All India Aakash Test Series for Medical - 2020

TEST - 2 (Code-E)

Test Date : 17/11/2019

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

1. Answer (2)

Hint : $a = \frac{(m_2 - m_1)}{(m_2 + m_1)} g$.

Sol. : $a = \frac{(2-1)}{(2+1)} g = \frac{10}{3}$ m/s^2 for each blocks.

2. Answer (1)

Hint : Conservation of linear momentum and e = 1.

Sol. : Before collision

After collision

Conservation of linear momentum

$10 \times 4 = 10v_1 + 6v_2$

$\Rightarrow \quad 20 = 5v_1 + 3v_2$

Coefficient of restitution = e = 1

$v_2 - v_1 = 4$

$\Rightarrow \quad 5v_2 - 5v_1 = 20$

v_2 = 5 m/s

v_1 = 1 m/s

3. Answer (2)

Hint : $\Delta U = -W_c$.

Sol. : $\Delta U = -(-3\hat{i}) \cdot (6\hat{i})$

ΔU = 18 J

4. Answer (2)

Hint : Use parallel axis theorem.

Sol. : $I = \frac{2}{5} mR^2 + mR^2$

$= \frac{7}{5} mR^2$

5. Answer (4)

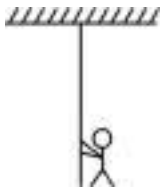
Hint : $F_{min} = \frac{\mu mg}{\sqrt{\mu^2 + 1}}$, when $\theta = \lambda$

Sol. : $F_{min} = \frac{1 \times 10 \times 10}{\sqrt{2}\sqrt{1^2 + \left(\frac{1}{\sqrt{2}}\right)^2}} = \frac{100}{\sqrt{3}}$ N

6. Answer (3)

Hint : Newton's second law of motion.

Sol. :



$mg - T = ma$

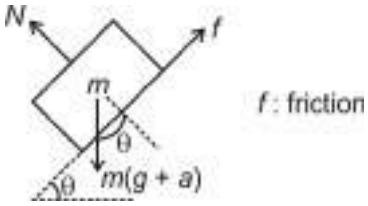
$a = \frac{mg - T}{m}$

$a_{(min)} = \frac{mg - mg/5}{m} = \frac{4g}{5} = 8$ m/s^2

7. Answer (4)

Hint : $\theta = \tan^{-1}(\mu)$ is angle of repose.

Sol. : *FBD* of block from frame of reference of the elevator.



$m(g + a) \cos\theta = N$

$m(g + a) \sin\theta = f$

Dividing $\Rightarrow \frac{f}{N} = \tan(\theta) \Rightarrow f = \mu N$

Since the value of friction = μN is possible.

$\therefore$ Block will remain at rest.

8. Answer (1)

Hint : Newton's second law of motion.

Sol. : Let tension in string be T

$50 - T = 5a$

$T - 10 = 10a$

$\Rightarrow \quad a = \frac{40}{15} = \frac{8}{3}$ m/s^2

9. Answer (3)

Hint : Conservation of mechanical energy.

Sol. : $mg\frac{l}{2} = \frac{1}{2}I\omega^2$

$mg\frac{l}{2} = \frac{1}{2}\left(\frac{ml^2}{3}\right)\omega^2$

$\sqrt{\frac{3g}{l}} = \omega$

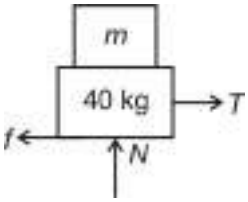
$\omega = \sqrt{\frac{30}{0.3}} = 10$ rad/s

10. Answer (3)

Hint : Maximum value of static friction = μN.

Sol. :

$\Rightarrow \quad T = 20$ g = 200 N



$T = f$

$\Rightarrow \quad T \le \mu N$

$T \le \mu(40 + m)g$

$200 \le 0.25\,(40 + m)(10)$

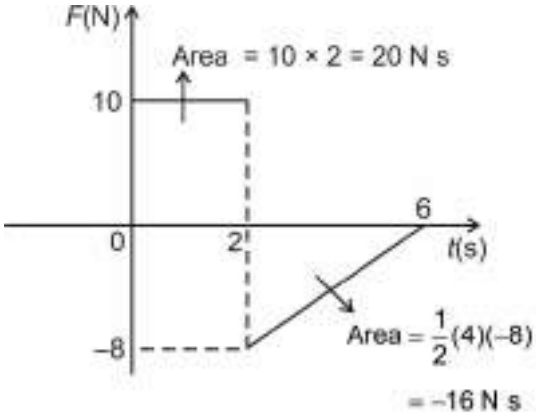
$\frac{20}{0.25} \le 40 + m$

$40 \text{ kg} \le m$

11. Answer (1)

Hint : Δp = area under F-t graph.

