secrete histamine, serotonin, heparin, *etc.*, and are involved in inflammatory reactions. Neutrophils (phagocytes) constitute 60-65% of the total WBCs.

Monocytes (phagocytes) constitute 6-8% while eosinophils (resist infections) constitute 2-3% of the total WBCs.

112. Answer (4)

Hint: Dense regular connective tissue.

Sol.: In the dense regular connective tissues, the collagen fibres are present in rows between many parallel bundles of fibres. Tendons, which attach skeletal muscles to bones and ligaments which attach one bone to another are examples of dense regular connective tissue.

Adipose tissue is specialised to store fats.

Areolar tissue serves as a support framework for epithelium. Bone marrow is the site of production of blood cells.

113. Answer (2)

Hint: Respiratory structures of fishes

Sol.: Special vascularised structures like gills are used by most of the aquatic arthropods. Earthworms use their moist cuticle for respiration. Lungs are respiratory structures of reptiles, birds and mammals. Green glands are the excretory structures of prawns.

114. Answer (3)

Hint: Homopolysaccharide

Sol.: Inulin is a polysaccharide made up of fructose (hexose sugar) as its monomeric unit.

Proteins are heteropolymers.

115. Answer (2)

Hint: Brush-border epithelium

Sol.: The epithelium of PCT of nephron in kidneys constitutes cuboidal cells with microvilli.

Squamous epithelium is present in the lining of air sacs of lungs and walls of blood vessels.

116. Answer (3)

Hint: *Cycas* has pinnately compound leaves persist for few years.

Sol.: The male or female cones or strobili may be borne on the same tree (*Pinus*). However, in *Cycas* male cones and megasporophylls are borne on different trees.

117. Answer (2)

Hint: Mannitol or laminarin are stored food in brown algae.

Sol.: *Dictyota* is a brown algae.

118. Answer (3)

Hint: *Entamoeba* is a parasitic form of amoeboid protozoans.

Sol.: *Plasmodium* is a protozoan which causes malaria, a disease which has a staggering effect on human population.

Trypanosoma in a parasitic form of flagellated protozoans.

119. Answer (2)

Hint: Vast majority of bacteria are dependent on other organisms or on dead organic matter for food.

Sol.: The vast majority of bacteria are heterotrophic.

120. Answer (1)

Hint: Class includes related order, for example order Primata is placed in class Mammalia along with order Carnivora.

Sol.:

Canidae	Comprises a group of related genera
Felis	Comprises a group of related species
Chordata	This category includes related classes comprising animals
Carnivora	This is the assemblage of related families

121. Answer (3)

Hint: Cotton and Larkspur show developmental heterophylly.

Sol.: Buttercup shows environmental heterophylly in different habitats.

122. Answer (3)

Hint: NADPH is not produced in the Krebs' cycle.

Sol.: $FADH_2$ is formed only once in a citric acid cycle and it gets oxidized during the oxidative phosphorylation.

123. Answer (3)

Hint: Pairing of homologous chromosomes takes place in the zygotene stage.

Sol.: The correct sequential order is

$c \rightarrow a \rightarrow b \rightarrow d$

124. Answer (2)

Hint: Protein synthesis is performed by Rough ER.

Sol.: Smooth ER is involved in the synthesis of steroidal hormones.

125. Answer (4)

Hint: Bulliform cells are large, empty and colourless cells of monocot leaves.

Sol.: When the bulliform cells in grass leaves absorb water, they become turgid and the leaf surface is exposed.

126. Answer (2)

Hint: Solanaceae and Brassicaceae families show features like superior ovary and bicarpellary gynoecium in flowers.

Sol.: *Petunia*, Mustard, Makoi, Tomato, Brinjal and Chilli have bicarpellary gynoecium and superior ovary.

127. Answer (2)

Hint: *Marchantia* is a bryophyte and it does not contain coralloid roots.

Sol.: Coralloid roots are found in *Cycas*.

128. Answer (1)

Hint: *Albugo candida* causes white rust in mustard and it has coenocytic mycelium.

