All India Aakash Test Series for NEET - 2027

TEST - 2 (Code-I)

Click here for Code-J Sol.

Test Date : 28/12/2025

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

1. Answer (4)

Hint: $R = \frac{u^2 \sin 2\theta}{g}$, $H = \frac{u^2 \sin^2 \theta}{2g}$

Sol.: $R = H$

$\Rightarrow \frac{u^2 \sin 2\theta}{g} = \frac{u^2 \sin^2 \theta}{2g}$

$2\sin(2\theta) = \sin^2\theta$

$4\sin\theta\cos\theta = \sin^2\theta$

$\theta = \tan^{-1}(4)$

2. Answer (4)

Hint: $\tan\alpha = \frac{v_y}{v_x}$

Sol.: At time t = 2 s,

$v_x = u\cos 60^\circ = \frac{u}{2}$

$v_y = u\sin 60^\circ - 20 = \frac{\sqrt{3}u}{2} - 20$

$\tan\alpha = \frac{\frac{\sqrt{3}u}{2} - 20}{\frac{u}{2}} = \frac{\sqrt{3}u - 40}{u}$

$\tan\alpha = \sqrt{3} - \frac{40}{u}$

$\tan\alpha = \left(\sqrt{3} - 2\right)$

3. Answer (3)

Hint: For complementary angle range is equal while maximum height is different.

Sol.: For θ and $(90^\circ - \theta)$,

$\sin^2\theta \neq \sin^2(90^\circ - \theta)$

$\Rightarrow H$ is different for both

But $\sin 2\theta = \sin(180^\circ - 2\theta)$

$\Rightarrow$ Horizontal range (R) is same for both

4. Answer (2)

Hint: Horizontal distance travelled by bomb, $x = u_x \times T$

Sol.: $h = \frac{1}{2}gt^2$

$980 = \frac{1}{2} \times 9.8 \times T^2$

$T^2 = 200$

$T = 10\sqrt{2}$ s

$x = 100 \times 10\sqrt{2}$ m

$= 1000\sqrt{2}$ m

5. Answer (1)

Hint & Sol: If the boat always heads directly across, then time taken, $t = \frac{d}{v_b}$

6. Answer (3)

Hint & Sol.: If $\vec{a} \perp \vec{v}$, then acceleration changes only direction of velocity but not its magnitude. Therefore, this is a case of uniform circular motion.

7. Answer (1)

Hint: Impulse = Change in momentum

Sol.: Just before t = 4 s,

velocity = $v = \frac{0-9}{6-3} = -3$ m/s

Just after t = 4 s, velocity = $v = -3$ m/s

$\therefore$ Impulse = $m(v - v)$ = zero

8. Answer (4)

Hint: Use formula $\mu_k = \frac{(n^2 - 1)\tan\theta}{n^2}$

Sol.: $\mu_k = \frac{((1.5)^2 - 1)}{(1.5)^2} \times \tan 30^\circ$

$= \frac{2.25 - 1}{2.25} \times \frac{1}{\sqrt{3}}$

$= \frac{1.25}{2.25} \times \frac{1}{\sqrt{3}}$

$= \frac{125}{225} \times \frac{1}{\sqrt{3}}$

$= \frac{5\sqrt{3}}{27}$

9. Answer (4)

Hint: $v_x = \frac{dx}{dt}$, $v_y = \frac{dy}{dt}$

$a_x = \frac{dv_x}{dt}$, $a_y = \frac{dv_y}{dt}$

Sol.: $x = 4 + 8t \quad y = 6t + 4t^2$

$v_x = 8 \quad v_y = 6 + 8t$

$a_x = 0 \quad a_y = 8$

The motion will be uniformly accelerated.

For path : $t = \frac{x-4}{8}$

$$y = \frac{6\times(x-4)}{8} + 4\left[\frac{(x-4)}{8}\right]^2$$

$$y = \frac{3}{4}(x-4) + \frac{1}{16}(x-4)^2$$

Quadratic equation, so path is parabolic.

10. Answer (3)

Hint: Range $R = vT$ and $T = \sqrt{\frac{2h}{g}}$

Sol.: $R_1 = v\sqrt{\frac{2H}{g}} = 200$ m

$$R_2 = \frac{v}{2}\sqrt{\frac{4H\times 2}{g}}$$

$$= \frac{v}{2}\times 2\sqrt{\frac{2H}{g}}$$

= 200 m

11. Answer (1)

Hint: $\vec{v}(t) = \frac{d\vec{s}}{dt}, \quad \vec{a}(t) = \frac{d\vec{v}}{dt}$

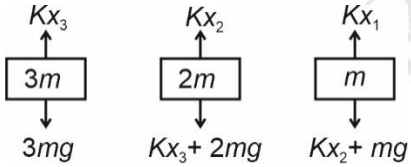
Sol.: $\vec{s}(t) = 4t\hat{j} + 5\hat{k}$

$\vec{v}(t) = 4\hat{j}$

$a(t) = 0$

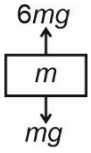
12. Answer (1)

Hint & Sol.: Consider the FBD of each block before cutting of spring.

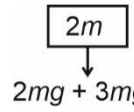


$Kx_3 = 3mg \Rightarrow Kx_2 = 5mg \Rightarrow Kx_1 = 6mg$

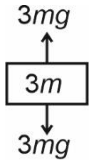
As spring 2 is cut, $Kx_2 = 0$



$\Rightarrow 5mg = ma \quad \Rightarrow a = 5g$ (upwards)



$\Rightarrow 5mg = 2ma \quad \Rightarrow a = \frac{5g}{2}$ (downwards)



$\Rightarrow a = 0$

13. Answer (3)

Hint: Use equation of motion in vector form

$\vec{v} = \vec{u} + \vec{a}t$

Sol.: $\vec{v} = 2\hat{i} + (2\hat{i} + 2\hat{j})6$

$\vec{v} = (14\hat{i} + 12\hat{j})$ m/s

$|\vec{v}| = \sqrt{196 + 144}$

$= \sqrt{340}$ m/s

14. Answer (2)

Hint: Time taken to cross the tunnel, $t = \frac{L+100}{v}$, where L is length of tunnel.

Sol.: $v_P = 72\times\frac{5}{18} = 20$ m/s

$v_Q = 36\times\frac{5}{18} = 10$ m/s

$t_P = \frac{L+100}{20}, t_Q = \frac{L+100}{10}$

$t_Q - t_P = 20$

$\frac{L+100}{10} - \frac{L+100}{20} = 20$

$2L + 200 - L - 100 = 400$

$L = 300$ m

15. Answer (4)

Hint: Apply equation of motion in vertical direction

$s_y = u_y t + \frac{a_y}{2}t^2$

Sol.: $-120 = 50t - 5t^2$

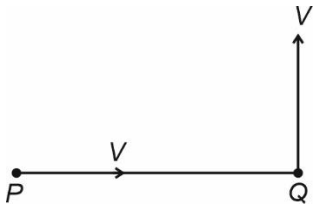
$(t - 12)(t + 2) = 0$

$t = 12$ s

16. Answer (1)

Hint: Time taken $= t = \frac{\text{relative distance}}{\text{relative velocity}}$

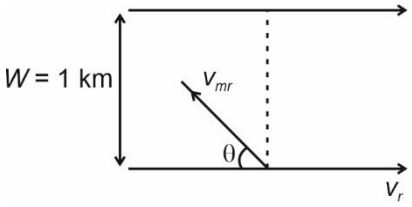
Sol.:



$$t = \frac{PQ}{v_r} = \frac{a}{v + v\cos 90^\circ} = \frac{a}{v}$$

17. Answer (1)

Hint & Sol.: Let θ = angle made by $\vec{v}_{mr}$ with upstream of river flow.



$$v_{mr}\cos\theta = v_r \Rightarrow \cos\theta = \frac{v_r}{v_{mr}} = \frac{1}{2}$$

$\therefore \theta = 60^\circ$ from upstream

With respect to ground, $v_m = v_{mr}\sin\theta$

$= 2 \times \frac{\sqrt{3}}{2} = \sqrt{3}$ km/h

Time taken, $t = \frac{\text{width}}{v_m} = \frac{1}{\sqrt{3}}$h

18. Answer (3)

Hint & Sol.: At two points on the path of a projectile at same height:

speed $v = \sqrt{v_x^2 + v_y^2}$

Horizontal component $\vec{v}_x$ remains constant

Vertical component of velocity changes its direction at topmost point.

19. Answer (4)

Hint: $a_c = \frac{v^2}{r}, a_t = \frac{dv}{dt}$

Sol.: Centripetal acceleration depends on speed and tangential acceleration depends on rate of change of speed. Hence, the relation between a_c and a_t can by anything, i.e. $a_c > a_t$, $a_c < a_t$ or $a_c = a_t$ all are possible

20. Answer (4)

Hint: Total time of flight, $T = \frac{2u_y}{a_y}$

Sol.: $T = \frac{2u_y}{a_y} = \frac{2\times 10\times \sin 53^\circ}{10} = \frac{8}{5}$ s

$u_{\min} = \frac{6\times 5}{8} = \frac{15}{4}$ m/s

21. Answer (3)

Hint: $R = |\vec{A} + \vec{B}| = \sqrt{A^2 + B^2 + 2AB\cos\theta}$

Sol.: $\vec{C} = -(\vec{A} + \vec{B})$

If $|\vec{C}| = 8$, then

$|\vec{C}|^2 = |\vec{A} + \vec{B}|^2 = R^2$

$64 = 20 + 16\cos\theta$

$\cos\theta = 2.75 > 1$ is not possible.

22. Answer (2)

Hint & Sol.: $\vec{r}(t) = \int v dt$

$= \frac{A}{\omega}(\sin\omega t\hat{i} + (1 - \cos\omega t\hat{j}))$

Particle moves with constant speed in a circular path and its distance from centre of circle is $\frac{A}{\omega}$

$|\vec{v}| = \sqrt{A^2\sin^2\omega t + A^2\cos^2\omega t} = A$

$\vec{a}(t) = \frac{d\vec{v}}{dt} = \omega^2\left(-\frac{A}{\omega}\sin\omega t\hat{i} + \frac{A}{\omega}\cos\omega t\hat{j}\right)$

$|\vec{a}| = A\omega$

Given position vector in statement (E) has a component along $\hat{k}$, so it is false.

23. Answer (4)

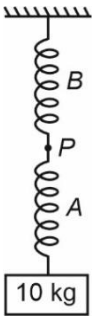
Hint: Range $R = \frac{2u_x u_y}{g}$, $H = \frac{u_y^2}{2g}$

Sol.: $R_{\max} = \frac{u^2\sin 2(45^\circ)}{g} = \frac{u^2}{g}$, $H = \frac{u^2}{4g}$

$R_{\max} = 4H$.

24. Answer (4)

Hint & Sol.: Tension in both the springs will be same and it is equal to weight of block.



25. Answer (2)

Hint: $\vec{F} = m\vec{a}$

Sol.: $m = \frac{|\vec{F}|}{|\vec{a}|}$

$= \frac{\sqrt{4+9}}{2\sqrt{2}} = \sqrt{\frac{13}{8}}$ kg

26. Answer (1)

Hint & Sol.: Net force, $\vec{F} = \frac{d\vec{p}}{dt}$

$\vec{F}_{avg} = \frac{\Delta\vec{p}}{\Delta t}$

$|\vec{F}_{avg}| \propto \frac{1}{\Delta t}$

27. Answer (2)

Hint: $\vec{F}_{pseudo} = -m \times$ (acceleration of frame)

Sol.: In case of upward acceleration (a) of lift,

$N = mg + ma$

$= m(g + a)$

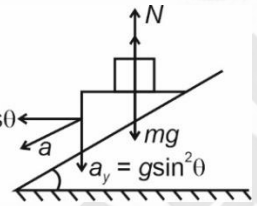
$W_{app} > W_{act}$

Reading = $60 \times \left(1 + \frac{a}{g}\right)$

= 60 × 2 = 120 kg

28. Answer (1)

Hint & Sol.: $a_x = g\sin\theta\cos\theta$



If m is not sliding and $a = g\sin\theta$

$mg - N = mg\sin^2\theta$

$N = mg(1 - \sin^2\theta) = mg\cos^2\theta$

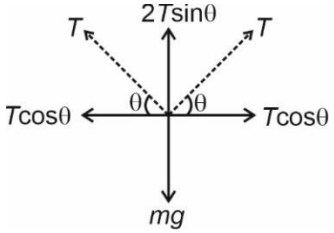
$\mu N = mg\sin\theta\cos\theta$

$\mu = \tan\theta = \frac{3}{4}$

29. Answer (1)

Hint: At equilibrium, $\vec{F}_{net}$ = Zero

Sol.:



For equilibrium, $2T\sin\theta = mg$

$T = \frac{mg}{2\sin\theta} = \frac{1\times10\times2}{2\times1}$ = 10 N

30. Answer (4)

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

Sol.: By constraint relation, if a is acceleration of 10 kg block, then acceleration of pulley Q and 20 kg block will be $\frac{a}{2}$

For 10 kg block, $T = 10(g - a)$

For pulley Q,

$2T - T' = 0 \times \frac{a}{2} \Rightarrow T' = 2T$

For 20 kg block,

$T' = 20\left(\frac{a}{2}\right) \Rightarrow T' = 10a$

$\Rightarrow T = 5a$

$\Rightarrow 5a = 10(g - a)$

$\therefore a = \frac{2}{3}g$

31. Answer (2)

Hint: Condition for motion of block:

Horizontal component of force $\geq$ frictional force

Sol.: $N = mg + F\cos60° = 20 + 10 = 30$ N

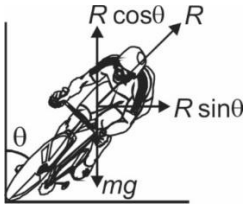
$F\sin60° \geq \mu N$

$10\sqrt{3} \geq 30\mu$

$\mu \leq \frac{1}{\sqrt{3}}$

32. Answer (3)

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



Sol.: Horizontal force $N\sin\theta = \frac{mv^2}{r}$

$N\cos\theta = mg$

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

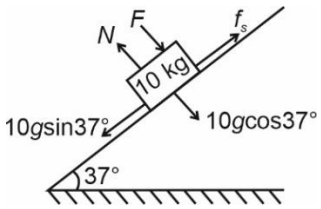
33. Answer (3)

Hint & Sol.: The necessary centripetal force is provided by friction on a horizontal circular road.

34. Answer (4)

Hint: Static friction, $f_s \leq \mu N$

Sol.:



$N = F + 10g\cos37° = F + 80$

$f_s = 10g\sin37° \leq \mu N$

$60 \leq \frac{F+80}{2}$

$F \geq 40$ N

$\therefore F_{min} = 40$ N

35. Answer (3)

Hint: Velocity will be maximum when acceleration is zero.