Sol. :



Total area = 20 – 16 = 4 N s

= 4 kg m s^{-1}

Momentum change/mass = $\frac{4}{2}$ = 2 m/s

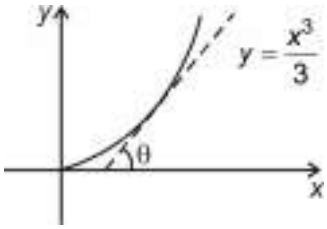
12. Answer (4)

Hint & Sol. : Since there is no external force on the system, velocity of centre of mass remains constant.

13. Answer (2)

Hint : Acceleration = $g\sin\theta$ (θ is slope angle).

Sol. :



Slope = $\tan(\theta) = \frac{dy}{dx} = x^2$

$\Rightarrow \quad \left.\frac{dy}{dx}\right|_{x=1} = 1$

$\theta = 45°$

$\sin\theta = \frac{1}{\sqrt{2}}$

$a = \frac{g}{\sqrt{2}}$

14. Answer (3)

Hint : Work-energy theorem.

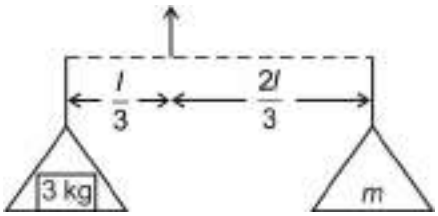
Sol. : Since the initial kinetic energies of both blocks are same. The work done on both blocks by the forces must be same.

$\Delta K = \vec{F}.\vec{S}$

15. Answer (2)

Hint : Rotational equilibrium.

Sol. :



$3g\left(\frac{l}{3}\right) = mg\left(\frac{2l}{3}\right)$

$3 = 2m$

$\Rightarrow \quad m = \frac{3}{2}$ = 1.5 kg

16. Answer (1)

Hint : Gravitational potential energy = *mgy*.

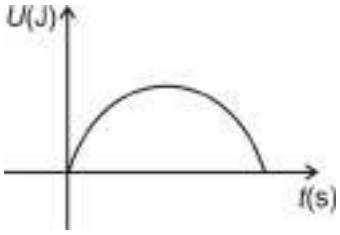
Sol. : $y = u\sin\theta t - \frac{1}{2}gt^2$

(symbols have their usual meanings)

$U = mgy = mg\left(u\sin\theta t - \frac{1}{2}gt^2\right)$

$\Rightarrow \quad U = At - Bt^2 \qquad \left\{\begin{matrix} A = mgu\sin\theta \\ B = \frac{mg^2}{2} \end{matrix}\right\}$

$\therefore$ *U* v/s *t* is a downward parabolic graph



17. Answer (4)

Hint & Sol. : Gravitational potential energy (*U*) can be negative as its value depends on zero potential energy reference frame chosen.

Kinetic energy $\left(K = \frac{1}{2}mv^2\right)$ is either zero or positive.

Mechanical energy (*U* + *K*) may be negative, positive or zero depending on value and sign of gravitational potential energy.

18. Answer (4)

Hint : $\tau = I\alpha$, $I = mk^2$ (k : radius of gyration).

Sol. : $\tau = I\alpha = mk^2\alpha$

$36 = m(4^2)(9)$

$m = \frac{36}{4^2 \times 9}$ = 0.25 kg

19. Answer (1)

Hint & Sol. : The theorem of perpendicular axes is applicable only for planar bodies.

20. Answer (2)

Hint : $\vec{v}_P = \vec{v}_{P/\text{com}} + \vec{v}_{\text{com}}$.

Sol. : $\vec{v}_{P/\text{com}} = 12 \times 2(-\hat{i}) = -24\hat{i}$

$\vec{v}_{\text{com}} = 6\hat{i}$

$\vec{v}_P = 6\hat{i} - 24\hat{i} = -18\hat{i}$ m/s

$|\vec{v}_P| = 18$ m/s

21. Answer (3)

Hint : $\text{KE} = \frac{1}{2}mv_{\text{cm}}^2 + \frac{1}{2}I_{\text{cm}}\omega^2$.

Sol. : $\text{KE}_{(\text{disc})} = \frac{1}{2}mv_0^2 + \frac{1}{2}\left(\frac{mR^2}{2}\right)\omega^2$

$= \frac{1}{2}mv_0^2 + \frac{mR^2}{4}\left(\frac{v_0^2}{R^2}\right)$

$\text{KE}_{(\text{disc})} = \frac{3}{4}mv_0^2$

$v_{\text{particle}} = \sqrt{2}v_0$

$\Rightarrow \quad \text{KE}_{(\text{particle})} = \frac{1}{2}m\left(\sqrt{2}v_0\right)^2$

$= mv_0^2$

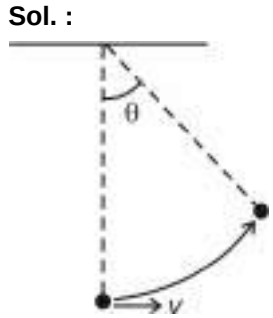
$\text{KE}_{(\text{net})} = \frac{3}{4}mv_0^2 + mv_0^2$

$= \frac{7}{4}mv_0^2$

22. Answer (2)

Hint : Conservation of momentum.