Sol.: Tobacco mosaic virus (TMV) has a single stranded RNA of approximately 6400 nucleotides in length.

129. Answer (4)

Hint: Gibberellins are responsible for foolish seedling disease in rice.

Sol.: Gibberellins induce bolting in certain rosette plants like cabbage and beet.

130. Answer (1)

Hint: 3 ATP are formed through substrate level phosphorylation.

Sol.: In glycolysis

1 NADH = 1 × 3 = 3 ATP

2 ATP in pay off phase

1 NADH from link reaction + 3 NADH from Krebs' cycle = 4 × 3 = 12 ATP

1 $FADH_2$ from Krebs' cycle = 1 × 2 = 2 ATP

1 GTP from Krebs' cycle = 1 ATP

Total = 15 ATP + 5 ATP = 20 ATP

131. Answer (2)

Hint: Enzyme commission number starts with 2

Sol.: **Transferases:** Enzymes catalysing a transfer of a group, other than hydrogen between a pair of substrate, S and S′.

Hydrolases: Enzymes catalysing hydrolysis of ester, ether, peptide, glydosidic, C–C, C-halide or P–N bonds.

Lyases: Enzymes that catalyse removal of groups from substrates by mechanisms other than hydrolysis leaving double bonds.

Dehydrogenases: Enzymes which catalyse oxidoreduction between two substrates S and S′ *e.g.*, S reduced + S′ oxidised $\rightarrow$ S oxidized + S′ reduced

132. Answer (2)

Hint: Trypsin is a proteolytic enzyme

Sol.:

Trypsin – Catalytic heteropolymer found in animals

Collagen – Structural heteropolymer found in animals

Cellulose – Polymer of hexose sugar (glucose) and found in cotton fibres

Chitin – Polymer of amino sugars (N-acetyl glucosamine) and found in arthropods

133. Answer (4)

Hint: Choose a mammal.

Sol.:

Animal	Type of fertilisation	Type of development
Pleurobrachia	External	Indirect
Fasciola	Internal	Indirect
Hyla	External	Indirect
Macropus	Internal	Direct

134. Answer (3)

Hint: Exclude the tessellated epithelium

Sol.: Some of the columnar or cuboidal cells get specialised for secretion and are called glandular epithelium.

135. Answer (3)

Hint: Movement of K^+ occurs during repolarisation

Sol.: After depolarisation, within a fraction of a second, K^+ diffuses outside the membrane and restores the resting potential of the membrane at the site of excitation.

136. Answer (3)

Hint: Knee joint

Sol.:

(1) Atlas and axis – Pivot joint

(2) Femur and acetabulum – Ball and socket joint

(3) Tibia and femur – Hinge joint

(4) Between carpal and metacarpal – Saddle joint

137. Answer (3)

Hint: Identify an aschelminth.

Sol.: Protonephridia or flame cells are the excretory structures in platyhelminths (Flatworms, *e.g., Planaria*), rotifers, some annelids and the cephalochordate – *Amphioxus*.

Renette cells are present in aschelminths (*Ascaris*).

138. Answer (1)

Hint: Complex functions are controlled by association areas

Sol.: Cerebral cortex is thrown into prominent folds and it contains motor areas, sensory areas and large regions that are neither clearly sensory nor motor in function, named association areas.

139. Answer (2)

Hint: Secreted from thyroid gland

Sol.: T_4 interacts with intracellular receptors and regulates gene expression. Epinephrine, somatostatin and thymosin interact with membrane bound receptors.

140. Answer (3)

Hint: Equal to 14

Sol.: False ribs = 6 in number

Phalanges = 14 in each limb

Tarsals = 7 in each lower limb

Lumbar vertebrae = 5 in number

True ribs = 14 in number

141. Answer (2)

Hint: More than one

Sol.: Low temperature preserves the enzyme in a temporarily inactive state whereas high temperature destroys enzymatic activity because proteins are denatured by heat.

142. Answer (4)

Hint: Complete separation of compartments

Sol.: In double circulation, blood passes through the heart twice in one complete circuit and is vital for efficient oxygen delivery as well as maintains a high metabolic rate in birds and mammals.

