All India Aakash Test Series for NEET - 2027

TEST - 2 (Code-C)

Click here for Code-D Sol.

Test Date : 02/11/2025

ANSWERS

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

10. Answer (2)

    Hint: Use equation of motion

    $$\vec{S} = \vec{u}t + \frac{1}{2}\vec{a}t^2$$

    Sol.: $\vec{S} = \vec{u}t + \frac{1}{2}\vec{a}t^2$

    $$\vec{r_f} - \vec{r_i} = (\hat{i} + 2\hat{j}) \times 3 + \frac{1}{2}(2\hat{i} + \hat{j}) \times 9$$

    $$\vec{r_f} = (3\hat{i} + 6\hat{j}) + 9\hat{i} + \frac{9}{2}\hat{j}$$

    $$\vec{r_f} = 12\hat{i} + \frac{21}{2}\hat{j}$$

    $$\vec{r_f} = (12\hat{i} + 10.5\hat{j})\, m$$

11. Answer (2)

    Hint: After time *t,* vertical component of velocity $v_y = gt$

    Sol.: T = 4 s

    $v_y = g \times 4 = 40 \text{ m s}^{-1}$

    and

    $$\tan\theta = \frac{v_y}{v_x}$$

    $$\tan 53° = \frac{v_y}{v_x}$$

    $$\Rightarrow v_x = \frac{v_y}{\tan 53°} = \frac{40 \times 3}{4} = 30 \text{ m s}^{-1}$$

    ∴ Speed of projection is 30 m s⁻¹

12. Answer (2)

    Hint: $\vec{a} = \dfrac{\vec{v} - \vec{u}}{t}$

    Sol.: $\vec{a} = \dfrac{(-2\hat{i} + 4\hat{j}) - (2\hat{i} + 3\hat{j})}{2}$

    $$= \frac{-4\hat{i} + \hat{j}}{2} = (-2\hat{i} + 0.5\hat{j}) \text{ m s}^{-2}$$

13. Answer (3)

    Hint: In uniform circular motion, $\theta = \omega t$

    Sol.: Angular displacement $\theta = \omega t$

    $$\frac{\pi}{6} = \frac{2\pi}{T} \times 5$$

    $$\Rightarrow T = 60 \text{ s}$$

14. Answer (2)

    Hint: Use relation between range and maximum height, $R = 4H\cot\theta$

15. **Sol.:** $\dfrac{R}{H} = 4\cot\theta$

    $$\frac{R}{H} = 4\cot 30° = 4\sqrt{3}$$

15. Answer (3)

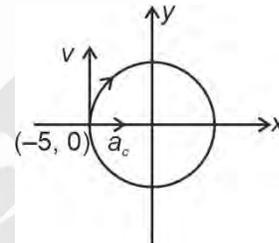   **Hint:** Properties of scalar quantity

    Sol.: Scalar quantity can be negative, positive or zero.

    A scalar quantity has the same value for observers with different orientation of axes.

16. Answer (2)

    Hint: In uniform circular motion, only centripetal acceleration is present and $|\vec{a_c}| = \dfrac{v^2}{R}$

    Sol.:

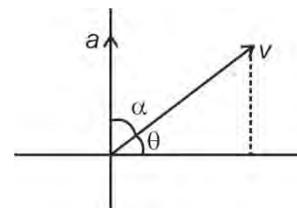 $$|\vec{a_c}| = \frac{v^2}{R} = \frac{10^2}{5} = 20 \text{ m s}^{-2}$$

    $$\vec{a_c} = 20\hat{i} \text{ m s}^{-2}$$

17. Answer (1)

    Hint: $a_t = \dfrac{d|\vec{v}|}{dt}$, $a_c = \dfrac{v^2}{R}$ and $\vec{a} = \dfrac{d\vec{v}}{dt}$

    Sol.: Acceleration $\vec{a} = \dfrac{d\vec{v}}{dt} = (8\hat{j}) \text{ m s}^{-2}$

    at t = 1 s, $\vec{v} = (6\hat{i} + 8\hat{j}) \text{ m s}^{-1}$

    $$\tan\theta = \frac{v_y}{v_x} = \frac{8}{6} = \frac{4}{3}, \theta = 53° \text{ and } \alpha = 37°$$

    As tangential acceleration is component of acceleration along velocity

    ∴ $a_t = a\cos\alpha$ and $a_n = a\sin\alpha$

    $$\frac{a_t}{a_n} = \frac{a\cos\alpha}{a\sin\alpha} = \cot\alpha = \cot 37° = \frac{4}{3}$$

18. Answer (2)

    Hint: Use $a_t = \alpha R$ and $\theta = \dfrac{1}{2}\alpha t^2$

    Sol.: Let both particles meet in time t

    $\therefore \quad \alpha_1 = \dfrac{a_1}{R} = \dfrac{4}{2} = 2 \text{ rad/s}^2$

    $\& \quad \alpha_2 = \dfrac{a_2}{R} = \dfrac{12}{2} = 6 \text{ rad/s}^2$
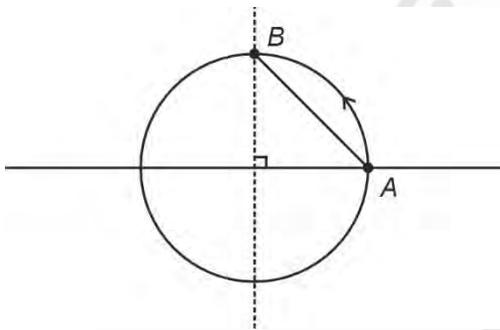
    $2\pi = \theta_1 + \theta_2$

    $2\pi = \dfrac{1}{2} \times 2 \times t^2 + \dfrac{1}{2} \times 6 \times t^2 = 4t^2$

    $\Rightarrow \quad t = \sqrt{\dfrac{\pi}{2}} \text{ s}$

    Now,

    $\theta_1 = \dfrac{1}{2}\alpha_1 t^2 = \dfrac{1}{2} \times 2 \times \dfrac{\pi}{2} = \dfrac{\pi}{2} \text{ rad}$

    $\theta_2 = \dfrac{1}{2}\alpha_2 t^2 = \dfrac{1}{2} \times 6 \times \dfrac{\pi}{2} = \dfrac{3\pi}{2} \text{ rad}$

19. Answer (3)

    Hint: Use $v_x = \dfrac{dx}{dt}$ and $v_y = \dfrac{dy}{dt}$

    Sol.: $v_x = \dfrac{dx}{dt} = \sqrt{3}y$

    $v_y = \dfrac{dy}{dt} = \dfrac{x}{\sqrt{3}}$

    $\Rightarrow \quad \dfrac{v_y}{v_x} = \dfrac{dy}{dx} = \dfrac{x}{\sqrt{3}.\sqrt{3}\,y} = \dfrac{x}{3y}$

    $\Rightarrow \quad 3\int y\,dy = \int x\,dx$

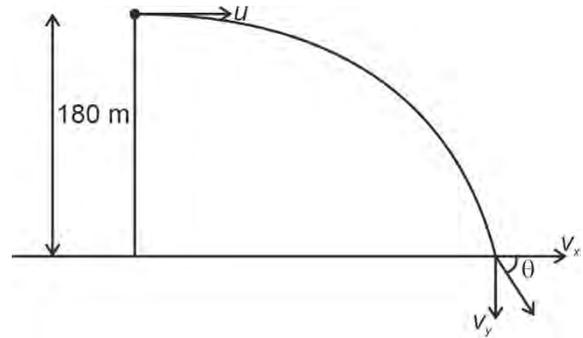 $\Rightarrow \quad \dfrac{3y^2}{2} = \dfrac{x^2}{2} + C$

    $\Rightarrow \quad 3y^2 = x^2 + C'$

20. Answer (3)

    Hint: In horizontal direction, motion is uniform and in vertical direction motion of particle is uniformly accelerated.

Sol.:

$v_x = u = 80 \text{ m s}^{-1}$

$\Rightarrow \quad T = \sqrt{\dfrac{2H}{g}} = \sqrt{\dfrac{2 \times 180}{10}} = 6 \text{ s}$

$\Rightarrow \quad v_y = gt = 10 \times 6 = 60 \text{ m s}^{-1}$

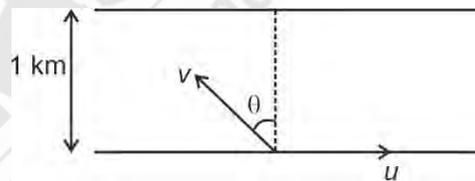$\Rightarrow \quad \tan\theta = \dfrac{v_y}{v_x} = \dfrac{60}{80} = \dfrac{3}{4}$

$\Rightarrow \quad \theta = 37°$

$v = \sqrt{v_x^2 + v_y^2} = \sqrt{(80)^2 + (60)^2} = 100 \text{ m s}^{-1}$

21. Answer (3)

    Hint: In case of shortest path, the net velocity of boat is perpendicular to river velocity.

    Sol.:

    $\Rightarrow$ Time to cross river through shortest path,

    $t = \dfrac{d}{v\cos\theta} = \dfrac{1}{10\cos\theta}$

    $\Rightarrow \quad \dfrac{1}{2} = \dfrac{1}{10\cos\theta} \Rightarrow \cos\theta = \dfrac{1}{5}$

    $\Rightarrow \quad \sin\theta = \dfrac{\sqrt{24}}{5} = \dfrac{2\sqrt{6}}{5}$

    $\therefore \quad u = v\sin\theta$

    $= 10 \times 2\dfrac{\sqrt{6}}{5}$

    $u = 4\sqrt{6} \text{ km/h}$

22. Answer (3)

    Hint: In uniform circular motion, $\omega = \dfrac{2\pi}{T}$

    Sol.: Since time period is same for both
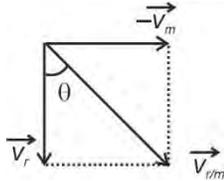
    $\therefore \quad \omega_1 = \omega_2$

23. Answer (1)

Hint & Sol.: $\theta = \omega \times t$

$= 3 \times 4 = 12$ rad

24. Answer (1)

Hint: $\vec{v}_{r/m} = \vec{v}_{r/g} - \vec{v}_{m/g}$

Sol.: $\vec{v}_{r/m} = \vec{v}_{r/g} - \vec{v}_{m/g}$

$\tan\theta = \dfrac{v_m}{v_r} = \dfrac{10}{20} = \dfrac{1}{2}$

$\theta = \tan^{-1}\left(\dfrac{1}{2}\right)$

25. Answer (2)

Hint: In circular motion, centripetal acceleration

$a_c = \dfrac{v^2}{R}$

Sol.: $a_c = \dfrac{v^2}{R}$

$\Rightarrow a\cos 37° = \dfrac{v^2}{R}$

$\Rightarrow 20 \times \dfrac{4}{5} \times 5 = v^2 \Rightarrow v^2 = 80 \Rightarrow v = 2\sqrt{20}$

$\simeq 8.94\ \text{ms}^{-1}$

26. Answer (3)

Hint & Sol: $\vec{v} = (3t^2 + 4)\hat{i} + 4t\hat{j}$

at $t = 0$, $\vec{v} = +4\hat{i}$ m s^{-1}

$\vec{a} = \left(6t\hat{i} + 4\hat{j}\right)$ m s^{-2}

at $t = 0$, $\vec{a} = 4\hat{j}$ m s^{-2}

Since total acceleration is perpendicular to velocity vector at $t = 0$

$\vec{a} = \vec{a_N} = 4\hat{j}$ m s^{-2}

& $a_t = 0$

27. Answer (2)

Hint: Horizontal velocity and man's speed should be same to catch the ball.

Sol.: $v = u\cos 37° = 5 \times \dfrac{4}{5} = 4$ m s^{-1}

28. Answer (4)

Hint: Horizontal range $R = \dfrac{2u_x u_y}{g}$

Sol.: $R = \dfrac{2u_x u_y}{g}$

$= \dfrac{2 \times 15 \times 10}{10} = 30$ m

29. Answer (2)

Hint: At the highest point of trajectory, speed is minimum.

Sol.: At the highest point,

$x = \dfrac{R}{2}$ and

In case of maximum possible range $y = H = \dfrac{R}{4}$

$\therefore$ Position vector $\vec{r}$ of topmost point $\left(\dfrac{R}{2}, \dfrac{R}{4}\right)$

$= (200\hat{i} + 100\hat{j})$ m

30. Answer (3)

Hint: $\tan\theta = \dfrac{dy}{dx}$
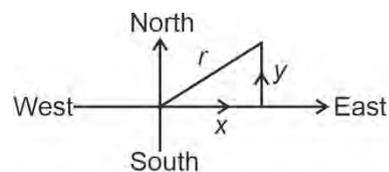
Sol.: $y = 8x - 3x^2$

$\dfrac{dy}{dx} = 8 - 6x$

$\tan\theta = 8 - 6x$

at $x = 1$, $\tan\theta = 2$

$\Rightarrow \theta = \tan^{-1}(2)$

31. Answer (4)

Hint:

Displacement $r = \sqrt{x^2 + y^2}$

Sol.: $x = 10 \times 2 = 20$ m

$y = 10 \times 3 = 30$ m

Displacement $r = \sqrt{x^2 + y^2}$

$= \sqrt{400 + 900} = 10\sqrt{13}$ m

32. Answer (1)

Hint: Magnitude of change in velocity = $|\overrightarrow{v_f} - \overrightarrow{v_i}|$

Sol.: $\overrightarrow{v_f} = u\cos\theta\hat{i}$

$\overrightarrow{v_i} = u\cos\theta\hat{i} + u\sin\theta\hat{j}$

$|\overrightarrow{v_f} - \overrightarrow{v_i}| = |(u\cos\theta\hat{i}) - (u\cos\theta\hat{i} + u\sin\theta\hat{j})|$

$= u\sin\theta$

33. Answer (4)

Hint: $v_x = \dfrac{dx}{dt}$ and $v_y = \dfrac{dy}{dt}$

Sol.: $v_x = 10$ m s^{-1} = u_x

and $v_y = 10\sqrt{3} - 2t$

at $t = 0$, $u_y = 10\sqrt{3}$ m s^{-1}

$u = \sqrt{u_x^2 + u_y^2} = \sqrt{10^2 + (10\sqrt{3})^2} = 20$ m s^{-1}

34. Answer (2)

Hint: Horizontal component of velocity remains constant during entire journey.

Sol.: Let required speed be v

$20\cos53° = v\cos37°$

$20 \times \dfrac{3}{5} = v \times \dfrac{4}{5}$

$\Rightarrow v = 15$ m s^{-1}

35. Answer (2)

Hint & Sol.: Horizontal velocity of stone is constant and vertical velocity increases continuously therefore, minimum velocity is at $t = 0$

$u_{\min} = u$

36. Answer (1)

Hint: In case of constant acceleration,

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

Sol.: $\vec{u} = 20\cos53°\hat{i} + 20\sin53°\hat{j}$

$= 20 \times \dfrac{3}{5}\hat{i} + 20 \times \dfrac{4}{5}\hat{j}$

$= \left(12\hat{i} + 16\hat{j}\right)$ m s^{-1}

and $\vec{v} = 20\cos53°\hat{i} = 12\hat{i}$ m s^{-1}

$<\vec{v}> = \dfrac{\vec{v} + \vec{u}}{2} = \dfrac{(12\hat{i}) + (12\hat{i} + 16\hat{j})}{2}$

$= (12\hat{i} + 8\hat{j})$ m s^{-1}

37. Answer (3)

Hint & Sol.: In uniform circular motion, magnitude of acceleration is constant but its direction is continuously changing.

When speed of particle performing circular motion decreases, then angle between velocity and acceleration is greater than 90°.

38. Answer (4)

Hint: $|\vec{v}_{A/B}| = |\overrightarrow{v_A} - \overrightarrow{v_B}|$

Sol.: $v_{A/B} = |12\hat{i} - 12\hat{j}| = 12\sqrt{2}$ m s^{-1}

39. Answer (2)

Hint: $\vec{v}_{avg} = \dfrac{\text{Total displacement}}{\text{total time}}$

Sol.: $\vec{v}_{avg} = \dfrac{\vec{r}_f - \vec{r}_i}{\Delta t}$

$= \dfrac{(13\hat{i} + 18\hat{j}) - (\hat{i} + 2\hat{j})}{4} = \left(\dfrac{12\hat{i} + 16\hat{j}}{4}\right)$

$= (3\hat{i} + 4\hat{j})$ m s^{-1}

40. Answer (2)

Hint: When ball is dropped out of a window, then motion of ball is under gravity

Sol.: At $t = 2$ s, velocity of ball

$v = at = 7.5 \times 2 = 15$ m s^{-1} along horizontal

at $t = 4$ second

$v_x = 15$ m s^{-1}

$v_y = g(2) = 10 \times 2 = 20$ m s^{-1}

Velocity $v = \sqrt{(15)^2 + (20)^2}$

$= \sqrt{225 + 400} = \sqrt{625} = 25$ m s^{-1}

and acceleration = $g = 10$ m s^{-2}

41. Answer (4)

Hint: Average velocity

$<\vec{v}_{avg}> = \dfrac{\text{Total displacement}}{\text{total time}}$

Sol.: Displacement = $\sqrt{2}R$

Total time $\Delta t = \dfrac{3\pi R}{2v}$

$<v_{avg}> = \dfrac{\sqrt{2}R}{\dfrac{3\pi}{2}\dfrac{R}{v}} = \dfrac{2\sqrt{2}\,v}{3\pi}$

42. Answer (3)

Hint: Vertical component of velocities should be same for collision.