Sol.: $F_1 = 9 - t$

$F_2 = 3$

Net force $F = F_1 - F_2$

$\Rightarrow F = 9 - t - 3$

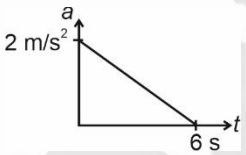
$\Rightarrow F = 6 - t$

$a = \frac{F}{m} = \frac{6-t}{3} = 2 - \frac{t}{3}$

Net force is positive till $t = 6$ s

$\therefore v_{max} = v_f$ is at $t = 6$ s

$v_f - v_i = \frac{1}{2} \times 6 \times 2$

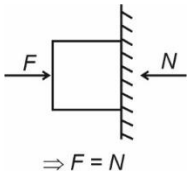


$v_f = 6$ m/s

36. Answer (1)

Hint: Maximum value of static friction, $(f_s)_{max} = \mu N$

Sol.:



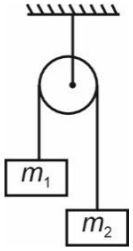
$\Rightarrow F = N$

Since normal force is F, $(f_s)_{max} = \mu_s F$

So as F increases, $(f_s)_{max}$ increases.

37. Answer (3)

Hint & Sol.:



For the heavier block to accelerate downward, tension must be less than its weight. Tension in the string depends on both masses.

38. Answer (4)

Hint: Time period, $T = \frac{2\pi R}{v}$

Sol.: $T = \frac{2\pi(2)}{2} = 2\pi$ sec

$t = \frac{T}{6}$

$\theta = \frac{\pi}{3}$ rad

Displacement $d = R = 2$ m

$\Delta v = \sqrt{2v^2 - 2v^2\cos\frac{\pi}{3}} = v$

$a_{avg} = \frac{\Delta v}{\frac{T}{6}} = \frac{2\times6}{2\pi} = \frac{6}{\pi}$ m/s²

$v_{avg} = \frac{d}{\frac{T}{6}} = \frac{2\times6}{2\pi} = \frac{6}{\pi}$ m/s

39. Answer (3)

Hint: Muzzle velocity of bullet, $\vec{v}_{bG} = \vec{v}_b - \vec{v}_G$

Sol.: From conservation of momentum,

$m_b v_b = m_G v_G$

$\Rightarrow v_G = \frac{m_b v_b}{m_G} = \frac{20\times10^{-3}\times50}{2} = 0.5$ m/s

$\therefore$ Muzzle speed, $|\vec{v}_{bG}| = v_b + v_G = 50 + 0.5$

$= 50.5$ m/s ($\because$ direction of $\vec{v}_b$ is opposite to $\vec{v}_G$)

40. Answer (3)

Hint: $\vec{F}_{AB} = -\vec{F}_{BA}$; $\Delta P = \int_0^t F\,dt$

Sol.: $\vec{F}_{AB}(t) = -Kt\hat{i}$

$\Delta\vec{P}_B = \left(\int_0^t Kt\,dt\right)\hat{i} = \frac{1}{2}Kt^2\hat{i}$

$\Rightarrow \vec{v}_B = \frac{1}{2m}Kt^2\hat{i}$ and $\vec{v}_A = \frac{-Kt^2\hat{i}}{2m}$

41. Answer (1)

Hint & Sol.: $v_{max} = \sqrt{\frac{Rg(\tan\theta + \mu)}{1 - \mu\tan\theta}}$

42. Answer (1)

Hint: $A_x = A\cos\theta$

$A_y = A\sin\theta$

Sol.: $A_x = \frac{10\sqrt{3}}{2} = 5\sqrt{3}$ units

$A_y = 10 \times \frac{1}{2} = 5$ units

43. Answer (3)

Hint: $\tan\theta = \frac{A_y}{A_x}$

Sol.: $\theta = \tan^{-1}\left(\frac{4}{3}\right)$

44. Answer (1)

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

Sol.: $\frac{dP}{dt} = (2t^2 + 4t + 1)$

$\int_0^P dP = \int_0^t (2t^2 + 4t + 1)dt$

$P = \left[\frac{2t^3}{3} + \frac{4t^2}{2} + t\right]_0^1$

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

$= \frac{11}{3}$ kg m/s

45. Answer (3)

Hint & Sol.: If $n = -1$,

then $n\vec{A} = -\vec{A}$ whose direction is opposite to $\vec{A}$.

[CHEMISTRY]

46. Answer (3)

Hint: According to one of the Dobereiner's Triad, the middle element has an atomic weight half of the sum of atomic weights of the other two elements.

Sol.: $y = \frac{x + z}{2}$

$x + z = 2y$

$z = 2y - x$

47. Answer (1)

Hint & Sol.: IUPAC name of an element with atomic number 103 will be Unniltrium.

48. Answer (3)

Hint: Element "As" belongs to the period 4 and group 15 of the periodic table.

Sol.: In the periodic table, phosphorus is present above arsenic (As) in the periodic table.

49. Answer (3)

Hint: *s* and *p* block elements are called representative elements.

Sol.: Oxidation state of oxygen in OF_2 is +2.

50. Answer (3)

Hint & Sol.: Eka-Aluminium and Eka-Silicon are gallium and germanium respectively.

51. Answer (1)

Hint: Unnilquadium is also known as Rutherfordium.

Sol.:

Unnilquadium	Rutherfordium
Unnilhexium	Seaborgium
Unniloctium	Hassium
Unnilbium	Nobelium

52. Answer (3)

Hint & Sol.: Promotion of electron is not essential condition prior to hybridisation.

53. Answer (3)

Hint & Sol.:

Element	**Electronegativity (on Pauling scale)**
Br	2.8
C	2.5
P	2.1

54. Answer (1)

Hint: Half-filled or completely filled subshells have extra stability. This causes irregularity in ionisation enthalpy of elements in a period.

Sol.:

Element	**Ionisation enthalpy/ (kJ mol^{-1})**
Li	520
Be	899
B	801
C	1086
N	1402
O	1314
F	1681

55. Answer (1)

Hint & Sol.: N_2O is a neutral oxide.

56. Answer (2)

Hint: Generally metallic character increases down the group while decreases on going from left to right in a period.

Sol.: So, order of metallic character will be

Na > Mg > Be > Si > P

57. Answer (1)

Hint: Al_2O_3 is an amphoteric oxide.

Sol.:

Cl_2O_7	Acidic
Na_2O	Basic
CO	Neutral

58. Answer (3)

Hint: Addition of an electron in an isolated gaseous atom is generally exothermic.

$H(g) + e^- \rightarrow H^-(g)$ $\Delta_{eg}H = -73$ kJmol^{-1}

Sol.: $Li(g) + e^- \rightarrow Li^-(g)$ $\Delta_{eg}H = -60$ kJmol^{-1}

$O^-(g) + e^- \rightarrow O^{2-}(g)$ $\Delta_{eg}H$ = +ve

$Ne(g) + e^- \rightarrow Ne^-(g)$ $\Delta_{eg}H = +116$ kJmol^{-1}

59. Answer (4)

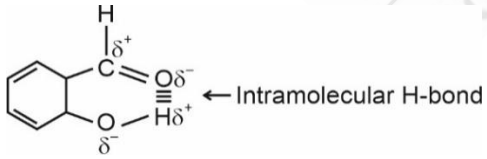
Hint: Cations have smaller size than their corresponding parent atoms due to increase in effective nuclear charge.

Sol.: Anions have larger size than their corresponding parent atoms due to increase in electronic repulsion.

60. 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.:



61. Answer (4)

Hint: When an electron is added to a neutral gaseous atom to convert it into a negative ion, the enthalpy change accompanying in this process is defined as the electron gain enthalpy ($\Delta_{eg}H$).

Sol.: Due to small size of O or F the added electron experience significant repulsion from the other electrons present in this energy level.

62. Answer (2)

Hint : Nickel is a transition element.

Sol.:

Bromine	Non-metal
Germanium	Metalloid
Cerium	Lanthanoid

63. Answer (2)

Hint: Alkali metal has less IP_1 and more IP_2 as compared to alkaline earth metal.

Sol.:

Element	1st IE(kJ/mole)	2nd IE (kJ/mole)
P	419	3068
Q	590	1145

Element P attains noble gas electronic configuration after the loss of one electron.

Therefore, P is an alkali metal and Q is an alkaline earth metal.

64. Answer (1)

Hint: $_{33}As$: Metalloid

Sol.: $_{53}I$: Non-metal

$_{83}Bi$: Metal

65. Answer (1)

Hint & Sol.:

Atomic number	Group number	Period number
42	6	5
58	3	6
46	10	5
56	2	6

66. Answer (4)

Hint: % Ionic character = $\frac{\mu_{observed}}{\mu_{calculated}} \times 100$

Sol.: 1D = 3.33×10^{-30}Cm

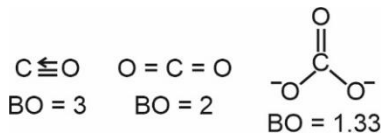
% Ionic character = $\frac{2.25 \times 3.33 \times 10^{-30} \times 100}{1.602 \times 10^{-19} \times 100 \times 10^{-12}}$

= 4.677 × 10 = 46.77%

67. Answer (1)

Hint: As the bond order (BO) increases bond length decreases.

Sol.:

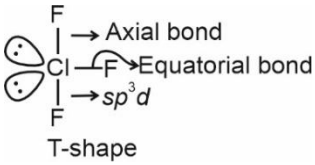


Therefore, correct bond length order will be $CO_3^{2-} > CO_2 > CO$

68. Answer (4)

Hint: In trigonal pyramidal geometry, axial bond length is longer than equatorial bond length for same type of bonds.

Sol.: XeF_4, NF_3 and BF_3 all bond lengths are equal but in ClF_3 axial bonds are longer than equatorial bond.



69. Answer (3)

Hint: SO_3^{2-} is Pyramidal in shape with sp^3 hybridisation.

Sol.:

Species	Structure
NO_3^-	Trigonal planar
SF_4	See-saw
XeF_4	Square planar
BrO_3^-	Trigonal pyramidal
XeO_3	Trigonal pyramidal
NH_4^+	Tetrahedral
SeF_4	See Saw

70. Answer (2)

Hint: Odd electron species like NO are paramagnetic.

Sol.:

Species	Bond order	Magnetic order
O_2	2	Paramagnetic
O_2^+	2.5	Paramagnetic
NO	2.5	Paramagnetic
NO^+	3	Diamagnetic
N_2	3	Diamagnetic
N_2^+	2.5	Paramagnetic
C_2	2	Diamagnetic
C_2^+	1.5	Paramagnetic

71. Answer (4)

Hint: Expanded octet molecule has more than 8 electrons in at least one atom.

Sol.: NO (Odd electron on N) H_2SO_4 (Expanded octet on S)

BCl_3 (Incomplete octet on B) SF_6 (Expanded octet on S)

72. Answer (3)

Hint: Dipole moment of BF_3 is zero.

Sol.: • Hydrogen bond is weaker than covalent bond.

• The magnitude of H-Bonding depends on the physical state of the compound.

73. Answer (1)

Hint: $XeOF_2$ has T-Shape with sp^3d hybridisation.

Sol.:

Molecule	Shape
$SOCl_2$	Trigonal pyramidal
BrF_5	Square pyramidal
PCl_5	Trigonal bipyramidal

74. Answer (1)

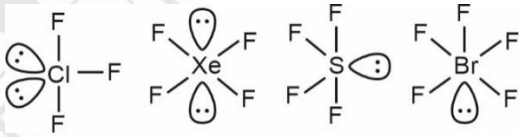
Hint: Percentage s character depends on the type of hybridisation.

Sol.:

Molecule	Hybridisation	Percentage s character in hybrid orbitals
$BeCl_2$	sp	50%
SO_3	sp^2	33%
CH_4	sp^3	25%
SF_6	sp^3d^2	16.7%

75. Answer (1)

Hint & Sol.:



76. Answer (1)

Hint: In XeF_6 hybridization is sp^3d^3.

Sol.: Shape of XeF_6 is distorted octahedral.

77. Answer (1)

Hint: As bond order increases bond length decreases.

Sol.:

Bond type	Covalent bond length (pm)
C ≡ C	120
C ≡ N	116
C = C	133
N = O	122

78. Answer (3)

Hint: H-bond are formed when the H-atom is attached to element with electronegativity more than 3.

Sol.: In liquid HCl hydrogen bonds are not present because the electronegativity of Cl is not enough to form H-bonds.

79. Answer (1)

Hint: Ability of anion to polarise towards cations is called polarizability

Sol.: As the size of anion increases polarizability increases. Therefore, the correct order will be

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

80. Answer (1)

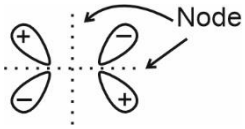
Hint: In O_2 molecule *sp* mixing does not get involved therefore $\sigma 2p_z$ will have lower energy than ($\pi 2p_x = \pi 2p_y$)

Sol.: The correct order of energies of molecular orbital of O_2 molecule will be

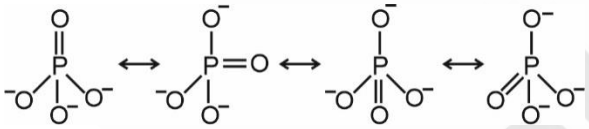
$\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \sigma 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$

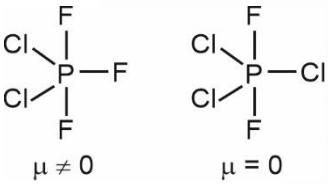
81. Answer (4)

Hint: $\pi^* 2p_x$ molecular orbital has two nodal planes.



Sol.: Following are the resonating structure of phosphate ion

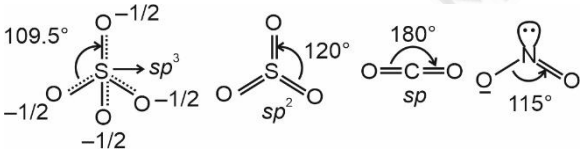




82. Answer (2)

Hint: Bond angle depends on type of hybridization and different type of electron pair repulsions.

Sol.:



83. Answer (3)

Hint: According to molecular orbital theory C_2 and B_2 have only π-bonds and no sigma (σ) bonds.

Sol.: The molecular orbital diagram of C_2 and B_2 shows electrons filling the $\pi 2p_x$ and $\pi 2p_y$ orbitals resulting in π-bond formation.

84. Answer (1)

Hint: Bond order in He_2 = $\frac{4-4}{2} = 0$.