This separation of oxygenated and deoxygenated blood ensures a consistent rich supply of oxygen to the body tissues, crucial for active lifestyle.

Incomplete double circulation is seen in amphibians and reptiles.

143. Answer (2)

Hint: Alteration of respiratory rate

Sol.: Neural signals from pneumotaxic centre can reduce the duration of inspiration and thereby alter the respiratory rate. Increase in respiratory rate will be seen as a result of activation of pneumotaxic centre.

144. Answer (3)

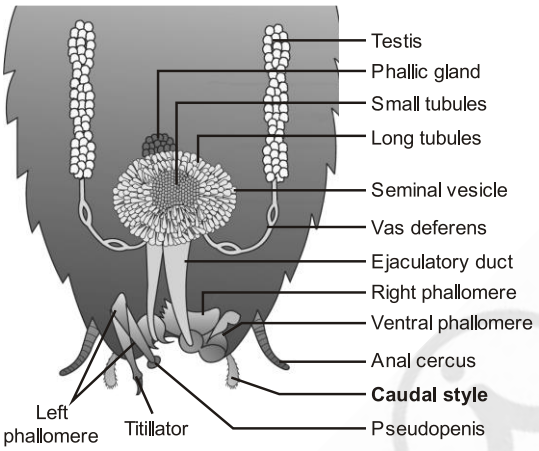
Hint: Function of hypothalamus

Sol.: Hypothalamus regulates body temperature. Medulla oblongata regulates cardiovascular reflexes. Hypothalamus secretes gonadotropin releasing hormones.

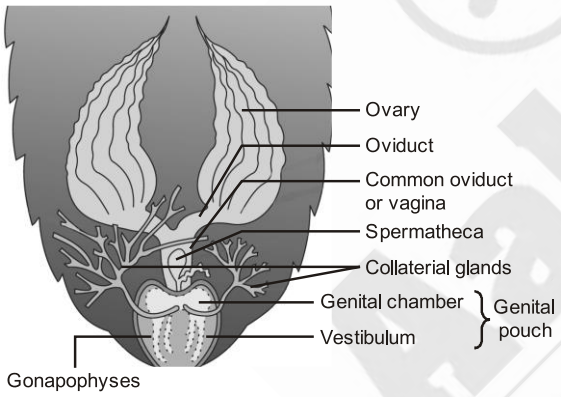
145. Answer (2)

Hint: Produce ova

Sol.: The female reproductive system consists of two large ovaries lying laterally in the 2nd to 6th abdominal segments.



A



B

146. Answer (4)

Hint: Cockroach excretes uric acid.

Sol.: Katla (bony fish) - ammonotelic

Cockroach (insect) - uricotelic

Vulture (bird) - uricotelic

147. Answer (4)

Hint: 16 carbon fatty acid

Sol.:

- Sugar in a nucleotide can be ribose or 2′ deoxyribose.
- Triglyceride consists of 3 ester bonds.
- In serine, hydroxy methyl group is attached to α-carbon.

148. Answer (2)

Hint: Cancer treatment drug

Sol.:

Pigments	Carotenoids, Anthocyanins, *etc.*
Alkaloids	Morphine, Codeine, *etc.*
Terpenoides	Monoterpenes, Diterpenes, *etc*.
Essential oils	Lemon grass oil, *etc.*
Toxins	Abrin, Ricin
Lectins	Concanavalin A
Drugs	Vinblastin, curcumin, *etc.*
Polymeric substances	Rubber, gums, cellulose

149. Answer (2)

Hint: Exclude the numerical value of tidal volume

Sol.: Volume of air inspired or expired during each breathe is approx. 500 mL, *i.e.*, a healthy man can inspire or expire approximately 6000 to 8000 mL of air per minute.

ERV = 1000 – 1100 mL

IRV = 2500 – 3000 mL

150. Answer (1)

Hint: Exclude lipids

Sol.: Amino acids are substituted methanes.