Sol. :



Applying conservation of momentum

$mu = (2m)v$

$\Rightarrow \quad v = \frac{u}{2}$

Conservation of mechanical energy:

$$\frac{1}{2}(2m)\left(\frac{u}{2}\right)^2 = 2mgl(1-\cos\theta)$$

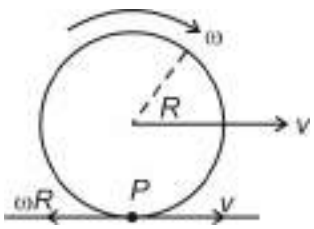
$$1-\cos\theta = \frac{u^2}{8gl}$$

$$\cos\theta = 1-\frac{u^2}{8gl}$$

$$\Rightarrow \quad \theta = \cos^{-1}\left(1-\frac{u^2}{8gl}\right)$$

23. Answer (2)

Hint & Sol. : For a body rolling purely on horizontal surface, the point of contact with the ground is instantaneously at rest



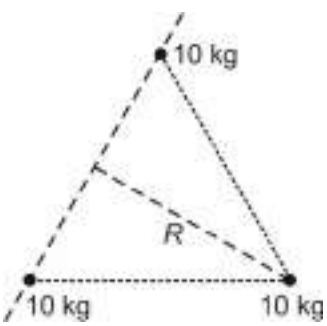
Net velocity of P

$v - \omega R = 0$

24. Answer (2)

Hint : Moment of inertia of a point mass = mR^2.

Sol. :



$R = \sqrt{2^2 - 1}$

$= \sqrt{3}$

$I = 10(0)^2 + 10(0)^2 + 10\left(\sqrt{3}\right)^2$

$= 30 \text{ kg m}^2$

25. Answer (2)

Hint & Sol. : Moment of inertia is not a vector quantity. According to parallel axis theorem, $I = I_{com} + md^2$.

$\therefore$ Minimum moment of inertia (among parallel axis) is about an axis passing through centre of mass

26. Answer (1)

Hint : $\vec{v} = \vec{\omega} \times \vec{r}$

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

$= 4\hat{k} - \hat{k} = 3\hat{k}$ m/s

27. Answer (3)

Hint & Sol. : In stable equilibrium, the potential energy is minimum.

28. Answer (2)

Hint : $\Delta KE = \frac{1}{2}\frac{m_1 m_2}{m_1 + m_2}(u_1 - u_2)^2(1-e^2)$.

Sol. : $\Delta KE = \frac{1}{2}\frac{(6\times 6)}{(6+6)}\{10\}^2\left\{1-\left(\frac{1}{4}\right)^2\right\}$

$= \frac{1125}{8}$ J

29. Answer (4)

Hint & Sol. : As the body moves towards ground, the potential energy decreases. Since the body accelerates, the kinetic energy increases.

30. Answer (2)

Hint : Conservation of mechanical energy.

Sol. : Let maximum extension = x

At maximum extension, speed of block = 0

$$-mg(x) + \frac{1}{2}kx^2 = 0$$

$$\Rightarrow \quad x = \frac{2mg}{k} = \frac{2\times 10\times 10}{400} = 0.5 \text{ m}$$

31. Answer (3)

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

Sol. : F = tension = mg = $10 \times 10^3 \times 10 = 10^5$ N

v = 0.6 m/s

Power = 6×10^4 W

= 60 kW

32. Answer (1)

Hint : Work done by gravity = change in kinetic energy.

Sol. : Work done by gravity = (mg) × displacement

∴ Ratio of work done = Ratio of displacement

= 1 : 5

33. Answer (2)

Hint & Sol. : $dK = m\vec{v} \cdot d\vec{v}$

$dK = \vec{p} \cdot d\vec{v}$

34. Answer (1)

Hint & Sol. : As internal forces cancel out in a system, according to Newton's III law of motion, they lead to no net force and hence no net change in momentum.

35. Answer (4)

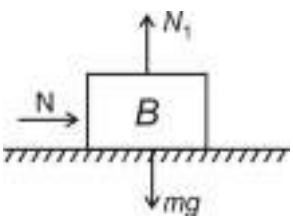
Hint : Newton's II law of motion.

Sol. : Acceleration of the system (a) = $\dfrac{F}{m_A + m_B}$

$= \dfrac{80}{4+12} = \dfrac{80}{16}$

= 5 m/s^2

FBD of block B



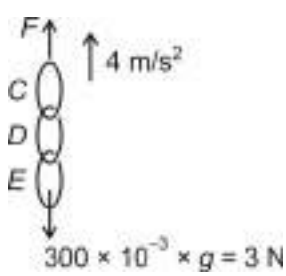
$N = m_B a$

N = 12 × 5 = 60 N

36. Answer (1)

Hint : $F_{net} = ma$.