Sol.:

Species	Bond order
O_2^+	2.5
O_2	2
O_2^-	1.5
O_2^{2-}	1

85. Answer (1)

Hint: Net dipole moment of any molecule/ species is the vector sum of all bond and lone pair moment.

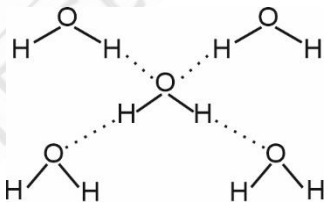
Sol.:

Molecule	Dipole moment, (D)
H_2O	1.85
HF	1.78
NH_3	1.47
$CHCl_3$	1.04

86. Answer (1)

Hint: Ethyl alcohol forms intermolecular H-bond with water.

Sol.: Each water molecule can form four H- bonds.



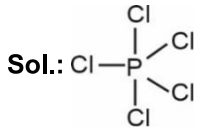
87. Answer (1)

Hint & Sol.: N_2^+ ion is paramagnetic due to presence of one unpaired electron in σ bonding molecular orbital.

88. Answer (3)

Hint: Ethyne ($HC \equiv CH$) has two π bonds.

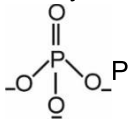
Sol.:



In PCl_5, maximum four atoms are present in a plane.

89. Answer (3)

Hint: If central atom contains *d* orbital $p\pi - d\pi$ bond formation may take place.

Sol.: •  P forms one $p\pi - d\pi$ bond with oxygen atom.

• In CO_3^{2-}, NO_3^- and O_3 only $p\pi - p\pi$ bonds are present.

90. Answer (3)

Hint: As the charge increases and size of cation decreases the polarising power increases. Therefore, covalent character increases.

Sol.: The correct covalent character will be

$NaCl < LiCl < BeCl_2$.

[BOTANY]

91. Answer (2)

Hint: The order Carnivora includes families like Felidae and Canidae.

Sol.: Cats and dogs are placed in similar families like Felidae and Canidae, respectively. Class mammalia includes animals like tiger, cat and dog.

92. Answer (1)

Hint: The problem of classification becomes more complex at higher category as there is greater 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 the characteristics that the members within the taxon share.

93. Answer (3)

Hint: The scientific name of the housefly is *Musca domestica* and it belongs to the family Muscidae.

Sol.: Taxonomic categories of housefly are as follows-

Order – Diptera

Class – Insecta

Phylum – Arthropoda

94. Answer (1)

Hint: Genus of Lion, leopard and tiger is same, *i.e., Panthera*

Sol.: Self-consciousness is the characteristic feature of human beings; it is not present in other living organisms.

95. Answer (4)

Hint: Order is the assemblage of families which exhibit a few similar characters.

Sol.: Chordata is a taxon of taxonomic category phylum.

96. Answer (2)

Hint: Binomial epithet includes generic name, specific epithet and author citation.

Sol.: The second component in the biological name denotes the specific epithet.

97. Answer (1)

Hint: The class of *Solanum, Petunia* and *Datura* is same *i.e.* Dicotyledonae.

Sol.: Three different genera *Solanum*, *Petunia* and *Datura* are placed in the family Solanaceae.

98. Answer (4)

Hint: The defining property of living organisms are the characteristics that distinguish them from non-living things and they are found in all living organisms without exception.

Sol.: Properties present in all human beings include growth, metabolism, cellular organization, and consciousness.

99. Answer (4)

Hint: In members of basidiomycetes, the sex organ is absent, the plasmogamy is brought about by fusion of two vegetative or somatic cells of different strains or genotype.

Sol.: In members of Phycomycetes, asexual spores are endogenously produced in the sporangium.

Yeast is a member of Ascomycetes. It asexually reproduces by budding.

The deuteromycetes reproduce only by asexual spores known as conidia.

100. Answer (3)

Hint: Morels and truffles belong to the class Ascomycetes.

Sol.: In members of Ascomycetes, ascospores are produced endogenously in sac like asci. Yeast is unicellular. They have dikaryophase in their sexual phase and mycelium is branched and septate.

101. Answer (4)

Hint: During sexual life cycle of fungi fusion of protoplasm takes place before the fusion of nuclei.

Sol.: The sexual cycle involves the following sequential three steps-

Plasmogamy →Karyogamy → Meiosis

102. Answer (3)

Hint: Kingdom Protista includes all the unicellular eukaryotic organisms. Euglenoids and protozoans lack cell wall.

Sol.: Euglenoids have mixotrophic mode of nutrition and have pigments identical to the higher plants. Protozoans live as predators or parasites and some marine forms of amoeboid protozoans have silica shells on their surface.

103. Answer (2)

Hint: To survive adverse conditions, some species are capable of developing spores, which exhibit minimal metabolic activity and remain viable in adverse environmental conditions.

Sol: In slime moulds, during unfavourable conditions, the plasmodium differentiates and forms the fruiting bodies bearing spores at the tips.

104. Answer (2)

Hint: Based on the sequence of 16S ribosomal RNA gene, Woese found that the six kingdoms naturally cluster into three main categories.

Sol.: Carl Woese called these categories as domains of life. These domains are Bacteria, Archaea and Eukarya and are believed to have originated from common ancestor called progenote.

105. Answer (4)

Hint: Red dinoflagellates are responsible for the death of a large number of marine animals like fishes by rapid multiplication.

Sol.: *Gonyaulax*, a unicellular eukaryotic organism is responsible for the red tides in the sea.

106. Answer (3)

Hint: Chrysophytes include diatoms and golden algae and they are found in fresh water as well as in marine environment.

Sol.: Chrysophytes float passively in water, they reproduce asexually and sexually by a process involving cell fusion and zygote formation.

Most of them are photosynthetic.

107. Answer (2)

Hint: Amoeboid protozoans do not have flagella or cilia.

Sol.: *Entamoeba* is an amoeboid protozoan and they have false feet or pseudopodia to capture their food.

108. Answer (4)

Hint: *Neurospora* is used extensively in the biochemical and genetic work by scientists.

Sol.: It belongs to the group Ascomycetes.

109. Answer (4)

Hint: The given organism is a filamentous blue green algae – *Nostoc*, with label X as heterocyst and label Y as mucilaginous sheath.

Sol.: In *Nostoc*, the heterocysts lack PS II activities and CO_2 fixation is done only by vegetative cells. Oxygen is not evolved due to absence of PS II. However, PS I remains active in heterocyst which generates ATP required to fix nitrogen.

110. Answer (1)

Hint: According to R.H Whittaker classification system, kingdom Monera and Protista have organisms with cellular body organization.

Sol.: According to five kingdom classification, two kingdoms have cellular body organization with heterotrophic mode of nutrition.

111. Answer (4)

Hint: Prions are the agents similar in size to the viruses which cause disease in both humans and animals.

Sol.: Prions cause most notable diseases bovine spongiform encephalopathy (BSE) commonly called mad cow disease in cattle and its analogous variant Creutzfeldt-Jakob disease (CJD) in humans.

112. Answer (3)

Hint: Lichens do not grow in polluted area.

Sol.: Most of the fungi are heterotrophs and they absorb soluble organic matter from the dead substrate and hence they are known as saprophytes.

113. Answer (2)

Hint: T.O. Diener discovered new infectious agent that was smaller than viruses and caused potato spindle tuber disease.

Sol.: M.W. Beijerinck demonstrated that the extract of the infected plants of tobacco could cause infection in healthy plants and named the new pathogen "virus" and called the fluid as *Contagium vivum fluidum* (infectious living fluid).

W.M. Stanley (1935) showed that viruses could be crystallised and crystals consist largely of proteins.

Dmitri Ivanowsky (1892) recognised certain microbes as causal organisms of the mosaic disease of tobacco.

114. Answer (2)

Hint: Toadstools belong to the class Basidiomycetes.

Sol.: In basidiomycetes, the mycelium is branched and septate. The asexual spores are generally not found, but vegetative reproduction by fragmentation is common. Mycelium is branched and septate. Basidiospores are produced exogenously on fruiting bodies.

115. Answer (2)

Hint: ssRNA is generally found in the virus which causes infection in plants.

Sol.: ssRNA is found in the virus causing tobacco mosaic disease.

116. Answer (4)

Hint: Linnaeus gave two kingdom classification system.

Sol.: Linnaeus proposed two kingdoms, *i.e.* kingdom Plantae and kingdom Animalia.

117. Answer (3)

Hint: Sole members of kingdom Monera are bacteria.

Sol.: Bacteria are structurally very simple but complex in behaviour.

118. Answer (2)

Hint: Vibrio is comma shaped bacteria.

Sol.: Cocci is spherical.

Bacillus is rod shaped.

Spirillum is spiral shaped.

119. Answer (3)

Hint: In lichens, phycobiont is the algal partner.

Sol.: In lichens, algal partner receives water and mineral salts from the fungus and prepares food.

120. Answer (4)

Hint: Heterotrophic bacteria depend on other organisms for food.

Sol.: Heterotrophic bacteria are most abundant in nature. The majority of them are decomposers.

121. Answer (4)

Hint: Viroids are infectious RNA particles which are devoid of protein coat.

Sol.: Both viruses and viroids are obligate parasites and both of them can cause disease in plants.

122. Answer (3)

Hint: Kingdom Protista includes only unicellular organisms.

Sol.: *Nostoc, Anabaena and Mycoplasma* belongs to kingdom Monera.

Spirogyra belongs to kingdom Plantae. *Amoeba*, *Chlamydomonas*, *Paramoecium*, *Chlorella*, *Euglena* and *Gonyaulax* belong to kingdom Protista.

123. Answer (3)

Hint: Both algae and fungi include eukaryotic organisms.

Sol.: Algae are photosynthetic organism and fungi are non-photosynthetic organism.

124. Answer (2)

Hint: Zoospores are produced in the members of Oomycetes class of fungi.

Sol.: Members of Oomycetes produce spores endogenously.

Site of meiosis is oospores. Rust disease in wheat is caused by *Puccinia*.

125. Answer (4)

Hint: Class Basidiomycetes are commonly known as club fungi.

Sol.: Club fungi include *Agaricus, Puccinia* and *Ustilago.*

126. Answer (2)

Hint: In members of Protista, process of cell fusion and zygote formation takes place.

Sol.: Members of Chrysophytes are mostly photosynthetic and majority of protozoans are parasitic in nature.

127. Answer (4)

Hint: Chrysophytes are found in both marine and fresh water environment.

Sol.: Dinoflagellates are mostly found in the marine water. Archaebacteria differ from other bacteria in having different cell wall.

Under unfavorable condition bacteria reproduce by the formation of spores.

128. Answer (4)

Hint: Viruses are not considered as truely 'living' structure.

Sol.: Viruses did not find a place in classification since they are not considered 'truly' living, if we understand living as those organisms that have a cell structure. The viruses are non-cellular organisms that are characterized by having inert crystalline structure outside the living cell.

129. Answer (2)

Hint: Methanogens are responsible for the production of the biogas.

Sol.: Methanogens are found in the marshy area and they are chemoautotrophs.

130. Answer (1)

Hint: *Aspergillus* belongs to the class Ascomycetes.

Sol.: *Puccinia* belongs to Basidiomycetes.

Mucor belongs to Phycomycetes.

Alternaria belongs to Deuteromycetes.

131. Answer (2)

Hint: Diatoms left behind large amount of cell wall deposits in their habitat, this accumulation over billions of years is referred to as diatomaceous earth.

Sol.: Diatoms are planktons and they are unicellular, autotrophic eukaryotic organism.

132. Answer (1)

Hint: Bladderwort and venus fly trap are examples of insectivorous plants.

Sol.: *Cuscuta* is a parasitic plant.

133. Answer (3)

Hint: Dikaryophase is the intervening stage in life cycle of members of Ascomycetes and Basidiomycetes.

Sol.: Dikaryotic stage is seen in the sexual life cycle of those fungi that form fruiting body.

134. Answer (2)

Hint: In members of Deuteromycetes, only vegetative or asexual phases are known.

Sol.: Members of Deuteromycetes reproduce by asexual spores conidia.

135. Answer (2)

Sol.: Oospores are sexual spores. Rest all are asexual spores.

[ZOOLOGY]

136. Answer (4)

Hint: About 2800 mL air

Sol.: The volume of air which remains in lungs at the end of a normal expiration is called the functional residual capacity (FRC) which equals to 2300 mL. So, amount of air which remains in lungs at the end of a normal inspiration will be about 2800 mL which is equal to TV + ERV + RV = TV + FRC.

137. Answer (1)

Hint: pCO_2 is less than one mm of Hg in atmospheric air.

Sol.: pO_2 in atmospheric air, it is 159 mmHg and in alveoli, it is 104 mmHg. pCO_2 in atmospheric air is 0.3 mmHg and in alveolar air is 40 mmHg. So, pCO_2 is higher and pO_2 is lesser in alveolar air as compared to atmospheric air.

138. Answer (3)

Hint: A network of tubes help in transport of gases

Sol.: Insects have a network of tubes (tracheal tubes) to transport atmospheric air within the body. Alveoli and alveolar ducts are present in lungs of humans for gaseous exchange whereas tracheoles are responsible for gaseous exchange in insects. Moist cuticle is responsible for gaseous exchange in annelids such as earthworms.

139. Answer (1)

Hint: Blood group systems are based on the presence or absence 'A' and 'B' antigens.

Sol.: Human blood is classified into A, B, AB and O groups based on presence or absence of two surface antigens, 'A' and 'B' on the RBCs. Rh factor (antigen) is also present on RBCs. The individuals having Rh factor are called positive blood group individuals, whereas who lacks Rh factor is considered as the negative blood group individual.

140. Answer (3)

Hint: Most of the invertebrates have an open type of circulation.

Sol.: All vertebrates and a few invertebrates have a closed circulatory system. Along with vertebrates, the cephalochordates, annelids and cephalopod molluscs have a closed circulatory system. Urochordates, included in the phylum Chordata, also have an open type of blood circulation.

141. Answer (4)

Hint: Each cardiac cycle includes the atrial and ventricular systole.

Sol.: During atrial systole, the atria pumps blood into ventricles and during ventricular systole, right ventricle pumps blood into the pulmonary artery, whereas left ventricle pumps blood into the aorta. So, cardiac systole pumps blood from atria to ventricles and ventricles to pulmonary artery and aorta.

142. Answer (2)

Hint: Beat volume is also called stroke volume.

Sol.: The amount of blood pumped out by single ventricle into aorta per minute is called cardiac output.

Cardiac output = Heart rate × Stroke volume.

The numerical value of stroke volume for a healthy adult human is 70 mL, under normal physiological conditions.

143. Answer (3)

Hint: Pulmonary circulation is related with lungs.