Example: Valine, glutamic acid, phenylalanine

Lipids - Palmitic acid, arachidonic acid

151. Answer (4)

Hint: Most of the mammals have enucleated RBCs

Sol.: RBCs are nucleated in frogs and contain red coloured pigment namely haemoglobin. The hind-brain of frogs consists of cerebellum and medulla oblongata. Urethra is the common urinogenital duct in human males. Renal portal system is absent in humans.

152. Answer (3)

Hint: Body cavity lined by mesoderm

Sol.: Presence or absence of a cavity between the body wall and the gut wall is very important in classification. The body cavity which is lined by mesoderm is called coelom. Animals possessing coelom are called coelomates, *e.g.*, annelids, molluscs, arthropods, echinoderms, hemichordates and chordates. Annelids have body cavity lined by mesoderm.

153. Answer (3)

Hint: Cyclostomes lack jaws

Sol.: Cyclostomes have cartilaginous cranium and vertebral column. Bony fishes, reptiles, birds and mammals have bony vertebral column. Members of the phylum Chordata have closed circulatory system. Members of the class Chondrichthyes have powerful jaws and backwardly directed teeth.

154. Answer (4)

Hint: Joint diastole

Sol.: The first heart sound (lub) is associated with the closure of the tricuspid and the bicuspid valves whereas the second heart sound (dub) is associated with the closure of semilunar valves.

155. Answer (4)

Hint: Locust is an arthropod.

Sol.: Locusts have jointed appendages. They have organ system level of organisation and bilateral symmetry. *Pennatula* is a diploblastic organism. Aquatic arthropods have statocysts for balancing.

156. Answer (1)

Hint: Cytokinin along with auxin causes callus proliferation.

Sol.: Extract of vascular tissues, yeast extract, degraded product of autoclaved herring sperm DNA and coconut milk are source of cytokinin. They along with auxin can proliferate callus.

157. Answer (2)

Hint: ABA is growth inhibitory hormone.

Sol.: ABA acts as an antagonist to GAs w.r.t. dormancy of seeds, buds and storage organs.

158. Answer (4)

Hint: Adenine derivative PGR is N^6-furfuryl aminopurine, kinetin.

Sol.: Cytokinin promotes nutrient mobilisation which helps in the delay of leaf senescence.

159. Answer (1)

Hint: RQ values of oxalic acid is 4.

Sol.: RQ value of organic acids is more than unity as organic acid contains high proportion of oxygen as compared to carbon and hydrogen, therefore, less oxygen is absorbed than CO_2 liberated.

160. Answer (3)

Hint: Complex I refers to NADH dehydrogenase complex.

Sol.: Complex I transfers electrons to ubiquinone.

Complex II (succinate dehydrogenase) does not transport H^+ from matrix to inter membrane space.

Complex IV is referred as cytochrome *c* oxidase complex.

161. Answer (4)

Hint: $FADH_2$ and NADH + H^+ are reduced coenzymes.

Sol.: During the TCA cycle following conversion reactions release reduced coenzymes.

- Malic acid $\rightarrow$ OAA
- Succinic acid $\rightarrow$ Fumaric acid
- α-ketoglutarate $\rightarrow$ Succinyl CoA

162. Answer (2)

Hint: Enzymes of TCA cycle require oxygenic conditions. Lactate dehydrogenase is required in lactic acid fermentation.

Sol.: Incomplete oxidation of glucose to form alcohol require enzymes involved in glycolysis and alcohol fermentation, *i.e.*, pyruvate decarboxylase and alcohol dehydrogenase.

163. Answer (4)

Hint: Light is rarely a limiting factor in nature except for plants in shade.

Sol.: Current availability of CO_2 levels is limiting for the C_3 plants.

164. Answer (2)

Hint: Phosphoglycolate is formed in C_3 plants during photorespiration.

Sol.:

Phosphoglycolate	Formed when RuBisCO binds with O_2 instead of CO_2 to convert RuBP
Phosphoenol pyruvate	Primary CO_2 acceptor; 3-carbon molecule which gets converted into 4-carbon molecule after carboxylation in mesophyll cell
3-phosphoglycerate	Primary stable product formed during the most crucial step of Calvin cycle in all photosynthetic plants
Oxaloacetic acid	Primary stable product of CO_2 fixation in the mesophyll cell of maize leaves

165. Answer (4)

Hint: The ground tissue system of monocot stem is not well differentiated.