Sol. : FBD of links C, D and E combined



F – 3 = (0.3) × 4

F = 3 + 1.2 = 4.2 N

37. Answer (3)

Hint : $\text{KE} = \dfrac{1}{2} I\omega^2$.

Sol. : $\dfrac{1}{2} I_A \omega_A^2 = \dfrac{1}{2} I_B \omega_B^2$

$\Rightarrow \dfrac{1}{2} I_A (\omega)^2 = \dfrac{1}{2} I_B (2\omega)^2$

$I_A = 4I_B$

38. Answer (2)

Hint : Spring force and Newton's II law of motion.

Sol. : Let compression in spring be x

For m_1

$F - kx = m_1 a_1$

$80 - kx = 10 \times 4$

$\Rightarrow kx = 40$ N

For m_2

$\Rightarrow 40 = m_2 a_2$

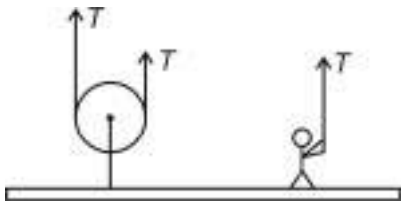
$a_2 = \dfrac{40}{20} = 2$ m/s^2

39. Answer (4)

Hint : Net force on man plus platform system will be zero.

Sol. : Let force applied by man be F

∴ Tension = T



$3T$ = (25 + 50) g

T = 25 × 10 = 250 N

40. Answer (2)

Hint & Sol. : Initially friction will be equal to the applied force. Later it becomes constant (kinetic friction).

41. Answer (1)

Hint : Rotational $\text{KE} = \dfrac{1}{2} I\omega^2$

Translational $\text{KE} = \dfrac{1}{2} mv^2$.

Sol. : $v = \omega R$

$$KE_{(Rotational)} = \frac{1}{2}I\omega^2 = \frac{1}{2}\left(\frac{2}{5}mR^2\right)\omega^2$$

$$= \frac{1}{5}mv^2$$

$$KE_{(Translational)} = \frac{1}{2}mv^2$$

$$\text{Ratio} = \frac{KE_{(Rotational)}}{KE_{(Rotational)} + KE_{(Translational)}}$$

$$= \frac{\frac{1}{5}mv^2}{\frac{1}{2}mv^2 + \frac{1}{5}mv^2} = \frac{2}{7}$$

42. Answer (3)

Hint : Rate of change of angular momentum = Torque = $mg(x)$.

Sol. : Torque = $mg\left(\frac{R}{2}\right)$

$$= mg\left(\frac{u^2\sin(2\theta)}{2g}\right)$$

$$= \frac{mgu^2}{2g} = \frac{1}{2}mu^2$$

43. Answer (4)

Hint : $x_{com} = \frac{\sum m_i x_i}{\sum m_i}$; $y_{com} = \frac{\sum m_i y_i}{\sum m_i}$.

Sol. : $x_{com} = \frac{1(0)+3(0)+6(4)}{6+3+1} = \frac{24}{10} = 2.4$

$$y_{com} = \frac{1(0)+3(4)+6(0)}{6+3+1} = \frac{12}{10} = 1.2$$

Position of COM = (2.4, 1.2)

44. Answer (2)

Hint : $p = \sqrt{2mK}$.

Sol. : $p_i = \sqrt{2mK_i}$

$K_f = 4K_i$

$$p_f = \sqrt{2mK_f} = \sqrt{2m(4K_i)} = 2\sqrt{2mK_i}$$

$p_f = 2p_i$

45. Answer (1)

Hint & Sol. : The moment of inertia of a uniform cylinder about its geometric axis is $\frac{1}{2}MR^2$.

[CHEMISTRY]

46. Answer (4)

Hint : For basic buffer, pOH = pK_b + log $\frac{[Salt]}{[Base]}$.

Sol. : pOH = $pK_b + \log\frac{[R\overset{+}{N}H_3]}{[RNH_2]}$

$$= -\log 10^{-5} + \log\left(\frac{0.40}{0.60}\right) = 4.82$$

pH = 14 – 4.82 = 9.18

47. Answer (4)

Hint : Hydrolysis of $RCOO^-$

$RCOO^-(aq) + H_2O(l) \rightleftharpoons RCOOH(aq) + OH^-(aq)$

Sol. : $K_h = \frac{K_w}{K_a(RCOOH)} = \frac{10^{-14}}{10^{-6}}$

$\Rightarrow K_h = 10^{-8}$

48. Answer (1)

Hint : For a reversible isothermal expansion of an ideal gas

$$\Delta S = nR \times 2.303 \log_{10}\left(\frac{V_f}{V_i}\right)$$

Sol. : $\Delta S = 2 \times 8.314 \times 2.303 \log_{10}\left(\frac{23.03}{2.303}\right)$

$= 38.29\ J\ K^{-1}$

49. Answer (2)

Hint : For H_2 gas, molecular attractive forces are insignificant.