Sol.: $(v_A)_y = (v_B)_y$
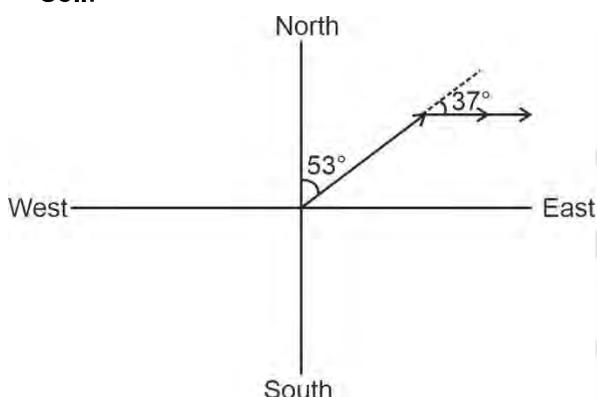
$\Rightarrow 50 \sin\theta = 30$

$\Rightarrow \sin\theta = \dfrac{3}{5} \Rightarrow \theta = 37°$

Now $x = 50\cos\theta \times t = 50 \times \dfrac{4}{5} \times 2 = 80$ m

43. Answer (2)

Hint: Average acceleration $<\vec{a}> = \dfrac{\vec{v_f} - \vec{v_i}}{\Delta t}$

Sol.:

$\vec{v_i} = 10\sin 53° \hat{i} + 10\cos 53° \hat{j} = (8\hat{i} + 6\hat{j})$ m s^{-1}

$\vec{v_f} = 10\hat{i}$ ms^{-1}

$<\vec{a}> = \dfrac{\vec{v_f} - \vec{v_i}}{\Delta t} = \dfrac{10\hat{i} - (8\hat{i} + 6\hat{j})}{5}$

$= \left(\dfrac{2}{5}\hat{i} - \dfrac{6}{5}\hat{j}\right)$ m s^{-2}

$<a> = \dfrac{\sqrt{2^2 + 6^2}}{5} = \dfrac{\sqrt{40}}{5}$

$= \sqrt{\dfrac{8}{5}} = 2\sqrt{\dfrac{2}{5}}$ m s^{-2}

44. Answer (4)

Hint & Sol.: Only vectors of same nature can be added.

45. Answer (1)

Hint: $\omega = \dfrac{v_\perp}{r}$

Sol.:

$\omega = \dfrac{v\sin 37°}{5/\sin 37°} = 1 \times \sin^2 37° = \left(\dfrac{3}{5}\right)^2$

$= \dfrac{9}{25}$ rad/s

[CHEMISTRY]

46. Answer (2)

Hint: Down the group for alkali metals, the negative electron gain enthalpy decreases.

Sol.: Negative electron gain enthalpy of sulphur is higher than oxygen because of larger size of the valence shell of sulphur hence the added electron-suffers less electronic repulsion than the electron added to an oxygen atom which has smaller valence shell.

Element	$\Delta_{eg}H$ (kJ mol^{-1})
Li	–60
Na	–53
O	–141
S	–200

47. Answer (4)

Hint: Iodine belongs to halogen family

Sol.: • Lanthanoid $\longrightarrow$ Samarium

• Semi-metal/metalloid $\longrightarrow$ Arsenic

• Transition element $\longrightarrow$ Platinum

48. Answer (4)

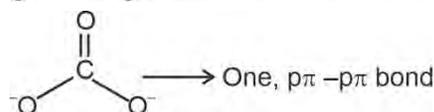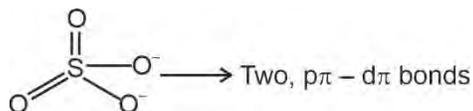**Hint:** Lithium shows diagonal relationship with magnesium
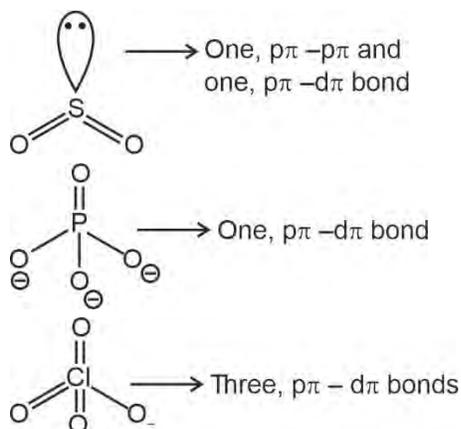
Sol.:

Element	Electronegativity value (on Pauling scale)
Li	1.0
Al	1.5

49. Answer (3)

Hint: For pπ – dπ bond, the central atom should contain the d-orbital

Sol.:

→ One, $p\pi - p\pi$ and one, $p\pi - d\pi$ bond

→ One, $p\pi - d\pi$ bond

→ Three, $p\pi - d\pi$ bonds

N_2^-	$\frac{1}{2}(10-5) = 2.5$
B_2^+	$\frac{1}{2}(5-4) = 0.5$
H_2^+	$\frac{1}{2}(1-0) = 0.5$
Li_2^+	$\frac{1}{2}(3-2) = 0.5$
Be_2	$\frac{1}{2}(4-4) = 0$
He_2	$\frac{1}{2}(2-2) = 0$

50. Answer (3)

Hint: Dipole moment is a vector quantity hence its value depends on shape, bond dipoles and orbital dipoles due to lone pair.

Sol.:

Molecule	Dipole Moment $\mu(D)$
NH_3	1.47
H_2S	0.95
NF_3	0.23
CH_4	0

51. Answer (3)

Hint: Intramolecular hydrogen bond is formed when hydrogen atom is in between the two highly electronegative (F, O, N) atoms present within the same molecule.

Sol.:

- p-nitrophenol forms intermolecular H-bond while o-nitrophenol forms intramolecular H-bond.
- Methyl alcohol forms hydrogen bond with water hence it is soluble in water.

52. Answer (4)

Hint: If bond order is zero, then the species does not exist.

Sol.:

Species	Bond order $\left\{\frac{1}{2}(N_b - N_a)\right\}$
F_2	$\frac{1}{2}(10-8) = 1$
O_2^{2-}	$\frac{1}{2}(10-8) = 1$

53. Answer (2)

Hint: Higher is the bond order, shorter is the bond length.

Sol.:

Species	Bond order
O_2	2
O_2^+	2.5
O_2^-	1.5

54. Answer (1)

Hint: IUPAC official name of element having atomic number 104 is Rutherfordium.

Sol.:

Atomic Number		IUPAC official Name
106	→	Seaborgium
108	→	Hassium
103	→	Lawrencium
104	→	Rutherfordium

55. Answer (3)

Hint: In SF_6, the central atom is sp^3d^2 hybridised.

Sol.:

- In PCl_5, the axial bond pairs suffer more repulsive interaction from the equatorial bond pairs, therefore axial bonds have been found to be slightly longer than equatorial bonds
- In SF_6, the maximum number of atoms lie in a plane is 5.

56. Answer (2)

Hint: Percentage ionic character =

$\dfrac{\text{Observed dipole moment} \times 100}{\text{Calculated dipole moment}}$

$1D = 3.33 \times 10^{-30}$ C m

Sol.: Percentage ionic character =

$\dfrac{1.5 \times 3.33 \times 10^{-30} \times 100}{1.602 \times 10^{-19} \times 160 \times 10^{-12}} = 19.5\%$

57. Answer (3)

Hint: Because of the half filled p-subshell of nitrogen, the first ionization enthalpy is higher than oxygen.

Sol.:

Element	Ionisation enthalpy (kJ mol⁻¹)
Ne	2080
F	1681
O	1314
N	1402

58. Answer (1)

Hint & Sol: Zn, Cd and Hg do not belong to Dobereiner's Triads.

59. Answer (3)

Hint: If a molecule contains unpaired electron (s) then it is called odd electron molecule.

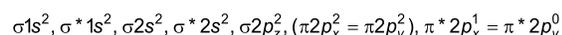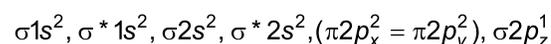Sol.: Octet theory does not account for the shape of the molecules.

60. Answer (4)

Hint: XeF_4 is square planar in shape.

Sol.:

Molecules		Characteristics
CH_4	⟶	Nonpolar and non-planar
XeF_4	⟶	Non-polar and planar
NH_3	⟶	Polar and non-planar
H_2S	⟶	Polar and planar

61. Answer (4)

Hint: Electronic configuration of O_2^+ :

$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, (\pi 2p_x^2 = \pi 2p_y^2), \pi^* 2p_x^1 = \pi^* 2p_y^0$

Sol.: Electronic configuration of N_2^+

$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, (\pi 2p_x^2 = \pi 2p_y^2), \sigma 2p_z^1$

Number of antibonding electrons in O_2^+ = 5

Number of bonding electrons in N_2^+ = 9

62. Answer (4)

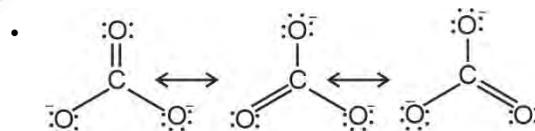Hint: A pi-bond is formed by the lateral overlap of pure p-orbitals between two adjacent atoms.

Sol.:
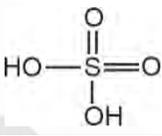
Molecule	Structure	Number of pi-bond(s)
CO_2	O = C = O	2
H_2SO_4	HO—S(=O)(=O)—OH	2
C_2H_4	$CH_2 = CH_2$	1
NF_3	N with lone pair, three F	Zero

63. Answer (1)

Hint: Resonance stabilizes the molecule or a species

Sol.:

• Resonance stabilises the molecule as the energy of the resonance hybrid is less than the energy of any single canonical structure.

64. Answer (4)

Hint: Down the group, atomic radius increases.

Sol.: In a period, the effective nuclear charge increases hence the atomic radius decreases.

Element	Atomic radii (pm)
O	66
F	64
S	104
Cl	99

65. Answer (1)

Hint: As_2O_3 is an amphoteric oxide.

Sol.:

Oxides		Chemical nature
N_2O	$\longrightarrow$	Neutral
CaO	$\longrightarrow$	Basic
SO_2	$\longrightarrow$	Acidic

66. Answer (3)

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

Sol.:

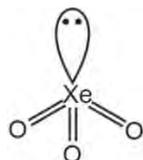| Species	Bond Order	Magnetic Behaviour
O_2	$\frac{1}{2}(10-6) = 2$	Paramagnetic
O_2^+	$\frac{1}{2}(10-5) = 2.5$	Paramagnetic
B_2	$\frac{1}{2}(6-4) = 1$	Paramagnetic
B_2^-	$\frac{1}{2}(7-4) = 1.5$	Paramagnetic
C_2	$\frac{1}{2}(8-4) = 2$	Diamagnetic
C_2^+	$\frac{1}{2}(7-4) = 1.5$	Paramagnetic
O_2^-	$\frac{1}{2}(10-7) = 1.5$	Paramagnetic

67. Answer (2)

Hint: In BrF_5, number of bond pairs are 5 and number of lone pair on central Br atom is 1.
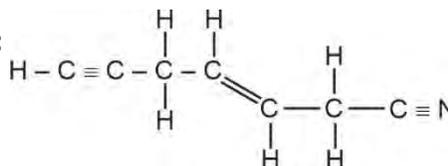
Sol.:
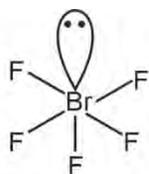
sp^3d^2
(Square pyramidal)
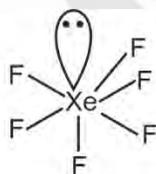
sp^3d^3
(Distorted octahedral)

sp^3
(Pyramidal)

68. Answer (4)

Hint: $-C \equiv N$ has two π bonds

Sol.:

Number of σ bonds = 14

Number of π bonds = 5

69. Answer (2)

Hint: Along a period electronegativity increases.

Sol.: Down the group electronegativity decreases

Element	Electronegativity (on Pauling scale)
B	2.0
C	2.5
Mg	1.2
Al	1.5
Si	1.8
P	2.1

70. Answer (4)

Hint: Smaller is the size of atom, smaller is the bond length.

Sol.: Order of atomic size : C > N > O > H

Order of bond length :

C – C > C – N > C – H > O – H

71. Answer (4)

Hint: Highest occupied molecular orbital is one, which is occupied and has highest energy.

Sol.: $N_2 : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2$

$= \pi 2p_y^2, \sigma 2p_z^2$

72. Answer (3)

Hint: *p*-block elements and *s*-block elements are called as representative elements or main group elements.

Sol.: • Boron does not have *d*-orbital. It contains 2*s* and 2*p* orbitals in its valence shell hence maximum valency of boron is 4.

• Fluorine in compounds has –1 oxidation state hence oxidation state of O in OF_2 is +2

73. **Answer (1)**

Hint & Sol.:
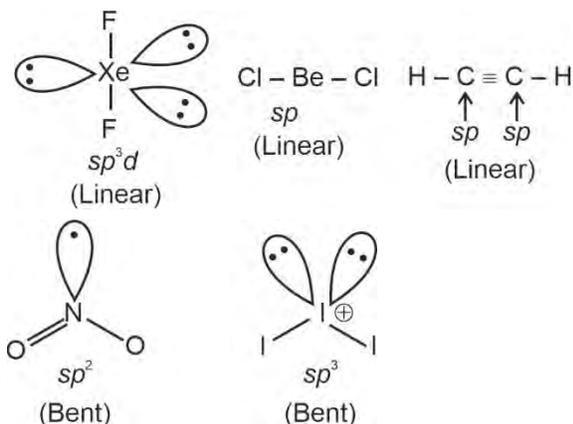
74. **Answer (4)**

Hint: In XeO_2F_2 the central atom is sp^3d hybridised.

Sol.:

Species	Hybridisation of central atom	Shape
SF_4	sp^3d	See-saw
$\overset{+}{N}H_4$	sp^3	Tetrahedral
SO_4^{2-}	sp^3	Tetrahedral
CCl_4	sp^3	Tetrahedral
XeO_2F_2	sp^3d	See-saw

75. **Answer (4)**

Hint: Electronic configuration of C_2:

$\sigma 1s^2, \sigma*1s^2, \sigma 2s^2, \sigma*2s^2, \pi 2p_x^2 = \pi 2p_y^2$

Sol.: • C_2 has 2π bonds.

• B_2 has one π bond.

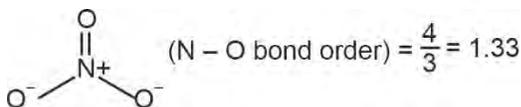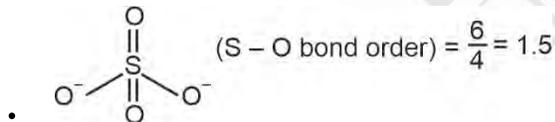(S – O bond order) $= \frac{6}{4} = 1.5$

•

(N – O bond order) $= \frac{4}{3} = 1.33$

76. **Answer (3)**

Hint: Electronic configuration of element having atomic number 50 is [Kr] $4d^{10}5s^25p^2$

Sol.: Valence shell is five hence it belongs to fifth period.

The group number will be 10 + 2 + 2 = 14

77. **Answer (3)**

Hint: In $\pi*2p_x$ orbital, the number of nodes = 2

Sol.: In $\sigma*1s$ orbital, number of node = 1

78. **Answer (3)**

Hint: The compounds in which central atoms are sp^3d and sp^3d^2 hybridised, contain 90° and 180° bond angles.

Sol.:
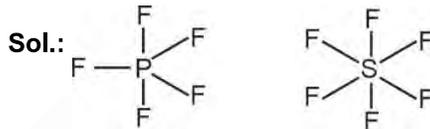
These compounds contain both 90° as well as 180° bond angles.

79. **Answer (3)**

Hint & Sol.: It is not necessary that only half-filled orbitals participate in hybridisation. In some cases even filled orbitals of valence shell take part in hybridisation.

80. **Answer (4)**

Hint: For isoelectronic species, more is the negative charge on the ion larger is the size of ion

Sol.: Na^+, Mg^{2+}, F^- and O^{2-} have inert gas configuration as of Ne.

