All India Aakash Test Series for Medical - 2021

TEST - 3 (Code-C)

Test Date : 01/12/2019

ANSWERS

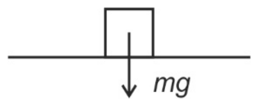
1. (4)	37. (3)	73. (3)	109. (3)	145. (4)
2. (3)	38. (4)	74. (2)	110. (3)	146. (1)
3. (1)	39. (1)	75. (1)	111. (4)	147. (3)
4. (2)	40. (2)	76. (1)	112. (4)	148. (2)
5. (4)	41. (3)	77. (2)	113. (4)	149. (3)
6. (4)	42. (3)	78. (1)	114. (1)	150. (2)
7. (1)	43. (1)	79. (3)	115. (1)	151. (2)
8. (4)	44. (1)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

HINTS & SOLUTIONS

[PHYSICS]

1. Answer (4)

Hint & Sol.: Normal force due to book on the table and weight of the book, both are in same direction.



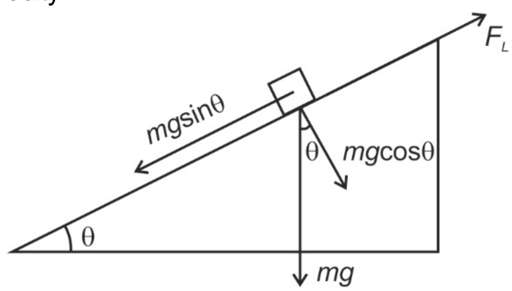
so θ = 0°

2. Answer (3)

Hint: Block is sliding with constant velocity,

so $a = 0$

Sol.: Block slides along the plane, with constant velocity



$mg\sin\theta - \mu mg\cos\theta = m(0)$

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

$F_f = mg\sin\theta$

3. Answer (1)

Hint: According to Newton's second law

$$\vec{F} = \frac{d\vec{P}}{dt}$$

Sol.: $\vec{P} = \vec{a} + \vec{b}t^2$

$$\frac{d\vec{P}}{dt} = 2\vec{b}t$$

$F \propto t$

4. Answer (2)

Hint & Sol.: In circular motion with increasing speed, tangential force and displacement are in same direction, (θ = 0°). So work done on the body is positive.

5. Answer (4)

Hint: $|\vec{F}| = \dfrac{|\Delta\vec{P}|}{\Delta t}$

Sol.: $F = \dfrac{|0.5(2\hat{i} + 2\hat{j})|}{1.414} = \dfrac{(0.5)(2\sqrt{2})}{1.414} = 1\text{ N}$

6. Answer (4)

Hint: ∴ No impulsive external force acts on bomb, so momentum of system remains constant

Sol.: $0 = -2mv\hat{i} + mv\hat{j} + 2m\vec{v}_3$

$$\vec{v}_3 = v\hat{i} - \frac{v}{2}\hat{j}$$

7. Answer (1)

Hint: Horse pushes the earth backward and earth applies force in forward direction.

Sol.: Total mass of system = 2000 kg

$F - \mu(mg) = (m + M)a$

$F - 0.2(1500 \times 10) = (2000) \times 2$

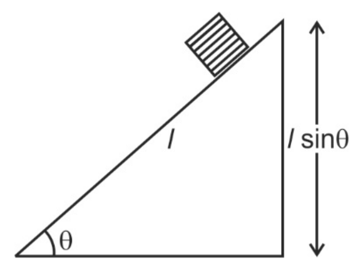
$F = 7000\text{ N}$

8. Answer (4)

Hint: When angle of inclination is θ

$a = g\sin\theta$

Sol.: $v = \sqrt{2gl\sin\theta}$



When angle of plane is 2θ

$v_1 = \sqrt{2gl\sin 2\theta}$

$v_1 = \sqrt{2gl(2\sin\theta\cos\theta)}$

$v_1 = v\sqrt{2\cos\theta}$

9. Answer (1)

Hint: $a_{\min} = \dfrac{g}{\mu}$

Sol.: Let common acceleration be a. Then

$$a = \frac{F}{2m}$$

$$N = \frac{F}{2m} \times m = \frac{F}{2}$$

For no slipping (in limiting equilibrium)

$\mu N = mg$

$\frac{\mu F}{2} = mg$

$F = 2mg/\mu$

10. Answer (2)

Hint: Force of limiting friction $f_{lim} = \mu mg$

Sol.: N = mg = 10 N

$F_f = \mu mg$ = 2 N

at t = 3 s, F = 6 N

$\Rightarrow$ friction = 2 N

11. Answer (4)

Hint: Applied force $F = 2t$ is time dependent.

So up to certain time, block will not move.

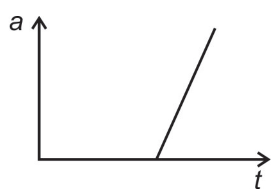
Sol.: Applied force $F = 2t$

Limiting friction $F_f = \mu mg$

$a = \frac{F - F_f}{m} = \frac{2t - \mu mg}{m}$

$a = \frac{2t}{m} - \mu g$

This is an equation of straight line of form $y = mx + c$, with positive slope and negative intercept.



12. Answer (3)

Hint: The compression will be maximum, when work done by pseudo force is stored in the form of elastic potential energy.

Sol.: As the plank is accelerated, pseudo force (ma) acts on the block, which compresses the spring through x,

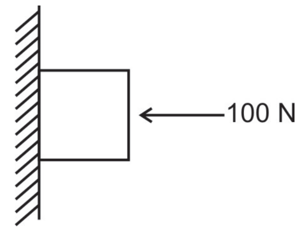
At maximum compression

$max = \frac{1}{2}kx^2$

$x = \frac{2ma}{k}$

13. Answer (1)

Hint: $mg \le \mu N$



Sol.: Normal reaction of wall N = 100 N

Force of limiting friction $F = \mu N$ = 25 N

Pulling force = mg = 20 N

So force of friction = 20 N (upwards)

14. Answer (2)

Hint: Impulse = Change in momentum

Sol.: Velocity up to 2 s $\vec{v}_1 = \frac{\Delta \vec{x}}{\Delta t} = 2$ m s^{-1}

velocity just after 2 s, $\vec{v}_2 = 0$

change in momentum

$\vec{\Delta} p = m[\vec{v}_2 - \vec{v}_1]$

= 1[0 – 2]

= –2 kg m/s

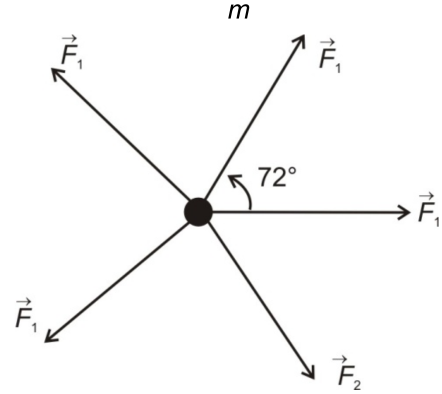
15. Answer (3)

Hint: According to polygon law a set of forces forming a closed polygon leads to a zero resultant.

Sol.: In closed polygon resultant of four identical forces is balanced by fifth force.

So, resultant magnitude force $= (F_2 - F_1)$

Net acceleration $a = \frac{(F_2 - F_1)}{m}$



16. Answer (1)

Hint & Sol.: Potential energy is defined for conservative forces.

17. Answer (2)

Hint: Total mass of rod can be assumed at its centre of mass.

Sol.: Work done = change in potential energy

$$= mg\left(\frac{l}{2}\right)$$

$$= \frac{mgl}{2}$$

18. Answer (3)

Hint: Work done by all forces is equal to change in kinetic energy.

Sol.: Work done by forces $\vec{F}_1$ and $\vec{F}_2$ + work done by gravity = ΔK = 0

work done by $\vec{F_1}$ and $\vec{F_2} = -[\text{work done by gravity}]$

work done by $\vec{F_1}$ and $\vec{F_2} = -[mg\ h\cos 180°]$

= mgh

19. Answer (3)

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

Sol.: $F \propto s^{-1/3}$

$a = \frac{k}{m}s^{-1/3}$ (k is a constant)

$$v.\frac{dv}{ds} = \frac{k}{m}s^{-1/3}$$

$$vdv = \frac{k}{m}s^{-1/3}ds$$

$$\frac{v^2}{2} = \frac{3}{2}\frac{k}{m}s^{2/3}$$

$$v = \sqrt{\frac{3k}{m}}s^{1/3}$$

$$P = Fv = ks^{-1/3}\sqrt{\frac{3k}{m}}s^{1/3}$$

$$P \propto s^0$$

20. Answer (1)

Hint: Work done by forces is equal to change in kinetic energy.

Sol.: $K = as^2$

$$\frac{dK}{ds} = 2as$$

$$F = 2as$$

21. Answer (1)

Hint: Law of conservation of linear momentum

Sol.: Mass of shell = 0.2 kg

Mass of gun = 4.0 kg

According to law of conservation of momentum

$$0 = 0.2\times\vec{v} + 4.0\,\vec{v}_1$$

$$\vec{v}_1 = -\frac{0.2}{4.0}\vec{v} = -\frac{1}{20}\vec{v}$$

Total kinetic energy = 1050

$$\frac{1}{2}\times 0.2v^2 + \frac{1}{2}\times 4\times v_1^{\,2} = 1050$$

$$0.2v^2 + 4\left(\frac{v}{20}\right)^2 = 2100$$

$$v^2\left[0.2 + \frac{1}{100}\right] = 2100$$

$$v^2 = \frac{100\times 2100}{21}$$

$$v = 100 \text{ m/s}$$

22. Answer (2)

Hint: Apply law of conservation of mechanical energy.

Sol.: Loss of potential energy = Gain in kinetic energy.

$$(3\times 10\times 5 - 2\times 10\times 5) = \frac{1}{2}(3+5)v^2$$

$50 \times 2 = 5v^2$

$$v = 2\sqrt{5} \text{ m/s}$$

23. Answer (4)

Hint & Sol.: Momentum of system is always conserved but kinetic energy of system just before collision is equal to kinetic energy of system just after collision.

24. Answer (3)

Hint: Energy stored in stretched spring $U = \frac{1}{2}kx^2 = \frac{F^2}{2k}$

Sol.: Given $K_A = 3K_B$

$$\frac{U_A}{U_B} = \frac{K_B}{K_A}$$

$$\frac{E}{E_B} = \frac{K_B}{3K_B}$$

$E_B = 3E$

25. Answer (4)

Hint & Sol.: Work done by friction may be positive, negative or zero.

26. Answer (2)

Hint: Because wall is in (y – z) plane, only x-component of velocity will change.

Sol.: $e = \dfrac{\text{velocity of separation}}{\text{velocity of approach}}$

$$\frac{1}{2} = \frac{0 - v_1}{2 - 0}$$

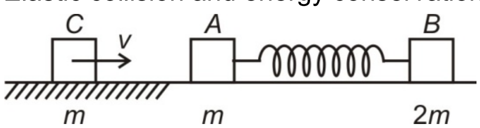
$$\vec{v}_1 = -\hat{i}$$

So, velocity just after collision $= -\hat{i} + 2\hat{j}$

27. Answer (1)

Hint: Elastic collision and energy conservation

Sol.:



When block C collide with A elastically then its kinetic energy transferred to A.

At maximum compression of spring, relative speed of A and B is zero.

According to momentum conservation

$$mv = (m + 2m)v_1$$

$$v_1 = \frac{v}{3}$$

$$\frac{1}{2}mv^2 = \frac{1}{2} \times 3m\left(\frac{v}{3}\right)^2 + \frac{1}{2}kx^2$$

$$\frac{1}{2}mv^2 - \frac{1}{6}mv^2 = \frac{1}{2}kx^2$$

$$\frac{2}{6}mv^2 = \frac{1}{2}kx^2$$

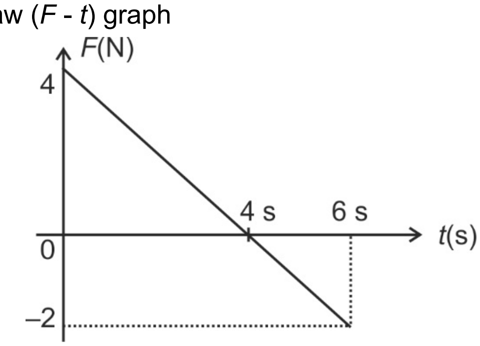
$$x = v\sqrt{\frac{2m}{3k}}$$

28. Answer (4)

Hint: Area of (F - t) graph gives change in momentum

Sol.: $F = -t + 4$

draw (F - t) graph



$$\Delta p = \left[\frac{1}{2} \times 4 \times 4 - \frac{1}{2} \times 2 \times 2\right]$$

$m[v - 1] = 6$

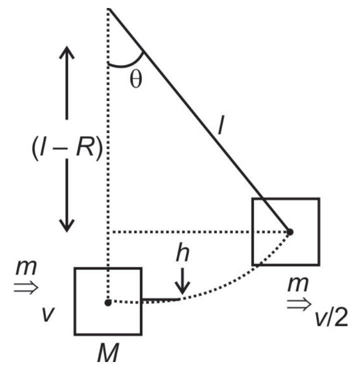
$v = 4$ m/s

$$\text{K.E.} = \frac{1}{2} \times (2) \times 4^2 = 16 \text{ J}$$

29. Answer (2)

Hint: First apply law of conservation of linear momentum and then mechanical energy conservation.