Sol. : $P + \frac{a}{V^2} \approx P$

van der Waals equation for 1 mole of gas becomes

$P(V-b) = RT \quad \Rightarrow \quad PV - bP = RT$

$$\Rightarrow \quad Z = 1 + \left(\frac{b}{RT}\right)P$$

For Z vs P graph, Slope = $\frac{b}{RT}$

50. Answer (3)

Hint : At identical T, P conditions

$$r \propto \frac{1}{\sqrt{\text{Molecular weight}}}$$

Sol. : $\frac{r_{O_2}}{r_{SO_2}} = \sqrt{\frac{64}{32}} = \sqrt{2} : 1$

51. Answer (1)

Hint $4Zn + NO_3^- + 7H_2O \longrightarrow 4Zn^{2+} + NH_4^+ + 10\ OH^-$

x = 4, y = 1, c = 10

52. Answer (3)

Hint : F is most electronegative element.

Sol. : Oxidation state of F is always –1 in its compound.

53. Answer (3)

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

Sol. : For reaction

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$

$\Delta n_g = 1$

So, $K_p = K_c(RT)$

or $K_p > K_c$

54. Answer (2)

Hint : Mass of pure solids do not affect pressure/ concentration of equilibrium.

Sol. : A decomposition reaction is endothermic. When temperature increases, equilibrium shifts in forward direction.

55. Answer (2)

Hint : For spontaneous reaction $\Delta_rG < 0$.

Sol. : $\Delta_rG = \Delta_rH - T\Delta_rS < 0$,

Reaction will be spontaneous at all temperatures when Δ_rH is –ve and Δ_rS is +ve.

56. Answer (1)

Hint : Conjugate acid is formed by addition of one H^+ while conjugate base is formed by release of one H^+.

57. Answer (3)

Hint : Acid having higher value of K_a will be more acidic.

58. Answer (3)

Hint : $R = 8.314 \frac{J}{mol\text{-}K}$.

Sol. : $C_p - C_v = R$

59. Answer (4)

Hint : HBr is a polar molecule.

Sol. : Dipole-dipole interaction energy between rotating polar molecules is proportional to $\frac{1}{r^6}$.

60. Answer (1)

Hint : Molecules involving more H-bond will have less vapour pressure.

Sol. : $C_2H_5-O-C_2H_5 > CCl_4 > C_2H_5OH > H_2O$ (vapour pressure).

61. Answer (4)

Hint : $V_1M_1 = (V_1 + V_2)M_2$.

Sol. : Initial $[H^+] = 10^{-3}$ M; Final $[H^+] = 10^{-5}$ M

$1 \times 10^{-3} = (1 + V_2) \times 10^{-5}$

$V_2 = 100 - 1 = 99$ L

Hence volume of water added = 100 – 1 = 99 L.

62. Answer (2)

Hint : Aqueous solution of salt of weak base and strong acid will undergo cationic hydrolysis.

Sol. : $NH_4Cl(aq) \longrightarrow \overset{\oplus}{N}H_4(aq) + \overset{\ominus}{C}l(aq)$

$\overset{\oplus}{N}H_4 + H_2O \rightleftharpoons NH_4OH + H^{\oplus}$

63. Answer (1)

Hint : $\Delta S = \frac{q_{rev}}{T}$

Sol. : When heat is added to the system, molecular motion increases, hence entropy increases.

64. Answer (4)

Hint : For a compound, net charge is zero.

Sol. : A_2BC_2 : Net charge $= 2 \times (1) + 4 + 2 \times (-3)$

$= 0$

65. Answer (4)

Hint : $E^o_{cell} = E^o_{Sn^{2+}/Sn} - E^o_{Cd^{2+}/Cd}$

Sol. : E^o_{cell} = –0.14 + 0.4

= 0.26 V

66. Answer (2)

Hint : K.E. = $n \times \frac{3}{2}RT$

Sol. : K.E. = $\frac{14}{28} \times \frac{3}{2} \times 8.314 \times (273 + 127)$

= 2.5 kJ

67. Answer (2)

Hint : $\Delta_r H = \Sigma$ BE of reactants – Σ BE of products.

Sol. : $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, $\Delta_r H = -83$ kJ

$\Delta_r H$ = {B.E (N ≡ N) + 3 B.E. (H – H)} – 6 B.E. (N – H)

$\Rightarrow$ –83 = 946 + (3 ×435) – 6 × B.E. (N – H)

$\Rightarrow$ B.E. (N – H) = 389 kJ mol^{-1}

68. Answer (3)

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

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

$= 5.7 - 300 \times 40 \times 10^{-3}$

= 5.7 – 12

= –6.3 kcal mol^{-1}

69. Answer (4)

Hint : More the polarity of gas, more will be its critical temperature.