The correct order of ionic size for these isoelectronic species is:

$O^{2-} > F^- > Na^+ > Mg^{2+}$

81. **Answer (2)**

Hint & Sol.: Symbol of element having atomic number 104 is Unq.

82. **Answer (3)**

Hint: Generally, more is the effective nuclear charge, higher is ionization enthalpy.

Elements having half filled or completely filled subshells have extra stability.

Sol.:

Electronic configuration	Element	Ionisation enthalpy (kJ mol^{-1})
$1s^22s^22p^63s^1$	Na	496
$1s^22s^22p^63s^2$	Mg	737
$1s^22s^22p^63s^23p^1$	Al	577
$1s^22s^22p^63s^23p^2$	Si	786

83. **Answer (2)**

Hint: In ClF_5, the central atom has one pair of non-bonding electrons.

Sol.:

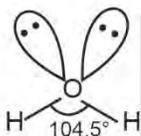| Molecules	Number of lone pairs
	15
	9
	16
	7

84. **Answer (2)**

Hint: Presence of more lone pair of electrons on central atom decreases the bond angle

Sol.:

85. **Answer (3)**

Hint: Co-ordinate bond is formed by donation of lone pair of electron from one atom to the vacant orbital of another atom.

Sol.:

　←　It contains ionic bond and covalent bond.

　→　Compound contains ionic bond, covalent bond and co-ordinate bond.

　→　Compound contains ionic bond, covalent bond and co-ordinate bond

　→　Compound contains ionic and covalent bond.

　→　Compound contains ionic bond covalent bond and co-ordinate bond.
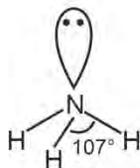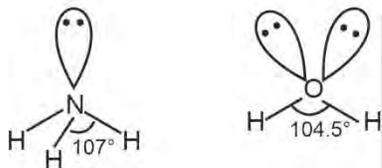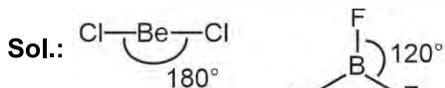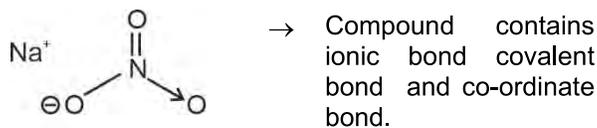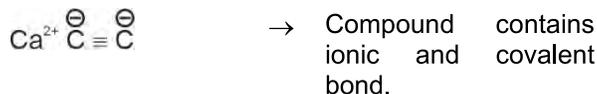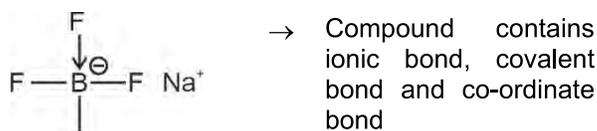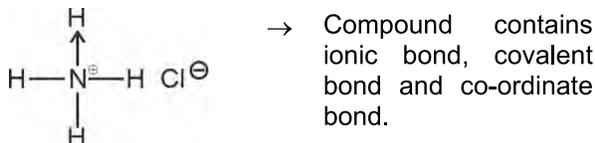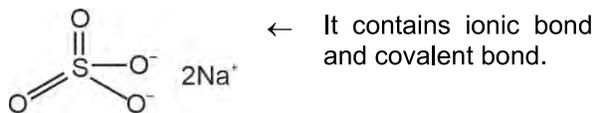
86. **Answer (1)**

Hint & Sol.: Gallium is also known as Eka-aluminium.

87. **Answer (2)**

Hint: Element X is a halogen.

Sol.: Valence of calcium is 2 while that of X is 1 hence the formula will be CaX_2.

88. **Answer (4)**

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

Sol.:

Species	Bond Order = $\frac{1}{2}(N_b - N_a)$
N_2^-	$\frac{1}{2}(10 - 5) = 2.5$
C_2^{2-}	$\frac{1}{2}(10 - 4) = 3$
NO^+	$\frac{1}{2}(10 - 4) = 3$
He_2^+	$\frac{1}{2}(2 - 1) = 0.5$

89. **Answer (2)**

Hint: For a given metal cation, larger is the size of anion more is the covalent character in the bond.

Sol.: Correct order of ionic size:

$I^- > Br^- > Cl^-$

Correct order of covalent character:

$LiI > LiBr > LiCl$

90. **Answer (2)**

Hint: BF_3 is trigonal planar in shape.
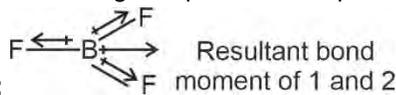
Sol.: Resultant bond moment of 1 and 2

In BF_3, the three bond moments give a net sum of zero as the resultant of any two is equal and opposite to the third.

[BOTANY]

91. Answer (3)

Hint: Pairing of homologous chromosomes takes place in the second sub-stage of prophase I.

Sol.: Pairing of homologous chromosomes takes place in meiotic cell division.

92. Answer (3)

Hint: In the metaphase stage, the nuclear envelope disappears and chromosomes spread through the cytoplasm of the cell.

Sol.: In the anaphase stage, spindle fibres shorten and daughter chromosomes begin to migrate towards the opposite poles.

93. Answer (2)

Hint: In a plant cell, cytokinesis is achieved by the formation of cell plate.

Sol.: In a plant cell, cell plate formation starts at the centre of the cell and grows outwards, towards the lateral wall, and thus, dividing the cell.

94. Answer (3)

Hint: Best stage to study the shape of the chromosome is anaphase.

Sol.: During anaphase, shape of the chromosomes can be easily studied and splitting of centromere will take place.

95. Answer (1)

Hint: Metaphase II of meiosis has half the number of chromosomes as compared to metaphase I.

Sol.: Metaphase I has bivalents arranged on the equatorial plate. While in metaphase II, univalents get arranged on an equatorial plate.

96. Answer (4)

Hint: Mitosis is also known as equational division.

Sol.: Mitosis is called equational division because the two daughter cells have same number of chromosomes as that of parent cell.

97. Answer (4)

Hint: APC is a protein degrading machinery, necessary for the proper mitosis in animal cells.

Sol.: APC facilitates the segregation of chromosomes and this leads to the transition of cell from metaphase to anaphase.

98. Answer (2)

Hint: G_0 phase is also known as quiescent phase.

Sol.: Gap 1 phase involves the duplication of most of the cell organelles.

During synthesis phase, DNA replication begins in the nucleus and the centriole duplicates in the cytoplasm.

Gap 2 phase involves the synthesis of RNA, protein, etc., required for the next phase by the cell.

99. Answer (2)

Hint: Interkinesis is followed by prophase II, a much simpler prophase than prophase I.

Sol.: No replication of DNA takes place during interkinesis.

100. Answer (4)

Hint: It is the last phase of karyokinesis.

Sol.: During telophase, chromosomes cluster at opposite spindle poles and their identity is lost as discrete elements.

101. Answer (2)

Hint: A bivalent consists of two homologous chromosomes.

Sol.: A bivalent consists of four chromatids of two homologous chromosomes.

102. Answer (3)

Hint: Prophase is the first phase and telophase is the last phase of karyokinesis.

Sol.: During prophase, condensation of chromatin material will take place. During telophase, nucleolus, ER, Golgi bodies and other organelles reappear in the daughter cells.

103. Answer (4)

Hint: The given cell is in late prophase.

Sol.: Synapsis occurs in zygotene stage. Prophase occurs in both haploid and diploid cells.

104. Answer (2)

Hint: Meiosis I products have double the amount of DNA as compared to meiosis II products.

Sol.: After meiosis I, the resultant cells will have 46 chromosomes and 2C of the DNA content.

105. Answer (1)

Hint: Diakinesis represents transition to metaphase.

Sol.: Pachytene stage is characterized by the exchange of genetic material. Diplotene stage is characterized by having X-shaped structure.

Zygotene stage involves pairing of homologous chromosomes known as, synapsis.

106. Answer (2)

    Hint: Condensation of chromatin is completed by metaphase and can be clearly observed under microscope.

    Sol.: The phase next to metaphase is anaphase.

    In anaphase, due to the splitting of centromere, chromatids get separated. Each chromosome moves away from the equatorial plate and the centromere of each chromosome remains directed towards the pole.

107. Answer (2)

    Hint: Pachytene is the third sub-stage of the prophase I.

    Sol.: Pachytene stage is characterized by the presence of the recombination nodules, the site at which crossing over occurs between non-sister chromatids of the homologous chromosomes.

108. Answer (3)

    Hint: Mitosis is also called equational division.

    Sol.: Meiosis helps in increasing the genetic variability in the daughter cells because it involves the crossing over of chromosomes.

109. Answer (4)

    Hint: This phase marks the end of cell division.

    Sol.: At the time of cytoplasmic division, organelles like mitochondria and plastids get distributed between the two daughter cells.

110. Answer (3)

    Hint: The complete disintegration of the nuclear envelope marks the start of the second phase of mitosis.

    Sol.: Complete disintegration of the nuclear membrane marks the beginning of metaphase stage.

111. Answer (4)

    Hint: The sequence of the phases in meiosis is as follows-

    Leptotene $\rightarrow$ Zygotene $\rightarrow$ Pachytene $\rightarrow$ Diplotene $\rightarrow$ Diakinesis $\rightarrow$ Metaphase I $\rightarrow$ Anaphase I $\rightarrow$ Telophase I.

    Sol.: Chromosomal synapsis is accompanied by the structure known as synaptonemal complex (Zygotene)

    $\downarrow$

    Mutual exchange of genetic material takes place by breakage and reunion of chromatid segments (Pachytene)

    $\downarrow$

The two homologous chromosomes begin to separate from each other but remain attached at the chiasmata (Diplotene)

$\downarrow$

The intact chromosome containing two chromatids separate from each other and start moving to the poles (Anaphase I)

$\downarrow$

The chromosomes uncoil and elongate but remain straight in this phase (Telophase I)

112. Answer (3)

    Hint: The two asters together with the spindle fibres form mitotic apparatus.

    Sol.: Each centrosome radiates out microtubules called asters.

    Centromere is the primary constriction of the chromosome and is not a part of the mitotic apparatus.

113. Answer (4)

    Hint: During anaphase, the spindle fibres attached to the kinetochore, now shorten and daughter chromosomes begin to migrate towards the opposite poles.

    Sol.: During mitotic anaphase, formation of interzonal fibres takes place.

114. Answer (4)

    Hint: During the S-phase, DNA replication begins in the nucleus.

    Sol.: In cell division, DNA replication and cell growth have to take place in a coordinated way to ensure correct division and formation of progeny cells, containing intact genomes.

115. Answer (4)

    Hint: By the end of meiosis II, four haploid cells are present.

    Sol.: The progenies which are obtained after meiosis II are haploid in nature. They have same amount of genetic material among them.

116. Answer (1)

    Hint: Meiosis leads to the formation of the haploid gametes.

    Sol.: Meiosis ensures the production of haploid phase in the life cycle of sexually reproducing organisms whereas, fertilisation restores the diploid phase.

117. Answer (3)

    Hint: G_1 phase is the interval between mitosis and initiation of DNA replication.

    Sol.: In G_1 phase, cells are metabolically active, most of the organelle duplication occurs in this phase and the number of chromosomes will remain the same as that of G_2 phase.

118. **Answer (3)**

    Hint: Centriole is not present in all eukaryotes.

    Sol.: Higher plants lack centrioles but still form mitotic apparatus.

119. **Answer (3)**

    Hint: In plants, cytokinesis is centrifugal in progression.

    Sol.: Cell plate is formed in the centre of the plant cell and further grows towards the periphery.

120. **Answer (4)**

    Hint: A human cell divides approximately in about 24 hours.

    Sol.: Yeast can progress through the cell cycle in only about 90 minutes.

121. **Answer (2)**

    Sol.: The cell cycle is divided into two basic phases, *i.e.,* interphase and M phase.

122. **Answer (3)**

    Hint: Anaphase II is similar to mitotic anaphase.

    Sol.: In anaphase I, the homologous chromosomes separate from each other and start moving towards the poles.

123. **Answer (4)**

    Hint: The given event in the image shows crossing over between homologous chromosomes.

    Sol.: Crossing over takes place in the pachytene stage of prophase I. It is the third sub-stage of the prophase I. It is an enzyme mediated process. The site where crossing over occurs, forms a recombination nodule.

124. **Answer (1)**

    Hint: The most dramatic period of cell cycle involves a major reorganisation of virtually all components of the cell.

    Sol.: M phase involves a major reorganisation of virtually all components of the cell.

125. **Answer (1)**

    Hint: Interphase is the resting phase of the cell cycle.

    Sol.: The interphase of the cell cycle is the time during which the cell prepares itself for the division. And it constitutes more than 95% of the duration of the human cell cycle.

126. **Answer (2)**

    Hint: Consciousness involves the behavioural changes or movement to external stimuli.

    Sol.: Metabolism is the sum total of all chemical reactions occurring in the body of an organism.

    For living organisms, growth is regarded as an intrinsic property through which they can increase both in mass and number of cells.

Reproduction refers to the production of progeny, possessing features more or less similar to those of parents.

127. **Answer (1)**

    Hint: Higher the category, greater is the difficulty of determining the relationship to other taxa at the same level.

    Sol.: As we go higher from species to kingdom, the number of common characteristics goes on decreasing. Lower the taxa, more are characteristics that the members within the taxon share.

128. **Answer (4)**

    Hint: *Triticum* is the genus and Angiospermae is the division.

    Sol.: The correct ascending order of taxonomic categories is as follows:

    Triticum → Poaceae → Poales → Monocotyledonae → Angiospermae

129. **Answer (2)**

    Hint: Worker bees are sterile.

    Sol.: Worker bees respond to the external stimuli and they have consciousness.

130. **Answer (3)**

    Hint: The process of classification is taxonomy.

    Sol.: Systematics includes evolutionary relationship between organisms.

131. **Answer (3)**

    Hint: Scientific name consists of genus and specific epithet.

    Sol.: Classification is based on some easily observable characters for categorising different organisms.

132. **Answer (4)**

    Hint: Hominidae, Muscidae and Anacardiaceae belong to the same taxonomical category, i.e., family.

133. **Answer (1)**

    Hint: Mammalia is a class.

    Sol.: Felidae and canidae are placed in the order, carnivora.

134. **Answer (3)**

    Hint: Scientific names are printed in italics.

    Sol.: The correctly printed scientific name of wheat is *Triticum aestivum.*

135. **Answer (4)**

    Hint: Consciousness is seen in all the living organisms.

    Sol.: Sensitivity or awareness is regarded as the defining property of an organism.

[ZOOLOGY]

136. Answer (4)

Hint: The animal contains haemolymph

Sol.: Cockroaches do not have capillary beds within their tracheal system.

For earthworms, as well as some amphibians (frogs), the skin serve as the respiratory organ.

A dense network of capillaries just below the skin facilitates the exchange of gases between the circulatory system and the environment.

Gills of fishes also contain a dense network of capillary beds.

137. Answer (4)

Hint: The horizontal rings of hyaline cartilage resemble the letter 'C'.

Sol.: The diameter of the trachea changes subtly during inhalation and exhalation, which is important in maintaining efficient airflow.

Trachea is surrounded by incomplete and horizontal rings of hyaline cartilage that resemble the letter 'C'.

Trachea is located anterior to the oesophagus and extends upto the mid-thoracic cavity, which divides at the level of 5th thoracic vertebra into a right and left primary bronchi.
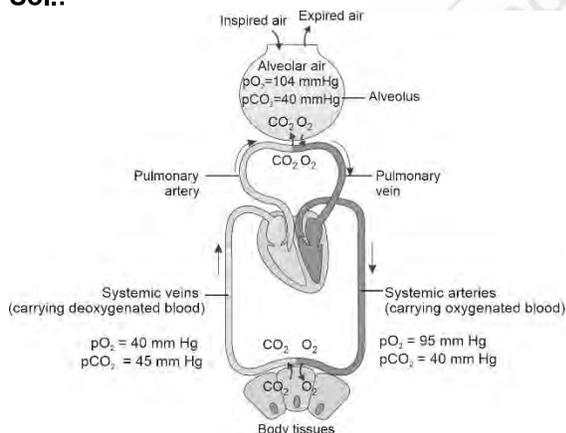
138. Answer (1)

Hint: Vital capacity can be measured by a simple spirometer.

Sol.: The maximum volume of air a person can breathe in after a forced expiration is called vital capacity. It includes ERV, TV and IRV.

RV stands for residual volume.

It is the volume of air remaining in the lungs even after a forcible expiration.

139. Answer (2)

Hint: Pulmonary veins carry oxygenated blood.

Sol.:

140. Answer (3)

Hint: The part of the conducting zone of the human respiratory system.

Sol.: Gaseous exchange between air and blood occurs in the respiratory airway of the lungs which consists of alveoli, alveolar ducts and alveolar sacs.