Sol.:



Apply law of conservation of momentum

$$mv = MV + \frac{mv}{2}$$

$$V = \frac{m}{2M}v$$

$$\frac{1}{2}MV^2 = Mgh$$

$$h = \frac{V^2}{2g} = \frac{m^2v^2}{8M^2g}$$

$$\cos\theta = \frac{l - h}{l}$$

$$\theta = \cos^{-1}\left(1 - \frac{m^2v^2}{8M^2gl}\right)$$

30. Answer (3)

Hint: Work will be done only by tangential force

Sol.: $dW = \vec{F}.\overrightarrow{dx}$

$$dW = mcx\,dx$$

$$W = mc\int_0^{2\pi r} x\,dx$$

$$\Delta K = 2\pi^2 cmr^2$$

31. Answer (1)

Hint: Work done by gravity is decrease in potential energy

Sol.: $W = \vec{F}.\vec{S}$

$$= mgh = mg\left[\frac{u^2\cos^2\theta}{2g}\right]$$

$$= \frac{1}{2}mu^2\cos^2\theta$$

32. Answer (3)

Hint: Law of conservation of linear momentum and conservation of mechanical energy.

Sol.: According to law of conservation of linear momentum

$$m_2v = m_1v_1 + m_2\frac{v}{3}$$

$$2m_2\frac{v}{3} = m_1v_1$$

$$v_1 = \frac{2}{3}\frac{m_2}{m_1}v$$

Block will complete the vertical circle if

$$v_1 \geq \sqrt{5gl}$$

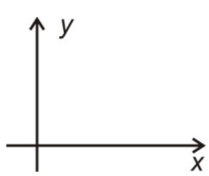
$$\frac{2}{3}\frac{m_2}{m_1}v = \sqrt{5gl}$$

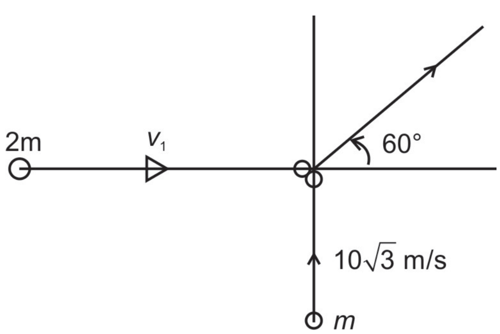
$$v = \frac{3}{2}\frac{m_1}{m_2}\sqrt{5gl}$$

33. Answer (3)

Hint: Law of conservation of linear momentum.

Sol.:





$$\tan\theta = \frac{P_y}{P_x}$$

$$\tan 60° = \frac{m\times 10\sqrt{3}}{2m\,v_1}$$

$$\sqrt{3} = \frac{10\sqrt{3}}{2v_1}$$

$$v_1 = 5 \text{ m/s}$$

34. Answer (4)

Hint: Work-energy theorem

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

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

$$v = t^2$$

speed at t = 0, v = 0

speed at t = 2 s, v = 4 m/s

$$W = \frac{1}{2}\times 2[16-0] = 16 \text{ J}$$

35. Answer (2)

Hint: Work-energy theorem

Sol.: Work done by air drag = change in kinetic energy

$$= \frac{1}{2}m\left[v_f^{\,2} - v_i^{\,2}\right]$$

$$= \frac{1}{2}\times 1[256-400]$$

$$= -72 \text{ J}$$

36. Answer (4)

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

Sol.: Because block slides down with constant speed, then

$$mg\sin\theta - F_f = 0$$

$$F_f = mg\sin\theta$$

When block moves up the plane then friction acts downward

$$P = \vec{F}.\vec{v}$$

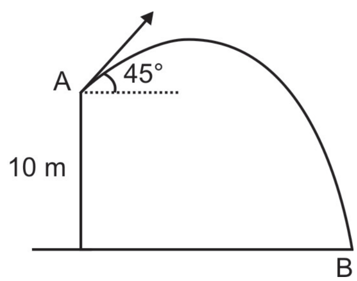
$$= (2mg\sin\theta)v$$

$$P = 2mgv\sin\theta$$

37. Answer (3)

Hint: Use energy conservation law

Sol.:



Total mechanical energy at A = Total mechanical energy at B

$$mg \times 10 + \frac{1}{2}m(10\sqrt{2})^2 = 0 + \frac{1}{2}mv_B{}^2$$

$$2 \times 100 + 200 = v_B{}^2$$

$$v_B = 20 \text{ m/s}$$

38. Answer (4)

Hint: In self explosion, linear momentum of system remains constant.

Sol.: $0 = m \times 50 - 2m \times 25 + 2m\vec{v}_3$

$$2m\vec{v}_3 = 0$$

$$v_3 = 0$$

Kinetic energy of third part = 0

39. Answer (1)

Hint & Sol.: Assume downward direction as negative direction

$$\vec{a}_{cm} = \frac{m(-g) + 2m(-g)}{m + 2m}$$

$$\vec{a}_{cm} = -g$$

$$|\vec{a}_{cm}| = g$$

40. Answer (2)

Hint & Sol.: $\vec{x}_{cm} = \dfrac{m \times \left(\frac{L}{2}\right) + m \times 0 + m\left(\frac{-L}{2}\right)}{m + m + m}$

$$\vec{x}_{cm} = 0$$

$$\vec{y}_{cm} = \frac{m \times 0 + m\frac{L}{2} + m \times L}{m + m + m}$$

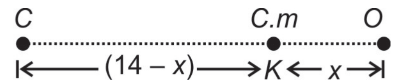
$$\vec{y}_{cm} = \frac{L}{2}$$

Co-ordinate of centre of mass $\left(0, \frac{L}{2}\right)$

41. Answer (3)

Hint: Moment of mass at centre of mass is zero.

Sol.:



Assume centre of mass as origin. Then moment of mass at C.M. is zero.

$16x + 12[-(14 - x)] = 0$

$16x - 12 \times 14 + 12x = 0$

$28x = 12 \times 14$

$x = 6$ Å

42. Answer (3)

Hint: Mass is continuously increasing with length, so first calculate centre of mass of elementary mass (dm)

Sol.: Linear mass density $\lambda = 2x$

Mass of element of length $dx, dm = 2xdx$

$$x_{cm} = \frac{\int_0^L xdm}{\int_0^L dm} = \frac{2\int_0^L x^2dx}{2\int_0^L xdx}$$

$$x_{cm} = \frac{2\left[\frac{L^3}{3}\right]}{2\left[\frac{L^2}{2}\right]} = \frac{2L}{3}$$

43. Answer (1)

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

Sol.: Position of 2 kg, $\vec{r}_1 = \hat{i} - 2\hat{j} - \hat{k}$

Position of 1 kg, $\vec{r}_2 = -4\hat{i} + 5\hat{j} - 2\hat{k}$

$$\vec{x}_{cm} = \left(\frac{2 \times 1 - 1 \times 4}{3}\right)\hat{i} = -\frac{2}{3}\hat{i}$$

$$\vec{y}_{cm} = \left(\frac{2 \times (-2) + 1 \times 5}{3}\right)\hat{j} = \frac{1}{3}\hat{j}$$

$$\vec{z}_{cm} = \left(\frac{2(-1) + 1(-2)}{3}\right)\hat{k} = -\frac{4}{3}\hat{k}$$

Position of centre of mass $= -\frac{2}{3}\hat{i} + \frac{1}{3}\hat{j} - \frac{4}{3}\hat{k}$

44. Answer (1)

Hint: Because no external force acts on system, so centre of mass of system remains in same position.

Sol.: As man shift to other end then boat shifts through a distance x in opposite direction.

$\because \quad \vec{F}_{ext} = 0$

$\overrightarrow{\Delta x}_{cm} = 0$

$50(5 - x) + 40(-x) = 0$

$250 - 50x - 40x = 0$

$x = \frac{25}{9}$ m

45. Answer (2)

Hint: In equilibrium, net force on system is zero.

Sol.: Assume the rope is pulled with force *F*.

In equilibrium

$2F = (25 + 50) \times 10$

$F = 375$ N

[CHEMISTRY]

46. Answer (2)

Hint: 1 bar = 0.987 atm

47. Answer (2)

Hint: At constant volume, $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

Sol.: $\frac{P^\circ}{273.15} = \frac{P_f}{274.15}$

$\Delta P = \frac{P^\circ}{273.15}$

48. Answer (1)

Hint: Rate of diffusion $\propto \sqrt{\left(\frac{1}{\text{molar mass}}\right)}$.

49. Answer (3)

Hint: Dalton's law is applicable for non-reacting gases. He(g) is least likely to react with CO_2(g).

50. Answer (4)

Hint: Higher is the critical temperature, easier will be the liquifaction of gas.

Sol.: H_2O(g) has highest critical temperature among the given gases due to H-bonding.

51. Answer (1)

Hint: Intensive properties do not depend on mass.

Sol.: Surface tension is an intensive property.

52. Answer (2)

Hint: In adiabatic process, heat exchange is zero.

53. Answer (4)

Hint: Enthalpy change for formation of 1 mole compound from its elements in standard states is known as enthalpy of formation.

54. Answer (4)

Hint: b depends on size of molecules/atoms.

Sol.: Correct order of 'b' is

$CO_2 > O_2 >$ He

55. Answer (1)

Hint: During evaporation, entropy increases.

56. Answer (4)

Hint: If $\Delta H < 0$ and $\Delta S > 0$ then reaction is spontaneous at all temperatures.

57. Answer (2)

Hint: For adiabatic process, Q = 0.

Sol.: $\Delta U = Q + W$ (first law of thermodynamics)

$\Delta U = W$ (for adiabatic process).

58. Answer (2)

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

Sol.: Greater is the positive value of Δn_g, higher will be '$\Delta H - \Delta U$'.

59. Answer (2)

Hint: $\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$

Sol.: $\frac{r_{X_2}}{r_{H_2}} = \sqrt{\frac{M_{H_2}}{M_{X_2}}} \Rightarrow \frac{1}{4} = \sqrt{\frac{M_{H_2}}{M_{X_2}}} \Rightarrow M_{X_2} = 16 \times 2 = 32$

60. Answer (2)

Hint: $\left(\frac{a}{V^2}\right)$ term is negligible for He(g).

Sol.: van der Waals equation for He(g).

$P(V - b) = RT$ or $\frac{PV}{RT} = 1 + \frac{Pb}{RT}$

$\therefore \quad Z = 1 + \frac{Pb}{RT}$

61. Answer (3)

Hint: Sum of fractions of molecules remains unaltered on changing the temperature.

62. Answer (3)

Hint: Molecules having H-bonding have higher boiling points.

Sol.: H-bonding is present in ethyl alcohol.

63. Answer (3)

Hint: $\left(P+\frac{n^2a}{V^2}\right)(V-nb)=nRT$

Sol.: Unit of (P) = unit of $\left(\frac{n^2a}{V^2}\right)$

Unit of a = atm L^2 mol^{-2}.

64. Answer (2)

Hint: At critical point, density of liquid and gas becomes equal.

65. Answer (1)

Hint: Among given liquids, H_2O has highest surface tension.

66. Answer (3)

Hint: $U_{rms}=\sqrt{\frac{3\,RT}{M}}$

Sol.: $U_{rms}=\sqrt{\frac{3\times 8.314\times 400}{32\times 10^{-3}}}=558.37$ m/s

67. Answer (3)

Hint: Polar and non-polar molecules have dipole-induced dipole interaction.

Sol.: H_2 and Cl_2 : induced dipole - induced dipole force.

HF and HCl : Dipole-dipole force.

NH_3 and He : Dipole induced-dipole force.

CCl_4 and $SiCl_4$: Induced dipole-induced dipole force.