Sol. :

Molecule	T_C(K)
H_2	33.2
CO_2	304.1
O_2	154.3
NH_3	405.5

70. Answer (3)

Hint : Multiplying through a factor 'n' in equilibrium reaction, equilibrium constant becomes n^{th} power of initial value.

Sol. : $N_2(g) + O_2(g) \rightleftarrows 2NO(g)$, $K_1 = 64 \times 10^{-2}$

$\frac{1}{2}[(N_2(g) + O_2(g) \rightleftarrows 2\,NO(g)]$, $K_2 = (K_1)^{1/2}$

$= 8 \times 10^{-1} = 0.8$

71. Answer (2)

Hint : $p_{O_2} = \frac{n_{O_2}}{n_{O_2} + n_{Ne}} \times P_{total}$

Sol. : $p_{O_2} = \frac{\frac{32}{32}}{\frac{32}{32} + \frac{180}{20}} \times 100$

$= \left(\frac{1}{10}\right) \times 100 = 10$ atm

72. Answer (3)

Hint : Work done in reversible isothermal expansion w = $-2.303\ nRT\ \log\left(\frac{V_f}{V_i}\right)$

Sol. : w = $-2.303 \times 6 \times 8.314 \times 300 \log\left(\frac{60}{30}\right)$

= –10.4 kJ

73. Answer (1)

Hint : Electron deficient species behaves as Lewis acid.

74. Answer (1)

Hint : The more negative standard electrode reduction potential implies increasing power of reducing nature of metal.

Sol. : Ascending order of reducing power

Ag	<	Hg	<	Zn	<	Mg	<	Na
+0.80 V		+0.79 V		–0.76 V		–2.37 V		–2.71 V

75. Answer (4)

Hint : Oxidation number of Oxygen atom in H_2O_2 is –1

Sol. : $2H_2\overset{-1}{O_2}(aq) \longrightarrow \overset{0}{O_2}(g) + 2H_2\overset{-2}{O}(l)$

76. Answer (2)

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

Sol. : Reaction for which Δn_g is maximum, will have large difference of ΔH and ΔU.

77. Answer (2)

Hint : Salts having high value of K_{sp}, will be more soluble.

78. Answer (2)

Hint : At constant temperature, Boyle's law is applicable.

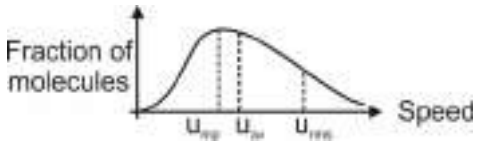
Sol. : $P_1V_1 = P_2V_2$

$\Rightarrow$ 10 bar × 2.27 L = 2 bar × V_2

$\Rightarrow$ V_2 = 11.35 L

79. Answer (3)

Hint :

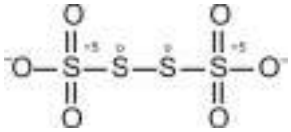


Sol. : $u_{rms} > u_{av} > u_{mp}$

80. Answer (1)

Hint : S — S linkage is present in $S_4O_6^{2-}$ ion.

Sol. :



81. Answer (2)

Hint : Extensive property depends on quantity / amount of matter.

Sol. : Temperature is an intensive property.

82. Answer (3)

Hint : At equilibrium, $K_p = \frac{(p_Y)^2}{(p_{Y_2})}$

Sol. : $Y_2(g) \rightleftharpoons 2Y(g)$

At equilibrium $1 - \alpha$ 2α, $P_T = 1$ atm

$$K_p = \frac{(p_y)^2}{(p_{y_2})} = \frac{\left(\frac{2\alpha}{1-\alpha+2\alpha} \times P_T\right)^2}{\left(\frac{1-\alpha}{1-\alpha+2\alpha} P_T\right)}$$

$$= \frac{(2 \times 0.5)^2}{(1-0.5)} \left(\frac{1}{1+0.5}\right)^{2-1} (\text{atm})^{2-1}$$

$$\Rightarrow K_p = \frac{1^2}{0.5} \times \left(\frac{1}{1.5}\right) = \frac{1}{0.75} = \frac{4}{3} = 1.33 \text{ atm}$$

83. Answer (1)

Hint : Third law permits the calculation of absolute value of entropy of pure crystalline substance.

84. Answer (4)

Hint : Ideal gas equation, PV = nRT

Sol. : $P = \frac{1}{V}(nRT)$

$\Rightarrow$ P vs $\frac{1}{V}$ is straight line passing through origin

As slope increases $\Rightarrow$ nRT increases

$\Rightarrow$ T increases

$\Rightarrow$ $T_1 > T_2 > T_3$

Hence, only set possible is

$T_1 = 800$ K, $T_2 = 600$ K, $T_3 = 100$ K

85. Answer (1)

Hint : $Cr_2O_7^{2-}$ does not act as self-indicator.