Sol.: In humans, two circulatory pathways, pulmonary and systemic circulations are present. Pulmonary circulation starts with pumping of deoxygenated blood by right ventricle which is carried to lungs by pulmonary artery, where it is oxygenated and returned to the left atrium by pulmonary veins. Systemic circulation starts with pumping of oxygenated blood into aorta from left ventricle which is carried to all body tissues and returned to the right atrium by vena cava.

144. Answer (4)

Hint: Exclude veins

Sol.: Aorta has higher blood pressure than veins. The aorta is the largest artery and is directly connected to the heart, receiving blood that is pumped under high blood pressure. Veins have significantly low blood pressure.

145. Answer (2)

Hint: Asthma is characterised by difficulty in breathing.

Sol.: Coronary artery disease is often referred to as atherosclerosis. When heart stops beating, it is called cardiac arrest which causes death of the individual. Alveolar cells get damaged in emphysema which decreases the surface available for gaseous exchange. Asthma is an allergic disease which causes difficulty in breathing and wheezing due to inflammation of bronchi and bronchioles.

146. Answer (4)

Hint: Auto-excitable cells.

Sol.: Nodal tissues are specialized auto-regulated muscles which regulate normal activities of the heart intrinsically. Special neural centre in medulla oblongata can moderate the cardiac functions through ANS. Adrenal medullary hormones (catecholamines) can also increase the cardiac output.

147. Answer (3)

Hint: Mechanism of respiration depends upon the complexity of the animal.

Sol.: O_2 is utilised by organisms to indirectly breakdown simple molecules like glucose, amino acids, *etc.* to derive energy to perform various activities. The process of exchange of O_2 from the atmosphere with CO_2 rich alveolar air is called breathing. In all animals, exchange of gases takes place by simple diffusion.

148. Answer (3)

Hint: The type of respiration performed by earthworm.

Sol.: On land, frogs respire through lungs, skin and buccal cavity. In water as well as during aestivation and hibernation, frogs perform cutaneous respiration. Branchial respiration occurs in molluscs, fishes, hemichordates and urochordates.

149. Answer (4)

Hint: Exchange part is the site of actual diffusion of gases.

Sol.: Our respiratory system consists of the conducting part (starting from external nostrils upto the terminal bronchioles), which is responsible for transport of atmospheric air to the alveoli, clears the foreign particles, humidifies and also brings the air to the body temperature. Exchange part is the site of actual diffusion of O_2 and CO_2 between blood and atmospheric air.

150. Answer (2)

Hint: Presence of negative pressure between two pleura.

Sol.: The lungs are situated in the thoracic chamber which is anatomically an air-tight chamber. Anatomical setup of lungs in thorax is such that any change in the volume of thoracic cavity will be reflected in the pulmonary cavity. So, during inspiration, the overall increase in the thoracic volume causes a similar increase in pulmonary volume.

151. Answer (4)

Hint: High binding affinity of haemoglobin causes difficulty in O_2 delivery to tissues.

Sol.: Adaptation at high altitude after living for a long time is called acclimatization. At high altitude, pO_2 is low as compared to pO_2 at sea levels. Hence, more RBCs are needed to deliver the required amount of O_2 in tissues. Increase in secretion of hormone erythropoietin at high altitude increases RBCs production. Affinity of haemoglobin for O_2 decreases due to increase in 2, 3-BPG which binds with β-chain of haemoglobin and is helpful in easy delivery of O_2 to the body cells.

152. Answer (3)

Hint: Low pCO_2 shifts oxyhaemoglobin dissociation curve to left side.

Sol.: Low H^+, high pH, low pCO_2 and low temperature, all favour the binding of haemoglobin with O_2 and lead to shift of oxygen dissociation curve towards the left side. Pneumotaxic centre is present in pons region of hindbrain. The volume of air which remains in lungs even at the end of forceful expiration is called residual volume which prevents collapsing of alveoli of lungs after maximum forceful expiration.

153. Answer (1)

Hint: The most commonly used body fluid for transportation is blood.

Sol.: Blood is the most commonly used body fluid in human and higher organisms. It is a specialised connective tissue like bones and cartilages, and is considered as fluid connective tissue. Blood consists of a fluid matrix, plasma, and formed element but lacks connective tissue fibres unlike most of the other connective tissues.

154. Answer (3)

Hint: Proteins contribute 6 – 8% of blood plasma.

Sol.: Percent of proteins in plasma is equal to the percent of monocytes in total WBCs. 3 percent of O_2 is transported in dissolved state and 20-25 percent CO_2 is transported in the form of carbamino-haemoglobin.

155. Answer (2)

Hint: Associated with allergic reactions.

Sol.: Neutrophils are polymorphonuclear leukocytes which are maximum in number among all WBCs and participate in phagocytosis. Percentage of neutrophils is 65% among total WBCs. Eosinophils are granulocytes having bilobed nucleus. They resist infections and are also associated with allergic reactions. Lymphocytes are agranulocytes and participate in humoral and cell-mediated immunity. Basophils release heparin, histamine and serotonin and participate in inflammatory reactions.

156. Answer (2)

Hint: Larger cells present in bone marrow

Sol.: Megakaryocytes are specialised cells in bone marrow that produce cell fragments. Reduction in number of platelets can lead to clotting disorders. Platelets/thrombocytes participate in clotting of blood.

157. Answer (3)

Hint: Rh^{-ve} mother lacks Rh-antigen.

Sol.: Rh incompatibility occurs in Rh^{+ve} foetus when mother is Rh^{-ve}. Rh antibodies are produced in mother against the Rh antigen of foetus after mixing of maternal and foetal blood during parturition. These Rh antibodies can cross placental barrier and cause erythroblastosis foetalis in foetus in subsequent pregnancies. It can be avoided by administering anti-Rh antibodies to the mother immediately after the delivery of the first Rh^{+ve} child.

158. Answer (3)

Hint: A thin muscular septum separates the right and left atria.

Sol.: The entire human heart is made of cardiac muscles and has the size of a clenched fist. A thin muscular septum, called inter-atrial septum, separates right and left atria. A thick fibrous septum, called atrio-ventricular septum, separates atrium and the ventricle of the same side. Mitral valve / bicuspid valve has two cusps which guards the opening of left atrium into left ventricle.

159. Answer (3)

Hint: Duration of heart's electrical activity in ventricle.

Sol.: In a standard ECG, QT interval is measured from the beginning of QRS complex (ventricular-depolarisation) to the end of T-wave (ventricular repolarisation). So, it represents the duration of the heart's electrical activity in the ventricles, specially the time it takes for the ventricles to depolarise and repolarise.

160. Answer (1)

Hint: Antibody of recipient reacts with donor antigens.

Sol.: Donor's compatibility is based on the destruction of its RBCs by action of antibodies of recipients, against blood group antigens on RBCs of donors. Because individuals with 'AB' blood group have no antibody against any blood group antigen, they can accept blood from donor of any ABO blood group. 'O' blood group individuals have no blood group antigen on RBCs, so, they can donate blood to individuals of any blood group and are considered as universal donors.

161. Answer (2)

Hint: Last branch of bronchiole

Sol.: The trachea, primary, secondary and tertiary bronchi and initial bronchioles are supported by incomplete cartilaginous rings. The exchange part of human respiratory system such as respiratory / terminal bronchiole, alveolar ducts and alveoli are not supported by incomplete cartilaginous rings.

162. Answer (3)

Hint: Trachea is present outside the lungs.

Sol.: Trachea is a straight tube extending up to the mid-thoracic cavity, which divides at the level of 5^{th} thoracic vertebra into a right and left primary bronchi. The branching network of bronchi, bronchioles and alveoli comprise the lungs.

163. Answer (2)

Hint: Decrease in affinity of Hb to O_2 shifts the oxygen dissociation curve to the right side.

Sol.: The factors such as increase in H^+, decrease in pH, increase in temperature, increase in pCO_2 and decrease in pO_2, decrease the affinity of Hb to O_2. So, oxygen dissociation curve is shifted towards right side which leads to dissociation of oxygen from the oxyhaemoglobin so that O_2 becomes easily available to tissues (Bohr's effect).

164. Answer (3)

Hint: Cellular respiration which produces CO_2 and energy is the last step in respiration.

Sol.: Respiration involves the following steps in the following sequence: -

(i) Pulmonary ventilation by which atmospheric air is drawn in and CO_2 rich alveolar air is released out.

(ii) Diffusion of gases across diffusion membrane.

(iii) Transport of gases by the blood.

(iv) Diffusion of O_2 and CO_2 between blood and tissues.

(v) Utilisation of O_2 by the cells for catabolic reaction and resultant release of CO_2.

165. Answer (4)

Hint: 70% of CO_2 is transported by bicarbonate ions.

Sol.: In people working in stone-breaking industries, the body cannot fully cope with the situation. Long exposure to dust particles can give rise to inflammation leading to fibrosis and thus, causing serious lung damage. At tissue surface, CO_2 produced in catabolism, enters RBCs and forms H^+ and HCO_3^-. Every 100 mL of deoxygenated blood delivers 4 mL of CO_2 to the lungs.

166. Answer (3)

Hint: Middle layer of walls of blood vessels

Sol.: Each artery and vein consists of three layers; inner lining of squamous endothelium, the tunica intima, a middle layer of smooth muscle and elastic fibres, the tunica media and an outer layer of fibrous connective tissue with collagen fibres, the tunica externa. The tunica media is comparatively thin in veins.

167. Answer (3)

Hint: To obtain a standard ECG, no lead is connected to the chest.

Sol.: To obtain a standard ECG, a patient is connected to the machine with three electrical leads; one to each wrist and to the left ankle joint. For a detailed evaluation of heart's function, multiple leads are attached to chest region. Each peak in ECG is identified with a letter from P to T. Ventricular systole occurs during the QT interval.

168. Answer (4)

Hint: Arteries always run away from the heart.

Sol.: In comparison to arteries, veins have valves, thinner tunica media and usually run towards the heart. Veins usually transport deoxygenated blood except pulmonary and umbilical vein.

169. Answer (2)

Hint: Thrombin acts on fibrinogen.

Sol.: An enzyme complex, thrombokinase, is required for blood clotting as it transforms inactive prothrombin into active thrombin. Certain factors from damaged tissue and platelet factor from platelets react in presence of Ca^{+2} to form an enzyme complex thrombokinase. Heparin activates anti-thrombin which prevents conversion of prothrombin into thrombin.

170. Answer (3)

Hint: Duration of cardiac cycle decreases on increasing heart rate.

Sol.: Duration of each cardiac cycle

$$= \frac{60 \text{ seconds}}{\text{Number of heart beats per minute}}$$

$$= \frac{60}{100} = 0.6 \text{ seconds}$$

171. Answer (4)

Hint: Heart sounds are produced due to closure of valves.

Sol.: During each cardiac cycle, two prominent sounds are produced. The first sound (lub) is associated with closure of AV valves and the 2^{nd} heart sound (dub) is produced due to closure of semilunar valves during ventricular diastole at the beginning of joint diastole.

172. Answer (2)

Hint: AV valves open during joint diastole.

Sol.: During joint diastole, all the four chambers of heart remain in relaxed state, AV valves remain open and semilunar valve remains closed. SAN stimulates atria causing atrial systole which occurs at the end of joint diastole but during ventricular diastole. Increase in ventricular pressure during systole is responsible for opening of semilunar valves.

173. Answer (3)

Hint: RMV (Respiratory Minute Volume)

= RR × TV.

Sol.: Total lung capacity (TLC)

= TV + IRV + ERV + RV

= 5100 to 5800 mL

RMV = Respiratory rate × Tidal volume

= 11 × 500 = 5500 mL

EC = 1500-1600 mL; FRC = 2100 – 2300 mL

VC = 4000-4600 mL

174. Answer (2)

Hint: Diffusion of gases depends upon their solubility.

Sol.: The solubility of CO_2 in blood is 20-25 times higher than that of O_2. The diffusion membrane in lungs is formed by two cellular layers (thin squamous epithelium of alveoli and endothelium of blood capillaries) and an acellular basement substance in between them. The factors such as pH, temperature, pCO_2 and pO_2 in our body are favourable for diffusion of O_2 from alveoli to the tissues and that of CO_2 from tissues to alveoli.

175. Answer (3)

Hint: Carbonic anhydrase is mainly present in RBCs.

Sol.: In most of the peripheral organs and tissues, CO_2 produced during catabolism enters in blood where it reacts with water in the presence of enzyme carbonic anhydrase to form carbonic acid. Reaction [1] in forward direction mainly occurs in RBCs due to presence of this enzyme. Holding of breath increases CO_2 in blood which forms carbonic acid. This carbonic acid dissociates into H^+ and HCO_3^- to increase H^+ of blood and this reduces blood pH.

176. Answer (2)

Hint: Antibodies are immunoglobulins.

Sol.: Thrombin converts fibrinogen into fibrin.

Ca^{2+} participates in blood clotting.

Albumin maintains osmotic pressure of blood.

Globulins are primarily responsible for immune response of the body.

177. Answer (4)

Hint: Nasal cavity does not participate in gaseous exchange.

Sol.: In tailed amphibians like salamanders, external gills are present for gaseous exchange and oxygenated blood from gills reaches into left ventricle. Adult frogs perform both cutaneous and pulmonary respiration and drain oxygenated blood from these structures into left atrium. Nasal cavity does not participate in oxygenation of blood.

178. Answer (3)

Hint: SAN is considered as the pacemaker.

Sol.: The SAN can generate maximum number of action potentials and is responsible for initiating and maintaining rhythmic contractile activity of heart. Therefore, it is called the pacemaker. It is situated in right upper corner of right atrium. AV node is situated in lower left corner of right atrium.

179. Answer (1)

Hint: When heart is not pumping blood effectively enough.

Sol.: The state of heart when it is not pumping blood effectively to meet the needs of the body, it is called heart failure or congestive heart failure because congestion of lungs is one of the main symptoms of this disease. Narrowing of lumen of blood vessels occurs in atherosclerosis. Acute chest pain is associated with angina pectoris. Increase in blood pressure of pulmonary capillaries (> 25 mm Hg) than normal (10 mm Hg) can cause pulmonary congestion.

180. Answer (4)

Hint: They release histamine.

Sol.: Eosinophils constitute 2-3% of total WBCs. Basophils are the least in number among all formed elements and constitute only 0.5-1 percent of total WBCs. They release histamine which is a vasodilator. Tunica externa is the outermost layer of arteries and veins and contains collagen fibres. QRS complex of ECG represents depolarisation of ventricles.

❑ ❑ ❑

All India Aakash Test Series for NEET - 2027

TEST - 2 (Code-J)

Click here for Code-I Sol.