68. Answer (2)

Hint: Density of ideal gas $(d)=\frac{PM}{RT}$

Sol.: $d=\frac{PM}{RT}$

$$d=\frac{(5\text{ atm})\times 44\text{ g mol}^{-1}}{(0.0821\text{ L-atm/mol-K})\times 700\text{ K}}=3.8\text{ g/L}$$

69. Answer (4)

Hint: PV = nRT

Sol.: PV = nRT

1 atm × 10 L = n × 0.0821 (L-atm mol^{-1} K^{-1}) × 300 K

n = 0.406

70. Answer (3)

Hint: Translational kinetic energy for n mole(s) of gas $=\frac{3}{2}$ nRT

Sol.: Translational KE (E_1) $=\frac{3}{2}\times n_1\times RT_1$

Translational KE (E_2) $=\frac{3}{2}\times n_2\times RT_2$

$$\frac{E_1}{E_2}=\frac{n_1T_1}{n_2T_2}$$

$$\frac{E_{O_2}}{E_{Kr}}=\frac{\frac{x}{32}\times T_1}{\frac{x}{54}\times T_2}$$

$$\frac{1}{4}=\frac{54}{32}\times\frac{T_1}{T_2}\Rightarrow\frac{T_1}{T_2}=\frac{8}{54}=\frac{4}{27}$$

71. Answer (1)

Hint: Partial pressure = mole fraction × Total pressure.

Sol.:

	$H_2(g)$ +	$Cl_2(g)$ $\longrightarrow$	2HCl
Initial	3 mol	0.5 mol	0
Final	2.5 mol	0	1.0 mol

$$P_{H_2}=\frac{2.5}{3.5}\times 7\text{ atm}=5\text{ atm}$$

$$P_{HCl}=\frac{1}{3.5}\times 7\text{ atm}=2\text{ atm}$$

72. Answer (4)

Hint: $U_{rms} > U_{avg} > U_{mp}$

Sol.: If U_{rms}, U_{avg} and U_{mp} are equal then temperatures at which these occur will have reverse order.

i.e. $T_1 < T_2 < T_3$.

73. Answer (3)

Hint: For adiabatic process, $TV^{\gamma-1}$ = constant

Sol.: $TV^{1/4}$ = constant

$$\gamma-1=\frac{1}{4}\Rightarrow\gamma=\frac{5}{4}\Rightarrow\frac{C_{p,m}}{C_{v,m}}=\frac{5}{4}$$

74. Answer (2)

Hint: $\Delta H = \Delta U + \Delta n_gRT$

Sol.: $C_7H_8(l) + 9O_2(g) \rightarrow 7CO_2(g) + 4H_2O(l)$

$\Delta H = \Delta U + \Delta n_gRT$

$\Delta U = \Delta H - \Delta n_gRT$ ($\because \Delta n_g = 7 - 9 = -2$)

$= -3910 + (2 \times 8.314 \times 10^{-3} \times 300)$

$= -3905$ kJ mol^{-1}

75. Answer (1)

Hint: For adiabatic process, Q = 0

Sol.: In isolated system, the exchange of neither energy nor the matter takes place.

76. Answer (1)

Hint: $\Delta U = nC_v\Delta T$

Sol.: $\Delta T = 0$

$\Delta U = 0$

77. Answer (2)

Hint: Enthalpy of ionization of acid is heat required to ionize 1 mol of weak acid completely into its respective ions.

Sol.: $HA + NaOH \longrightarrow NaA + H_2O$

Heat released on neutralisation of 0.2 mol of HA = 6.2 kJ

Heat released on neutralisation of 1 mol of HA = 31 kJ

Hence, enthalpy of ionization = 57.1 – 31

= 26.1 kJ/mol

78. Answer (1)

Hint: Entropy of vaporization $= \dfrac{n\Delta H}{T_{B.P.}}$

Sol.: $\Delta S = \dfrac{0.5 \times 40.66 \times 10^3}{373} = 54.5$ J/K

79. Answer (3)

Hint: Apply Hess's Law.

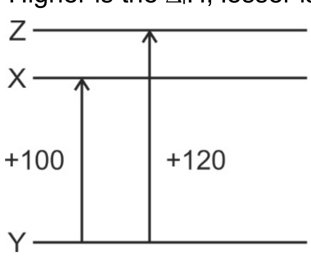
Sol.:

$$\begin{array}{lll} 2A & \longrightarrow 2B, & \Delta H = +600 \\ 2B & \longrightarrow 3C + D, & \Delta H = -200 \\ 3E + 3C & \longrightarrow 12D, & \Delta H = +2100 \\ \hline 2A + 3E & \longrightarrow 13D; & \Delta H = +2500 \text{ kJ/mol} \end{array}$$

80. Answer (2)

Hint: Higher is the $\Delta_f H$, lesser is the stability.

Sol.:



Stability order : Y > X > Z.

81. Answer (1)

Hint: $\Delta H = \Delta U + \Delta(PV)$

Sol.: $\Delta H = \Delta U + n_g R\Delta T$

$10 = \Delta U + (2 \times 2 \times 1)$

$\Rightarrow \Delta U = 6$ cal

82. Answer (2)

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

Sol.: $\Delta G = \Delta H - T\Delta S$

$\Delta H = T\Delta S$

$\Delta S = \dfrac{\Delta H}{T} = \dfrac{149 \times 1000}{298} = 500$ J/K-mol

83. Answer (4)

Hint: $H_2O(l) \rightleftharpoons H_2O(g), \Delta H > 0$

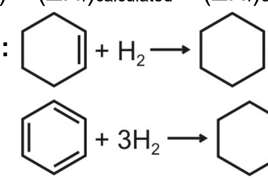
Sol.: $H_2O(l) \rightleftharpoons H_2O(g), \Delta S > 0, \Delta U > 0$ and $\Delta G = 0$

84. Answer (3)

Hint: Resonance energy

(RE) = $(\Delta H_f)_{calculated} - (\Delta H_f)_{experimental}$

Sol.:



, $\Delta H = -x$

, $\Delta H_{calculated} = -3x$

$\therefore$ RE = (–3x) – (–y) = y – 3x.

85. Answer (1)

Hint: $\Delta H_r = \Sigma(\Delta_f H)_{products} - \Sigma(\Delta_f H)_{reactants}$

Sol.: $C_2H_4(g) + 3O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(l)$

$\Delta H_r = \Delta_c H(C_2H_4(g)) = 2\Delta_f H(CO_2(g)) + 2\Delta_f H(H_2O(l))$
$\quad -\Delta_f H(C_2H_4(g))$

$-z = 2(-x) + 2(-y) - \Delta_f H(C_2H_4(g))$

$\Delta_f H(C_2H_4(g)) = 2(-x) + 2(-y) + z$

$= (z - 2x - 2y)$

86. Answer (3)

Hint: For spontaneity, $\Delta G_{system} < 0$ or $\Delta S_{total} > 0$

87. Answer (1)

Hint: $\Delta H = \Delta U + \Delta(PV)$

Sol.: $\Delta H = \Delta U + (P_2V_2 - P_1V_1)$

40 L-atm = ΔU + {(4 × 10) – (2 × 3)} L-atm

40 L-atm = ΔU + 34 L-atm

ΔU = (40 – 34) L-atm = 6 L-atm

88. Answer (1)

Hint: $\Delta S = 2.303\, nC_P \log\left(\dfrac{T_2}{T_1}\right)$

Sol.: $\Delta S = 2.303 \times 2 \times 20 \times \log\left(\dfrac{800}{400}\right) = 27.7$ J/K.

89. Answer (2)

Hint: Work done (w) and heat change (q) are path dependent.

90. Answer (2)

Hint: $\Delta_r H = \Sigma(B.E.)_{reactants} - \Sigma(B.E.)_{products}$

Sol.: $OCl_2(g) \longrightarrow O(g) + 2Cl(g)$

$\Delta_r H = 2B.E._{O-Cl} = 420$

$B.E._{O-Cl} = 210$ kJ mol^{-1}.

[BIOLOGY]

91. Answer (2)

Hint: Epigynous flowers have inferior ovary.

Sol.: When margin of thalamus grows upward and encloses the ovary completely the ovary is said to be inferior *eg*. guava, cucumber etc.

92. Answer (2)

Hint: In china rose all the stamens are united in single bundle.

Sol.: China rose has

(1) Monoadelphous stamens

(2) Placenta in the axial position *i.e*. axile placentation.

93. Answer (3)

Sol.: In imbricate aestivation, margins of petals and sepals overlap each other but not in a particular direction. *eg*. *Cassia*.

94. Answer (3)

Hint: In bean flower, petals show vexillary aestivation.

Sol.: In bean flower, petals are of three types.

(1) **Standard :** largest posterior one.

(2) **Keel :** smallest anterior petals.

(3) **Wings :** smaller lateral petals.

95. Answer (3)

Hint: In epiphyllous condition, stamens are attached to perianth.

Sol.: Tomato lacks perianth, thus epiphyllous condition is absent in it, rather it shows epipetalous stamens.

96. Answer (2)

Hint: In lotus, ovary is apocarpous.

Sol.: In apocarpous ovary, carpels are free. Lotus has multicarpellary, apocarpous ovary.

97. Answer (2)

Hint: Mango and coconut have drupe type of fruits.

Sol.: In mango, mesocarp is edible and epicarp is thin while in coconut, mesocarp is used in making coir. Endocarp is hard and stony in both.

Drupe develops from monocarpellary superior ovary.

98. Answer (1)

Hint: Banana have parthenocarpic fruits.

Sol.: Parthenocarpic fruits are seedless and develop from ovary but without fertilization.

99. Answer (3)

Hint: Castor have albuminous seeds.

Sol.: Being albuminous castor have triploid endosperm rich in oil and fats. In all angiosperms endosperm develops after fertilisation.

100. Answer (3)

Hint: Scutellum represents the single cotyledon.

Sol.: Single cotyledon of monocots is called scutellum.

101. Answer (1)

Hint: Aestivation and placentation are shown in floral diagram.

Sol.: Given floral formula is of family Brassicaceae. A floral formula does not represent aestivation of petals or sepals and placentation of ovary.

102. Answer (2)

Hint: Tulip flowers have epiphyllous stamens.

Sol.: $\widehat{C\ A}$ – epipetalous stamens

$\widehat{P\ A}$ – epiphyllous stamens

103. Answer (2)

Hint: *Indigofera* belongs to family Fabaceae.

Sol.: Members of Fabaceae family have

- Non endospermic seeds
- Legume type of fruit
- Zygomorphic flower
- Racemose inflorescence

104. Answer (1)

Sol.: Sunhemp – Fabaceae

Gloriosa – Liliaceae

Belladonna – Solanaceae

105. Answer (4)

Sol.: Lupin, tulip, sweet pea and *Petunia* all are ornamental plants.

Lupin, sweet pea – Fabaceae

Tulip – Liliaceae

Petunia – Solanaceae

106. Answer (3)

Hint: Seeds of cereals have thin and membranous seed coat.

Sol.: Cereals are monocots and have thin seed coat. Tobacco (*Nicotiana tabacum*) is a fumigatory plant of Solanaceae family.

107. Answer (1)

Hint: Persistent calyx is a feature of members of family Solanaceae.

Sol.: Brinjal – Solanaceae (persistent calyx)

Tulip, *Gloriosa* – Liliaceae

Mustard – Brassicaceae

108. Answer (1)

Sol.: Muliathi – Medicinal plant

Lupin – Ornamental plant

Sesbania – Fodder plant

Colchicum – Yields colchicine which is used in doubling of chromosomes.

109. Answer (3)

Sol.: Tendril is modification of stem in pumpkin, grape vine, cucumber whereas it is modified leaf in pea, sweet pea, *Nepenthes* & *Smilax*. Belladonna & wheat lack tendril.

110. Answer (3)

Hint: Onion belongs to family Liliaceae while potato belongs to family Solanceae.

Sol.: Both onion and potato are/have

- Modified underground stem
- Actinomorphic flower & ovary with axile placentation

In onion, fleshy leaves are modified for food storage and being monocot it has fibrous roots. However these features are absent in potato.

111. Answer (4)

Hint: Parenchyma and collenchyma both are living simple permanent tissues.

Sol.: Parenchyma – thin walled, may have chloroplast & intercellular space.

Collenchyma – may have chloroplast, intercellular space always absent, it provides mechanical support.

112. Answer (4)

Hint: In some plants adventitious roots provide mechanical support.

Sol.: Banyan tree – roots arise from stem branches to provide mechanical support.

Turnip, Radish – modified tap root for food storage.

Rhizophora – modified tap root for respiration.

113. Answer (4)

Hint: Protoxylem is a type of primary xylem.

Sol.: Protoxylem & metaxylem both are found in dicot as well as monocot plants.

114. Answer (1)

Hint: A vessel is made up of many cells.

Sol.: Tracheid is a single elongated cell. However both are dead, thick walled tissues and involved in conduction of water.

115. Answer (1)

Hint: Vessel is mainly found in members of angiospermae.

Sol.: Vessel is main water conducting element of angiosperms while tracheid is main water conducting element of gymnosperms & pteridophytes. Algae lack vascular tissues.

116. Answer (4)

Sol.: Pneumatophores or respiratory roots are modified tap roots. Rest are adventitious roots.

117. Answer (1)

Hint: In *Opuntia*, leaves modify to minimise water loss.