The initial bronchioles are the part of the conducting (non-respiratory) airway system. They are supported by incomplete cartilaginous rings.

141. Answer (1)

Hint: It flattens due to contraction during inhalation.

Sol.: The most important muscle for inhalation is diaphragm, the dome-shaped skeletal muscle that forms the floor of the thoracic cavity.

Inter-costal muscles are found attached to ribs. Also, internal inter-costal muscles participate in forceful expiration.

Abdominal muscles participate in forceful expiration.

Sternum is a flat bone on the ventral midline of thorax.

142. Answer (1)

Hint: We cannot directly alter the pulmonary volume.

Sol.: Since the lungs in mammals do not completely empty with each breath, and inhalation occurs through the same airway as exhalation, each inhalation mixes fresh air with oxygen-depleted residual air.

As a result, the maximum pO_2 in alveoli is always considerably less than that in the atmosphere.

Within the thoracic cavity, a double membrane surrounds the lungs.

The layers of this membrane can slide smoothly past each other, but they cannot be pulled apart easily. Consequently, the volume of the thoracic cavity and the volume of the lungs change in unison.

143. Answer (2)

Hint: Organisms that live in water respire *via* gills.

Sol.: Aquatic arthropods use gills for respiration.

Most insects have a network of tubes (tracheal tubes) to transport atmospheric air within the body.

We have two lungs which are covered by a double-layered pleura, with pleural fluid between them.

Breathing involves two phases: breathing in and breathing out.

144. Answer (1)

Hint: Equal to the number of primary bronchi.

Sol.: The diffusion membrane is made up of three major layers namely, the thin squamous epithelium of alveoli, the endothelium of alveolar capillaries, and the basement substance in between them.

The basement substance is the acellular layer.

145. Answer (2)

Hint: Has a life span of 120 days

Sol.: The enzyme carbonic anhydrase belongs to the class IV of enzymes as it acts as a lyase.

RBCs contain a very high concentration of this enzyme and minute quantities of the same is present in the plasma too.

Zn^{+2} acts as its co-factor.

146. Answer (4)

Hint: Multiples of 2

Sol.: For inhalation to occur, the lungs expand, which increases lung volume and thus decreases the pressure in the lungs to below the atmospheric pressure.

The contraction of external inter-costal muscles lifts up the ribs and the sternum causing an increase in the volume of the thoracic chamber in the dorso-ventral axis.

During quiet inhalations, the pressure between the two pleural layers in the pleural cavity, called intrapleural pressure, is always sub-atmospheric.

147. Answer (3)

Hint: Amongst the given capacities, EC has the lowest value.

Sol.: Inspiratory Capacity = 3000 – 3500 mL

Expiratory Capacity = 1500 – 1600 mL

Functional Residual Capacity = 2100 – 2300 mL

Total Lung capacity = 5100 – 5800 mL

148. Answer (3)

Hint: Function of acidophilic leucocytes

Sol.: About 3% O_2 is carried in dissolved state through plasma.

Eosinophils constitute about 2–3% of the total WBCs.

Eosinophils have bilobed nucleus. They are granulocytes. RBCs have the life span of 120 days. Eosinophils increase in number during allergy and play an important role against infections.

Neutrophils have multi-lobed nucleus.

149. Answer (1)

Hint: Eliminate the symptoms associated with asthma.

Sol.: Emphysema is a disorder characterized by destruction of the walls of the alveoli.

Due to damaged alveolar walls, the respiratory surface is decreased.

Asthma is a disorder characterized by chronic airway inflammation and airway obstruction.

Airway obstruction may be due to smooth muscle spasms in the walls of bronchi and bronchioles. Lungs are not muscular.

Fibrosis of the upper respiratory tract takes place in occupational respiratory disorders.

150. Answer (1)

Hint: Unloading of O_2 from oxyhaemoglobin occurs at tissue site.

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

151. Answer (4)

Hint: Respiratory rhythm centre is present in medulla region of the brain.

Sol.: Pneumotaxic centre is present in the pons region of the brain. It moderates the function of respiratory rhythm centre.

Strong signals from pneumotaxic area result in shallow and fast breathing as duration of inspiration shortens.

Complete filling of lungs does not take place when the inspiratory area is turned off.

152. Answer (2)

Hint: Rate of diffusion of gases is inversely proportional to thickness.

Sol.: Factors that affect the rate of diffusion of gases are:

(1) Solubility of gases → A gas having higher solubility, diffuses at a faster rate than the gas having low solubility.

(2) Partial pressure → Gases diffuse according to their partial pressure.

(3) Thickness of membrane → More the thickness of a membrane, lesser will be the rate of diffusion across it.
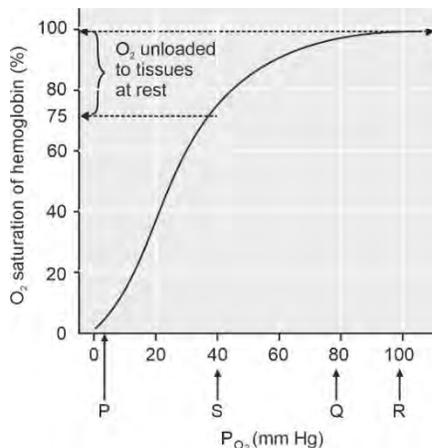
153. Answer (4)

Hint: Involves relaxation of muscles

Sol.: Normal exhalation is a passive process and it occurs by the natural elastic recoil of the lung tissue and is accompanied by the relaxation of all breathing muscles.

The pCO_2 is higher in tissues due to catabolism, thus, diffusion of CO_2 occurs from tissues to blood (RBCs and plasma) where HCO_3^- and H^+ are formed.

154. Answer (3)

Hint: Haemoglobin can release more O_2 to metabolically active tissues.

Sol.:

155. Answer (4)

Hint: End of T-wave marks the end of systole.

Sol.: T-wave – Represents return of the ventricles from excited to normal state (repolarisation).

QRS complex represents the depolarisation of ventricles.

By counting the number of QRS complexes that occur in a given time period, one can determine the heart beat rate of an individual.

In ECG, the T-P gap refers to the period between the end of the T-wave and the beginning of the P-wave.

It represents the isoelectric baseline where no underlying cardiac electrical activity is present.

156. Answer (4)

Hint: Platelets

Sol.: Thrombocytes – Non-nucleated fragments of cells; help in blood clotting.

Erythrocytes – Enucleated in their mature form; are not involved in blood clotting.

Lymphocytes – Possess large round nucleus; involved in providing immunity.

Monocytes – Possess bean-shaped nucleus; phagocytic cells that engulf germs and cell debris.

157. Answer (4)

Hint: Universal donor

Sol.: People with O^{-ve} blood group are universal donors because their RBCs do not carry antigens. Individuals with O^{+ve} blood group cannot give blood to Rh-negative people.

'A' blood group individuals have anti-B antibodies in plasma and 'A' antigens on RBCs.

'B' blood group individuals have anti-A antibodies in plasma and 'B' antigens on RBCs.

158. Answer (2)

Hint: Receives oxygenated blood from lungs.

Sol.: The pulmonary veins carry oxygenated blood from the lungs back to the heart, specifically into the left atrium. From there, the blood flows into the left ventricle, which then pumps it out from the heart *via* aorta.

159. Answer (2)

Hint: Delay of about 0.1 sec

Sol.: AV node is a specialised nodal tissue embedded in the lower left corner of the right atrium.

It delays the spreading of impulses to heart apex for about 0.1 sec.

This delay allows the atria to fully contract and empty into the ventricles before the ventricles contract.

The conducting pathway of heart is

SA node (signal spreads through atria) $\rightarrow$ AV node $\rightarrow$ AV bundle $\rightarrow$ Bundle branches $\rightarrow$ Purkinje fibres

160. Answer (2)

Hint: More than the number of external nares you have

Sol.: Arterial blood pressure is highest when the heart contracts during ventricular systole.

The pressure at this time is called systolic pressure.

Since cardiac muscle cells are electrically coupled through gap junctions, impulses from the SA node spread rapidly within heart tissue.

Since veins carry blood back to the heart at a lower pressure, they do not require thick walls.

161. Answer (3)

Hint: Rh incompatibility is seen

Sol.: A special case of Rh incompatibility is observed between the Rh^{-ve} blood of a pregnant mother with Rh^{+ve} blood of the foetus.

During the delivery of the first child, there is a possibility of exposure of the maternal blood to small amounts of the Rh^{+ve} blood from the foetus. In such cases, the mother starts preparing antibodies against Rh antigen in her blood. In case of her subsequent pregnancies, the Rh antibodies from the mother (Rh^{-ve}) can leak into the blood of the foetus (Rh^{+ve}) and destroy the foetal RBCs.

This condition can be avoided by administering anti-Rh antibodies to the mother immediately after the delivery of the first child.

162. **Answer (1)**

Hint: Also known as heart strings

Sol.: The papillary muscles, arising from the walls of the ventricles, are connected to the cusps of the atrio-ventricular valves (tricuspid and bicuspid) *via* chordae tendineae, which are strong and fibrous cords.

During ventricular contraction, these structures prevent the valves from being pushed back into the atria under pressure, thereby ensuring unidirectional blood flow.

163. **Answer (3)**

Hint: Largest artery in the human body

Sol.: Systemic circulation delivers oxygenated blood from the heart to the rest of the body and returns deoxygenated blood back to the heart.

The left ventricle pumps oxygen-rich blood into the aorta, which then branches into arteries, eventually reaching capillaries in body tissues, where gas exchange occurs.

164. **Answer (3)**

Hint: Made up of three muscular flaps

Sol.: The opening between the right atrium and the right ventricle is guarded by a valve formed of three muscular flaps or cusps, the tricuspid valve,

whereas a bicuspid or mitral valve guards the opening between the left atrium and the left ventricle.

The openings of the right and the left ventricles into the pulmonary artery and the aorta, respectively, are provided with the semilunar valves.

165. **Answer (4)**

Hint: Valves regulate flow of blood

Sol.: Arteries, veins and capillaries are different types of blood vessels.

Within each type, blood flows in only one direction.

Smaller animals have higher metabolic rates than larger animals. This means that they require more energy per unit of body mass to maintain their body temperature and other life processes.

Capillaries are the smallest blood vessels, having diameter only slightly greater than that of RBCs.

RBCs carry a red-coloured, iron containing complex protein called haemoglobin.

166. **Answer (2)**

Hint: Fluid connective tissue

Sol.: Lymph is devoid of RBCs.

It has the same mineral distribution as that in plasma.

Fats are absorbed through lymph in the lacteals present in the intestinal villi.

Exchange of nutrients, gases, *etc.*, between the blood and the cells always occur through tissue fluid.

167. **Answer (2)**

Hint: Blood clot or coagulum is formed by fibrin.

Sol.: Prothrombin $\xrightarrow{\frac{\text{Thrombokinase}}{\text{Ca}^{+2}}}$ Thrombin

Fibrinogen $\xrightarrow{\frac{\text{Thrombin}}{\text{Ca}^{+2}}}$ Fibrin

Fibrins form a network of threads which traps dead and damaged formed elements of blood to form the blood clot or coagulum.

An injury or trauma stimulates the platelets in blood to release coagulation promoting substances called thromboplastins.

168. **Answer (4)**

Hint: pO$_2$ content is more than pCO$_2$

Sol.: In amphibians and reptiles, the left atrium receives oxygenated blood from the gills/ lungs / skin and the right atrium gets the deoxygenated blood from other body parts.

169

170. Answer (4)

    Hint: Eliminate the proteins that are involved in blood clotting

    Sol.: Fibrinogens, globulins and albumins are the major proteins present in the blood plasma.

    Structural proteins like collagen and elastin are absent in blood plasma.

171. Answer (1)

    Hint: Just like the pleura of the lungs

    Sol.: The human heart is protected by a double walled membranous bag, pericardium, enclosing the pericardial fluid.

    It confines the heart to its position in the mediastinum.

    A space called pericardial cavity is present between the two layers which is filled with a fluid called pericardial fluid. The pericardium protects the heart from shocks and mechanical injuries.

172. Answer (4)

    Hint: RBCs are highly specialized for their O_2 transport function.

    Sol.: Mature RBCs have no nucleus, all their internal space is available for O_2 transport. They are biconcave in shape.

    A biconcave disc has a greater surface area for the diffusion of gas molecules into and out of the RBCs.

173. Answer (1)

    Hint: CAD

    Sol.: Coronary artery disease, atherosclerosis, affects the vessels that supply blood to the heart muscle.

    Artificial pacemaker is required when a person is suffering from irregularity of heart beat.

    Atherosclerosis is treated by administering anti-coagulants to the patient.

174. Answer (2)

    Hint: Cardiac output = Heart rate × Stroke volume

    Sol.: Heart rate = 80 beats / min

    Stroke volume = End diastolic volume –

    End systolic volume

    = (90 – 40) mL = 50 mL

    Cardiac output = Heart rate × Stroke volume

    = (80 × 50) mL = 4000 mL

175. Answer (3)

    Hint: Stroke volume

    Sol.: Regular exercise causes the heart to enlarge and become more robust (cardiomegaly).

    A stronger heart is expected to have a greater stroke volume, which would lead to decrease in heart rate.

    The body has the ability to alter the stroke volume, as well as the heart rate and thereby the cardiac output remains unchanged in normal conditions.

    Cardiac output of an athlete will be much higher than that of an ordinary man during strenuous exercise.

176. Answer (3)

    Hint: Electrocardiogram is analysed.

    Sol.: The closed circulatory system is considered to be more advantageous as fluid can be precisely regulated.

    Electro-cardiograph is used to obtain an electrocardiogram which is a graphical representation of the electrical activity of the heart during a cardiac cycle.

177. Answer (2)

    Hint: Occurs at the beginning of ventricular systole.

    Sol.: The buildup of pressure that results due to filling of atria just before the joint diastole, causes the AV valves to open during joint diastole.

    As the ventricles begin their contraction, the intra-ventricular pressure rises, causing the closure of tricuspid and bicuspid valves to prevent backflow of blood into atria.

    When the pressure in the left ventricle becomes greater than the pressure in aorta, the semilunar valves are forced open.

    The first heart sound 'Lub' is associated with the closure of the AV (mitral and tricuspid) valves.

178. Answer (3)

    Hint: Tunica externa contains collagen fibres.

    Sol.: Veins carry blood from all body parts to heart (except pulmonary veins).

    Arteries carry blood away from the heart.

Blood vessels have 3 layers:

(i) Tunica intima-An inner layer of squamous endothelium

(ii) Tunica media- A middle layer of smooth muscle and elastic fibres

(iii) Tunica externa-An external layer of fibrous connective tissue with collagen fibres.

The tunica media is comparatively thin in the veins.

179. **Answer (4)**

Hint: Connection present in GIT

Sol.: The hepatic portal vein carries blood from intestine to the liver before it is delivered to the systemic circulation.

180. **Answer (4)**

Hint: Increases cardiac output.

Sol.: Neural signals through sympathetic nerves can increase the rate of heart beat, the strength of ventricular contraction and thereby the cardiac output.

Parasympathetic neural signals decrease the cardiac output.

Adrenal medullary hormones increase the cardiac output.

❏   ❏   ❏

All India Aakash Test Series for NEET - 2027

TEST - 2 (Code-D)

Click here for Code-C Sol.

Test Date : 02/11/2025

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

1. **Answer (1)**

   Hint: $\omega = \dfrac{v_\perp}{r}$

   Sol.:
   $$\omega = \frac{v\sin 37^\circ}{5/\sin 37^\circ} = 1\times \sin^2 37^\circ = \left(\frac{3}{5}\right)^2$$
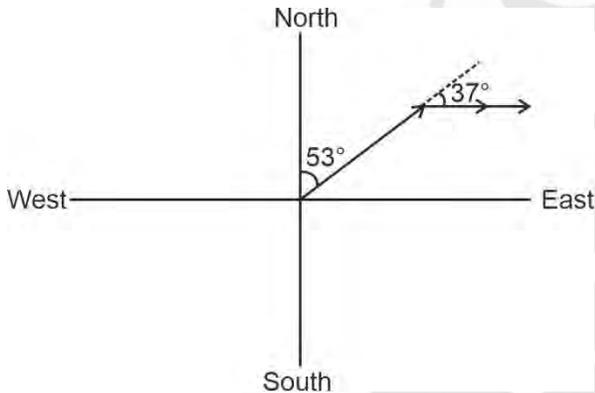 $$= \frac{9}{25}\,\text{rad/s}$$

2. **Answer (4)**

   Hint & Sol.: Only vectors of same nature can be added.