Test Date : 28/12/2025

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

1. Answer (3)

Hint & Sol.: If $n = -1$,

then $n\vec{A} = -\vec{A}$ whose direction is opposite to $\vec{A}$.

2. Answer (1)

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

Sol.: $\frac{dP}{dt} = (2t^2 + 4t + 1)$

$\int_0^P dP = \int_0^t (2t^2 + 4t + 1)dt$

$P = \left[\frac{2t^3}{3} + \frac{4t^2}{2} + t\right]_0^1$

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

$= \frac{11}{3}$ kg m/s

3. Answer (3)

Hint: $\tan\theta = \frac{A_y}{A_x}$

Sol.: $\theta = \tan^{-1}\left(\frac{4}{3}\right)$

4. Answer (1)

Hint: $A_x = A\cos\theta$

$A_y = A\sin\theta$

Sol.: $A_x = \frac{10\sqrt{3}}{2} = 5\sqrt{3}$ units

$A_y = 10 \times \frac{1}{2} = 5$ units

5. Answer (1)

Hint & Sol.: $v_{max} = \sqrt{\frac{Rg(\tan\theta + \mu)}{1 - \mu\tan\theta}}$

6. Answer (3)

Hint: $\vec{F}_{AB} = -\vec{F}_{BA}$; $\Delta P = \int_0^t F\, dt$

Sol.: $\vec{F}_{AB}(t) = -Kt\hat{i}$

$\Delta\vec{P}_B = \left(\int_0^t Ktdt\right)\hat{i} = \frac{1}{2}Kt^2\hat{i}$

$\Rightarrow \vec{v}_B = \frac{1}{2m}Kt^2\hat{i}$ and $\vec{v}_A = \frac{-Kt^2\hat{i}}{2m}$

7. Answer (3)

Hint: Muzzle velocity of bullet, $\vec{v}_{bG} = \vec{v}_b - \vec{v}_G$

Sol.: From conservation of momentum,

$m_b v_b = m_G v_G$

$\Rightarrow v_G = \frac{m_b v_b}{m_G} = \frac{20 \times 10^{-3} \times 50}{2} = 0.5$ m/s

$\therefore$ Muzzle speed, $|\vec{v}_{bG}| = v_b + v_G = 50 + 0.5$

$= 50.5$ m/s ($\because$ direction of $\vec{v}_b$ is opposite to $\vec{v}_G$)

8. Answer (4)

Hint: Time period, $T = \frac{2\pi R}{v}$

Sol.: $T = \frac{2\pi(2)}{2} = 2\pi$ sec

$t = \frac{T}{6}$

$\theta = \frac{\pi}{3}$ rad

Displacement $d = R = 2$ m

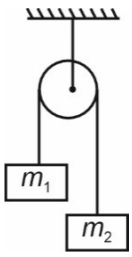
$\Delta v = \sqrt{2v^2 - 2v^2\cos\frac{\pi}{3}} = v$

$a_{avg} = \frac{\Delta v}{\frac{T}{6}} = \frac{2 \times 6}{2\pi} = \frac{6}{\pi}$ m/s^2

$v_{avg} = \frac{d}{\frac{T}{6}} = \frac{2 \times 6}{2\pi} = \frac{6}{\pi}$ m/s

9. Answer (3)

Hint & Sol.:

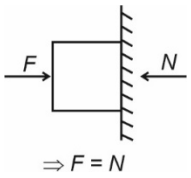


For the heavier block to accelerate downward, tension must be less than its weight. Tension in the string depends on both masses.

10. Answer (1)

Hint: Maximum value of static friction, $(f_s)_{max} = \mu N$

Sol.:



Since normal force is F, $(f_s)_{max} = \mu_s F$

So as F increases, $(f_s)_{max}$ increases.

11. Answer (3)

Hint: Velocity will be maximum when acceleration is zero.

Sol.: $F_1 = 9 - t$

$F_2 = 3$

Net force $F = F_1 - F_2$

$\Rightarrow F = 9 - t - 3$

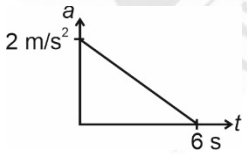
$\Rightarrow F = 6 - t$

$$a = \frac{F}{m} = \frac{6-t}{3} = 2 - \frac{t}{3}$$

Net force is positive till $t = 6$ s

$\therefore v_{max} = v_f$ is at $t = 6$ s

$$v_f - v_i = \frac{1}{2} \times 6 \times 2$$

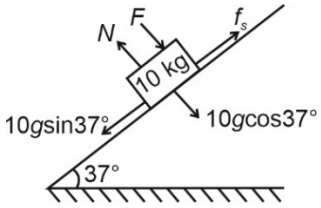


$v_f = 6$ m/s

12. Answer (4)

Hint: Static friction, $f_s \le \mu N$

Sol.:



$N = F + 10g\cos37° = F + 80$

$f_s = 10g\sin37° \le \mu N$

$$60 \le \frac{F+80}{2}$$

$F \ge 40$ N

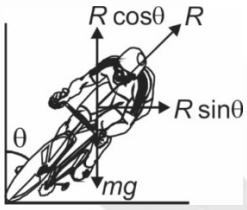
$\therefore F_{min} = 40$ N

13. Answer (3)

Hint & Sol.: The necessary centripetal force is provided by friction on a horizontal circular road.

14. Answer (3)

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



Sol.: Horizontal force $N\sin\theta = \frac{mv^2}{r}$

$N\cos\theta = mg$

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

15. Answer (2)

Hint: Condition for motion of block:

Horizontal component of force $\ge$ frictional force

Sol.: $N = mg + F\cos60° = 20 + 10 = 30$ N

$F\sin60° \ge \mu N$

$10\sqrt{3} \ge 30\mu$

$$\mu \le \frac{1}{\sqrt{3}}$$

16. Answer (4)

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

Sol.: By constraint relation, if a is acceleration of 10 kg block, then acceleration of pulley Q and 20 kg block will be $\frac{a}{2}$

For 10 kg block, $T = 10(g - a)$

For pulley Q,

$$2T - T' = 0 \times \frac{a}{2} \Rightarrow T' = 2T$$

For 20 kg block,

$T' = 20\left(\frac{a}{2}\right) \Rightarrow T' = 10a$

$\Rightarrow T = 5a$

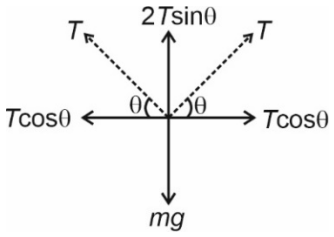
$\Rightarrow 5a = 10(g - a)$

$\therefore a = \frac{2}{3}g$

17. Answer (1)

Hint: At equilibrium, $\vec{F}_{net}$ = Zero

Sol.:

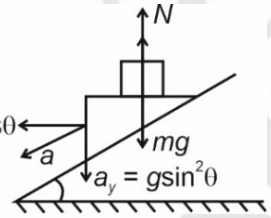


For equilibrium, $2T\sin\theta = mg$

$T = \frac{mg}{2\sin\theta} = \frac{1\times10\times2}{2\times1}$ = 10 N

18. Answer (1)

Hint & Sol.: $a_x = g\sin\theta\cos\theta$



If m is not sliding and $a = g\sin\theta$

$mg - N = mg\sin^2\theta$

$N = mg(1 - \sin^2\theta) = mg\cos^2\theta$

$\mu N = mg\sin\theta\cos\theta$

$\mu = \tan\theta = \frac{3}{4}$

19. Answer (2)

Hint: $\vec{F}_{pseudo} = -m \times$ (acceleration of frame)

Sol.: In case of upward acceleration (a) of lift,

$N = mg + ma$

$= m(g + a)$

$W_{app} > W_{act}$

Reading = $60\times\left(1+\frac{a}{g}\right)$

= 60 × 2 = 120 kg

20. Answer (1)

Hint & Sol.: Net force, $\vec{F} = \frac{d\vec{p}}{dt}$

$\vec{F}_{avg} = \frac{\Delta\vec{p}}{\Delta t}$

$|\vec{F}_{avg}| \propto \frac{1}{\Delta t}$

21. Answer (2)

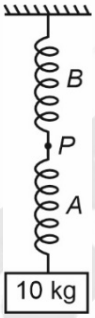
Hint: $\vec{F} = m\vec{a}$

Sol.: $m = \frac{|\vec{F}|}{|\vec{a}|}$

$= \frac{\sqrt{4+9}}{2\sqrt{2}} = \sqrt{\frac{13}{8}}$ kg

22. Answer (4)

Hint & Sol.: Tension in both the springs will be same and it is equal to weight of block.



23. Answer (4)

Hint: Range $R = \frac{2u_xu_y}{g}$, $H = \frac{u_y^2}{2g}$

Sol.: $R_{max} = \frac{u^2\sin2(45^\circ)}{g} = \frac{u^2}{g}$, $H = \frac{u^2}{4g}$

$R_{max} = 4H$.

24. Answer (2)

Hint & Sol.: $\vec{r}(t) = \int v dt$

$= \frac{A}{\omega}(\sin\omega t\hat{i} + (1-\cos\omega t\hat{j}))$

Particle moves with constant speed in a circular path and its distance from centre of circle is $\frac{A}{\omega}$

$|\vec{v}| = \sqrt{A^2\sin^2\omega t + A^2\cos^2\omega t} = A$

$\vec{a}(t) = \frac{d\vec{v}}{dt} = \omega^2\left(-\frac{A}{\omega}\sin\omega t\hat{i} + \frac{A}{\omega}\cos\omega t\hat{j}\right)$

$|\vec{a}| = A\omega$

Given position vector in statement (E) has a component along $\hat{k}$, so it is false.

25. Answer (3)

Hint: $R = |\vec{A} + \vec{B}| = \sqrt{A^2 + B^2 + 2AB\cos\theta}$

Sol.: $\vec{C} = -(\vec{A} + \vec{B})$

If $|\vec{C}| = 8$, then

$|\vec{C}|^2 = |\vec{A} + \vec{B}|^2 = R^2$

$64 = 20 + 16\cos\theta$

$\cos\theta = 2.75 > 1$ is not possible.

26. Answer (4)

Hint: Total time of flight, $T = \dfrac{2u_y}{a_y}$

Sol.: $T = \dfrac{2u_y}{a_y} = \dfrac{2\times 10\times \sin 53^\circ}{10} = \dfrac{8}{5}$ s

$u_{\min} = \dfrac{6\times 5}{8} = \dfrac{15}{4}$ m/s

27. Answer (4)

Hint: $a_c = \dfrac{v^2}{r}, a_t = \dfrac{dv}{dt}$

Sol.: Centripetal acceleration depends on speed and tangential acceleration depends on rate of change of speed. Hence, the relation between a_c and a_t can by anything, i.e. $a_c > a_t$, $a_c < a_t$ or $a_c = a_t$ all are possible

28. Answer (3)

Hint & Sol.: At two points on the path of a projectile at same height:

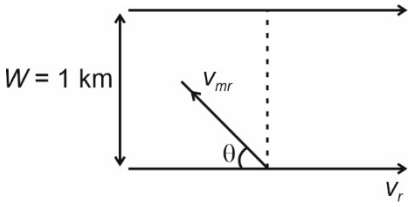
speed $v = \sqrt{v_x^2 + v_y^2}$

Horizontal component $\vec{v}_x$ remains constant

Vertical component of velocity changes its direction at topmost point.

29. Answer (1)

Hint & Sol.: Let θ = angle made by $\vec{v}_{mr}$ with upstream of river flow.



$v_{mr}\cos\theta = v_r \Rightarrow \cos\theta = \dfrac{v_r}{v_{mr}} = \dfrac{1}{2}$

$\therefore \theta = 60^\circ$ from upstream

With respect to ground, $v_m = v_{mr}\sin\theta$

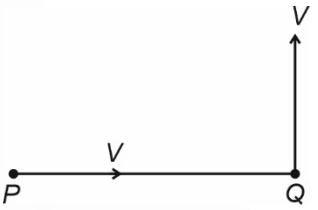
$= 2\times\dfrac{\sqrt{3}}{2} = \sqrt{3}$ km/h

Time taken, $t = \dfrac{\text{width}}{v_m} = \dfrac{1}{\sqrt{3}}$ h

30. Answer (1)

Hint: Time taken $= t = \dfrac{\text{relative distance}}{\text{relative velocity}}$

Sol.:



$t = \dfrac{PQ}{v_r} = \dfrac{a}{v + v\cos 90^\circ} = \dfrac{a}{v}$

31. Answer (4)

Hint: Apply equation of motion in vertical direction

$s_y = u_y t + \dfrac{a_y}{2}t^2$

Sol.: $-120 = 50t - 5t^2$

$(t - 12)(t + 2) = 0$

$t = 12$ s

32. Answer (2)

Hint: Time taken to cross the tunnel, $t = \dfrac{L + 100}{v}$, where L is length of tunnel.

Sol.: $v_P = 72\times\dfrac{5}{18} = 20$ m/s

$v_Q = 36\times\dfrac{5}{18} = 10$ m/s

$t_P = \dfrac{L + 100}{20}, t_Q = \dfrac{L + 100}{10}$

$t_Q - t_P = 20$

$\dfrac{L + 100}{10} - \dfrac{L + 100}{20} = 20$

$2L + 200 - L - 100 = 400$

$L = 300$ m

33. Answer (3)

Hint: Use equation of motion in vector form

$\vec{v} = \vec{u} + \vec{a}t$

Sol.: $\vec{v} = 2\hat{i} + (2\hat{i} + 2\hat{j})6$

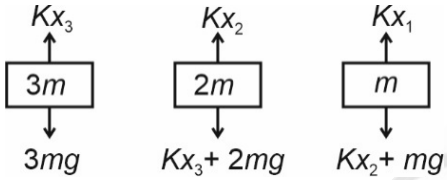
$\vec{v} = (14\hat{i} + 12\hat{j})$ m/s

$|\vec{v}| = \sqrt{196 + 144}$

$= \sqrt{340}$ m/s

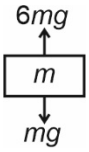
34. Answer (1)

Hint & Sol.: Consider the FBD of each block before cutting of spring.