Sol.: In *Opuntia*, stem is modified to perform photosynthesis and leaves modify into spines. Such stems are called phylloclade.

118. Answer (4)

Hint: Phloem parenchyma is absent in monocots.

Sol.: Roots have exarch condition of xylem in vascular bundles in which protoxylem is towards the periphery.

Given features are true for monocot stem as they have sclerenchymatous hypodermis and endarch xylem *i.e*. protoxylem towards pith.

119. Answer (1)

Hint: In alternate phyllotaxy the stem bear single leaf at each node in alternate fashion.

Sol.: Guava, *Calotropis* – Opposite phyllotaxy

Sunflower – Alternate phyllotaxy

Nerium – Whorled phyllotaxy.

120. Answer (3)

Hint: Trichomes prevent water loss whereas root hairs increase water absorption.

Sol.: Root hair – Unicellular, unbranched

Trichome – Unicellular / multicellular and Branched / unbranched

Both are epidermal appendages.

121. Answer (4)

Sol.: Stele includes all the tissues inside the endodermis *i.e*. pericycle, vascular bundle and pith. Hypodermis is the part of ground tissue.

122. Answer (2)

Hint: Pericycle is a cylinder of thin walled parenchymatous or thick walled sclerenchymatous tissue.

Sol.: Pericycle is absent in monocot stem. In roots, pericycle forms lateral roots and a part of vascular cambium.

123. Answer (1)

Sol.: In cymose inflorescence, main axis (peduncle) terminates into a flower, thus shows limited growth. Flowers are arranged in basipetal order.

124. Answer (3)

Hint: Axillary bud may modify into thorns or tendrils.

Sol.: Spines of *Aloe* – modified leaves.

Thorns of *Citrus* and *Bougainvillea* ⎤ Modified axillary buds
Tendril of watermelon ⎦

125. Answer (1)

Hint: Cells of endodermis may store starch grains in stem.

Sol.: In dicot stem, endodermis is also called starch sheath, however endodermis is absent in monocot stem.

126. Answer (2)

Hint: Isobilateral leaves have equal number of stomata on both the surfaces.

Sol.: Isobilateral leaves are found in monocots. They lack palisade parenchyma & have close type of vascular bundles.

127. Answer (3)

Hint: In plants of temperate region, cambium is more active in spring & less active in autumn season.

Sol.: Spring wood – lighter in colour, less density

Autumn wood – darker in colour, high density.

While plants of tropical regions do not show differential activity of cambium.

128. Answer (1)

Hint: Sapwood is peripheral active region of wood.

Sol.: Sapwood – conduct water.

Heartwood – • filled with tannins, phenols
• do not conduct water

129. Answer (1)

Hint: Cork has suberin deposited cells.

Sol.: Cork/phellem is formed by redifferentiation and has thick walled cells at maturity. It is also found in dicot roots.

130. Answer (2)

Sol.: After many secondary growth—

Oldest layer of sapwood – just outside the heartwood.

Oldest secondary phloem – just inner to primary phloem.

Primary phloem – inner to pericycle.

131. Answer (1)

Sol.: *Pistia* & *Eicchornia* have subaerial stem called offset.

132. Answer (3)

Hint: Heartwood is nonfunctional wood.

Sol.: Heartwood includes nonfunctional secondary xylem.

133. Answer (2)

Hint: Tyloses are formed in heartwood.

Sol.: Tyloses are balloon like swellings formed by xylem parenchyma cells in xylem vessels to make them nonfunctional. They are found in angiospermic woods.

134. Answer (1)

Hint: Growth rings are very distinct in plants of temperate regions.

Sol.: Roots are underground structures thus cambium do not show variation in its activity due to seasonal change. In roots, vascular cambium is formed at the time of secondary growth and thus completely secondary in origin.

135. Answer (1)

Hint: Bulliform cells are large, empty, colourless cells.

Sol.: Bulliform cells become flaccid during water stress and curl the leaf inward. They are found in monocots especially grasses.

136. Answer (3)

Hint: Protein that is the main content of bird's egg.

Sol.: Albumin helps in maintaining the blood colloidal osmotic pressure.

- Fibrinogen & prothrombin are blood clotting proteins.
- Globulins are involved in defence mechanisms of the body.

137. Answer (4)

Hint: Proteins contribute 6 – 8% of plasma.

Sol.: RBCs, WBCs & platelets are collectively called formed elements. Plasma proteins are not formed elements.

138. Answer (3)

Hint: Blood cells that lack nucleus and other organelles.

Sol.: RBCs are biconcave in shape so it helps in providing more room for haemoglobin.

139. Answer (3)

Hint: Cells that secrete histamine, serotonin and heparin.

Sol.: Differential leukocyte count in blood – Neutrophils (Maximum) > Lymphocytes > Monocytes > Eosinophils > Basophils (Minimum)

Basophils are least (0.5 – 1%) in number.

140. Answer (3)

Hint: These are also called platelets.

Sol.: Thrombocytes are cell fragments produced from megakaryocytes. Thrombocytes/platelets release a variety of substances involved in coagulation of blood.

141. Answer (1)

Hint: Universal blood donor.

Sol.:

Blood Groups and Donor Compatibility

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

142. Answer (3)

Hint: Thrombocytes are platelets.

Sol.: Leukocytes - 6000 to 8000 mm^{-3}.

143. Answer (4)

Hint: Thrombokinase catalyses conversion of prothrombin to thrombin.

Sol.: Fibrinogen $\xrightarrow{\text{Thrombin}}$ Fibrin

144. Answer (4)

Hint: Lymph is filtered product of blood.

Sol.: Lymph has the same mineral distribution as that in plasma.

145. Answer (4)

Hint: Notochord extends from head to tail region in this taxon.

Sol.: In protochordates and urochordate have open circulatory system, while cephalochordates have closed circulatory system. In open circulatory system, blood fills in open spaces/sinuses.

- Except urochordates all chordates have closed circulatory system.
- In non-chordates, annelids (except leech) and cephalopods have closed circulatory system.

146. Answer (1)

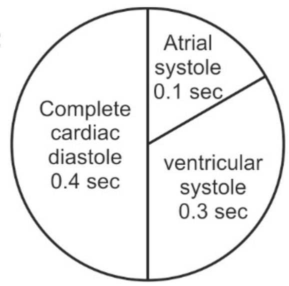
Hint: Atrio-ventricular valve.

Sol.: Opening between right atrium and right ventricle and opening between left atrium and left ventricle is guarded by tricuspid and bicuspid valve respectively.

147. Answer (3)

Hint: Atrial diastole coincides with ventricular systole.

Sol.:



148. Answer (2)

Hint: Phase of cardiac cycle in which volume of heart chambers increases.

Sol.: Blood from pulmonary veins and venae cavae, fills the left and right atria, respectively. The pressure causes AV valves to open and blood to flow from atria into ventricles.

149. Answer (3)

Hint: SAN is called Pacemaker of heart.

Sol.:
- SAN generates an action potential which stimulates both the atria to undergo simultaneous contraction.
- Ventricular systole increases the ventricular pressure causing closure of tricuspid and bicuspid valves due to attempted backflow of blood into the atria.

150. Answer (2)

Hint: Cardiac output = Stroke volume × Heart rate.

Sol.: SV = EDV – ESV

EDV = 120 ml,

ESV = 50 ml

So, SV = 120 – 50 = 70 ml

SV = Stroke volume

EDV = End diastolic volume

ESV = End systolic volume

151. Answer (2)

Hint: White fibrous cords attached with tricuspid and bicuspid valves.

Sol.: Chordae tendinae are attached to the flaps of bicuspid and tricuspid valves at one end and their other ends are attached to the ventricular wall with papillary muscles.

152. Answer (3)

Hint: SA node is called pace maker.

Sol.: Cardiac muscle cells have ability to generate the electrical impulses that trigger cardiac contraction. SA node generates the maximum number of action potentials *i.e.* 70 – 75 min^{-1}.

153. Answer (3)

Hint: AV valves guard between atria and ventricles.

Sol.: First heart sound 'lub' is low pitched and of longer duration than dub and is produced by closure of AV valves.

154. Answer (2)

Hint: Maximum filling of ventricles occurs during joint diastole.

Sol.: 70% filling of ventricles occurs during joint diastole and 30% occurs during filling atrial contraction.

155. Answer (3)

Hint: Ventricular repolarisation.

Sol.: The T-wave represents the return of the ventricles from excited to normal state.

156. Answer (4)

Hint: First downward wave in ECG.

Sol.: QRS complex represents depolarisation of the ventricles, which initiates ventricular contraction. The contraction of ventricles starts shortly after Q and marks the beginning of systole.

157. Answer (3)

Hint: Veins carry blood to the heart.

Sol.:
- Arteries distribute blood from heart to different parts of the body.
- Tunica media is thicker in arteries having more muscle fibres.

158. Answer (2)

Hint: Second heart sound.

Sol.: Isovolumetric systole represents the duration between closure of AV valve and opening of semilunar valve.

159. Answer (3)

Hint: The term pulmonary refers to lungs.

Sol.: From the ascending aorta, right and left coronary arteries arise which supply oxygenated blood to the heart muscles.

160. Answer (2)

Hint: Identify the most abundant WBCs.

Sol.: Neutrophils and monocytes are phagocytic cells which destroy foreign organisms entering the body.

161. Answer (3)

Hint: Myeloid tissue present in bones.

Sol.: In humans, erythropoiesis during embryonic development occurs in yolk sac, liver and spleen. When RBC count is very low yellow bone marrow converts into red bone marrow in adults.

162. Answer (2)

Hint: This is evaluated using inulin.

Sol.: 99% of filtrate is reabsorbed.

163. Answer (4)

Hint: Acetylcholine has inhibitory effect on cardiac musculature.

Sol.: Parasympathetic nerve endings release acetylcholine which decreases the rate of heart beat, speed of conduction of action potential and cardiac output.

164. Answer (4)

Hint: Epithelial part of blood vessels.

Sol.: The wall of capillaries are composed of just one cell layer of simple squamous epithelium or endothelium.

165. Answer (3)

Hint: Respiratory rhythm centre is also present here.

Sol.: Medulla oblongata can moderate the cardiac functions through ANS. ANS provides both sympathetic and parasympathetic supply to the heart.

166. Answer (3)

Hint: Common salt increases blood pressure.

Sol.: Hypertension – Systolic ≥ 140 mmHg
Diastolic ≥ 90 mmHg

Heart failure – Congestion of lungs is one of the main symptoms due to which heart does not pump blood effectively enough to meet the need of the body.

167. Answer (2)

Hint: The nitrogenous waste which is most soluble in water.

Sol.: Ammonia is the most toxic form and requires large amount of water for its elimination. Ammonotelism occurs in many bony fishes, aquatic amphibians and aquatic insects.

168. Answer (4)

Hint: Identify a free living flatworm.

Sol.: Protonephridia or flame cells are the excretory structures in platyhelminthes, rotifers, some annelids and cephalochordates.

169. Answer (2)

Hint: Aquatic arthropods.

Sol.: Antennal glands/green glands perform the excretory function in crustaceans like prawns.

170. Answer (1)

Hint: Maximum water is required for elimination of ammonia.

Sol.: Ammonia is the most toxic form of nitrogenous waste and requires large amount of water for its elimination, whereas uric acid, being the least toxic, can be removed with a minimum loss of water.

171. Answer (3)

Hint: Renal columns.

Sol.: Extended cortex between the medullary pyramids as renal columns are called columns of Bertini.

172. Answer (2)

Hint: Cardiac output is 5L.

Sol.: 1000 - 1200 ml is the renal blood flow which is filtered by kidney per minute.

173. Answer (1)

Hint: Part of renal tubule having maximum microvilli.

Sol.: PCT is lined by simple cuboidal brush border epithelium which increases the surface area for reabsorption.

174. Answer (1)

Hint: Conditional reabsorption.

Sol.: Angiotensin II activates the adrenal cortex to release aldosterone, which causes reabsorption of Na^+ and water from DCT.

175. Answer (4)

Hint: This structure is not a part of nephron.

Sol.: Conditional reabsorption and tubular secretion occur in DCT.

176. Answer (3)

Hint: Insulin deficiency.

Sol.: Presence of glucose and ketone bodies urine are indicative of diabetes mellitus.

177. Answer (3)

Hint: One gram = 1000 mg.

Sol.: An adult human excretes, on an average, 1 - 1.5 L of urine per day. 25-30 gm of urea is excreted per day.

178. Answer (2)

Hint: Urea cycle.

Sol.: Ornithine cycle occurs in liver in which 1 molecule of urea is syntherised from 1 molecule of CO_2 and 2 molecules of NH_3.

179. Answer (1)

Hint: 288 L of CO_2 is released per day.

Sol.: Our lungs remove large amounts of CO_2 *i.e.* 200 mL/min.

180. Answer (3)

Hint: Suffix ‘itis’ indicates inflammation.