3. **Answer (2)**

   Hint: Average acceleration $<\vec{a}> = \dfrac{\vec{v_f} - \vec{v_i}}{\Delta t}$

   Sol.:

   $$\vec{v_i} = 10\sin 53^\circ \hat{i} + 10\cos 53^\circ \hat{j} = (8\hat{i} + 6\hat{j})\,\text{m s}^{-1}$$
   $$\vec{v_f} = 10\hat{i}\;\text{ms}^{-1}$$
   $$<\vec{a}> = \frac{\vec{v_f} - \vec{v_i}}{\Delta t} = \frac{10\hat{i} - (8\hat{i} + 6\hat{j})}{5}$$
   $$= \left(\frac{2}{5}\hat{i} - \frac{6}{5}\hat{j}\right)\text{m s}^{-2}$$
   $$<a> = \frac{\sqrt{2^2 + 6^2}}{5} = \frac{\sqrt{40}}{5}$$
   $$= \sqrt{\frac{8}{5}} = 2\sqrt{\frac{2}{5}}\;\text{m s}^{-2}$$

4. **Answer (3)**

   Hint: Vertical component of velocities should be same for collision.

   Sol.: $(v_A)_y = (v_B)_y$

   $\Rightarrow\;50\sin\theta = 30$

   $\Rightarrow\;\sin\theta = \dfrac{3}{5} \Rightarrow \theta = 37^\circ$

   Now $x = 50\cos\theta \times t = 50\times\dfrac{4}{5}\times 2 = 80\,\text{m}$

5. **Answer (4)**

   Hint: Average velocity
   $$<\vec{v}_{avg}> = \frac{\text{Total displacement}}{\text{total time}}$$

   Sol.: Displacement $= \sqrt{2}R$

   Total time $\Delta t = \dfrac{3\pi R}{2\,v}$

   $$<v_{avg}> = \frac{\sqrt{2}R}{\dfrac{3\pi}{2}\dfrac{R}{v}} = \frac{2\sqrt{2}\,v}{3\pi}$$

6. **Answer (2)**

   Hint: When ball is dropped out of a window, then motion of ball is under gravity

   Sol.: At $t = 2$ s, velocity of ball

   $v = at = 7.5 \times 2 = 15\,\text{m s}^{-1}$ along horizontal

   at $t = 4$ second

   $v_x = 15\,\text{m s}^{-1}$

   $v_y = g(2) = 10 \times 2 = 20\,\text{m s}^{-1}$

   Velocity $v = \sqrt{(15)^2 + (20)^2}$
   $$= \sqrt{225 + 400} = \sqrt{625} = 25\,\text{m s}^{-1}$$

   and acceleration $= g = 10\,\text{m s}^{-2}$

7. **Answer (2)**

   Hint: $\vec{v}_{avg} = \dfrac{\text{Total displacement}}{\text{total time}}$

   Sol.: $\vec{v}_{avg} = \dfrac{\vec{r_f} - \vec{r_i}}{\Delta t}$

   $$= \frac{(13\hat{i} + 18\hat{j}) - (\hat{i} + 2\hat{j})}{4} = \left(\frac{12\hat{i} + 16\hat{j}}{4}\right)$$
   $$= (3\hat{i} + 4\hat{j})\,\text{m s}^{-1}$$

8. **Answer (4)**

   Hint: $|\vec{v}_{A/B}| = |\vec{v}_A - \vec{v}_B|$

   Sol.: $v_{A/B} = |12\hat{i} - 12\hat{j}| = 12\sqrt{2}$ m s^{-1}

9. **Answer (3)**

   Hint & Sol.: In uniform circular motion, magnitude of acceleration is constant but its direction is continuously changing.

   When speed of particle performing circular motion decreases, then angle between velocity and acceleration is greater than 90°.

10. **Answer (1)**

    Hint: In case of constant acceleration,

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

    Sol.: $\vec{u} = 20\cos 53°\hat{i} + 20\sin 53°\hat{j}$

    $$= 20 \times \frac{3}{5}\hat{i} + 20 \times \frac{4}{5}\hat{j}$$

    $$= \left(12\hat{i} + 16\hat{j}\right) \text{m s}^{-1}$$

    & $\vec{v} = 20\cos 53°\hat{i} = 12\hat{i}$ m s^{-1}

    $$<\vec{v}> = \frac{\vec{v} + \vec{u}}{2} = \frac{(12\hat{i}) + (12\hat{i} + 16\hat{j})}{2}$$

    $$= (12\hat{i} + 8\hat{j}) \text{m s}^{-1}$$

11. **Answer (2)**

    Hint & Sol.: Horizontal velocity of stone is constant and vertical velocity increases continuously therefore, minimum velocity is at $t = 0$

    $u_{min} = u$

12. **Answer (2)**

    Hint: Horizontal component of velocity remains constant during entire journey.

    Sol.: Let required speed be v

    $20\cos 53° = v \cos 37°$

    $$20 \times \frac{3}{5} = v \times \frac{4}{5}$$

    $\Rightarrow v = 15$ m s^{-1}

13. **Answer (4)**

    Hint: $v_x = \dfrac{dx}{dt}$ and $v_y = \dfrac{dy}{dt}$

    Sol.: $v_x = 10$ m s$^{-1} = u_x$

    and $v_y = 10\sqrt{3} - 2t$

    at $t = 0$, $u_y = 10\sqrt{3}$ m s^{-1}

    $u = \sqrt{u_x^2 + u_y^2} = \sqrt{10^2 + (10\sqrt{3})^2} = 20$ m s^{-1}

14. **Answer (1)**

    Hint: Magnitude of change in velocity $= |\vec{v}_f - \vec{v}_i|$

    Sol.: $\vec{v}_f = u\cos\theta\hat{i}$
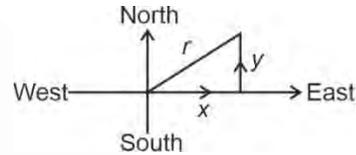
    $\vec{v}_i = u\cos\theta\hat{i} + u\sin\theta\hat{j}$

    $|\vec{v}_f - \vec{v}_i| = |(u\cos\theta\hat{i}) - (u\cos\theta\hat{i} + u\sin\theta\hat{j})|$

    $= u\sin\theta$

15. **Answer (4)**

    Hint:

    Displacement $r = \sqrt{x^2 + y^2}$

    Sol.: $x = 10 \times 2 = 20$ m

    $y = 10 \times 3 = 30$ m

    Displacement $r = \sqrt{x^2 + y^2}$

    $= \sqrt{400 + 900} = 10\sqrt{13}$ m

16. **Answer (3)**

    Hint: $\tan\theta = \dfrac{dy}{dx}$

    Sol.: $y = 8x - 3x^2$

    $\dfrac{dy}{dx} = 8 - 6x$

    $\tan\theta = 8 - 6x$

    at $x = 1$, $\tan\theta = 2 \Rightarrow \theta = \tan^{-1}(2)$

17. **Answer (2)**

    Hint: At the highest point of trajectory, speed is minimum.

    Sol.: At the highest point,

    $$x = \frac{R}{2} \text{ and}$$

    In case of maximum possible range $y = H = \dfrac{R}{4}$

    $\therefore$ Position vector $\vec{r}$ of topmost point $\left(\dfrac{R}{2}, \dfrac{R}{4}\right)$

    $= (200\hat{i} + 100\hat{j})$ m

18. **Answer (4)**

    Hint: Horizontal range $R = \dfrac{2u_x u_y}{g}$

    Sol.: $R = \dfrac{2u_x u_y}{g} = \dfrac{2 \times 15 \times 10}{10} = 30$ m

19. **Answer (2)**

Hint: Horizontal velocity and man's speed should be same to catch the ball.

Sol.: $v = u \cos 37° = 5 \times \dfrac{4}{5} = 4$ m s^{-1}

20. **Answer (3)**

Hint & Sol: $\vec{v} = (3t^2 + 4)\hat{i} + 4t\hat{j}$

at $t = 0$, $\vec{v} = +4\hat{i}$ m s^{-1}

$\vec{a} = \left(6t\hat{i} + 4\hat{j}\right)$ m s^{-2}

at $t = 0$, $\vec{a} = 4\hat{j}$ m s^{-2}

Since total acceleration is perpendicular to velocity vector at $t = 0$

$\vec{a} = \vec{a_N} = 4\hat{j}$ m s^{-2}

& $a_t = 0$

21. **Answer (2)**

Hint: In circular motion, centripetal acceleration

$a_c = \dfrac{v^2}{R}$

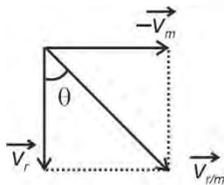**Sol.:** $a_c = \dfrac{v^2}{R}$

$\Rightarrow a \cos 37° = \dfrac{v^2}{R}$

$\Rightarrow 20 \times \dfrac{4}{5} \times 5 = v^2 \Rightarrow v^2 = 80 \Rightarrow v = 2\sqrt{20}$

$\simeq 8.94$ ms^{-1}

22. **Answer (1)**

Hint: $\vec{v}_{r/m} = \vec{v}_{r/g} - \vec{v}_{m/g}$

Sol.: $\vec{v}_{r/m} = \vec{v}_{r/g} - \vec{v}_{m/g}$

$\tan\theta = \dfrac{v_m}{v_r} = \dfrac{10}{20} = \dfrac{1}{2}$

$\theta = \tan^{-1}\left(\dfrac{1}{2}\right)$

23. **Answer (1)**

Hint & Sol.: $\theta = \omega \times t = 3 \times 4 = 12$ rad

24. **Answer (3)**

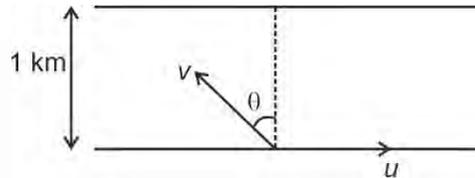**Hint:** In uniform circular motion, $\omega = \dfrac{2\pi}{T}$

Sol.: Since time period is same for both

$\therefore \omega_1 = \omega_2$

25. **Answer (3)**

Hint: In case of shortest path, the net velocity of boat is perpendicular to river velocity.

Sol.:

$\Rightarrow$ Time to cross river through shortest path,

$t = \dfrac{d}{v\cos\theta} = \dfrac{1}{10\cos\theta}$

$\Rightarrow \dfrac{1}{2} = \dfrac{1}{10\cos\theta} \Rightarrow \cos\theta = \dfrac{1}{5}$

$\Rightarrow \sin\theta = \dfrac{\sqrt{24}}{5} = \dfrac{2\sqrt{6}}{5}$
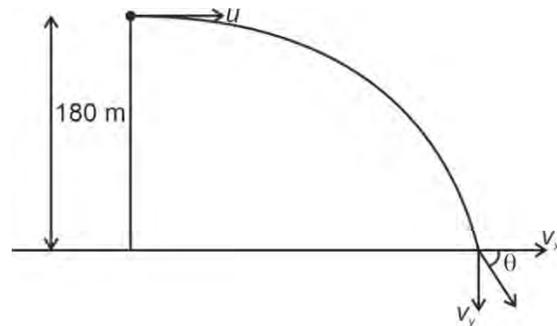
$\therefore u = v \sin\theta$

$= 10 \times 2\dfrac{\sqrt{6}}{5}$

$u = 4\sqrt{6}$ km/h

26. **Answer (3)**

Hint: In horizontal direction, motion is uniform and in vertical direction motion of particle is uniformly accelerated.

Sol.:

$v_x = u = 80$ m s^{-1}

$\Rightarrow T = \sqrt{\dfrac{2H}{g}} = \sqrt{\dfrac{2 \times 180}{10}} = 6$ s

$\Rightarrow v_y = gt = 10 \times 6 = 60$ m s^{-1}

$$\Rightarrow \quad \tan\theta = \frac{v_y}{v_x} = \frac{60}{80} = \frac{3}{4}$$

$$\Rightarrow \quad \theta = 37°$$

$$v = \sqrt{v_x^2 + v_y^2} = \sqrt{(80)^2 + (60)^2} = 100 \text{ m s}^{-1}$$

27. **Answer (3)**

Hint: Use $v_x = \dfrac{dx}{dt}$ and $v_y = \dfrac{dy}{dt}$

Sol.: $v_x = \dfrac{dx}{dt} = \sqrt{3}y$

$$v_y = \frac{dy}{dt} = \frac{x}{\sqrt{3}}$$

$$\Rightarrow \quad \frac{v_y}{v_x} = \frac{dy}{dx} = \frac{x}{\sqrt{3}.\sqrt{3}\,y} = \frac{x}{3y}$$

$$\Rightarrow \quad 3\int y\,dy = \int x\,dx$$

$$\Rightarrow \quad \frac{3y^2}{2} = \frac{x^2}{2} + C$$

$$\Rightarrow \quad 3y^2 = x^2 + C$$

28. **Answer (2)**

Hint: Use $a_t = \alpha R$ and $\theta = \dfrac{1}{2}\alpha t^2$

Sol.: Let both particles meet in time t

$$\therefore \quad \alpha_1 = \frac{a_1}{R} = \frac{4}{2} = 2 \text{ rad/s}^2$$

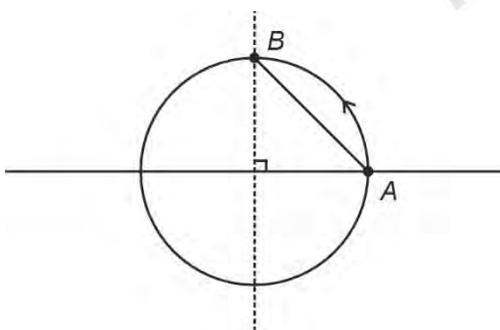$$\& \quad \alpha_2 = \frac{a_2}{R} = \frac{12}{2} = 6 \text{ rad/s}^2$$

$$2\pi = \theta_1 + \theta_2$$

$$2\pi = \frac{1}{2} \times 2 \times t^2 + \frac{1}{2} \times 6 \times t^2 = 4t^2 \Rightarrow \quad t = \sqrt{\frac{\pi}{2}} \text{ s}$$

Now,

$$\theta_1 = \frac{1}{2}\alpha_1 t^2 = \frac{1}{2} \times 2 \times \frac{\pi}{2} = \frac{\pi}{2} \text{ rad}$$

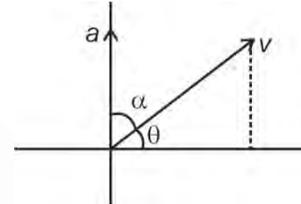$$\theta_2 = \frac{1}{2}\alpha_2 t^2 = \frac{1}{2} \times 6 \times \frac{\pi}{2} = \frac{3\pi}{2} \text{ rad}$$

29. **Answer (1)**

Hint: $a_t = \dfrac{d\,|\vec{v}|}{dt}$, $a_c = \dfrac{v^2}{R}$ and $\vec{a} = \dfrac{d\vec{v}}{dt}$

Sol.: Acceleration $\vec{a} = \dfrac{d\vec{v}}{dt} = \left(8\hat{j}\right) \text{ m s}^{-2}$

at $t = 1$ s, $\vec{v} = \left(6\hat{i} + 8\hat{j}\right) \text{ m s}^{-1}$

$$\tan\theta = \frac{v_y}{v_x} = \frac{8}{6} = \frac{4}{3}, \theta = 53° \text{ and } \alpha = 37°$$

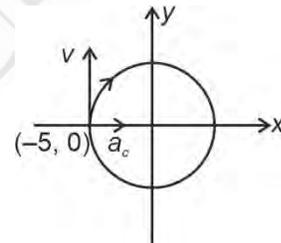As tangential acceleration is component of acceleration along velocity

$$\therefore \quad a_t = a\cos\alpha \text{ and } a_n = a\sin\alpha$$

$$\frac{a_t}{a_n} = \frac{a\cos\alpha}{a\sin\alpha} = \cot\alpha = \cot 37° = \frac{4}{3}$$

30. **Answer (2)**

Hint: In uniform circular motion, only centripetal acceleration is present and $|\overrightarrow{a_c}| = \dfrac{v^2}{R}$

Sol.:

$$|\overrightarrow{a_c}| = \frac{v^2}{R} = \frac{10^2}{5} = 20 \text{ m s}^{-2}$$

$$\overrightarrow{a_c} = 20\hat{i} \text{ m s}^{-2}$$

31. **Answer (3)**

Hint: Properties of scalar quantity

Sol.: Scalar quantity can be negative, positive or zero.

A scalar quantity has the same value for observers with different orientation of axes.