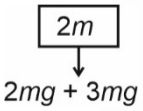


$Kx_3 = 3mg \Rightarrow Kx_2 = 5mg \Rightarrow Kx_1 = 6mg$

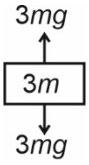
As spring 2 is cut, $Kx_2 = 0$



$\Rightarrow 5mg = ma \quad \Rightarrow a = 5g$ (upwards)



$\Rightarrow 5mg = 2ma \quad \Rightarrow a = \frac{5g}{2}$ (downwards)



$\Rightarrow a = 0$

35. Answer (1)

Hint: $\vec{v}(t) = \frac{d\vec{s}}{dt}, \quad \vec{a}(t) = \frac{d\vec{v}}{dt}$

Sol.: $\vec{s}(t) = 4t\hat{j} + 5\hat{k}$

$\vec{v}(t) = 4\hat{j}$

$a(t) = 0$

36. Answer (3)

Hint: Range $R = vT$ and $T = \sqrt{\frac{2h}{g}}$

Sol.: $R_1 = v\sqrt{\frac{2H}{g}} = 200$ m

$R_2 = \frac{v}{2}\sqrt{\frac{4H \times 2}{g}}$

$= \frac{v}{2} \times 2\sqrt{\frac{2H}{g}}$

= 200 m

37. Answer (4)

Hint: $v_x = \frac{dx}{dt}, \quad v_y = \frac{dy}{dt}$

$a_x = \frac{dv_x}{dt}, \quad a_y = \frac{dv_y}{dt}$

Sol.: $x = 4 + 8t \qquad y = 6t + 4t^2$

$v_x = 8 \qquad v_y = 6 + 8t$

$a_x = 0 \qquad a_y = 8$

The motion will be uniformly accelerated.

For path : $t = \frac{x-4}{8}$

$y = \frac{6 \times (x-4)}{8} + 4\left[\frac{(x-4)}{8}\right]^2$

$y = \frac{3}{4}(x-4) + \frac{1}{16}(x-4)^2$

Quadratic equation, so path is parabolic.

38. Answer (4)

Hint: Use formula $\mu_k = \frac{(n^2-1)\tan\theta}{n^2}$

Sol.: $\mu_k = \frac{((1.5)^2 - 1)}{(1.5)^2} \times \tan 30^\circ$

$= \frac{2.25 - 1}{2.25} \times \frac{1}{\sqrt{3}}$

$= \frac{1.25}{2.25} \times \frac{1}{\sqrt{3}}$

$= \frac{125}{225} \times \frac{1}{\sqrt{3}}$

$= \frac{5\sqrt{3}}{27}$

39. Answer (1)

Hint: Impulse = Change in momentum

Sol.: Just before $t = 4$ s,

velocity = $v = \frac{0-9}{6-3} = -3$ m/s

Just after $t = 4$ s, velocity = $v = -3$ m/s

$\therefore$ Impulse = $m(v - v)$ = zero

40. Answer (3)

Hint & Sol.: If $\vec{a} \perp \vec{v}$, then acceleration changes only direction of velocity but not its magnitude. Therefore, this is a case of uniform circular motion.

41. Answer (1)

Hint & Sol: If the boat always heads directly across, then time taken, $t = \frac{d}{v_b}$

42. Answer (2)

Hint: Horizontal distance travelled by bomb, $x = u_x \times T$

Sol.: $h = \frac{1}{2}gt^2$

$980 = \frac{1}{2} \times 9.8 \times T^2$

$T^2 = 200$

$T = 10\sqrt{2}$ s

$x = 100 \times 10\sqrt{2}$ m

$= 1000\sqrt{2}$ m

43. Answer (3)

Hint: For complementary angle range is equal while maximum height is different.

Sol.: For θ and $(90° - \theta)$,

$\sin^2\theta \neq \sin^2(90° - \theta)$

$\Rightarrow H$ is different for both

But $\sin 2\theta = \sin(180° - 2\theta)$

$\Rightarrow$ Horizontal range (R) is same for both

44. Answer (4)

Hint: $\tan\alpha = \frac{v_y}{v_x}$

Sol.: At time t = 2 s,

$v_x = u\cos 60° = \frac{u}{2}$

$v_y = u\sin 60° - 20 = \frac{\sqrt{3}u}{2} - 20$

$\tan\alpha = \frac{\frac{\sqrt{3}u}{2} - 20}{\frac{u}{2}} = \frac{\sqrt{3}u - 40}{u}$

$\tan\alpha = \sqrt{3} - \frac{40}{u}$

$\tan\alpha = \left(\sqrt{3} - 2\right)$

45. Answer (4)

Hint: $R = \frac{u^2\sin 2\theta}{g}$, $H = \frac{u^2\sin^2\theta}{2g}$

Sol.: $R = H$

$\Rightarrow \frac{u^2\sin 2\theta}{g} = \frac{u^2\sin^2\theta}{2g}$

$2\sin(2\theta) = \sin^2\theta$

$4\sin\theta\cos\theta = \sin^2\theta$

$\theta = \tan^{-1}(4)$

[CHEMISTRY]

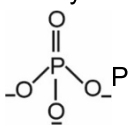
46. Answer (3)

Hint: As the charge increases and size of cation decreases the polarising power increases. Therefore, covalent character increases.

Sol.: The correct covalent character will be $NaCl < LiCl < BeCl_2$.

47. Answer (3)

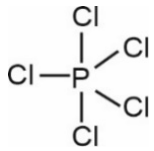
Hint: If central atom contains d orbital $p\pi - d\pi$ bond formation may take place.

Sol.: •  P forms one $p\pi - d\pi$ bond with oxygen atom.

• In CO_3^{2-}, NO_3^- and O_3 only $p\pi - p\pi$ bonds are present.

48. Answer (3)

Hint: Ethyne $(HC \equiv CH)$ has two π bonds.

Sol.: 

In PCl_5, maximum four atoms are present in a plane.

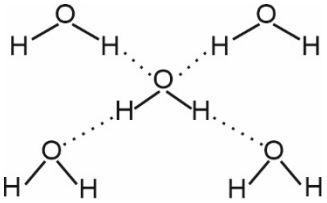
49. Answer (1)

Hint & Sol.: N_2^+ ion is paramagnetic due to presence of one unpaired electron in σ bonding molecular orbital.

50. Answer (1)

Hint: Ethyl alcohol forms intermolecular H-bond with water.

Sol.: Each water molecule can form four H- bonds.



51. Answer (1)

Hint: Net dipole moment of any molecule/ species is the vector sum of all bond and lone pair moment.

Sol.:

Molecule	Dipole moment, (D)
H_2O	1.85
HF	1.78
NH_3	1.47
$CHCl_3$	1.04

52. Answer (1)

Hint: Bond order in He_2 = $\frac{4-4}{2} = 0$.

Sol.:

Species	Bond order
O_2^+	2.5
O_2	2
O_2^-	1.5
O_2^{2-}	1

53. Answer (3)

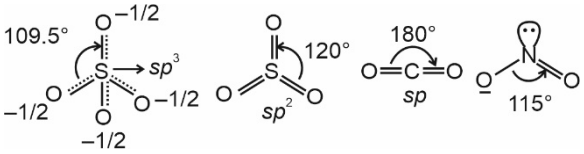
Hint: According to molecular orbital theory C_2 and B_2 have only π-bonds and no sigma (σ) bonds.

Sol.: The molecular orbital diagram of C_2 and B_2 shows electrons filling the $\pi 2p_x$ and $\pi 2p_y$ orbitals resulting in π-bond formation.

54. Answer (2)

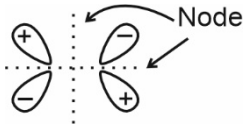
Hint: Bond angle depends on type of hybridization and different type of electron pair repulsions.

Sol.:

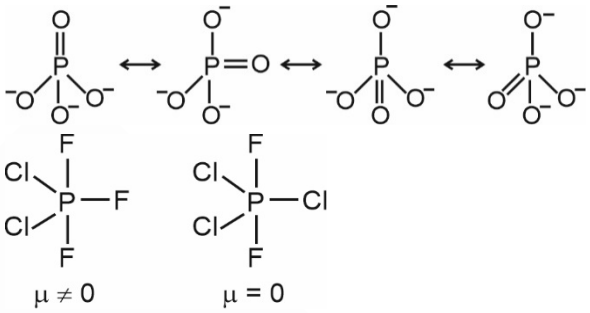


55. Answer (4)

Hint: π^*2p_x molecular orbital has two nodal planes.



Sol.: Following are the resonating structure of phosphate ion



$\mu \neq 0$ $\mu = 0$

56. Answer (1)

Hint: In O_2 molecule *sp* mixing does not get involved therefore $\sigma 2p_z$ will have lower energy than ($\pi 2p_x = \pi 2p_y$)

Sol.: The correct order of energies of molecular orbital of O_2 molecule will be

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

57. Answer (1)

Hint: Ability of anion to polarise towards cations is called polarizability

Sol.: As the size of anion increases polarizability increases. Therefore, the correct order will be

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

58. Answer (3)

Hint: H-bond are formed when the H-atom is attached to element with electronegativity more than 3.

Sol.: In liquid HCl hydrogen bonds are not present because the electronegativity of Cl is not enough to form H-bonds.

59. Answer (1)

Hint: As bond order increases bond length decreases.

Sol.:

Bond type	Covalent bond length (pm)
C ≡ C	120
C ≡ N	116
C = C	133
N = O	122

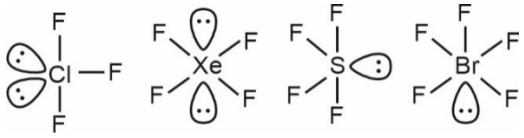
60. Answer (1)

Hint: In XeF_6 hybridization is sp^3d^3.

Sol.: Shape of XeF_6 is distorted octahedral.

61. Answer (1)

Hint & Sol.:



62. Answer (1)

Hint: Percentage s character depends on the type of hybridisation.

Sol.:

Molecule	Hybridisation	Percentage s character in hybrid orbitals
$BeCl_2$	sp	50%
SO_3	sp^2	33%
CH_4	sp^3	25%
SF_6	sp^3d^2	16.7%

63. Answer (1)

Hint: $XeOF_2$ has T-Shape with sp^3d hybridisation.

Sol.:

Molecule	Shape
$SOCl_2$	Trigonal pyramidal
BrF_5	Square pyramidal
PCl_5	Trigonal bipyramidal

64. Answer (3)

Hint: Dipole moment of BF_3 is zero.

Sol.: • Hydrogen bond is weaker than covalent bond.

• The magnitude of H-Bonding depends on the physical state of the compound.

65. Answer (4)

Hint: Expanded octet molecule has more than 8 electrons in at least one atom.

Sol.: NO (Odd electron on N) H_2SO_4 (Expanded octet on S)

BCl_3 (Incomplete octet on B) SF_6 (Expanded octet on S)

66. Answer (2)

Hint: Odd electron species like NO are paramagnetic.

Sol.:

Species	Bond order	Magnetic order
O_2	2	Paramagnetic
O_2^+	2.5	Paramagnetic
NO	2.5	Paramagnetic
NO^+	3	Diamagnetic
N_2	3	Diamagnetic
N_2^+	2.5	Paramagnetic
C_2	2	Diamagnetic
C_2^+	1.5	Paramagnetic

67. Answer (3)

Hint: SO_3^{2-} is Pyramidal in shape with sp^3 hybridisation.

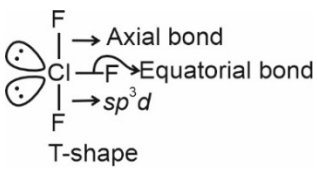
Sol.:

Species	Structure
NO_3^-	Trigonal planar
SF_4	See-saw
XeF_4	Square planar
BrO_3^-	Trigonal pyramidal
XeO_3	Trigonal pyramidal
NH_4^+	Tetrahedral
SeF_4	See Saw

68. Answer (4)

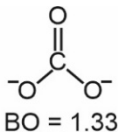
Hint: In trigonal pyramidal geometry, axial bond length is longer than equatorial bond length for same type of bonds.

Sol.: XeF_4, NF_3 and BF_3 all bond lengths are equal but in ClF_3 axial bonds are longer than equatorial bond.



69. Answer (1)

Hint: As the bond order (BO) increases bond length decreases.

Sol.: $C \equiv O$ BO = 3 $O = C = O$ BO = 2  BO = 1.33

Therefore, correct bond length order will be $CO_3^{2-} > CO_2 > CO$

70. Answer (4)

Hint: % Ionic character = $\frac{\mu_{observed}}{\mu_{calculated}} \times 100$

Sol.: 1D = 3.33×10^{-30}Cm

% Ionic character = $\frac{2.25 \times 3.33 \times 10^{-30} \times 100}{1.602 \times 10^{-19} \times 100 \times 10^{-12}}$

= 4.677 × 10 = 46.77%

71. Answer (1)

Hint & Sol.:

Atomic number	Group number	Period number
42	6	5
58	3	6
46	10	5
56	2	6

72. Answer (1)

Hint: $_{33}As$: Metalloid

Sol.: $_{53}I$: Non-metal

$_{83}Bi$: Metal

73. Answer (2)

Hint: Alkali metal has less IP_1 and more IP_2 as compared to alkaline earth metal.

Sol.:

Element	1st IE(kJ/mole)	2nd IE (kJ/mole)
P	419	3068
Q	590	1145

Element P attains noble gas electronic configuration after the loss of one electron.

Therefore, P is an alkali metal and Q is an alkaline earth metal.

74. Answer (2)

Hint : Nickel is a transition element.

Sol.:

Bromine	Non-metal
Germanium	Metalloid
Cerium	Lanthanoid

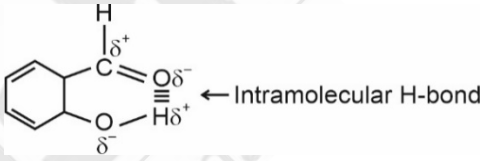
75. Answer (4)

Hint: When an electron is added to a neutral gaseous atom to convert it into a negative ion, the enthalpy change accompanying in this process is defined as the electron gain enthalpy ($\Delta_{eg}H$).

Sol.: Due to small size of O or F the added electron experience significant repulsion from the other electrons present in this energy level.

76. 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.: 

77. Answer (4)

Hint: Cations have smaller size than their corresponding parent atoms due to increase in effective nuclear charge.

Sol.: Anions have larger size than their corresponding parent atoms due to increase in electronic repulsion.

78. Answer (3)

Hint: Addition of an electron in an isolated gaseous atom is generally exothermic.

$H(g) + e^- \rightarrow H^-(g)$ $\Delta_{eg}H = -73$ kJmol^{-1}

Sol.: $Li(g) + e^- \rightarrow Li^-(g)$ $\Delta_{eg}H = -60$ kJmol^{-1}

$O^-(g) + e^- \rightarrow O^{2-}(g)$ $\Delta_{eg}H$ = +ve

$Ne(g) + e^- \rightarrow Ne^-(g)$ $\Delta_{eg}H$ = + 116 kJmol^{-1}

79. Answer (1)

Hint: Al_2O_3 is an amphoteric oxide.