Sol.: (a) Nephritis – Inflammation of kidney

(b) Cystitis – Inflammation of urinary bladder

(c) Uremia – Increased concentration of urea in blood

(d) Haematuria – Presence of blood in the urine

❑ ❑ ❑

All India Aakash Test Series for Medical - 2021

TEST - 3 (Code-D)

Test Date : 01/12/2019

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

1. Answer (2)

Hint: In equilibrium, net force on system is zero.

Sol.: Assume the rope is pulled with force F.

In equilibrium

$2F = (25 + 50) \times 10$

$F = 375$ N

2. Answer (1)

Hint: Because no external force acts on system, so centre of mass of system remains in same position.

Sol.: As man shift to other end then boat shifts through a distance x in opposite direction.

$\because \quad \vec{F}_{ext} = 0$

$\overrightarrow{\Delta x}_{cm} = 0$

$50(5 - x) + 40(-x) = 0$

$250 - 50x - 40x = 0$

$x = \dfrac{25}{9}$ m

3. Answer (1)

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

Sol.: Position of 2 kg, $\vec{r}_1 = \hat{i} - 2\hat{j} - \hat{k}$

Position of 1 kg, $\vec{r}_2 = -4\hat{i} + 5\hat{j} - 2\hat{k}$

$\vec{x}_{cm} = \left(\dfrac{2 \times 1 - 1 \times 4}{3}\right)\hat{i} = -\dfrac{2}{3}\hat{i}$

$\vec{y}_{cm} = \left(\dfrac{2 \times (-2) + 1 \times 5}{3}\right)\hat{j} = \dfrac{1}{3}\hat{j}$

$\vec{z}_{cm} = \left(\dfrac{2(-1) + 1(-2)}{3}\right)\hat{k} = -\dfrac{4}{3}\hat{k}$

Position of centre of mass $= -\dfrac{2}{3}\hat{i} + \dfrac{1}{3}\hat{j} - \dfrac{4}{3}\hat{k}$

4. Answer (3)

Hint: Mass is continuously increasing with length, so first calculate centre of mass of elementary mass (dm).

Sol.: Linear mass density $\lambda = 2x$

Mass of element of length $dx, dm = 2xdx$

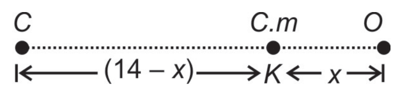
$$x_{cm} = \frac{\int_0^L x\,dm}{\int_0^L dm} = \frac{2\int_0^L x^2 dx}{2\int_0^L x\,dx}$$

$$x_{cm} = \frac{2\left[\frac{L^3}{3}\right]}{2\left[\frac{L^2}{2}\right]} = \frac{2L}{3}$$

5. Answer (3)

Hint: Moment of mass at centre of mass is zero.

Sol.:



Assume centre of mass as origin. Then moment of mass at C.M. is zero.

$16x + 12[-(14 - x)] = 0$

$16x - 12 \times 14 + 12x = 0$

$28x = 12 \times 14$

$x = 6$ Å

6. Answer (2)

Hint & Sol.: $\vec{x}_{cm} = \dfrac{m \times \left(\frac{L}{2}\right) + m \times 0 + m\left(\frac{-L}{2}\right)}{m + m + m}$

$\vec{x}_{cm} = 0$

$\vec{y}_{cm} = \dfrac{m \times 0 + m\frac{L}{2} + m \times L}{m + m + m}$

$\vec{y}_{cm} = \dfrac{L}{2}$

Co-ordinate of centre of mass $\left(0, \dfrac{L}{2}\right)$

7. Answer (1)

Hint & Sol.: Assume downward direction as negative direction

$\vec{a}_{cm} = \dfrac{m(-g) + 2m(-g)}{m + 2m}$

$\vec{a}_{cm} = -g$

$|\vec{a}_{cm}| = g$

8. Answer (4)

Hint: In self explosion, linear momentum of system remains constant.

Sol.: $0 = m \times 50 - 2m \times 25 + 2m\vec{v}_3$

$2m\vec{v}_3 = 0$

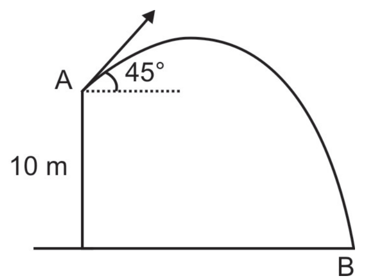
$v_3 = 0$

Kinetic energy of third part = 0

9. Answer (3)

Hint: Use energy conservation law

Sol.:



Total mechanical energy at A = Total mechanical energy at B

$mg \times 10 + \frac{1}{2}m(10\sqrt{2})^2 = 0 + \frac{1}{2}mv_B^{\,2}$

$2 \times 100 + 200 = v_B^{\,2}$

$v_B = 20$ m/s

10. Answer (4)

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

Sol.: Because block slides down with constant speed, then

$mg\sin\theta - F_f = 0$

$F_f = mg\sin\theta$

When block moves up the plane then friction acts downward

$P = \vec{F}.\vec{v}$

$= (2mg\sin\theta)v$

$P = 2mgv\sin\theta$

11. Answer (2)

Hint: Work-energy theorem

Sol.: Work done by air drag = change in kinetic energy

$= \frac{1}{2}m\left[v_f^{\,2} - v_i^{\,2}\right]$

$= \frac{1}{2} \times 1[256 - 400]$

$= -72$ J

12. Answer (4)

Hint: Work-energy theorem

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

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

$v = t^2$

speed at $t = 0$, $v = 0$

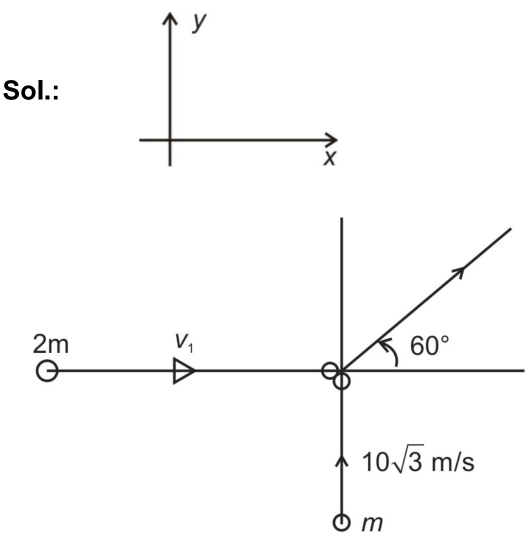
speed at $t = 2$ s, $v = 4$ m/s

$W = \frac{1}{2} \times 2[16 - 0] = 16$ J

13. Answer (3)

Hint: Law of conservation of linear momentum.

Sol.:



$\tan\theta = \frac{P_y}{P_x}$

$\tan 60° = \frac{m \times 10\sqrt{3}}{2m\, v_1}$

$\sqrt{3} = \frac{10\sqrt{3}}{2v_1}$

$v_1 = 5$ m/s

14. Answer (3)

Hint: Law of conservation of linear momentum and conservation of mechanical energy.

Sol.: According to law of conservation of linear momentum

$m_2 v = m_1 v_1 + m_2 \frac{v}{3}$

$2m_2 \frac{v}{3} = m_1 v_1$

$v_1 = \frac{2}{3}\frac{m_2}{m_1}v$

Block will complete the vertical circle if

$v_1 \geq \sqrt{5gl}$

$\frac{2}{3}\frac{m_2}{m_1}v = \sqrt{5gl}$

$v = \frac{3}{2}\frac{m_1}{m_2}\sqrt{5gl}$

15. Answer (1)

Hint: Work done by gravity is decrease in potential energy

Sol.: $W = \vec{F}.\vec{S}$

$= mgh = mg\left[\frac{u^2\cos^2\theta}{2g}\right]$

$= \frac{1}{2}mu^2\cos^2\theta$

16. Answer (3)

Hint: Work will be done only by tangential force

Sol.: $dW = \vec{F}.\overrightarrow{dx}$

$dW = mcx\ dx$

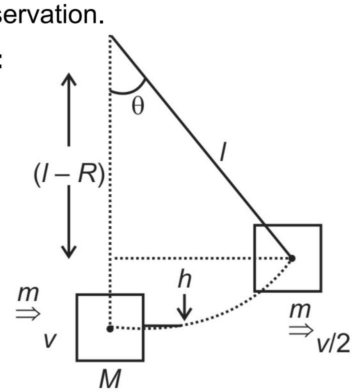
$W = mc\int_0^{2\pi r} x\ dx$

$\Delta K = 2\pi^2 cmr^2$

17. Answer (2)

Hint: First apply law of conservation of linear momentum and then mechanical energy conservation.

Sol.:



Apply law of conservation of momentum

$mv = MV + \frac{mv}{2}$

$V = \frac{m}{2M}v$

$\frac{1}{2}MV^2 = Mgh$

$h = \frac{V^2}{2g} = \frac{m^2v^2}{8M^2g}$

$\cos\theta = \frac{l-h}{l}$

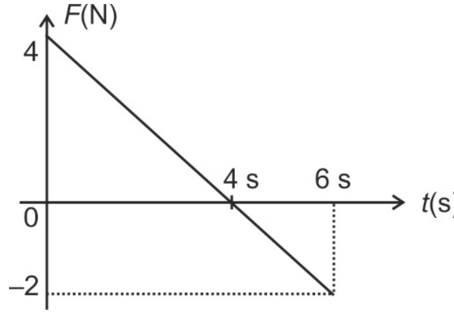
$\theta = \cos^{-1}\left(1-\frac{m^2v^2}{8M^2gl}\right)$

18. Answer (4)

Hint: Area of (*F* - *t*) graph gives change in momentum

Sol.: *F* = – *t* + 4

draw (*F* - *t*) graph



$\Delta p = \left[\frac{1}{2}\times 4\times 4 - \frac{1}{2}\times 2\times 2\right]$

$m[v - 1] = 6$

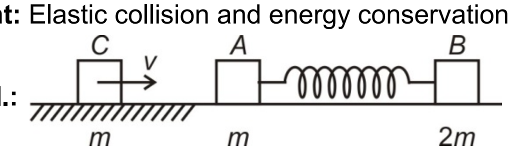
$v = 4$ m/s

K.E. $= \frac{1}{2}\times(2)\times 4^2 = 16$ J

19. Answer (1)

Hint: Elastic collision and energy conservation

Sol.:



When block *C* collide with *A* elastically then its kinetic energy transferred to A.

At maximum compression of spring, relative speed of *A* and *B* is zero.

According to momentum conservation

$mv = (m+2m)v_1$

$v_1 = \frac{v}{3}$

$\frac{1}{2}mv^2 = \frac{1}{2}\times 3m\left(\frac{v}{3}\right)^2 + \frac{1}{2}kx^2$

$\frac{1}{2}mv^2 - \frac{1}{6}mv^2 = \frac{1}{2}kx^2$

$\frac{2}{6}mv^2 = \frac{1}{2}kx^2$

$x = v\sqrt{\frac{2m}{3k}}$

20. Answer (2)

Hint: Because wall is in (y – z) plane, only x-component of velocity will change.

Sol.: $e = \dfrac{\text{velocity of separation}}{\text{velocity of approach}}$

$$\frac{1}{2} = \frac{0 - v_1}{2 - 0}$$

$$\vec{v}_1 = -\hat{i}$$

So, velocity just after collision $= -\hat{i} + 2\hat{j}$

21. Answer (4)

Hint & Sol.: Work done by friction may be positive, negative or zero.

22. Answer (3)

Hint: Energy stored in stretched spring $U = \dfrac{1}{2}kx^2 = \dfrac{F^2}{2k}$

Sol.: Given K_A = 3K_B

$$\frac{U_A}{U_B} = \frac{K_B}{K_A}$$

$$\frac{E}{E_B} = \frac{K_B}{3K_B}$$

E_B = 3E

23. Answer (4)

Hint & Sol.: Momentum of system is always conserved but kinetic energy of system just before collision is equal to kinetic energy of system just after collision.

24. Answer (2)

Hint: Apply law of conservation of mechanical energy.

Sol.: Loss of potential energy = Gain in kinetic energy.

$$(3 \times 10 \times 5 - 2 \times 10 \times 5) = \frac{1}{2}(3+5)v^2$$

50 × 2 = 5v^2

$$v = 2\sqrt{5}\text{ m/s}$$

25. Answer (1)

Hint: Law of conservation of linear momentum

Sol.: Mass of shell = 0.2 kg

Mass of gun = 4.0 kg

According to law of conservation of momentum

$$0 = 0.2 \times \vec{v} + 4.0\,\vec{v}_1$$

$$\vec{v}_1 = -\frac{0.2}{4.0}\vec{v} = -\frac{1}{20}\vec{v}$$

Total kinetic energy = 1050

$$\frac{1}{2} \times 0.2v^2 + \frac{1}{2} \times 4 \times {v_1}^2 = 1050$$

$$0.2v^2 + 4\left(\frac{v}{20}\right)^2 = 2100$$

$$v^2\left[0.2 + \frac{1}{100}\right] = 2100$$

$$v^2 = \frac{100 \times 2100}{21}$$

$$v = 100\text{ m/s}$$

26. Answer (1)

Hint: Work done by forces is equal to change in kinetic energy.