Sol. : MnO_4^- acts as the self-indicator in the titration of MnO_4^- and Fe^{2+}.

86. Answer (1)

Hint : If $K_c > 10^3$, then the reaction proceeds nearly to completion.

87. Answer (3)

Hint : $\Delta_{sub}H = \Delta_{fus}H + \Delta_{vap}H$.

Sol. :

$X(s) \longrightarrow X(g)$, $\Delta H = 57.3$ kJ mol^{-1} …(i)

$X(l) \longrightarrow X(g)$, $\Delta H = 41.8$ kJ mol^{-1} …(ii)

Applying (i) – (ii)

$X(s) \longrightarrow X(l)$, $\Delta H = 57.3 - 41.8 = 15.5$ kJ mol^{-1}

88. Answer (4)

Hint : Work done is path function.

89. Answer (3)

Hint : $C_2H_6(g) + \frac{7}{2}O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(l)$

Sol. : $\Delta_rH = 2\,\Delta_fH\{CO_2(g)\} + 3\Delta_fH\{H_2O(l)\} - \Delta_fH\{C_2H_6(g)\}$

$= 2 \times (-90) + 3 \times (-70) - (-20)$

$= -180 - 210 + 20$

$= -370$ kcal mol^{-1}

90. Answer (3)

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

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

$= 10^{-5} \times [3 \times 10^{-5}]^3$

$= 27 \times 10^{-20} = 2.7 \times 10^{-19}$

[BIOLOGY]

91. Answer (1)

Hint : Carl Woese noticed that members of Monera differ from each other.

Sol. : Monera was divided into two kingdoms Archaebacteria and Eubacteria by Carl Woese.

92. Answer (4)

Hint : Cytoplasmic streaming occurs only in eukaryotes.

Sol. : Since monerans are prokaryotes they do not show cytoplasmic streaming.

93. Answer (3)

Sol. : According to shapes, bacteria are classified into four groups: Cocci (spherical), Bacillus (Rod shaped), Vibrio (comma shaped) Spirillum (Spiral)

94. Answer (4)

Hint : These bacteria lack enzymes for aerobic respiration.

Sol. : Obligate anaerobes show anaerobic mode of respiration only.

95. Answer (2)

Sol. : Ability of bacteria to pick up the DNA from solution is called competence.

96. Answer (1)

Hint : Peptidoglycan is not found in some of the monerans.

Sol. : Archaebacteria lack peptidoglycan.

97. Answer (2)

Hint : Streptomycin, erythromycin and chloramphenicol don't interfere synthesis of peptidoglycan.

Sol. : Penicillin interferes synthesis of cell wall. As *Mycoplasma* don't have cell wall they are insensitive to penicillin.

98. Answer (3)

Hint : Slime moulds are connecting link of plants, animals and fungi.

Sol. : Diatoms : Lack flagella throughout the life.

Dinoflagellates : Have heterokont flagella.

Sporozoan : Endoparasite

99. Answer (2)

Hint : Body of *Euglena* is covered by proteinaceous covering.

Sol. : *Euglena* lacks cell wall rather its body is covered with pellicle.

100. Answer (2)

Hint : Dead diatoms are nearly indestructible.

Sol. : Silica deposited cell wall of diatoms make them indestructible.

101. Answer (4)

Hint : Fungal body is called mycelium.

Sol. : Mycelium is made up of a network of hyphae.

102. Answer (2)

Hint : Zygospores are formed by fusion of gametes.

Sol. : Zygospores are diploid sexual spores formed by members of Phycomycetes.

103. Answer (2)

Hint : Members of ascomycetes are called sac fungi.

Sol. : Ascus is the site of karyogamy and meiosis in sac fungi.

104. Answer (3)

Hint : Primary mycelium is monokaryotic and short lived in Basidiomycetes.

Sol. : Dikaryophase is dominant phase of life cycle in Basidiomycetes.

105. Answer (1)

Hint : *Alternaria, Colletotrichum and Trichoderma* belong to class Deuteromycetes.

Sol. : Members of Deuteromycetes lack sexual reproduction. Sexual reproduction in *Rhizopus* takes place by conjugation.

106. Answer (4)

Sol. : Mycorrhizal roots lack root cap, root hairs and depend on fungal partner for the supply of H_2O, N, P and S. Roots provide shelter and nourishment to the fungal partner.

107. Answer (2)

Hint : UV rays and autoclave are used for sterilisation purpose.

Sol. : Viruses can be killed by autoclaving and UV rays.

108. Answer (3)

Sol. : First crystallization of virus-W. M. Stanley,

Discovery of virus-D. J. Ivanowsky.

Term virus-Pasteur.

Contagium vivum fluidum by M.W. Beijerinck

109. Answer (2)

Hint : Envelope is optional structure in viruses.

Sol. : Outer protein coat of viruses is called capsid, made up of capsomeres. Viruses lack capsule.