32. **Answer (2)**

Hint: Use relation between range and maximum height, $R = 4H\cot\theta$

Sol.: $\dfrac{R}{H} = 4\cot\theta$

$\dfrac{R}{H} = 4\cot 30° = 4\sqrt{3}$

33. **Answer (3)**

Hint: In uniform circular motion, $\theta = \omega t$

Sol.: Angular displacement $\theta = \omega t$

$\dfrac{\pi}{6} = \dfrac{2\pi}{T} \times 5$

$\Rightarrow$ $T = 60$ s

34. **Answer (2)**

Hint: $\vec{a} = \dfrac{\vec{v} - \vec{u}}{t}$

Sol.: $\vec{a} = \dfrac{(-2\hat{i} + 4\hat{j}) - (2\hat{i} + 3\hat{j})}{2}$

$= \dfrac{-4\hat{i} + \hat{j}}{2} = (-2\hat{i} + 0.5\hat{j})\,\text{m s}^{-2}$

35. **Answer (2)**

Hint: After time t, vertical component of velocity $v_y = gt$

Sol.: T = 4 s

$v_y = g \times 4 = 40$ m s^{-1}

and

$\tan\theta = \dfrac{v_y}{v_x}$

$\tan 53° = \dfrac{v_y}{v_x}$

$\Rightarrow$ $v_x = \dfrac{v_y}{\tan 53°} = \dfrac{40 \times 3}{4} = 30$ m s^{-1}

$\therefore$ Speed of projection is 30 m s^{-1}

36. **Answer (2)**

Hint: Use equation of motion

$\vec{S} = \vec{u}t + \dfrac{1}{2}\vec{a}t^2$

Sol.: $\vec{S} = \vec{u}t + \dfrac{1}{2}\vec{a}t^2$

$\vec{r_f} - \vec{r_i} = (\hat{i} + 2\hat{j}) \times 3 + \dfrac{1}{2}(2\hat{i} + \hat{j}) \times 9$

$\vec{r_f} = (3\hat{i} + 6\hat{j}) + 9\hat{i} + \dfrac{9}{2}\hat{j}$

$\vec{r_f} = 12\hat{i} + \dfrac{21}{2}\hat{j}$

$\vec{r_f} = (12\hat{i} + 10.5\hat{j})$ m

37. **Answer (2)**

Hint: Velocity $\vec{v} = \dfrac{d\vec{r}}{dt}$

Sol.: $\vec{r} = \left(3t^2\,\hat{i} - 2t\,\hat{j}\right)$ m

$\vec{v} = \dfrac{d\vec{r}}{dt} = \left(6t\,\hat{i} - 2\hat{j}\right)$ m s^{-1}

$\vec{v}_{(\text{at } t = 2\,\text{s})} = 6 \times 2\hat{i} - 2\hat{j} = (12\hat{i} - 2\hat{j})$ ms^{-1}

38. **Answer (4)**

Hint & Sol.: Net displacement $= \sqrt{4^2 + 3^2 + 12^2}$
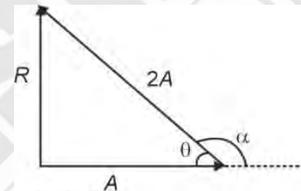
$= \sqrt{16 + 9 + 144} = \sqrt{169} = 13$ m

39. **Answer (1)**

Hint: $\left|\vec{A} + \vec{B}\right|_{max} = A + B$ and $\left|\vec{A} + \vec{B}\right|_{min} = A - B$

Sol.: $\dfrac{A + B}{A - B} = \dfrac{4}{3} \Rightarrow 3A + 3B = 4A - 4B \Rightarrow A = 7B$
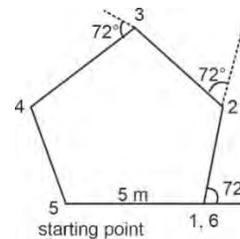
40. **Answer (3)**

Hint & Sol.:

$\cos\theta = \dfrac{A}{2A} = \dfrac{1}{2} \Rightarrow \theta = 60°$

$\therefore$ Angle between these two vectors $= \alpha = \pi - \theta$
$= 180° - 60° = 120°$

41. **Answer (1)**

Hint: In 5 turns, the man reaches to his initial position.

Sol.:

Displacement just after 6th turn = 5 m

42. **Answer (3)**

Hint: Velocity vector $\vec{v} = |\vec{v}|\,\hat{n}$

Sol.: $\hat{n} = \dfrac{\vec{r_f} - \vec{r_i}}{|\vec{r_f} - \vec{r_i}|}$

$$\vec{r}_f - \vec{r}_i = (2\hat{i} + 6\hat{j}) - (-\hat{i} + 2\hat{j}) = (3\hat{i} + 4\hat{j})\ m$$

$$|\vec{r}_f - \vec{r}_i| = \sqrt{3^2 + 4^2} = 5\ m$$

$$\hat{v} = \left(\frac{3\hat{i} + 4\hat{j}}{5}\right)$$

$$\therefore\quad \vec{v} = |\vec{v}|\ \hat{n}$$

$$= 10\left(\frac{3\hat{i} + 4\hat{j}}{5}\right) = (6\hat{i} + 8\hat{j})\ m\ s^{-1}$$

43. Answer (3)

Hint: Acceleration $a = \dfrac{v\ dv}{dx}$

Sol.: $v = 3x^2 - 5$

$$\frac{dv}{dx} = 6x$$

$(a)_{x = 2\ m} = (3x^2 - 5)(6x)$

$= (3 \times 2^2 - 5)(6 \times 2) = 7 \times 12 = 84\ m\ s^{-2}$

44. Answer (3)

Hint: Horizontal range $R = \dfrac{u^2 \sin 2\theta}{g}$

Sol.: For same speed of projection, $R \propto \sin 2\theta$

$$\frac{R_2}{R_1} = \frac{\sin 2\theta_2}{\sin 2\theta_1}$$

$$\frac{R_2}{80} = \frac{\sin 90°}{\sin 30°}$$

$R_2 = 80 \times 2 = 160\ m$

45. Answer (2)

Hint: When particle passes through same height after time t_1 and t_2, then $T = t_1 + t_2$

Sol.: Time of flight, $T = t_1 + t_2$

$= 2 + 7 = 9\ s$

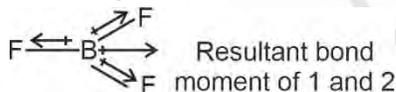$$u_x = \frac{180}{\Delta t} = \frac{180}{5} = 36\ m\ s^{-1}$$

Range $R = u_x T = 36 \times 9 = 324\ m$

[CHEMISTRY]

46. Answer (2)

Hint: BF$_3$ is trigonal planar in shape.

Sol.:

In BF$_3$, the three bond moments give a net sum of zero as the resultant of any two is equal and opposite to the third.

47. Answer (2)

Hint: For a given metal cation, larger is the size of anion more is the covalent character in the bond.

Sol.: Correct order of ionic size:

I⁻ > Br⁻ > Cl⁻

Correct order of covalent character:

LiI > LiBr > LiCl

48. Answer (4)

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

Sol.:

Species	Bond Order $= \dfrac{1}{2}(N_b - N_a)$
N_2^-	$\dfrac{1}{2}(10 - 5) = 2.5$
C_2^{2-}	$\dfrac{1}{2}(10 - 4) = 3$
NO^+	$\dfrac{1}{2}(10 - 4) = 3$
He_2^+	$\dfrac{1}{2}(2 - 1) = 0.5$

49. Answer (2)

Hint: Element X is a halogen.

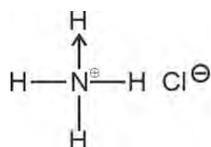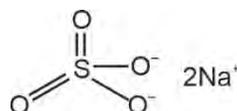**Sol.:** Valence of calcium is 2 while that of X is 1 hence the formula will be CaX$_2$.
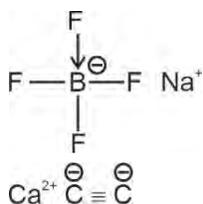
50. Answer (1)

Hint & Sol.: Gallium is also known as Eka-aluminium.

51. Answer (3)
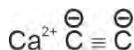
Hint: Co-ordinate bond is formed by donation of lone pair of electron from one atom to the vacant orbital of another atom.
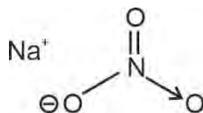
Sol.:

← It contains ionic bond and covalent bond.

→ Compound contains ionic bond, covalent bond and co-ordinate bond.

→ Compound contains ionic bond, covalent bond and co-ordinate bond

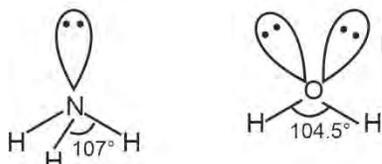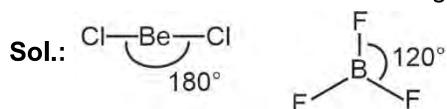Ca^{2+} $\overset{\ominus}{C} \equiv \overset{\ominus}{C}$ → Compound contains ionic and covalent bond.

→ Compound contains ionic bond covalent bond and co-ordinate bond.

52. Answer (2)

Hint: Presence of more lone pair of electrons on central atom decreases the bond angle

Sol.:

53. Answer (2)

Hint: In ClF_5, the central atom has one pair of non-bonding electrons.

Sol.:

Molecules	Number of lone pairs
	15
	9
	16
	7

54. Answer (3)

Hint: Generally, more is the effective nuclear charge, higher is ionization enthalpy.

Elements having half filled or completely filled subshells have extra stability.

Sol.:

Electronic configuration	Element	Ionisation enthalpy (kJ mol^{-1})
$1s^2 2s^2 2p^6 3s^1$	Na	496
$1s^2 2s^2 2p^6 3s^2$	Mg	737
$1s^2 2s^2 2p^6 3s^2 3p^1$	Al	577
$1s^2 2s^2 2p^6 3s^2 3p^2$	Si	786

55. Answer (2)

Hint & Sol.: Symbol of element having atomic number 104 is Unq.

56. Answer (4)

Hint: For isoelectronic species, more is the negative charge on the ion larger is the size of ion

Sol.: Na^+, Mg^{2+}, F^- and O^{2-} have inert gas configuration as of Ne.

The correct order of ionic size for these isoelectronic species is:

$O^{2-} > F^- > Na^+ > Mg^{2+}$

57. Answer (3)

Hint & Sol.: It is not necessary that only half-filled orbitals participate in hybridisation. In some cases even filled orbitals of valence shell take part in hybridisation.

58. Answer (3)

Hint: The compounds in which central atoms are $sp^3 d$ and $sp^3 d^2$ hybridised, contain 90° and 180° bond angles.

Sol.:
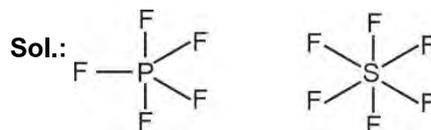
These compounds contain both 90° as well as 180° bond angles.

59. Answer (3)

Hint: In $\pi^* 2p_x$ orbital, the number of nodes = 2

Sol.: In $\sigma^* 1s$ orbital, number of node = 1

60. Answer (3)

Hint: Electronic configuration of element having atomic number 50 is [Kr] $4d^{10} 5s^2 5p^2$

Sol.: Valence shell is five hence it belongs to fifth period.

The group number will be 10 + 2 + 2 = 14

61. Answer (4)

Hint: Electronic configuration of C_2:

$\sigma 1s^2, \sigma *1s^2, \sigma 2s^2, \sigma *2s^2, \pi 2p_x^2 = \pi 2p_y^2$

Sol.: • C_2 has 2π bonds.

• B_2 has one π bond.

(S – O bond order) = $\dfrac{6}{4}$ = 1.5

(N – O bond order) = $\dfrac{4}{3}$ = 1.33
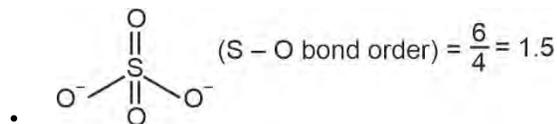
62. Answer (4)

Hint: In XeO_2F_2 the central atom is sp^3d hybridised.

Sol.:

Species	Hybridisation of central atom	Shape
SF_4	sp^3d	See-saw
NH_4^+	sp^3	Tetrahedral
SO_4^{2-}	sp^3	Tetrahedral
CCl_4	sp^3	Tetrahedral
XeO_2F_2	sp^3d	See-saw

63. Answer (1)

Hint & Sol.:
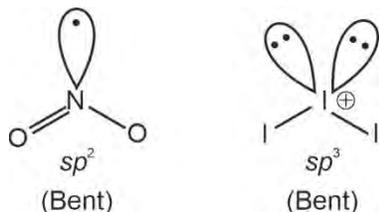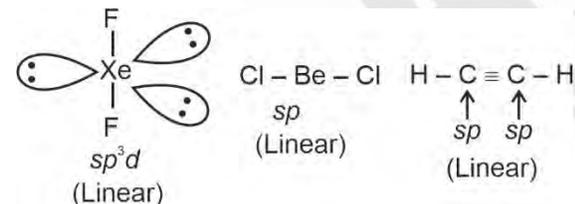
64. Answer (3)

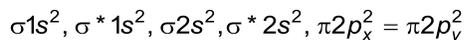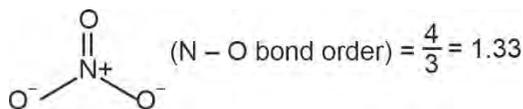**Hint:** *p*-block elements and *s*-block elements are called as representative elements or main group elements.

Sol.: • Boron does not have *d*-orbital. It contains 2*s* and 2*p* orbitals in its valence shell hence maximum valency of boron is 4.

• Fluorine in compounds has –1 oxidation state hence oxidation state of O in OF_2 is +2

65. Answer (4)

Hint: Highest occupied molecular orbital is one, which is occupied and has highest energy.

Sol.: $N_2 : \sigma 1s^2, \sigma *1s^2, \sigma 2s^2, \sigma *2s^2, \pi 2p_x^2$

$= \pi 2p_y^2, \sigma 2p_z^2$
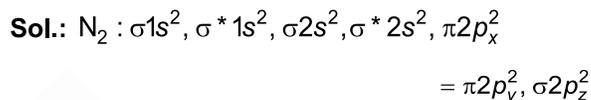
66. Answer (4)

Hint: Smaller is the size of atom, smaller is the bond length.

Sol.: Order of atomic size: C > N > O > H

Order of bond length:

C – C > C – N > C – H > O – H
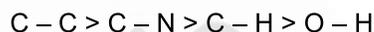
67. Answer (2)

Hint: Along a period electronegativity increases.

Sol.: Down the group electronegativity decreases

Element	Electronegativity (on Pauling scale)
B	2.0
C	2.5
Mg	1.2
Al	1.5
Si	1.8
P	2.1

68. Answer (4)

Hint: $-C \equiv N$ has two π bonds

Sol.:
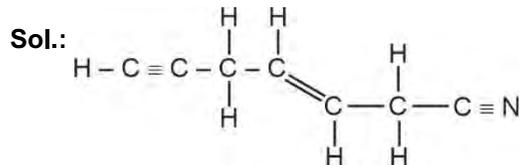
Number of σ bonds = 14

Number of π bonds = 5

69. Answer (2)

Hint: In BrF_5, number of bond pairs are 5 and number of lone pair on central Br atom is 1.

Sol.:

sp^3d^2
(Square pyramidal)

sp^3d^3
(Distorted octahedral)
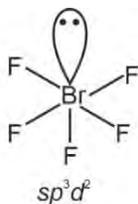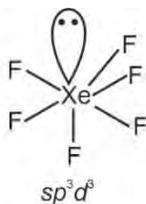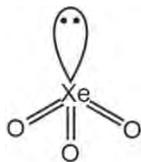
sp^3
(Pyramidal)

70. Answer (3)

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

Sol.:

Species	Bond Order	Magnetic Behaviour
O_2	$\frac{1}{2}(10-6)=2$	Paramagnetic
O_2^+	$\frac{1}{2}(10-5)=2.5$	Paramagnetic
B_2	$\frac{1}{2}(6-4)=1$	Paramagnetic
B_2^-	$\frac{1}{2}(7-4)=1.5$	Paramagnetic
C_2	$\frac{1}{2}(8-4)=2$	Diamagnetic
C_2^+	$\frac{1}{2}(7-4)=1.5$	Paramagnetic
O_2^-	$\frac{1}{2}(10-7)=1.5$	Paramagnetic

71. Answer (1)

Hint: As_2O_3 is an amphoteric oxide.

Sol.:

Oxides		Chemical nature
N_2O	$\longrightarrow$	Neutral
CaO	$\longrightarrow$	Basic
SO_2	$\longrightarrow$	Acidic

72. Answer (4)

Hint: Down the group, atomic radius increases.

Sol.: In a period, the effective nuclear charge increases hence the atomic radius decreases.

Element	Atomic radii (pm)
O	66
F	64
S	104
Cl	99

73. Answer (1)

Hint: Resonance stabilizes the molecule or a species

Sol.:

- Resonance stabilises the molecule as the energy of the resonance hybrid is less than the energy of any single canonical structure.

-
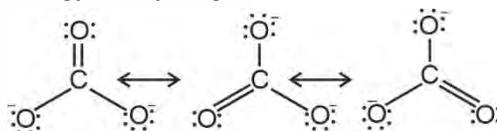
74. Answer (4)

Hint: A pi-bond is formed by the lateral overlap of pure p-orbitals between two adjacent atoms.