Sol.: $K = as^2$

$$\frac{dK}{ds} = 2as$$

$$F = 2as$$

27. Answer (3)

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

Sol.: $F \propto s^{-1/3}$

$a = \dfrac{k}{m}s^{-1/3}$ (k is a constant)

$$v.\frac{dv}{ds} = \frac{k}{m}s^{-1/3}$$

$$vdv = \frac{k}{m}s^{-1/3}ds$$

$$\frac{v^2}{2} = \frac{3}{2}\frac{k}{m}s^{2/3}$$

$$v = \sqrt{\frac{3k}{m}}s^{1/3}$$

$$P = Fv = ks^{-1/3}\sqrt{\frac{3k}{m}}s^{1/3}$$

$$P \propto s^0$$

28. Answer (3)

Hint: Work done by all forces is equal to change in kinetic energy.

Sol.: Work done by forces $\vec{F}_1$ and $\vec{F}_2$ + work done by gravity = ΔK = 0

work done by $\vec{F}_1$ and $\vec{F}_2 = -[\text{work done by gravity}]$

work done by $\vec{F}_1$ and $\vec{F}_2 = -[mg\,h\cos 180°]$

$= mgh$

29. Answer (2)

Hint: Total mass of rod can be assumed at its centre of mass.

Sol.: Work done = change in potential energy

$$= mg\left(\frac{l}{2}\right)$$

$$= \frac{mgl}{2}$$

30. Answer (1)

Hint & Sol.: Potential energy is defined for conservative forces.

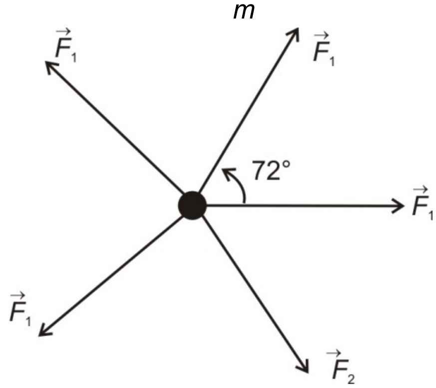
31. Answer (3)

Hint: According to polygon law a set of forces forming a closed polygon leads to a zero resultant.

Sol.: In closed polygon resultant of four identical forces is balanced by fifth force.

So, resultant magnitude force $= (F_2 - F_1)$

Net acceleration $a = \frac{(F_2 - F_1)}{m}$



32. Answer (2)

Hint: Impulse = Change in momentum

Sol.: Velocity up to 2 s $\vec{v}_1 = \frac{\Delta\vec{x}}{\Delta t} = 2\text{ m s}^{-1}$

velocity just after 2 s, $\vec{v}_2 = 0$

change in momentum

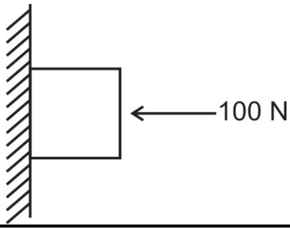
$\vec{\Delta p} = m[\vec{v}_2 - \vec{v}_1]$

= 1[0 – 2]

= –2 kg m/s

33. Answer (1)

Hint: $mg \le \mu N$



Sol.: Normal reaction of wall N = 100 N

Force of limiting friction $F = \mu N$ = 25 N

Pulling force = mg = 20 N

So force of friction = 20 N (upwards)

34. Answer (3)

Hint: The compression will be maximum, when work done by pseudo force is stored in the form of elastic potential energy.

Sol.: As the plank is accelerated, pseudo force (ma) acts on the block, which compresses the spring through x,

At maximum compression

$$max = \frac{1}{2}kx^2$$

$$x = \frac{2ma}{k}$$

35. Answer (4)

Hint: Applied force $F = 2t$ is time dependent.

So up to certain time, block will not move.

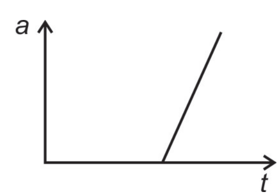
Sol.: Applied force $F = 2t$

Limiting friction $F_f = \mu mg$

$$a = \frac{F - F_f}{m} = \frac{2t - \mu mg}{m}$$

$$a = \frac{2t}{m} - \mu g$$

This is an equation of straight line of form $y = mx + c$, with positive slope and negative intercept.



36. Answer (2)

Hint: Force of limiting friction $f_{\lim} = \mu mg$

Sol.: N = mg = 10 N

$F_f = \mu mg$ = 2 N

at t = 3 s, F = 6 N

$\Rightarrow$ friction = 2 N

37. Answer (1)

Hint: $a_{\min} = \frac{g}{\mu}$

Sol.: Let common acceleration be a. Then

$a = \frac{F}{2m}$

$N = \frac{F}{2m} \times m = \frac{F}{2}$

For no slipping (in limiting equilibrium)

$\mu N = mg$

$\frac{\mu F}{2} = mg$

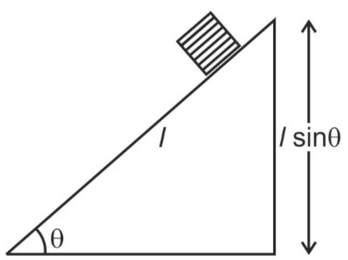
$F = 2mg/\mu$

38. Answer (4)

Hint: When angle of inclination is θ

$a = g\sin\theta$

Sol.: $v = \sqrt{2gl\sin\theta}$



When angle of plane is 2θ

$v_1 = \sqrt{2gl\sin 2\theta}$

$v_1 = \sqrt{2gl(2\sin\theta\cos\theta)}$

$v_1 = v\sqrt{2\cos\theta}$

39. Answer (1)

Hint: Horse pushes the earth backward and earth applies force in forward direction.

Sol.: Total mass of system = 2000 kg

$F - \mu(mg) = (m + M)a$

$F - 0.2(1500 \times 10) = (2000) \times 2$

$F = 7000$ N

40. Answer (4)

Hint: $\therefore$ No impulsive external force acts on bomb, so momentum of system remains constant

Sol.: $0 = -2mv\hat{i} + mv\hat{j} + 2m\vec{v}_3$

$\vec{v}_3 = v\hat{i} - \frac{v}{2}\hat{j}$

41. Answer (4)

Hint: $|\vec{F}| = \frac{|\Delta\vec{P}|}{\Delta t}$

Sol.: $F = \frac{|0.5(2\hat{i} + 2\hat{j})|}{1.414} = \frac{(0.5)(2\sqrt{2})}{1.414} = 1\text{ N}$

42. Answer (2)

Hint & Sol.: In circular motion with increasing speed, tangential force and displacement are in same direction, (θ = 0°). So work done on the body is positive.

43. Answer (1)

Hint: According to Newton's second law

$\vec{F} = \frac{d\vec{P}}{dt}$

Sol.: $\vec{P} = \vec{a} + \vec{b}t^2$

$\frac{d\vec{P}}{dt} = 2\vec{b}t$

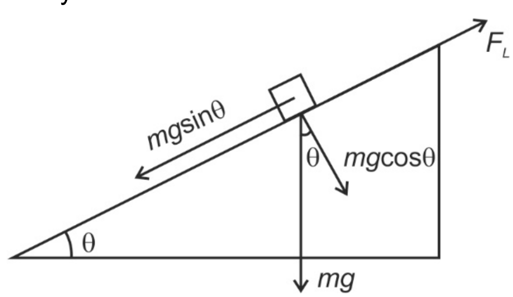
$F \propto t$

44. Answer (3)

Hint: Block is sliding with constant velocity,

so $a = 0$

Sol.: Block slides along the plane, with constant velocity



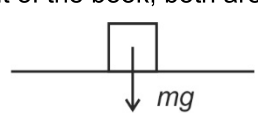
$mg\sin\theta - \mu mg\cos\theta = m(0)$

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

$F_f = mg\sin\theta$

45. Answer (4)

Hint & Sol.: Normal force due to book on the table and weight of the book, both are in same direction.



so θ = 0°

[CHEMISTRY]

46. Answer (2)

Hint: $\Delta_r H = \Sigma(\text{B.E.})_{\text{reactants}} - \Sigma(\text{B.E.})_{\text{products}}$

Sol.: $OCl_2(g) \longrightarrow O(g) + 2Cl(g)$

$\Delta_r H = 2\text{B.E.}_{O-Cl} = 420$

$\text{B.E.}_{O-Cl} = 210$ kJ mol^{-1}.

47. Answer (2)

Hint: Work done (w) and heat change (q) are path dependent.

48. Answer (1)

Hint: $\Delta S = 2.303\, nC_P \log\left(\frac{T_2}{T_1}\right)$

Sol.: $\Delta S = 2.303 \times 2 \times 20 \times \log\left(\frac{800}{400}\right) = 27.7$ J/K.

49. Answer (1)

Hint: $\Delta H = \Delta U + \Delta(PV)$

Sol.: $\Delta H = \Delta U + (P_2V_2 - P_1V_1)$

40 L-atm = ΔU + {(4 × 10) – (2 × 3)} L-atm

40 L-atm = ΔU + 34 L-atm

ΔU = (40 – 34) L-atm = 6 L-atm

50. Answer (3)

Hint: For spontaneity, $\Delta G_{\text{system}} < 0$ or $\Delta S_{\text{total}} > 0$

51. Answer (1)

Hint: $\Delta H_r = \Sigma(\Delta_f H)_{\text{products}} - \Sigma(\Delta_f H)_{\text{reactants}}$

Sol.: $C_2H_4(g) + 3O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(l)$

$\Delta H_r = \Delta_c H(C_2H_4(g)) = 2\Delta_f H(CO_2(g)) + 2\Delta_f H(H_2O(l))$

$-\Delta_f H(C_2H_4(g))$

$-z = 2(-x) + 2(-y) - \Delta_f H(C_2H_4(g))$

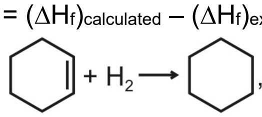
$\Delta_f H(C_2H_4(g)) = 2(-x) + 2(-y) + z$

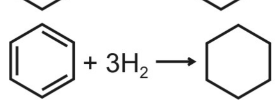
$= (z - 2x - 2y)$

52. Answer (3)

Hint: Resonance energy

(RE) = $(\Delta H_f)_{\text{calculated}} - (\Delta H_f)_{\text{experimental}}$

Sol.: , $\Delta H = -x$

, $\Delta H_{\text{calculated}} = -3x$

$\therefore$ RE = (–3x) – (–y) = y – 3x.

53. Answer (4)

Hint: $H_2O(l) \rightleftharpoons H_2O(g), \Delta H > 0$

Sol.: $H_2O(l) \rightleftharpoons H_2O(g), \Delta S > 0, \Delta U > 0$ and $\Delta G = 0$

54. Answer (2)

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

Sol.: $\Delta G = \Delta H - T\Delta S$

$\Delta H = T\Delta S$

$\Delta S = \frac{\Delta H}{T} = \frac{149 \times 1000}{298} = 500$ J/K-mol

55. Answer (1)

Hint: $\Delta H = \Delta U + \Delta(PV)$

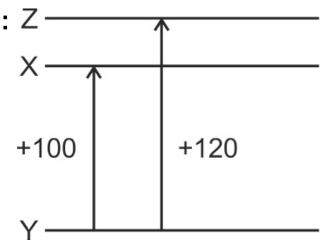
Sol.: $\Delta H = \Delta U + n_g R\Delta T$

$10 = \Delta U + (2 \times 2 \times 1)$

$\Rightarrow \Delta U = 6$ cal

56. Answer (2)

Hint: Higher is the $\Delta_f H$, lesser is the stability.

Sol.: 

Stability order : Y > X > Z.

57. Answer (3)

Hint: Apply Hess's Law.

Sol.:

$$\begin{array}{lll} 2A & \longrightarrow 2B, & \Delta H = +600 \\ 2B & \longrightarrow 3C + D, & \Delta H = -200 \\ 3E + 3C & \longrightarrow 12D, & \Delta H = +2100 \\ \hline 2A + 3E & \longrightarrow 13D; & \Delta H = +2500 \text{ kJ/mol} \end{array}$$

58. Answer (1)

Hint: Entropy of vaporization $= \frac{n\Delta H}{T_{\text{B.P.}}}$

Sol.: $\Delta S = \frac{0.5 \times 40.66 \times 10^3}{373} = 54.5$ J/K

59. Answer (2)

Hint: Enthalpy of ionization of acid is heat required to ionize 1 mol of weak acid completely into its respective ions.