Sol.:

Cl_2O_7	Acidic
Na_2O	Basic
CO	Neutral

80. Answer (2)

Hint: Generally metallic character increases down the group while decreases on going from left to right in a period.

Sol.: So, order of metallic character will be

Na > Mg > Be > Si > P

81. Answer (1)

Hint & Sol.: N_2O is a neutral oxide.

82. Answer (1)

Hint: Half-filled or completely filled subshells have extra stability. This causes irregularity in ionisation enthalpy of elements in a period.

Sol.:

Element	Ionisation enthalpy/ (kJ mol^{-1})
Li	520
Be	899
B	801
C	1086
N	1402
O	1314
F	1681

83. Answer (3)

Hint & Sol.:

Element	Electronegativity (on Pauling scale)
Br	2.8
C	2.5
P	2.1

84. Answer (3)

Hint & Sol.: Promotion of electron is not essential condition prior to hybridisation.

85. Answer (1)

Hint: Unnilquadium is also known as Rutherfordium.

Sol.:

Unnilquadium	Rutherfordium
Unnilhexium	Seaborgium
Unniloctium	Hassium
Unnilbium	Nobelium

86. Answer (3)

Hint & Sol.: Eka-Aluminium and Eka-Silicon are gallium and germanium respectively.

87. Answer (3)

Hint: *s* and *p* block elements are called representative elements.

Sol.: Oxidation state of oxygen in OF_2 is +2.

88. Answer (3)

Hint: Element "As" belongs to the period 4 and group 15 of the periodic table.

Sol.: In the periodic table, phosphorus is present above arsenic (As) in the periodic table.

89. Answer (1)

Hint & Sol.: IUPAC name of an element with atomic number 103 will be Unniltrium.

90. Answer (3)

Hint: According to one of the Dobereiner's Triad, the middle element has an atomic weight half of the sum of atomic weights of the other two elements.

Sol.: $y = \frac{x+z}{2}$

$x + z = 2y$

$z = 2y - x$

[BOTANY]

91. Answer (2)

Sol.: Oospores are sexual spores. Rest all are asexual spores.

92. Answer (2)

Hint: In members of Deuteromycetes, only vegetative or asexual phases are known.

Sol.: Members of Deuteromycetes reproduce by asexual spores conidia.

93. Answer (3)

Hint: Dikaryophase is the intervening stage in life cycle of members of Ascomycetes and Basidiomycetes.

Sol.: Dikaryotic stage is seen in the sexual life cycle of those fungi that form fruiting body.

94. Answer (1)

Hint: Bladderwort and venus fly trap are examples of insectivorous plants.

Sol.: *Cuscuta* is a parasitic plant.

95. Answer (2)

Hint: Diatoms left behind large amount of cell wall deposits in their habitat, this accumulation over billions of years is referred to as diatomaceous earth.

Sol.: Diatoms are planktons and they are unicellular, autotrophic eukaryotic organism.

96. Answer (1)

Hint: *Aspergillus* belongs to the class Ascomycetes.

Sol.: *Puccinia* belongs to Basidiomycetes.

Mucor belongs to Phycomycetes.

Alternaria belongs to Deuteromycetes.

97. Answer (2)

Hint: Methanogens are responsible for the production of the biogas.

Sol.: Methanogens are found in the marshy area and they are chemoautotrophs.

98. Answer (4)

Hint: Viruses are not considered as truely 'living' structure.

Sol.: Viruses did not find a place in classification since they are not considered 'truly' living, if we understand living as those organisms that have a cell structure. The viruses are non-cellular organisms that are characterized by having inert crystalline structure outside the living cell.

99. Answer (4)

Hint: Chrysophytes are found in both marine and fresh water environment.

Sol.: Dinoflagellates are mostly found in the marine water. Archaebacteria differ from other bacteria in having different cell wall.

Under unfavorable condition bacteria reproduce by the formation of spores.

100. Answer (2)

Hint: In members of Protista, process of cell fusion and zygote formation takes place.

Sol.: Members of Chrysophytes are mostly photosynthetic and majority of protozoans are parasitic in nature.

101. Answer (4)

Hint: Class Basidiomycetes are commonly known as club fungi.

Sol.: Club fungi include *Agaricus, Puccinia* and *Ustilago.*

102. Answer (2)

Hint: Zoospores are produced in the members of Oomycetes class of fungi.

Sol.: Members of Oomycetes produce spores endogenously.

Site of meiosis is oospores. Rust disease in wheat is caused by *Puccinia*.

103. Answer (3)

Hint: Both algae and fungi include eukaryotic organisms.

Sol.: Algae are photosynthetic organism and fungi are non-photosynthetic organism.

104. Answer (3)

Hint: Kingdom Protista includes only unicellular organisms.

Sol.: *Nostoc, Anabaena and Mycoplasma* belongs to kingdom Monera.

Spirogyra belongs to kingdom Plantae. *Amoeba*, *Chlamydomonas*, *Paramoecium*, *Chlorella*, *Euglena* and *Gonyaulax* belong to kingdom Protista.

105. Answer (4)

Hint: Viroids are infectious RNA particles which are devoid of protein coat.

Sol.: Both viruses and viroids are obligate parasites and both of them can cause disease in plants.

106. Answer (4)

Hint: Heterotrophic bacteria depend on other organisms for food.

Sol.: Heterotrophic bacteria are most abundant in nature. The majority of them are decomposers.

107. Answer (3)

Hint: In lichens, phycobiont is the algal partner.

Sol.: In lichens, algal partner receives water and mineral salts from the fungus and prepares food.

108. Answer (2)

Hint: Vibrio is comma shaped bacteria.

Sol.: Cocci is spherical.

Bacillus is rod shaped.

Spirillum is spiral shaped.

109. Answer (3)

Hint: Sole members of kingdom Monera are bacteria.

Sol.: Bacteria are structurally very simple but complex in behaviour.

110. Answer (4)

Hint: Linnaeus gave two kingdom classification system.

Sol.: Linnaeus proposed two kingdoms, *i.e.* kingdom Plantae and kingdom Animalia.

111. Answer (2)

Hint: ssRNA is generally found in the virus which causes infection in plants.

Sol.: ssRNA is found in the virus causing tobacco mosaic disease.

112. Answer (2)

Hint: Toadstools belong to the class Basidiomycetes.

Sol.: In basidiomycetes, the mycelium is branched and septate. The asexual spores are generally not found, but vegetative reproduction by fragmentation is common. Mycelium is branched and septate. Basidiospores are produced exogenously on fruiting bodies.

113. Answer (2)

Hint: T.O. Diener discovered new infectious agent that was smaller than viruses and caused potato spindle tuber disease.

Sol.: M.W. Beijerinck demonstrated that the extract of the infected plants of tobacco could cause infection in healthy plants and named the new pathogen "virus" and called the fluid as *Contagium vivum fluidum* (infectious living fluid).

W.M. Stanley (1935) showed that viruses could be crystallised and crystals consist largely of proteins.

Dmitri Ivanowsky (1892) recognised certain microbes as causal organisms of the mosaic disease of tobacco.

114. Answer (3)

Hint: Lichens do not grow in polluted area.

Sol.: Most of the fungi are heterotrophs and they absorb soluble organic matter from the dead substrate and hence they are known as saprophytes.

115. Answer (4)

Hint: Prions are the agents similar in size to the viruses which cause disease in both humans and animals.

Sol.: Prions cause most notable diseases bovine spongiform encephalopathy (BSE) commonly called mad cow disease in cattle and its analogous variant Creutzfeldt-Jakob disease (CJD) in humans.

116. Answer (1)

Hint: According to R.H Whittaker classification system, kingdom Monera and Protista have organisms with cellular body organization.

Sol.: According to five kingdom classification, two kingdoms have cellular body organization with heterotrophic mode of nutrition.

117. Answer (4)

Hint: The given organism is a filamentous blue green algae – *Nostoc*, with label X as heterocyst and label Y as mucilaginous sheath.

Sol.: In *Nostoc*, the heterocysts lack PS II activities and CO_2 fixation is done only by vegetative cells. Oxygen is not evolved due to absence of PS II. However, PS I remains active in heterocyst which generates ATP required to fix nitrogen.

118. Answer (4)

Hint: *Neurospora* is used extensively in the biochemical and genetic work by scientists.

Sol.: It belongs to the group Ascomycetes.

119. Answer (2)

Hint: Amoeboid protozoans do not have flagella or cilia.

Sol.: *Entamoeba* is an amoeboid protozoan and they have false feet or pseudopodia to capture their food.

120. Answer (3)

Hint: Chrysophytes include diatoms and golden algae and they are found in fresh water as well as in marine environment.

Sol.: Chrysophytes float passively in water, they reproduce asexually and sexually by a process involving cell fusion and zygote formation.

Most of them are photosynthetic.

121. Answer (4)

Hint: Red dinoflagellates are responsible for the death of a large number of marine animals like fishes by rapid multiplication.

Sol.: *Gonyaulax*, a unicellular eukaryotic organism is responsible for the red tides in the sea.

122. Answer (2)

Hint: Based on the sequence of 16S ribosomal RNA gene, Woese found that the six kingdoms naturally cluster into three main categories.

Sol.: Carl Woese called these categories as domains of life. These domains are Bacteria, Archaea and Eukarya and are believed to have originated from common ancestor called progenote.

123. Answer (2)

Hint: To survive adverse conditions, some species are capable of developing spores, which exhibit minimal metabolic activity and remain viable in adverse environmental conditions.

Sol: In slime moulds, during unfavourable conditions, the plasmodium differentiates and forms the fruiting bodies bearing spores at the tips.

124. Answer (3)

Hint: Kingdom Protista includes all the unicellular eukaryotic organisms. Euglenoids and protozoans lack cell wall.

Sol.: Euglenoids have mixotrophic mode of nutrition and have pigments identical to the higher plants. Protozoans live as predators or parasites and some marine forms of amoeboid protozoans have silica shells on their surface.

125. Answer (4)

Hint: During sexual life cycle of fungi fusion of protoplasm takes place before the fusion of nuclei.

Sol.: The sexual cycle involves the following sequential three steps-

Plasmogamy →Karyogamy → Meiosis

126. Answer (3)

Hint: Morels and truffles belong to the class Ascomycetes.

Sol.: In members of Ascomycetes, ascospores are produced endogenously in sac like asci. Yeast is unicellular. They have dikaryophase in their sexual phase and mycelium is branched and septate.

127. Answer (4)

Hint: In members of basidiomycetes, the sex organ is absent, the plasmogamy is brought about by fusion of two vegetative or somatic cells of different strains or genotype.

Sol.: In members of Phycomycetes, asexual spores are endogenously produced in the sporangium.

Yeast is a member of Ascomycetes. It asexually reproduces by budding.

The deuteromycetes reproduce only by asexual spores known as conidia.

128. Answer (4)

Hint: The defining property of living organisms are the characteristics that distinguish them from non-living things and they are found in all living organisms without exception.

Sol.: Properties present in all human beings include growth, metabolism, cellular organization, and consciousness.

139. Answer (1)

Hint: The class of *Solanum, Petunia* and *Datura* is same *i.e.* Dicotyledonae.

Sol.: Three different genera *Solanum*, *Petunia* and *Datura* are placed in the family Solanaceae.

130. Answer (2)

Hint: Binomial epithet includes generic name, specific epithet and author citation.

Sol.: The second component in the biological name denotes the specific epithet.

131. Answer (4)

Hint: Order is the assemblage of families which exhibit a few similar characters.

Sol.: Chordata is a taxon of taxonomic category phylum.

132. Answer (1)

Hint: Genus of Lion, leopard and tiger is same, *i.e., Panthera*

Sol.: Self-consciousness is the characteristic feature of human beings; it is not present in other living organisms.

133. Answer (3)

Hint: The scientific name of the housefly is *Musca domestica* and it belongs to the family Muscidae.

Sol.: Taxonomic categories of housefly are as follows-

Order – Diptera

Class – Insecta

Phylum – Arthropoda

134. Answer (1)

Hint: The problem of classification becomes more complex at higher category as there is greater 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 the characteristics that the members within the taxon share.

135. Answer (2)

Hint: The order Carnivora includes families like Felidae and Canidae.

Sol.: Cats and dogs are placed in similar families like Felidae and Canidae, respectively. Class mammalia includes animals like tiger, cat and dog.

[ZOOLOGY]

136. Answer (4)

Hint: About 2800 mL air

Sol.: The volume of air which remains in lungs at the end of a normal expiration is called the functional residual capacity (FRC) which equals to 2300 mL. So, amount of air which remains in lungs at the end of a normal inspiration will be about 2800 mL which is equal to TV + ERV + RV = TV + FRC.

137. Answer (1)

Hint: pCO_2 is less than one mm of Hg in atmospheric air.

Sol.: pO_2 in atmospheric air, it is 159 mmHg and in alveoli, it is 104 mmHg. pCO_2 in atmospheric air is 0.3 mmHg and in alveolar air is 40 mmHg. So, pCO_2 is higher and pO_2 is lesser in alveolar air as compared to atmospheric air.

138. Answer (3)

Hint: A network of tubes help in transport of gases

Sol.: Insects have a network of tubes (tracheal tubes) to transport atmospheric air within the body. Alveoli and alveolar ducts are present in lungs of humans for gaseous exchange whereas tracheoles are responsible for gaseous exchange in insects. Moist cuticle is responsible for gaseous exchange in annelids such as earthworms.

139. Answer (1)

Hint: Blood group systems are based on the presence or absence 'A' and 'B' antigens.

Sol.: Human blood is classified into A, B, AB and O groups based on presence or absence of two surface antigens, 'A' and 'B' on the RBCs. Rh factor (antigen) is also present on RBCs. The individuals having Rh factor are called positive blood group individuals, whereas who lacks Rh factor is considered as the negative blood group individual.

140. Answer (3)

Hint: Most of the invertebrates have an open type of circulation.

Sol.: All vertebrates and a few invertebrates have a closed circulatory system. Along with vertebrates, the cephalochordates, annelids and cephalopod molluscs have a closed circulatory system. Urochordates, included in the phylum Chordata, also have an open type of blood circulation.

141. Answer (4)

Hint: Each cardiac cycle includes the atrial and ventricular systole.

Sol.: During atrial systole, the atria pumps blood into ventricles and during ventricular systole, right ventricle pumps blood into the pulmonary artery, whereas left ventricle pumps blood into the aorta. So, cardiac systole pumps blood from atria to ventricles and ventricles to pulmonary artery and aorta.

142. Answer (2)

Hint: Beat volume is also called stroke volume.

Sol.: The amount of blood pumped out by single ventricle into aorta per minute is called cardiac output.

Cardiac output = Heart rate × Stroke volume.