Sol.:

Molecule	Structure	Number of pi-bond(s)
CO_2	O = C = O	2
H_2SO_4		2
C_2H_4	$CH_2 = CH_2$	1
NF_3		Zero

75. Answer (4)

Hint: Electronic configuration of O_2^+ :

$\sigma 1s^2, \sigma*1s^2, \sigma 2s^2, \sigma*2s^2, \sigma 2p_z^2, (\pi 2p_x^2 = \pi 2p_y^2), \pi*2p_x^1 = \pi*2p_y^0$

Sol.: Electronic configuration of N_2^+

$\sigma 1s^2, \sigma*1s^2, \sigma 2s^2, \sigma*2s^2, (\pi 2p_x^2 = \pi 2p_y^2), \sigma 2p_z^1$

Number of antibonding electrons in O_2^+ = 5

Number of bonding electrons in N_2^+ = 9

76. Answer (4)

Hint: XeF_4 is square planar in shape.

Sol.:

Molecules		Characteristics
CH_4	$\longrightarrow$	Nonpolar and non-planar
XeF_4	$\longrightarrow$	Non-polar and planar
NH_3	$\longrightarrow$	Polar and non-planar
H_2S	$\longrightarrow$	Polar and planar

77. Answer (3)

Hint: If a molecule contains unpaired electron (s) then it is called odd electron molecule.

Sol.: Octet theory does not account for the shape of the molecules.

78. Answer (1)

Hint & Sol: Zn, Cd and Hg do not belong to Dobereiner's Triads.

79. Answer (3)

Hint: Because of the half filled p-subshell of nitrogen, the first ionization enthalpy is higher than oxygen.

Sol.:

Element	Ionisation enthalpy (kJ mol^{-1})
Ne	2080
F	1681
O	1314
N	1402

80. Answer (2)

Hint: Percentage ionic character =

$$\frac{\text{Observed dipole moment} \times 100}{\text{Calculated dipole moment}}$$

1D = 3.33 × 10^{-30} C m

Sol.: Percentage ionic character =

$$\frac{1.5 \times 3.33 \times 10^{-30} \times 100}{1.602 \times 10^{-19} \times 160 \times 10^{-12}} = 19.5\%$$

81. Answer (3)

Hint: In SF_6, the central atom is sp^3d^2 hybridised.

Sol.:

- In PCl_5, the axial bond pairs suffer more repulsive interaction from the equatorial bond pairs, therefore axial bonds have been found to be slightly longer than equatorial bonds
- In SF_6, the maximum number of atoms lie in a plane is 5.

82. Answer (1)

Hint: IUPAC official name of element having atomic number 104 is Rutherfordium.

Sol.:

Atomic Number		IUPAC official Name
106	$\longrightarrow$	Seaborgium
108	$\longrightarrow$	Hassium
103	$\longrightarrow$	Lawrencium
104	$\longrightarrow$	Rutherfordium

83. Answer (2)

Hint: Higher is the bond order, shorter is the bond length.

Sol.:

Species	Bond order
O_2	2
O_2^+	2.5
O_2^-	1.5

84. Answer (4)

Hint: If bond order is zero, then the species does not exist.

Sol.:

Species	Bond order $\left\{\frac{1}{2}(N_b - N_a)\right\}$
F_2	$\frac{1}{2}(10-8)=1$
O_2^{2-}	$\frac{1}{2}(10-8)=1$
N_2^-	$\frac{1}{2}(10-5)=2.5$
B_2^+	$\frac{1}{2}(5-4)=0.5$
H_2^+	$\frac{1}{2}(1-0)=0.5$
Li_2^+	$\frac{1}{2}(3-2)=0.5$
Be_2	$\frac{1}{2}(4-4)=0$
He_2	$\frac{1}{2}(2-2)=0$

85. **Answer (3)**

    Hint: Intramolecular hydrogen bond is formed when hydrogen atom is in between the two highly electronegative (F, O, N) atoms present within the same molecule.

    Sol.:

    - p-nitrophenol forms intermolecular H-bond while o-nitrophenol forms intramolecular H-bond.
    - Methyl alcohol forms hydrogen bond with water hence it is soluble in water.

86. **Answer (3)**

    Hint: Dipole moment is a vector quantity hence its value depends on shape, bond dipoles and orbital dipoles due to lone pair.

    Sol.:

Molecule	Dipole Moment $\mu(D)$
NH_3	1.47
H_2S	0.95
NF_3	0.23
CH_4	0

87. **Answer (3)**

    Hint: For $p\pi - d\pi$ bond, the central atom should contain the d-orbital

    Sol.:

    → Two, $p\pi - d\pi$ bonds

    → One, $p\pi - p\pi$ bond

    → One, $p\pi - p\pi$ and one, $p\pi - d\pi$ bond

    → One, $p\pi - d\pi$ bond

    → Three, $p\pi - d\pi$ bonds
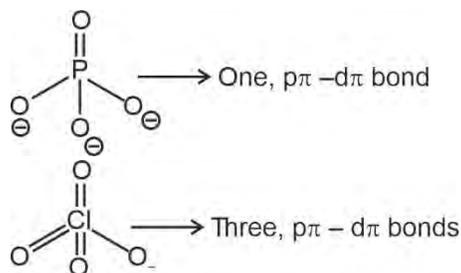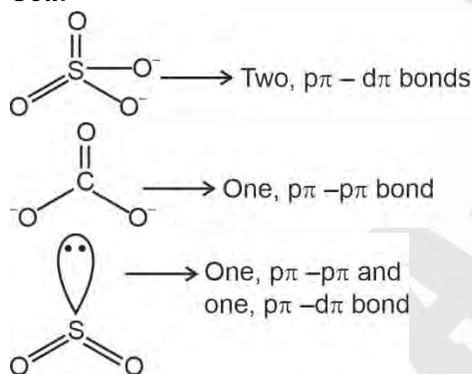
88. **Answer (4)**

    Hint: Lithium shows diagonal relationship with magnesium

    Sol.:

Element	Electronegativity value (on Pauling scale)
Li	1.0
Al	1.5

89. **Answer (4)**

    Hint: Iodine belongs to halogen family

    Sol.:
    - Lanthanoid ⟶ Samarium
    - Semi-metal/metalloid ⟶ Arsenic
    - Transition element ⟶ Platinum

90. **Answer (2)**

    Hint: Down the group for alkali metals, the negative electron gain enthalpy decreases.

    Sol.: Negative electron gain enthalpy of sulphur is higher than oxygen because of larger size of the valence shell of sulphur hence the added electron- suffers less electronic repulsion than the electron added to an oxygen atom which has smaller valence shell.

Element	$\Delta_{eg}H$ (kJ mol⁻¹)
Li	–60
Na	–53
O	–141
S	–200

[BOTANY]

91. **Answer (4)**

    Hint: Consciousness is seen in all the living organisms.

    Sol.: Sensitivity or awareness is regarded as the defining property of an organism.

92. **Answer (3)**

    Hint: Scientific names are printed in italics.

    Sol.: The correctly printed scientific name of wheat is *Triticum aestivum.*

93. **Answer (1)**

    Hint: Mammalia is a class.

    Sol.: Felidae and canidae are placed in the order, carnivora.

94. **Answer (4)**

    Hint: Hominidae, Muscidae and Anacardiaceae belong to the same taxonomical category, i.e., family.

95. Answer (3)

Hint: Scientific name consists of genus and specific epithet.

Sol.: Classification is based on some easily observable characters for categorising different organisms.

96. Answer (3)

Hint: The process of classification is taxonomy.

Sol.: Systematics includes evolutionary relationship between organisms.

97. Answer (2)

Hint: Worker bees are sterile.

Sol.: Worker bees respond to the external stimuli and they have consciousness.

98. Answer (4)

Hint: *Triticum* is the genus and Angiospermae is the division.

Sol.: The correct ascending order of taxonomic categories is as follows:

Triticum → Poaceae → Poales → Monocotyledonae → Angiospermae

99. Answer (1)

Hint: Higher the category, greater is the difficulty of determining the relationship to other taxa at the same level.

Sol.: As we go higher from species to kingdom, the number of common characteristics goes on decreasing. Lower the taxa, more are characteristics that the members within the taxon share.

100. Answer (2)

Hint: Consciousness involves the behavioural changes or movement to external stimuli.

Sol.: Metabolism is the sum total of all chemical reactions occurring in the body of an organism.

For living organisms, growth is regarded as an intrinsic property through which they can increase both in mass and number of cells.

Reproduction refers to the production of progeny, possessing features more or less similar to those of parents.

101. Answer (1)

Hint: Interphase is the resting phase of the cell cycle.

Sol.: The interphase of the cell cycle is the time during which the cell prepares itself for the division. And it constitutes more than 95% of the duration of the human cell cycle.

102. Answer (1)

Hint: The most dramatic period of cell cycle involves a major reorganisation of virtually all components of the cell.

Sol.: M phase involves a major reorganisation of virtually all components of the cell.

103. Answer (4)

Hint: The given event in the image shows crossing over between homologous chromosomes.

Sol.: Crossing over takes place in the pachytene stage of prophase I. It is the third sub-stage of the prophase I. It is an enzyme mediated process. The site where crossing over occurs, forms a recombination nodule.

104. Answer (3)

Hint: Anaphase II is similar to mitotic anaphase.

Sol.: In anaphase I, the homologous chromosomes separate from each other and start moving towards the poles.

105. Answer (2)

Sol.: The cell cycle is divided into two basic phases, *i.e.,* interphase and M phase.

106. Answer (4)

Hint: A human cell divides approximately in about 24 hours.

Sol.: Yeast can progress through the cell cycle in only about 90 minutes.

107. Answer (3)

Hint: In plants, cytokinesis is centrifugal in progression.

Sol.: Cell plate is formed in the centre of the plant cell and further grows towards the periphery.

108. Answer (3)

Hint: Centriole is not present in all eukaryotes.

Sol.: Higher plants lack centrioles but still form mitotic apparatus.

109. Answer (3)

Hint: G_1 phase is the interval between mitosis and initiation of DNA replication.

Sol.: In G_1 phase, cells are metabolically active, most of the organelle duplication occurs in this phase and the number of chromosomes will remain the same as that of G_2 phase.

110. Answer (1)

Hint: Meiosis leads to the formation of the haploid gametes.

Sol.: Meiosis ensures the production of haploid phase in the life cycle of sexually reproducing organisms whereas, fertilisation restores the diploid phase.

111. Answer (4)

    Hint: By the end of meiosis II, four haploid cells are present.

    Sol.: The progenies which are obtained after meiosis II are haploid in nature. They have same amount of genetic material among them.

112. Answer (4)

    Hint: During the S-phase, DNA replication begins in the nucleus.

    Sol.: In cell division, DNA replication and cell growth have to take place in a coordinated way to ensure correct division and formation of progeny cells, containing intact genomes.

113. Answer (4)

    Hint: During anaphase, the spindle fibres attached to the kinetochore, now shorten and daughter chromosomes begin to migrate towards the opposite poles.

    Sol.: During mitotic anaphase, formation of interzonal fibres takes place.

114. Answer (3)

    Hint: The two asters together with the spindle fibres form mitotic apparatus.

    Sol.: Each centrosome radiates out microtubules called asters.

    Centromere is the primary constriction of the chromosome and is not a part of the mitotic apparatus.

115. Answer (4)

    Hint: The sequence of the phases in meiosis is as follows-

    Leptotene $\rightarrow$ Zygotene $\rightarrow$ Pachytene $\rightarrow$ Diplotene $\rightarrow$ Diakinesis $\rightarrow$ Metaphase I $\rightarrow$ Anaphase I $\rightarrow$ Telophase I.

    Sol.: Chromosomal synapsis is accompanied by the structure known as synaptonemal complex (Zygotene)

    $\downarrow$

    Mutual exchange of genetic material takes place by breakage and reunion of chromatid segments (Pachytene)

    $\downarrow$

    The two homologous chromosomes begin to separate from each other but remain attached at the chiasmata (Diplotene)

    $\downarrow$

    The intact chromosome containing two chromatids separate from each other and start moving to the poles (Anaphase I)

    $\downarrow$

    The chromosomes uncoil and elongate but remain straight in this phase (Telophase I)

116. Answer (3)

    Hint: The complete disintegration of the nuclear envelope marks the start of the second phase of mitosis.

    Sol.: Complete disintegration of the nuclear membrane marks the beginning of metaphase stage.

117. Answer (4)

    Hint: This phase marks the end of cell division.

    Sol.: At the time of cytoplasmic division, organelles like mitochondria and plastids get distributed between the two daughter cells.

118. Answer (3)

    Hint: Mitosis is also called equational division.

    Sol.: Meiosis helps in increasing the genetic variability in the daughter cells because it involves the crossing over of chromosomes.

119. Answer (2)

    Hint: Pachytene is the third sub-stage of the prophase I.

    Sol.: Pachytene stage is characterized by the presence of the recombination nodules, the site at which crossing over occurs between non-sister chromatids of the homologous chromosomes.

120. Answer (2)

    Hint: Condensation of chromatin is completed by metaphase and can be clearly observed under microscope.

    Sol.: The phase next to metaphase is anaphase.

    In anaphase, due to the splitting of centromere, chromatids get separated. Each chromosome moves away from the equatorial plate and the centromere of each chromosome remains directed towards the pole.

121. Answer (1)

    Hint: Diakinesis represents transition to metaphase.

    Sol.: Pachytene stage is characterized by the exchange of genetic material. Diplotene stage is characterized by having X-shaped structure.

    Zygotene stage involves pairing of homologous chromosomes known as, synapsis.

122. Answer (2)

    Hint: Meiosis I products have double the amount of DNA as compared to meiosis II products.

    Sol.: After meiosis I, the resultant cells will have 46 chromosomes and 2C of the DNA content.

123. Answer (4)

    Hint: The given cell is in late prophase.

    Sol.: Synapsis occurs in zygotene stage. Prophase occurs in both haploid and diploid cells.

124. **Answer (3)**

Hint: Prophase is the first phase and telophase is the last phase of karyokinesis.

Sol.: During prophase, condensation of chromatin material will take place. During telophase, nucleolus, ER, Golgi bodies and other organelles reappear in the daughter cells.

125. **Answer (2)**

Hint: A bivalent consists of two homologous chromosomes.

Sol.: A bivalent consists of four chromatids of two homologous chromosomes.

126. **Answer (4)**

Hint: It is the last phase of karyokinesis.

Sol.: During telophase, chromosomes cluster at opposite spindle poles and their identity is lost as discrete elements.

127. **Answer (2)**

Hint: Interkinesis is followed by prophase II, a much simpler prophase than prophase I.

Sol.: No replication of DNA takes place during interkinesis.

128. **Answer (2)**

Hint: G_0 phase is also known as quiescent phase.

Sol.: Gap 1 phase involves the duplication of most of the cell organelles.

During synthesis phase, DNA replication begins in the nucleus and the centriole duplicates in the cytoplasm.

Gap 2 phase involves the synthesis of RNA, protein, etc., required for the next phase by the cell.

129. **Answer (4)**

Hint: APC is a protein degrading machinery, necessary for the proper mitosis in animal cells.

Sol.: APC facilitates the segregation of chromosomes and this leads to the transition of cell from metaphase to anaphase.

130. **Answer (4)**

Hint: Mitosis is also known as equational division.

Sol.: Mitosis is called equational division because the two daughter cells have same number of chromosomes as that of parent cell.

131. **Answer (1)**

Hint: Metaphase II of meiosis has half the number of chromosomes as compared to metaphase I.

Sol.: Metaphase I has bivalents arranged on the equatorial plate. While in metaphase II, univalents get arranged on an equatorial plate.

132. **Answer (3)**

Hint: Best stage to study the shape of the chromosome is anaphase.

Sol.: During anaphase, shape of the chromosomes can be easily studied and splitting of centromere will take place.

133. **Answer (2)**

Hint: In a plant cell, cytokinesis is achieved by the formation of cell plate.

Sol.: In a plant cell, cell plate formation starts at the centre of the cell and grows outwards, towards the lateral wall, and thus, dividing the cell.

134. **Answer (3)**

Hint: In the metaphase stage, the nuclear envelope disappears and chromosomes spread through the cytoplasm of the cell.

Sol.: In the anaphase stage, spindle fibres shorten and daughter chromosomes begin to migrate towards the opposite poles.

135. **Answer (3)**

Hint: Pairing of homologous chromosomes takes place in the second sub-stage of prophase I.

Sol.: Pairing of homologous chromosomes takes place in meiotic cell division.

[ZOOLOGY]

136. **Answer (4)**

Hint: The animal contains haemolymph

Sol.: Cockroaches do not have capillary beds within their tracheal system.

For earthworms, as well as some amphibians (frogs), the skin serve as the respiratory organ.