Sol.: HA + NaOH $\longrightarrow$ NaA + H_2O

Heat released on neutralisation of 0.2 mol of HA = 6.2 kJ

Heat released on neutralisation of 1 mol of HA = 31 kJ

Hence, enthalpy of ionization = 57.1 – 31

= 26.1 kJ/mol

60. Answer (1)

Hint: $\Delta U = nC_v\Delta T$

Sol.: $\Delta T = 0$

$\Delta U = 0$

61. Answer (1)

Hint: For adiabatic process, Q = 0

Sol.: In isolated system, the exchange of neither energy nor the matter takes place.

62. Answer (2)

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

Sol.: $C_7H_8(l) + 9O_2(g) \rightarrow 7CO_2(g) + 4H_2O(l)$

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

$\Delta U = \Delta H - \Delta n_g RT$ ($\because \Delta n_g = 7 - 9 = -2$)

$= -3910 + (2 \times 8.314 \times 10^{-3} \times 300)$

$= -3905$ kJ mol^{-1}

63. Answer (3)

Hint: For adiabatic process, $TV^{\gamma-1}$ = constant

Sol.: $TV^{1/4}$ = constant

$$\gamma - 1 = \frac{1}{4} \Rightarrow \gamma = \frac{5}{4} \Rightarrow \frac{C_{p,m}}{C_{v,m}} = \frac{5}{4}$$

64. Answer (4)

Hint: $U_{rms} > U_{avg} > U_{mp}$

Sol.: If U_{rms}, U_{avg} and U_{mp} are equal then temperatures at which these occur will have reverse order.

i.e. $T_1 < T_2 < T_3$.

65. Answer (1)

Hint: Partial pressure = mole fraction × Total pressure.

Sol.:

	$H_2(g)$	+	$Cl_2(g)$	$\longrightarrow$	2HCl
Initial	3 mol		0.5 mol		0
Final	2.5 mol		0		1.0 mol

$$P_{H_2} = \frac{2.5}{3.5} \times 7 \text{ atm} = 5 \text{ atm}$$

$$P_{HCl} = \frac{1}{3.5} \times 7 \text{ atm} = 2 \text{ atm}$$

66. Answer (3)

Hint: Translational kinetic energy for n mole(s) of gas $= \frac{3}{2}$ nRT

Sol.: Translational KE (E_1) $= \frac{3}{2} \times n_1 \times RT_1$

Translational KE (E_2) $= \frac{3}{2} \times n_2 \times RT_2$

$$\frac{E_1}{E_2} = \frac{n_1T_1}{n_2T_2}$$

$$\frac{E_{O_2}}{E_{Kr}} = \frac{\frac{x}{32} \times T_1}{\frac{x}{54} \times T_2}$$

$$\frac{1}{4} = \frac{54}{32} \times \frac{T_1}{T_2} \Rightarrow \frac{T_1}{T_2} = \frac{8}{54} = \frac{4}{27}$$

67. Answer (4)

Hint: PV = nRT

Sol.: PV = nRT

1 atm × 10 L = n × 0.0821 (L-atm mol^{-1} K^{-1}) × 300 K

n = 0.406

68. Answer (2)

Hint: Density of ideal gas $(d) = \frac{PM}{RT}$

Sol.: $d = \frac{PM}{RT}$

$$d = \frac{(5 \text{ atm}) \times 44 \text{ g mol}^{-1}}{(0.0821 \text{ L-atm/mol-K}) \times 700 \text{ K}} = 3.8 \text{ g/L}$$

69. Answer (3)

Hint: Polar and non-polar molecules have dipole-induced dipole interaction.

Sol.: H_2 and Cl_2 : induced dipole - induced dipole force.

HF and HCl : Dipole-dipole force.

NH_3 and He : Dipole induced-dipole force.

CCl_4 and $SiCl_4$: Induced dipole-induced dipole force.

70. Answer (3)

Hint: $U_{rms} = \sqrt{\frac{3RT}{M}}$

Sol.: $U_{rms} = \sqrt{\frac{3 \times 8.314 \times 400}{32 \times 10^{-3}}} = 558.37$ m/s

71. Answer (1)

Hint: Among given liquids, H_2O has highest surface tension.

72. Answer (2)

Hint: At critical point, density of liquid and gas becomes equal.

73. Answer (3)

Hint: $\left(P + \frac{n^2a}{V^2}\right)(V - nb) = nRT$

Sol.: Unit of (P) = unit of $\left(\frac{n^2a}{V^2}\right)$

Unit of a = atm L^2 mol^{-2}.

74. Answer (3)

Hint: Molecules having H-bonding have higher boiling points.

Sol.: H-bonding is present in ethyl alcohol.

75. Answer (3)

Hint: Sum of fractions of molecules remains unaltered on changing the temperature.

76. Answer (2)

Hint: $\left(\frac{a}{V^2}\right)$ term is negligible for He(g).

Sol.: van der Waals equation for He(g).

P(V – b) = RT or $\frac{PV}{RT} = 1 + \frac{Pb}{RT}$

$\therefore \quad Z = 1 + \frac{Pb}{RT}$

77. Answer (2)

Hint: $\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$

Sol.: $\frac{r_{X_2}}{r_{H_2}} = \sqrt{\frac{M_{H_2}}{M_{X_2}}} \Rightarrow \frac{1}{4} = \sqrt{\frac{M_{H_2}}{M_{x_2}}} \Rightarrow M_{X_2} = 16 \times 2 = 32$

78. Answer (2)

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

Sol.: Greater is the positive value of Δn_g, higher will be '$\Delta H - \Delta U$'.

79. Answer (2)

Hint: For adiabatic process, Q = 0.

Sol.: $\Delta U = Q + W$ (first law of thermodynamics)

$\Delta U = W$ (for adiabatic process).

80. Answer (4)

Hint: If $\Delta H < 0$ and $\Delta S > 0$ then reaction is spontaneous at all temperatures.

81. Answer (1)

Hint: During evaporation, entropy increases.

82. Answer (4)

Hint: b depends on size of molecules/atoms.

Sol.: Correct order of 'b' is

$CO_2 > O_2 > He$

83. Answer (4)

Hint: Enthalpy change for formation of 1 mole compound from its elements in standard states is known as enthalpy of formation.

84. Answer (2)

Hint: In adiabatic process, heat exchange is zero.

85. Answer (1)

Hint: Intensive properties do not depend on mass.

Sol.: Surface tension is an intensive property.

86. Answer (4)

Hint: Higher is the critical temperature, easier will be the liquifaction of gas.

Sol.: H_2O(g) has highest critical temperature among the given gases due to H-bonding.

87. Answer (3)

Hint: Dalton's law is applicable for non-reacting gases. He(g) is least likely to react with CO_2(g).

88. Answer (1)

Hint: Rate of diffusion $\propto \sqrt{\left(\frac{1}{\text{molar mass}}\right)}$.

89. Answer (2)

Hint: At constant volume, $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

Sol.: $\frac{P^\circ}{273.15} = \frac{P_f}{274.15}$

$\Delta P = \frac{P^\circ}{273.15}$

90. Answer (2)

Hint: 1 bar = 0.987 atm

[BIOLOGY]

91. Answer (1)

Hint: Bulliform cells are large, empty, colourless cells.

Sol.: Bulliform cells become flaccid during water stress and curl the leaf inward. They are found in monocots especially grasses.

92. Answer (1)

Hint: Growth rings are very distinct in plants of temperate regions.

Sol.: Roots are underground structures thus cambium do not show variation in its activity due to seasonal change. In roots, vascular cambium is formed at the time of secondary growth and thus completely secondary in origin.

93. Answer (2)

Hint: Tyloses are formed in heartwood.

Sol.: Tyloses are balloon like swellings formed by xylem parenchyma cells in xylem vessels to make them nonfunctional. They are found in angiospermic woods.

94. Answer (3)

Hint: Heartwood is nonfunctional wood.

Sol.: Heartwood includes nonfunctional secondary xylem.

95. Answer (1)

Sol.: *Pistia* & *Eicchornia* have subaerial stem called offset.

96. Answer (2)

Sol.: After many secondary growth—

Oldest layer of sapwood – just outside the heartwood.

Oldest secondary phloem – just inner to primary phloem.

Primary phloem – inner to pericycle.

97. Answer (1)

Hint: Cork has suberin deposited cells.

Sol.: Cork/phellem is formed by redifferentiation and has thick walled cells at maturity. It is also found in dicot roots.

98. Answer (1)

Hint: Sapwood is peripheral active region of wood.

Sol.: Sapwood – conduct water.

Heartwood – • filled with tannins, phenols

• do not conduct water

99. Answer (3)

Hint: In plants of temperate region, cambium is more active in spring & less active in autumn season.

Sol.: Spring wood – lighter in colour, less density

Autumn wood – darker in colour, high density.

While plants of tropical regions do not show differential activity of cambium.

100. Answer (2)

Hint: Isobilateral leaves have equal number of stomata on both the surfaces.

Sol.: Isobilateral leaves are found in monocots. They lack palisade parenchyma & have close type of vascular bundles.

101. Answer (1)

Hint: Cells of endodermis may store starch grains in stem.

Sol.: In dicot stem, endodermis is also called starch sheath, however endodermis is absent in monocot stem.

102. Answer (3)

Hint: Axillary bud may modify into thorns or tendrils.

Sol.: Spines of *Aloe* – modified leaves.

Thorns of *Citrus* and *Bougainvillea*
Tendril of watermelon] Modified axillary buds

103. Answer (1)

Sol.: In cymose inflorescence, main axis (peduncle) terminates into a flower, thus shows limited growth. Flowers are arranged in basipetal order.

104. Answer (2)

Hint: Pericycle is a cylinder of thin walled parenchymatous or thick walled sclerenchymatous tissue.

Sol.: Pericycle is absent in monocot stem. In roots, pericycle forms lateral roots and a part of vascular cambium.

105. Answer (4)

Sol.: Stele includes all the tissues inside the endodermis *i.e*. pericycle, vascular bundle and pith. Hypodermis is the part of ground tissue.

106. Answer (3)

Hint: Trichomes prevent water loss whereas root hairs increase water absorption.

Sol.: Root hair – Unicellular, unbranched

Trichome – Unicellular / multicellular and Branched / unbranched

Both are epidermal appendages.

107. Answer (1)

Hint: In alternate phyllotaxy the stem bear single leaf at each node in alternate fashion.

Sol.: Guava, *Calotropis* – Opposite phyllotaxy

Sunflower – Alternate phyllotaxy

Nerium – Whorled phyllotaxy.

108. Answer (4)

Hint: Phloem parenchyma is absent in monocots.

Sol.: Roots have exarch condition of xylem in vascular bundles in which protoxylem is towards the periphery.

Given features are true for monocot stem as they have sclerenchymatous hypodermis and endarch xylem *i.e*. protoxylem towards pith.

109. Answer (1)

Hint: In *Opuntia*, leaves modify to minimise water loss.

Sol.: In *Opuntia*, stem is modified to perform photosynthesis and leaves modify into spines. Such stems are called phylloclade.

110. Answer (4)

Sol.: Pneumatophores or respiratory roots are modified tap roots. Rest are adventitious roots.

111. Answer (1)

Hint: Vessel is mainly found in members of angiospermae.

Sol.: Vessel is main water conducting element of angiosperms while tracheid is main water conducting element of gymnosperms & pteridophytes. Algae lack vascular tissues.

112. Answer (1)

Hint: A vessel is made up of many cells.

Sol.: Tracheid is a single elongated cell. However both are dead, thick walled tissues and involved in conduction of water.

113. Answer (4)

Hint: Protoxylem is a type of primary xylem.

Sol.: Protoxylem & metaxylem both are found in dicot as well as monocot plants.

114. Answer (4)

Hint: In some plants adventitious roots provide mechanical support.

Sol.: Banyan tree – roots arise from stem branches to provide mechanical support.

Turnip, Radish – modified tap root for food storage.

Rhizophora – modified tap root for respiration.

115. Answer (4)

Hint: Parenchyma and collenchyma both are living simple permanent tissues.

Sol.: Parenchyma – thin walled, may have chloroplast & intercellular space.

Collenchyma – may have chloroplast, intercellular space always absent, it provides mechanical support.

116. Answer (3)

Hint: Onion belongs to family Liliaceae while potato belongs to family Solanceae.

Sol.: Both onion and potato are/have

- Modified underground stem
- Actinomorphic flower & ovary with axile placentation

In onion, fleshy leaves are modified for food storage and being monocot it has fibrous roots. However these features are absent in potato.

117. Answer (3)

Sol.: Tendril is modification of stem in pumpkin, grape vine, cucumber whereas it is modified leaf in pea, sweet pea, *Nepenthes* & *Smilax*. Belladonna & wheat lack tendril.