Sol.: Vascular bundles in dicot stem and monocot stem are endarch type.

166. Answer (3)

Hint: Open vascular bundles possess the activity to form secondary xylem and phloem tissues.

Sol.: Monocots do not undergo secondary growth as they lack cambium in their vascular bundles.

167. Answer (4)

Hint: Legume type of fruit may have one or many seeds.

Sol.: *Calotropis* shows valvate aestivation of petals.

Castor has endospermic seeds.

168. Answer (4)

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

Sol.: Cymose inflorescence is observed in *Solanum.*

169. Answer (3)

Hint: Potato belongs to Solanaceae family.

Sol.: The floral diagram of potato family is follows:

170. Answer (4)

Hint: Axile placentation is seen in Malvaceae family.

Sol.: In alternate type of phyllotaxy, a single leaf arises at each node in alternate manner, as in China rose, mustard and sun flower plants.

171. Answer (3)

Hint: Universal donor blood group

Sol.:

Blood Group	Antigens on RBCs	Antibodies in Plasma	Donor's Group
A	A	anti-B	A, O
B	B	anti-A	B, O
AB	A, B	nil	AB, A, B, O
O	nil	anti-A B	O

172. Answer (2)

Hint: Characterised by enlargement of lower jaw

Sol.: Excess secretion of growth hormone in adults especially in middle age can result in severe disfigurement (especially of the face) called Acromegaly, which may lead to serious complications and premature death if unchecked.

Addison's disease – Hyposecretion of adrenal cortical hormone

Cretinism – Hyposecretion of thyroxine

Diabetes mellitus – Hyposecretion of insulin

173. Answer (4)

Hint: Organ that also aids in hearing

Sol.: Frog has different types of sense organs, namely organs of touch (sensory papillae), taste (taste buds), smell (nasal epithelium), vision (eyes) and hearing (tympanum with internal ears). Out of these, eyes and internal ears are well organised sense structures.

174. Answer (2)

Hint: No energy formation after death

Sol.: When a new ATP binds to the myosin head the cross-bridge is broken. After death, no new ATP is formed and thus rigor mortis occurs.

175. Answer (4)

Hint: CO. = HR × SV

Sol.: Heart rate = 85 beats per minute

End diastolic volume = 120 mL

End systolic volume = 50 mL

Stroke volume = 120 – 50 = 70 mL

Cardiac output = 70 × 85 mL / min = 5.95 L / min

176. Answer (1)

Hint: Synaptic delay

Sol.: Synaptic delay is significantly seen in chemical synapses compared to electrical synapses. Because former involves the release of chemical neurotransmitters from the pre-synaptic neuron which diffuse across the synaptic cleft to bind to receptors on the post-synaptic neuron.

177. Answer (3)

Hint: Identify an aschelminth

Sol.: Hookworm (*Ancylostoma*) → Sexes are separate and complete digestive system is present

Earthworm (*Pheretima*) and leech (*Hirudinaria*) → Sexes are not separate.

Tapeworm (*Taenia*) → Hermaphrodite with no digestive system

178. Answer (3)

Hint: Hormone from pars nervosa

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

Somatostatin – Hypothalamus

Prolactin releasing hormone – Hypothalamus

ADH – Hypothalamus

Prolactin (Milk secreting hormone) - Pituitary gland

179. Answer (4)

Hint: Right side shift of O_2-dissociation curve

Sol.: In tissues, where low pO_2, high pCO_2, high H^+ concentration and higher temperature exist, the conditions are favourable for dissociation of oxygen from oxyhaemoglobin.

180. Answer (2)

Hint: Identify a cyclostome

Sol.: Cyclostomes have a sucking and circular mouth without jaws. Their body is devoid of scales and paired fins. Cranium and vertebral column are cartilaginous. *ex-Petromyzon*

Scoliodon → Cartilaginous fish

Devil fish, cuttlefish → Mollusc

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