A dense network of capillaries just below the skin facilitates the exchange of gases between the circulatory system and the environment.

Gills of fishes also contain a dense network of capillary beds.

137. **Answer (4)**

Hint: The horizontal rings of hyaline cartilage resemble the letter 'C'.

Sol.: The diameter of the trachea changes subtly during inhalation and exhalation, which is important in maintaining efficient airflow.

Trachea is surrounded by incomplete and horizontal rings of hyaline cartilage that resemble the letter 'C'.

Trachea is located anterior to the oesophagus and extends upto the mid-thoracic cavity, which divides at the level of 5th thoracic vertebra into a right and left primary bronchi.

138. Answer (1)

Hint: Vital capacity can be measured by a simple spirometer.

Sol.: The maximum volume of air a person can breathe in after a forced expiration is called vital capacity. It includes ERV, TV and IRV.
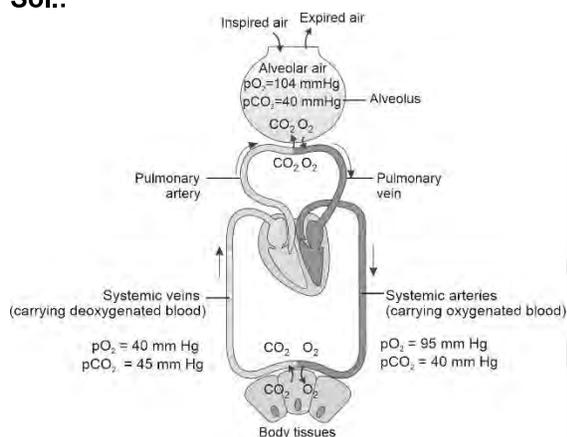
RV stands for residual volume.

It is the volume of air remaining in the lungs even after a forcible expiration.

139. Answer (2)

Hint: Pulmonary veins carry oxygenated blood.

Sol.:

140. Answer (3)

Hint: The part of the conducting zone of the human respiratory system.

Sol.: Gaseous exchange between air and blood occurs in the respiratory airway of the lungs which consists of alveoli, alveolar ducts and alveolar sacs.

The initial bronchioles are the part of the conducting (non-respiratory) airway system. They are supported by incomplete cartilaginous rings.

141. Answer (1)

Hint: It flattens due to contraction during inhalation.

Sol.: The most important muscle for inhalation is diaphragm, the dome-shaped skeletal muscle that forms the floor of the thoracic cavity.

Inter-costal muscles are found attached to ribs. Also, internal inter-costal muscles participate in forceful expiration.

Abdominal muscles participate in forceful expiration.

Sternum is a flat bone on the ventral midline of thorax.

142. Answer (1)

Hint: We cannot directly alter the pulmonary volume.

Sol.: Since the lungs in mammals do not completely empty with each breath, and inhalation occurs through the same airway as exhalation, each inhalation mixes fresh air with oxygen-depleted residual air.

As a result, the maximum pO_2 in alveoli is always considerably less than that in the atmosphere.

Within the thoracic cavity, a double membrane surrounds the lungs.

The layers of this membrane can slide smoothly past each other, but they cannot be pulled apart easily. Consequently, the volume of the thoracic cavity and the volume of the lungs change in unison.

143. Answer (2)

Hint: Organisms that live in water respire *via* gills.

Sol.: Aquatic arthropods use gills for respiration.

Most insects have a network of tubes (tracheal tubes) to transport atmospheric air within the body.

We have two lungs which are covered by a double-layered pleura, with pleural fluid between them.

Breathing involves two phases: breathing in and breathing out.

144. Answer (1)

Hint: Equal to the number of primary bronchi.

Sol.: The diffusion membrane is made up of three major layers namely, the thin squamous epithelium of alveoli, the endothelium of alveolar capillaries, and the basement substance in between them.

The basement substance is the acellular layer.

145. Answer (2)

Hint: Has a life span of 120 days

Sol.: The enzyme carbonic anhydrase belongs to the class IV of enzymes as it acts as a lyase.

RBCs contain a very high concentration of this enzyme and minute quantities of the same is present in the plasma too.

Zn^{+2} acts as its co-factor.

146. Answer (4)

Hint: Multiples of 2

Sol.: For inhalation to occur, the lungs expand, which increases lung volume and thus decreases the pressure in the lungs to below the atmospheric pressure.

The contraction of external inter-costal muscles lifts up the ribs and the sternum causing an increase in the volume of the thoracic chamber in the dorso-ventral axis.

During quiet inhalations, the pressure between the two pleural layers in the pleural cavity, called intrapleural pressure, is always sub-atmospheric.

147. Answer (3)

Hint: Amongst the given capacities, EC has the lowest value.

Sol.: Inspiratory Capacity = 3000 – 3500 mL

Expiratory Capacity = 1500 – 1600 mL

Functional Residual Capacity = 2100 – 2300 mL

Total Lung capacity = 5100 – 5800 mL

148. Answer (3)

Hint: Function of acidophilic leucocytes

Sol.: About 3% O_2 is carried in dissolved state through plasma.

Eosinophils constitute about 2–3% of the total WBCs.

Eosinophils have bilobed nucleus. They are granulocytes. RBCs have the life span of 120 days. Eosinophils increase in number during allergy and play an important role against infections.

Neutrophils have multi-lobed nucleus.

149. Answer (1)

Hint: Eliminate the symptoms associated with asthma.

Sol.: Emphysema is a disorder characterized by destruction of the walls of the alveoli.

Due to damaged alveolar walls, the respiratory surface is decreased.

Asthma is a disorder characterized by chronic airway inflammation and airway obstruction.

Airway obstruction may be due to smooth muscle spasms in the walls of bronchi and bronchioles. Lungs are not muscular.

Fibrosis of the upper respiratory tract takes place in occupational respiratory disorders.

150. Answer (1)

Hint: Unloading of O_2 from oxyhaemoglobin occurs at tissue site.

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

151. Answer (4)

Hint: Respiratory rhythm centre is present in medulla region of the brain.

Sol.: Pneumotaxic centre is present in the pons region of the brain. It moderates the function of respiratory rhythm centre.

Strong signals from pneumotaxic area result in shallow and fast breathing as duration of inspiration shortens.

Complete filling of lungs does not take place when the inspiratory area is turned off.

152. Answer (2)

Hint: Rate of diffusion of gases is inversely proportional to thickness.

Sol.: Factors that affect the rate of diffusion of gases are:

(1) Solubility of gases → A gas having higher solubility, diffuses at a faster rate than the gas having low solubility.

(2) Partial pressure → Gases diffuse according to their partial pressure.

(3) Thickness of membrane → More the thickness of a membrane, lesser will be the rate of diffusion across it.

153. Answer (4)

Hint: Involves relaxation of muscles

Sol.: Normal exhalation is a passive process and it occurs by the natural elastic recoil of the lung tissue and is accompanied by the relaxation of all breathing muscles.

The pCO_2 is higher in tissues due to catabolism, thus, diffusion of CO_2 occurs from tissues to blood (RBCs and plasma) where HCO_3^- and H^+ are formed.

154. Answer (3)

Hint: Haemoglobin can release more O_2 to metabolically active tissues.

Sol.:

155. **Answer (4)**

    Hint: End of T-wave marks the end of systole.

    Sol.: T-wave – Represents return of the ventricles from excited to normal state (repolarisation).

    QRS complex represents the depolarisation of ventricles.

    By counting the number of QRS complexes that occur in a given time period, one can determine the heart beat rate of an individual.

    In ECG, the T-P gap refers to the period between the end of the T-wave and the beginning of the P-wave.

    It represents the isoelectric baseline where no underlying cardiac electrical activity is present.

156. **Answer (4)**

    Hint: Increases cardiac output.

    Sol.: Neural signals through sympathetic nerves can increase the rate of heart beat, the strength of ventricular contraction and thereby the cardiac output.

    Parasympathetic neural signals decrease the cardiac output.

    Adrenal medullary hormones increase the cardiac output.

157. **Answer (4)**

    Hint: Connection present in GIT

    Sol.: The hepatic portal vein carries blood from intestine to the liver before it is delivered to the systemic circulation.

158. **Answer (3)**

    Hint: Tunica externa contains collagen fibres.

    Sol.: Veins carry blood from all body parts to heart (except pulmonary veins).

    Arteries carry blood away from the heart.

    Blood vessels have 3 layers:

    (i) Tunica intima-An inner layer of squamous endothelium

    (ii) Tunica media- A middle layer of smooth muscle and elastic fibres

    (iii) Tunica externa-An external layer of fibrous connective tissue with collagen fibres.

    The tunica media is comparatively thin in the veins.

159. **Answer (2)**

    Hint: Occurs at the beginning of ventricular systole.

    Sol.: The buildup of pressure that results due to filling of atria just before the joint diastole, causes the AV valves to open during joint diastole.

As the ventricles begin their contraction, the intra-ventricular pressure rises, causing the closure of tricuspid and bicuspid valves to prevent backflow of blood into atria.

When the pressure in the left ventricle becomes greater than the pressure in aorta, the semilunar valves are forced open.

The first heart sound 'Lub' is associated with the closure of the AV (mitral and tricuspid) valves.

160. **Answer (3)**

    Hint: Electrocardiogram is analysed.

    Sol.: The closed circulatory system is considered to be more advantageous as fluid can be precisely regulated.

    Electro-cardiograph is used to obtain an electrocardiogram which is a graphical representation of the electrical activity of the heart during a cardiac cycle.

161. **Answer (3)**

    Hint: Stroke volume

    Sol.: Regular exercise causes the heart to enlarge and become more robust (cardiomegaly).

    A stronger heart is expected to have a greater stroke volume, which would lead to decrease in heart rate.

    The body has the ability to alter the stroke volume, as well as the heart rate and thereby the cardiac output remains unchanged in normal conditions.

    Cardiac output of an athlete will be much higher than that of an ordinary man during strenuous exercise.

162. **Answer (2)**

    Hint: Cardiac output = Heart rate × Stroke volume

    Sol.: Heart rate = 80 beats / min

    Stroke volume = End diastolic volume –

    End systolic volume

    = (90 – 40) mL = 50 mL

    Cardiac output = Heart rate × Stroke volume

    = (80 × 50) mL = 4000 mL

163. **Answer (1)**

    Hint: CAD

    Sol.: Coronary artery disease, atherosclerosis, affects the vessels that supply blood to the heart muscle.

    Artificial pacemaker is required when a person is suffering from irregularity of heart beat.

    Atherosclerosis is treated by administering anti-coagulants to the patient.

164. **Answer (4)**

Hint: RBCs are highly specialized for their O_2 transport function.

Sol.: Mature RBCs have no nucleus, all their internal space is available for O_2 transport. They are biconcave in shape.

A biconcave disc has a greater surface area for the diffusion of gas molecules into and out of the RBCs.

165. **Answer (1)**

Hint: Just like the pleura of the lungs

Sol.: The human heart is protected by a double walled membranous bag, pericardium, enclosing the pericardial fluid.

It confines the heart to its position in the mediastinum.

A space called pericardial cavity is present between the two layers which is filled with a fluid called pericardial fluid. The pericardium protects the heart from shocks and mechanical injuries.

166. **Answer (4)**

Hint: Eliminate the proteins that are involved in blood clotting

Sol.: Fibrinogens, globulins and albumins are the major proteins present in the blood plasma.

Structural proteins like collagen and elastin are absent in blood plasma.

167. **Answer (3)**

Hint: Ventricles have more muscular wall than atria.

Sol.: Since the ventricles pump blood under higher pressure over greater distances, their walls are thicker.

The left ventricle is the thickest chamber of the heart and forms the apex of the heart.

168. **Answer (4)**

Hint: pO_2 content is more than pCO_2

Sol.: In amphibians and reptiles, the left atrium receives oxygenated blood from the gills/ lungs / skin and the right atrium gets the deoxygenated blood from other body parts.

169. **Answer (2)**

Hint: Blood clot or coagulum is formed by fibrin.

Sol.: Prothrombin $\xrightarrow[\text{Ca}^{+2}]{\text{Thrombokinase}}$ Thrombin

Fibrinogen $\xrightarrow[\text{Ca}^{+2}]{\text{Thrombin}}$ Fibrin

Fibrins form a network of threads which traps dead and damaged formed elements of blood to form the blood clot or coagulum.

An injury or trauma stimulates the platelets in blood to release coagulation promoting substances called thromboplastins.

170. **Answer (2)**

Hint: Fluid connective tissue

Sol.: Lymph is devoid of RBCs.

It has the same mineral distribution as that in plasma.

Fats are absorbed through lymph in the lacteals present in the intestinal villi.

Exchange of nutrients, gases, *etc.*, between the blood and the cells always occur through tissue fluid.

171. **Answer (4)**

Hint: Valves regulate flow of blood

Sol.: Arteries, veins and capillaries are different types of blood vessels.

Within each type, blood flows in only one direction. Smaller animals have higher metabolic rates than larger animals. This means that they require more energy per unit of body mass to maintain their body temperature and other life processes.

Capillaries are the smallest blood vessels, having diameter only slightly greater than that of RBCs.

RBCs carry a red-coloured, iron containing complex protein called haemoglobin.

172. **Answer (3)**

Hint: Made up of three muscular flaps

Sol.: The opening between the right atrium and the right ventricle is guarded by a valve formed of three muscular flaps or cusps, the tricuspid valve, whereas a bicuspid or mitral valve guards the opening between the left atrium and the left ventricle.

The openings of the right and the left ventricles into the pulmonary artery and the aorta, respectively, are provided with the semilunar valves.

173. **Answer (3)**

Hint: Largest artery in the human body

Sol.: Systemic circulation delivers oxygenated blood from the heart to the rest of the body and returns deoxygenated blood back to the heart.

The left ventricle pumps oxygen-rich blood into the aorta, which then branches into arteries, eventually reaching capillaries in body tissues, where gas exchange occurs.

174. Answer (1)

    Hint: Also known as heart strings

    Sol.: The papillary muscles, arising from the walls of the ventricles, are connected to the cusps of the atrio-ventricular valves (tricuspid and bicuspid) *via* chordae tendineae, which are strong and fibrous cords.

    During ventricular contraction, these structures prevent the valves from being pushed back into the atria under pressure, thereby ensuring unidirectional blood flow.

175. Answer (3)

    Hint: Rh incompatibility is seen

    Sol.: A special case of Rh incompatibility is observed between the Rh^{-ve} blood of a pregnant mother with Rh^{+ve} blood of the foetus.

    During the delivery of the first child, there is a possibility of exposure of the maternal blood to small amounts of the Rh^{+ve} blood from the foetus. In such cases, the mother starts preparing antibodies against Rh antigen in her blood. In case of her subsequent pregnancies, the Rh antibodies from the mother (Rh^{-ve}) can leak into the blood of the foetus (Rh^{+ve}) and destroy the foetal RBCs.

    This condition can be avoided by administering anti-Rh antibodies to the mother immediately after the delivery of the first child.

176. Answer (2)

    Hint: More than the number of external nares you have

    Sol.: Arterial blood pressure is highest when the heart contracts during ventricular systole.

    The pressure at this time is called systolic pressure.

    Since cardiac muscle cells are electrically coupled through gap junctions, impulses from the SA node spread rapidly within heart tissue.

    Since veins carry blood back to the heart at a lower pressure, they do not require thick walls.

177. Answer (2)

    Hint: Delay of about 0.1 sec

    Sol.: AV node is a specialised nodal tissue embedded in the lower left corner of the right atrium.

    It delays the spreading of impulses to heart apex for about 0.1 sec.

    This delay allows the atria to fully contract and empty into the ventricles before the ventricles contract.

    The conducting pathway of heart is

    SA node (signal spreads through atria) → AV node → AV bundle → Bundle branches → Purkinje fibres

178. Answer (2)

    Hint: Receives oxygenated blood from lungs.

    Sol.: The pulmonary veins carry oxygenated blood from the lungs back to the heart, specifically into the left atrium. From there, the blood flows into the left ventricle, which then pumps it out from the heart *via* aorta.

179. Answer (4)

    Hint: Universal donor

    Sol.: People with O^{-ve} blood group are universal donors because their RBCs do not carry antigens. Individuals with O^{+ve} blood group cannot give blood to Rh-negative people.

    'A' blood group individuals have anti-B antibodies in plasma and 'A' antigens on RBCs.

    'B' blood group individuals have anti-A antibodies in plasma and 'B' antigens on RBCs.

180. Answer (4)

    Hint: Platelets

    Sol.: Thrombocytes – Non-nucleated fragments of cells; help in blood clotting.

    Erythrocytes – Enucleated in their mature form; are not involved in blood clotting.

    Lymphocytes – Possess large round nucleus; involved in providing immunity.

    Monocytes – Possess bean-shaped nucleus; phagocytic cells that engulf germs and cell debris.

❑ ❑ ❑