118. Answer (1)

Sol.: Muliathi – Medicinal plant

Lupin – Ornamental plant

Sesbania – Fodder plant

Colchicum – Yields colchicine which is used in doubling of chromosomes.

119. Answer (1)

Hint: Persistent calyx is a feature of members of family Solanaceae.

Sol.: Brinjal – Solanaceae (persistent calyx)

Tulip, *Gloriosa* – Liliaceae

Mustard – Brassicaceae

120. Answer (3)

Hint: Seeds of cereals have thin and membranous seed coat.

Sol.: Cereals are monocots and have thin seed coat. Tobacco (*Nicotiana tabacum*) is a fumigatory plant of Solanaceae family.

121. Answer (4)

Sol.: Lupin, tulip, sweet pea and *Petunia* all are ornamental plants.

Lupin, sweet pea – Fabaceae

Tulip – Liliaceae

Petunia – Solanaceae

122. Answer (1)

Sol.: Sunhemp – Fabaceae

Gloriosa – Liliaceae

Belladonna – Solanaceae

123. Answer (2)

Hint: *Indigofera* belongs to family Fabaceae.

Sol.: Members of Fabaceae family have

- Non endospermic seeds
- Legume type of fruit
- Zygomorphic flower
- Racemose inflorescence

124. Answer (2)

Hint: Tulip flowers have epiphyllous stamens.

Sol.: $\overset{\frown}{C\ A}$ – epipetalous stamens

$\overset{\frown}{P\ A}$ – epiphyllous stamens

125. Answer (1)

Hint: Aestivation and placentation are shown in floral diagram.

Sol.: Given floral formula is of family Brassicaceae. A floral formula does not represent aestivation of petals or sepals and placentation of ovary.

126. Answer (3)

Hint: Scutellum represents the single cotyledon.

Sol.: Single cotyledon of monocots is called scutellum.

127. Answer (3)

Hint: Castor have albuminous seeds.

Sol.: Being albuminous castor have triploid endosperm rich in oil and fats. In all angiosperms endosperm develops after fertilisation.

128. Answer (1)

Hint: Banana have parthenocarpic fruits.

Sol.: Parthenocarpic fruits are seedless and develop from ovary but without fertilization.

129. Answer (2)

Hint: Mango and coconut have drupe type of fruits.

Sol.: In mango, mesocarp is edible and epicarp is thin while in coconut, mesocarp is used in making coir. Endocarp is hard and stony in both.

Drupe develops from monocarpellary superior ovary.

130. Answer (2)

Hint: In lotus, ovary is apocarpous.

Sol.: In apocarpous ovary, carpels are free. Lotus has multicarpellary, apocarpous ovary.

131. Answer (3)

Hint: In epiphyllous condition, stamens are attached to perianth.

Sol.: Tomato lacks perianth, thus epiphyllous condition is absent in it, rather it shows epipetalous stamens.

132. Answer (3)

Hint: In bean flower, petals show vexillary aestivation.

Sol.: In bean flower, petals are of three types.

(1) **Standard :** largest posterior one.

(2) **Keel :** smallest anterior petals.

(3) **Wings :** smaller lateral petals.

133. Answer (3)

Sol.: In imbricate aestivation, margins of petals and sepals overlap each other but not in a particular direction. *eg*. *Cassia*.

134. Answer (2)

Hint: In china rose all the stamens are united in single bundle.

Sol.: China rose has

(1) Monoadelphous stamens

(2) Placenta in the axial position *i.e*. axile placentation.

135. Answer (2)

Hint: Epigynous flowers have inferior ovary.

Sol.: When margin of thalamus grows upward and encloses the ovary completely the ovary is said to be inferior *eg*. guava, cucumber etc.

136. Answer (3)

Hint: Suffix ‘itis’ indicates inflammation.

Sol.:

(a) Nephritis – Inflammation of kidney

(b) Cystitis – Inflammation of urinary bladder

(c) Uremia – Increased concentration of urea in blood

(d) Haematuria – Presence of blood in the urine

137. Answer (1)

Hint: 288 L of CO_2 is released per day.

Sol.: Our lungs remove large amounts of CO_2 *i.e*. 200 mL/min.

138. Answer (2)

Hint: Urea cycle.

Sol.: Ornithine cycle occurs in liver in which 1 molecule of urea is syntherised from 1 molecule of CO_2 and 2 molecules of NH_3.

139. Answer (3)

Hint: One gram = 1000 mg.

Sol.: An adult human excretes, on an average, 1 - 1.5 L of urine per day. 25-30 gm of urea is excreted per day.

140. Answer (3)

Hint: Insulin deficiency.

Sol.: Presence of glucose and ketone bodies urine are indicative of diabetes mellitus.

141. Answer (4)

Hint: This structure is not a part of nephron.

Sol.: Conditional reabsorption and tubular secretion occur in DCT.

142. Answer (1)

Hint: Conditional reabsorption.

Sol.: Angiotensin II activates the adrenal cortex to release aldosterone, which causes reabsorption of Na^+ and water from DCT.

143. Answer (1)

Hint: Part of renal tubule having maximum microvilli.

Sol.: PCT is lined by simple cuboidal brush border epithelium which increases the surface area for reabsorption.

144. Answer (2)

Hint: Cardiac output is 5L.

Sol.: 1000 - 1200 ml is the renal blood flow which is filtered by kidney per minute.

145. Answer (3)

Hint: Renal columns.

Sol.: Extended cortex between the medullary pyramids as renal columns are called columns of Bertini.

146. Answer (1)

Hint: Maximum water is required for elimination of ammonia.

Sol.: Ammonia is the most toxic form of nitrogenous waste and requires large amount of water for its elimination, whereas uric acid, being the least toxic, can be removed with a minimum loss of water.

147. Answer (2)

Hint: Aquatic arthropods.

Sol.: Antennal glands/green glands perform the excretory function in crustaceans like prawns.

148. Answer (4)

Hint: Identify a free living flatworm.

Sol.: Protonephridia or flame cells are the excretory structures in platyhelminthes, rotifers, some annelids and cephalochordates.

149. Answer (2)

Hint: The nitrogenous waste which is most soluble in water.

Sol.: Ammonia is the most toxic form and requires large amount of water for its elimination. Ammonotelism occurs in many bony fishes, aquatic amphibians and aquatic insects.

150. Answer (3)

Hint: Common salt increases blood pressure.

Sol.: Hypertension – Systolic $\geq$ 140 mmHg

Diastolic $\geq$ 90 mmHg

Heart failure – Congestion of lungs is one of the main symptoms due to which heart does not pump blood effectively enough to meet the need of the body.

151. Answer (3)

Hint: Respiratory rhythm centre is also present here.

Sol.: Medulla oblongata can moderate the cardiac functions through ANS. ANS provides both sympathetic and parasympathetic supply to the heart.

152. Answer (4)

Hint: Epithelial part of blood vessels.

Sol.: The wall of capillaries are composed of just one cell layer of simple squamous epithelium or endothelium.

153. Answer (4)

Hint: Acetylcholine has inhibitory effect on cardiac musculature.

Sol.: Parasympathetic nerve endings release acetylcholine which decreases the rate of heart beat, speed of conduction of action potential and cardiac output.

154. Answer (2)

Hint: This is evaluated using inulin.

Sol.: 99% of filtrate is reabsorbed.

155. Answer (3)

Hint: Myeloid tissue present in bones.

Sol.: In humans, erythropoiesis during embryonic development occurs in yolk sac, liver and spleen. When RBC count is very low yellow bone marrow converts into red bone marrow in adults.

156. Answer (2)

Hint: Identify the most abundant WBCs.

Sol.: Neutrophils and monocytes are phagocytic cells which destroy foreign organisms entering the body.

157. Answer (3)

Hint: The term pulmonary refers to lungs.

Sol.: From the ascending aorta, right and left coronary arteries arise which supply oxygenated blood to the heart muscles.

158. Answer (2)

Hint: Second heart sound.

Sol.: Isovolumetric systole represents the duration between closure of AV valve and opening of semilunar valve.

159. Answer (3)

Hint: Veins carry blood to the heart.

Sol.:
- Arteries distribute blood from heart to different parts of the body.
- Tunica media is thicker in arteries having more muscle fibres.

160. Answer (4)

Hint: First downward wave in ECG.

Sol.: QRS complex represents depolarisation of the ventricles, which initiates ventricular contraction. The contraction of ventricles starts shortly after Q and marks the beginning of systole.

161. Answer (3)

Hint: Ventricular repolarisation.

Sol.: The T-wave represents the return of the ventricles from excited to normal state.

162. Answer (2)

Hint: Maximum filling of ventricles occurs during joint diastole.

Sol.: 70% filling of ventricles occurs during joint diastole and 30% occurs during filling atrial contraction.

163. Answer (3)

Hint: AV valves guard between atria and ventricles.

Sol.: First heart sound ‘lub’ is low pitched and of longer duration than dub and is produced by closure of AV valves.

164. Answer (3)

Hint: SA node is called pace maker.

Sol.: Cardiac muscle cells have ability to generate the electrical impulses that trigger cardiac contraction. SA node generates the maximum number of action potentials *i.e.* 70 – 75 min^{-1}.

165. Answer (2)

Hint: White fibrous cords attached with tricuspid and bicuspid valves.

Sol.: Chordae tendinae are attached to the flaps of bicuspid and tricuspid valves at one end and their other ends are attached to the ventricular wall with papillary muscles.

166. Answer (2)

Hint: Cardiac output = Stroke volume × Heart rate.

Sol.: SV = EDV – ESV

EDV = 120 ml,

ESV = 50 ml

So, SV = 120 – 50 = 70 ml

SV = Stroke volume

EDV = End diastolic volume

ESV = End systolic volume

167. Answer (3)

Hint: SAN is called Pacemaker of heart.

Sol.:
- SAN generates an action potential which stimulates both the atria to undergo simultaneous contraction.
- Ventricular systole increases the ventricular pressure causing closure of tricuspid and bicuspid valves due to attempted backflow of blood into the atria.

168. Answer (2)

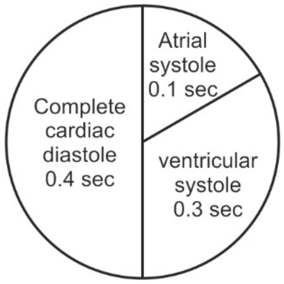
Hint: Phase of cardiac cycle in which volume of heart chambers increases.

Sol.: Blood from pulmonary veins and venae cavae, fills the left and right atria, respectively. The pressure causes AV valves to open and blood to flow from atria into ventricles.

169. Answer (3)

Hint: Atrial diastole coincides with ventricular systole.

Sol.:



170. Answer (1)

Hint: Atrio-ventricular valve.

Sol.: Opening between right atrium and right ventricle and opening between left atrium and left ventricle is guarded by tricuspid and bicuspid valve respectively.

171. Answer (4)

Hint: Notochord extends from head to tail region in this taxon.

Sol.: In protochordates and urochordate have open circulatory system, while cephalochordates have closed circulatory system. In open circulatory system, blood fills in open spaces/sinuses.

- Except urochordates all chordates have closed circulatory system.
- In non-chordates, annelids (except leech) and cephalopods have closed circulatory system.

172. Answer (4)

Hint: Lymph is filtered product of blood.

Sol.: Lymph has the same mineral distribution as that in plasma.

173. Answer (4)

Hint: Thrombokinase catalyses conversion of prothrombin to thrombin.

Sol.: Fibrinogen $\xrightarrow{\text{Thrombin}}$ Fibrin

174. Answer (3)

Hint: Thrombocytes are platelets.

Sol.: Leukocytes - 6000 to 8000 mm^{-3}.

175. Answer (1)

Hint: Universal blood donor.

Sol.:

Blood Groups and Donor Compatibility

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

176. Answer (3)

Hint: These are also called platelets.

Sol.: Thrombocytes are cell fragments produced from megakaryocytes. Thrombocytes/platelets release a variety of substances involved in coagulation of blood.

177. Answer (3)

Hint: Cells that secrete histamine, serotonin and heparin.

Sol.: Differential leukocyte count in blood – Neutrophils (Maximum) > Lymphocytes > Monocytes > Eosinophils > Basophils (Minimum)

Basophils are least (0.5 – 1%) in number.

178. Answer (3)

Hint: Blood cells that lack nucleus and other organelles.

Sol.: RBCs are biconcave in shape so it helps in providing more room for haemoglobin.

179. Answer (4)

Hint: Proteins contribute 6 – 8% of plasma.

Sol.: RBCs, WBCs & platelets are collectively called formed elements. Plasma proteins are not formed elements.

180. Answer (3)

Hint: Protein that is the main content of bird's egg.

Sol.: Albumin helps in maintaining the blood colloidal osmotic pressure.

- Fibrinogen & prothrombin are blood clotting proteins.
- Globulins are involved in defence mechanisms of the body.

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