The numerical value of stroke volume for a healthy adult human is 70 mL, under normal physiological conditions.

143. Answer (3)

Hint: Pulmonary circulation is related with lungs.

Sol.: In humans, two circulatory pathways, pulmonary and systemic circulations are present. Pulmonary circulation starts with pumping of deoxygenated blood by right ventricle which is carried to lungs by pulmonary artery, where it is oxygenated and returned to the left atrium by pulmonary veins. Systemic circulation starts with pumping of oxygenated blood into aorta from left ventricle which is carried to all body tissues and returned to the right atrium by vena cava.

144. Answer (4)

Hint: Exclude veins

Sol.: Aorta has higher blood pressure than veins. The aorta is the largest artery and is directly connected to the heart, receiving blood that is pumped under high blood pressure. Veins have significantly low blood pressure.

145. Answer (2)

Hint: Asthma is characterised by difficulty in breathing.

Sol.: Coronary artery disease is often referred to as atherosclerosis. When heart stops beating, it is called cardiac arrest which causes death of the individual. Alveolar cells get damaged in emphysema which decreases the surface available for gaseous exchange. Asthma is an allergic disease which causes difficulty in breathing and wheezing due to inflammation of bronchi and bronchioles.

146. Answer (4)

Hint: Auto-excitable cells.

Sol.: Nodal tissues are specialized auto-regulated muscles which regulate normal activities of the heart intrinsically. Special neural centre in medulla oblongata can moderate the cardiac functions through ANS. Adrenal medullary hormones (catecholamines) can also increase the cardiac output.

147. Answer (3)

Hint: Mechanism of respiration depends upon the complexity of the animal.

Sol.: O_2 is utilised by organisms to indirectly breakdown simple molecules like glucose, amino acids, *etc*. to derive energy to perform various activities. The process of exchange of O_2 from the atmosphere with CO_2 rich alveolar air is called breathing. In all animals, exchange of gases takes place by simple diffusion.

148. Answer (3)

Hint: The type of respiration performed by earthworm.

Sol.: On land, frogs respire through lungs, skin and buccal cavity. In water as well as during aestivation and hibernation, frogs perform cutaneous respiration. Branchial respiration occurs in molluscs, fishes, hemichordates and urochordates.

149. Answer (4)

Hint: Exchange part is the site of actual diffusion of gases.

Sol.: Our respiratory system consists of the conducting part (starting from external nostrils upto the terminal bronchioles), which is responsible for transport of atmospheric air to the alveoli, clears the foreign particles, humidifies and also brings the air to the body temperature. Exchange part is the site of actual diffusion of O_2 and CO_2 between blood and atmospheric air.

150. Answer (2)

Hint: Presence of negative pressure between two pleura.

Sol.: The lungs are situated in the thoracic chamber which is anatomically an air-tight chamber. Anatomical setup of lungs in thorax is such that any change in the volume of thoracic cavity will be reflected in the pulmonary cavity. So, during inspiration, the overall increase in the thoracic volume causes a similar increase in pulmonary volume.

151. Answer (4)

Hint: High binding affinity of haemoglobin causes difficulty in O_2 delivery to tissues.

Sol.: Adaptation at high altitude after living for a long time is called acclimatization. At high altitude, pO_2 is low as compared to pO_2 at sea levels. Hence, more RBCs are needed to deliver the required amount of O_2 in tissues. Increase in secretion of hormone erythropoietin at high altitude increases RBCs production. Affinity of haemoglobin for O_2 decreases due to increase in 2, 3-BPG which binds with β-chain of haemoglobin and is helpful in easy delivery of O_2 to the body cells.

152. Answer (3)

Hint: Low pCO_2 shifts oxyhaemoglobin dissociation curve to left side.

Sol.: Low H^+, high pH, low pCO_2 and low temperature, all favour the binding of haemoglobin with O_2 and lead to shift of oxygen dissociation curve towards the left side. Pneumotaxic centre is present in pons region of hindbrain. The volume of air which remains in lungs even at the end of forceful expiration is called residual volume which prevents collapsing of alveoli of lungs after maximum forceful expiration.

153. Answer (1)

Hint: The most commonly used body fluid for transportation is blood.

Sol.: Blood is the most commonly used body fluid in human and higher organisms. It is a specialised connective tissue like bones and cartilages, and is considered as fluid connective tissue. Blood consists of a fluid matrix, plasma, and formed element but lacks connective tissue fibres unlike most of the other connective tissues.

154. Answer (3)

Hint: Proteins contribute 6 – 8% of blood plasma.

Sol.: Percent of proteins in plasma is equal to the percent of monocytes in total WBCs. 3 percent of O_2 is transported in dissolved state and 20-25 percent CO_2 is transported in the form of carbamino-haemoglobin.

155. Answer (2)

Hint: Associated with allergic reactions.

Sol.: Neutrophils are polymorphonuclear leukocytes which are maximum in number among all WBCs and participate in phagocytosis. Percentage of neutrophils is 65% among total WBCs. Eosinophils are granulocytes having bilobed nucleus. They resist infections and are also associated with allergic reactions. Lymphocytes are agranulocytes and participate in humoral and cell-mediated immunity. Basophils release heparin, histamine and serotonin and participate in inflammatory reactions.

156. Answer (4)

Hint: They release histamine.

Sol.: Eosinophils constitute 2-3% of total WBCs. Basophils are the least in number among all formed elements and constitute only 0.5-1 percent of total WBCs. They release histamine which is a vasodilator. Tunica externa is the outermost layer of arteries and veins and contains collagen fibres. QRS complex of ECG represents depolarisation of ventricles.

157. Answer (1)

Hint: When heart is not pumping blood effectively enough.

Sol.: The state of heart when it is not pumping blood effectively to meet the needs of the body, it is called heart failure or congestive heart failure because congestion of lungs is one of the main symptoms of this disease. Narrowing of lumen of blood vessels occurs in atherosclerosis. Acute chest pain is associated with angina pectoris. Increase in blood pressure of pulmonary capillaries (> 25 mm Hg) than normal (10 mm Hg) can cause pulmonary congestion.

158. Answer (3)

Hint: SAN is considered as the pacemaker.

Sol.: The SAN can generate maximum number of action potentials and is responsible for initiating and maintaining rhythmic contractile activity of heart. Therefore, it is called the pacemaker. It is situated in right upper corner of right atrium. AV node is situated in lower left corner of right atrium.

159. Answer (4)

Hint: Nasal cavity does not participate in gaseous exchange.

Sol.: In tailed amphibians like salamanders, external gills are present for gaseous exchange and oxygenated blood from gills reaches into left ventricle. Adult frogs perform both cutaneous and pulmonary respiration and drain oxygenated blood from these structures into left atrium. Nasal cavity does not participate in oxygenation of blood.

160. Answer (2)

Hint: Antibodies are immunoglobulins.

Sol.: Thrombin converts fibrinogen into fibrin.

Ca^{2+} participates in blood clotting.

Albumin maintains osmotic pressure of blood.

Globulins are primarily responsible for immune response of the body.

161. Answer (3)

Hint: Carbonic anhydrase is mainly present in RBCs.

Sol.: In most of the peripheral organs and tissues, CO_2 produced during catabolism enters in blood where it reacts with water in the presence of enzyme carbonic anhydrase to form carbonic acid. Reaction [1] in forward direction mainly occurs in RBCs due to presence of this enzyme. Holding of breath increases CO_2 in blood which forms carbonic acid. This carbonic acid dissociates into H^+ and HCO_3^- to increase H^+ of blood and this reduces blood pH.

162. Answer (2)

Hint: Diffusion of gases depends upon their solubility.

Sol.: The solubility of CO_2 in blood is 20-25 times higher than that of O_2. The diffusion membrane in lungs is formed by two cellular layers (thin squamous epithelium of alveoli and endothelium of blood capillaries) and an acellular basement substance in between them. The factors such as pH, temperature, pCO_2 and pO_2 in our body are favourable for diffusion of O_2 from alveoli to the tissues and that of CO_2 from tissues to alveoli.

163. Answer (3)

Hint: RMV (Respiratory Minute Volume)

= RR × TV.

Sol.: Total lung capacity (TLC)

= TV + IRV + ERV + RV

= 5100 to 5800 mL

RMV = Respiratory rate × Tidal volume

= 11 × 500 = 5500 mL

EC = 1500-1600 mL; FRC = 2100 – 2300 mL

VC = 4000-4600 mL

164. Answer (2)

Hint: AV valves open during joint diastole.

Sol.: During joint diastole, all the four chambers of heart remain in relaxed state, AV valves remain open and semilunar valve remains closed. SAN stimulates atria causing atrial systole which occurs at the end of joint diastole but during ventricular diastole. Increase in ventricular pressure during systole is responsible for opening of semilunar valves.

165. Answer (4)

Hint: Heart sounds are produced due to closure of valves.

Sol.: During each cardiac cycle, two prominent sounds are produced. The first sound (lub) is associated with closure of AV valves and the 2^{nd} heart sound (dub) is produced due to closure of semilunar valves during ventricular diastole at the beginning of joint diastole.

166. Answer (3)

Hint: Duration of cardiac cycle decreases on increasing heart rate.

Sol.: Duration of each cardiac cycle

$$= \frac{60 \text{ seconds}}{\text{Number of heart beats per minute}}$$

$$= \frac{60}{100} = 0.6 \text{ seconds}$$

167. Answer (2)

Hint: Thrombin acts on fibrinogen.

Sol.: An enzyme complex, thrombokinase, is required for blood clotting as it transforms inactive prothrombin into active thrombin. Certain factors from damaged tissue and platelet factor from platelets react in presence of Ca^{+2} to form an enzyme complex thrombokinase. Heparin activates anti-thrombin which prevents conversion of prothrombin into thrombin.

168. Answer (4)

Hint: Arteries always run away from the heart.

Sol.: In comparison to arteries, veins have valves, thinner tunica media and usually run towards the heart. Veins usually transport deoxygenated blood except pulmonary and umbilical vein.

169. Answer (3)

Hint: To obtain a standard ECG, no lead is connected to the chest.

Sol.: To obtain a standard ECG, a patient is connected to the machine with three electrical leads; one to each wrist and to the left ankle joint. For a detailed evaluation of heart's function, multiple leads are attached to chest region. Each peak in ECG is identified with a letter from P to T. Ventricular systole occurs during the QT interval.

170. Answer (3)

Hint: Middle layer of walls of blood vessels

Sol.: Each artery and vein consists of three layers; inner lining of squamous endothelium, the tunica intima, a middle layer of smooth muscle and elastic fibres, the tunica media and an outer layer of fibrous connective tissue with collagen fibres, the tunica externa. The tunica media is comparatively thin in veins.

171. Answer (4)

Hint: 70% of CO_2 is transported by bicarbonate ions.

Sol.: In people working in stone-breaking industries, the body cannot fully cope with the situation. Long exposure to dust particles can give rise to inflammation leading to fibrosis and thus, causing serious lung damage. At tissue surface, CO_2 produced in catabolism, enters RBCs and forms H^+ and HCO_3^-. Every 100 mL of deoxygenated blood delivers 4 mL of CO_2 to the lungs.

172. Answer (3)

Hint: Cellular respiration which produces CO_2 and energy is the last step in respiration.

Sol.: Respiration involves the following steps in the following sequence: -

(i) Pulmonary ventilation by which atmospheric air is drawn in and CO_2 rich alveolar air is released out.

(ii) Diffusion of gases across diffusion membrane.

(iii) Transport of gases by the blood.

(iv) Diffusion of O_2 and CO_2 between blood and tissues.

(v) Utilisation of O_2 by the cells for catabolic reaction and resultant release of CO_2.

173. Answer (2)

Hint: Decrease in affinity of Hb to O_2 shifts the oxygen dissociation curve to the right side.

Sol.: The factors such as increase in H^+, decrease in pH, increase in temperature, increase in pCO_2 and decrease in pO_2, decrease the affinity of Hb to O_2. So, oxygen dissociation curve is shifted towards right side which leads to dissociation of oxygen from the oxyhaemoglobin so that O_2 becomes easily available to tissues (Bohr's effect).

174. Answer (3)

Hint: Trachea is present outside the lungs.

Sol.: Trachea is a straight tube extending up to the mid-thoracic cavity, which divides at the level of 5th thoracic vertebra into a right and left primary bronchi. The branching network of bronchi, bronchioles and alveoli comprise the lungs.

175. Answer (2)

Hint: Last branch of bronchiole

Sol.: The trachea, primary, secondary and tertiary bronchi and initial bronchioles are supported by incomplete cartilaginous rings. The exchange part of human respiratory system such as respiratory / terminal bronchiole, alveolar ducts and alveoli are not supported by incomplete cartilaginous rings.

176. Answer (1)

Hint: Antibody of recipient reacts with donor antigens.

Sol.: Donor's compatibility is based on the destruction of its RBCs by action of antibodies of recipients, against blood group antigens on RBCs of donors. Because individuals with 'AB' blood group have no antibody against any blood group antigen, they can accept blood from donor of any ABO blood group. 'O' blood group individuals have no blood group antigen on RBCs, so, they can donate blood to individuals of any blood group and are considered as universal donors.

177. Answer (3)

Hint: Duration of heart's electrical activity in ventricle.

Sol.: In a standard ECG, QT interval is measured from the beginning of QRS complex (ventricular-depolarisation) to the end of T-wave (ventricular repolarisation). So, it represents the duration of the heart's electrical activity in the ventricles, specially the time it takes for the ventricles to depolarise and repolarise.

178. Answer (3)

Hint: A thin muscular septum separates the right and left atria.

Sol.: The entire human heart is made of cardiac muscles and has the size of a clenched fist. A thin muscular septum, called inter-atrial septum, separates right and left atria. A thick fibrous septum, called atrio-ventricular septum, separates atrium and the ventricle of the same side. Mitral valve / bicuspid valve has two cusps which guards the opening of left atrium into left ventricle.

179. Answer (3)

Hint: Rh^{-ve} mother lacks Rh-antigen.

Sol.: Rh incompatibility occurs in Rh^{+ve} foetus when mother is Rh^{-ve}. Rh antibodies are produced in mother against the Rh antigen of foetus after mixing of maternal and foetal blood during parturition. These Rh antibodies can cross placental barrier and cause erythroblastosis foetalis in foetus in subsequent pregnancies. It can be avoided by administering anti-Rh antibodies to the mother immediately after the delivery of the first Rh^{+ve} child.

180. Answer (2)

Hint: Larger cells present in bone marrow

Sol.: Megakaryocytes are specialised cells in bone marrow that produce cell fragments. Reduction in number of platelets can lead to clotting disorders. Platelets/thrombocytes participate in clotting of blood.

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