110. Answer (1)

Sol. : Usually plant viruses have ss RNA as their genetic material.

111. Answer (4)

Hint : PSTD is caused by a viroid.

Sol. : Viroids cause diseases in plants only.

112. Answer (3)

Hint : Proteinaceous infectious particles cause 'Kuru' disease.

Sol. : Prions are proteinaceous infectious particles.

113. Answer (2)

Hint : Lichens are indicators of air pollution.

Sol. : Lichens are highly sensitive to SO_2 and cannot grow in SO_2 polluted area.

114. Answer (3)

Hint : Tap roots are found in dicots.

Sol. : Fibrous roots are found in monocots not in dicots.

115. Answer (4)

Sol. : Root hairs are present in the region of maturation

116. Answer (2)

Sol. : Radish (storage root), *Rhizophora* (respiratory roots), Banyan tree (prop root), sugarcane (stilt root).

117. Answer (2)

Hint : In pea, tendril is modification of leaf.

Sol. Stem tendrils are found in pumpkin, watermelon and cucumber.

118. Answer (3)

Hint : In phylloclade, stem modifies for photosynthesis.

Sol. : Fleshy cylindrical stem of *Euphorbia* contains chlorophyll and performs photosynthesis called phylloclade.

119. Answer (1)

Hint : In suckers lateral branches come out form soil.

Sol. : *Chrysanthemum* and pineapple are examples of sucker.

120. Answer (4)

Sol. : Swollen leaf base is called pulvinus.

121. Answer (3)

Hint : *Alstonia* have whorled phyllotaxy.

Sol. : Guava – Opposite phyllotaxy

Sunflower – Alternate phyllotaxy.

122. Answer (2)

Hint : Tendrils in peas, fleshy edible scale of onion and pitcher of plant are modified leaves.

Sol. : Tendrils in grapevines are the modifications of stem.

123. Answer (3)

Sol. : Venation – Arrangement of veins and veinlets

Floral symmetry – Arrangement of floral organs on thalamus of flower

Phyllotaxy – Pattern of arrangement of leaves on stem

Arrangement of flowers on floral axis is termed as inflorescence.

124. Answer (1)

Hint : Members of Fabaceae family have racemose inflorescence.

Sol. : Cymose inflorescence – *Dianthus, Solanum, Bougainvillea*.

Racemose inflorescence – Lupin

125. Answer (2)

Hint : Androecium and gynoecium are the reproductive parts of flower.

Sol. : Calyx and corolla form accessory whorls of flower and do not take part directly in reproduction.

126. Answer (1)

Hint : Perianth is found in members of Liliaceae family.

Sol. : Tulip being a member of Liliaceae family has perianth.

127. Answer (3)

Hint : Chilli flower can be divided into two equal halves by any plane passing through the centre.

Sol. : *Datura* – actinomorphic, *Hibiscus* – bisexual flower, Maize – unisexual flower, Chilli – actinomorphic flower.

128. Answer (2)

Hint : Flower with superior ovary is hypogynous.

Sol. : When female reproductive part occupies highest position then flower is called hypogynous with superior ovary.

129. Answer (3)

Sol. : One margin of a petal/sepal overlaps and other is overlapped in twisted aestivation.

130. Answer (1)

Hint : In diadelphous condition, stamens are united in two bundles.

Sol. : Pea – diadelphous stamens

China rose – monoadelphous stamens

Citrus – polyadelphous stamens

131. Answer (3)

Hint : This placentation is found in mustard.

Sol. : Ovary becomes two chambered due to formation of false septum in parietal placentation.

132. Answer (1)

Hint : Mango and coconut are drupe fruits.

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

133. Answer (2)

Hint : Non-endospermous seeds are found in Fabaceae family.

Sol. : Castor is an endospermous seed.

Pea, bean, gram-non endospermous seeds.

134. Answer (4)

Hint : Epipetalous stamens are found in members of Solanaceae family.

Sol. : Tomato have alternate phyllotaxy, epipetalous stamens and valvate aestivation of petals.

135. Answer (1)

Sol. : Colchicine is obtained from *Colchicum autumnale* which is not a medicinal plant.

Medicinal plants-*Aloe*, Belladonna, Muliathi.

136. Answer (2)

Hint : TV + ERV.

Sol. : Expiratory capacity is the sum of tidal volume and expiratory reserve volume *i.e.* the amount of air which can be breathed out normally followed by a forced exhalation.

137. Answer (1)

Hint : Hb has affinity for both CO_2 and O_2.

Sol. : High pCO_2 and low pO_2 in tissues favour binding of CO_2 to haemoglobin. CO_2 travels in blood in bicarbonate form. CO_2 is transported as carbaminohaemoglobin.

138. Answer (4)

Hint : 20-25% CO_2 is transported as carbaminohaemoglobin.

Sol. : 70% CO_2 is transported via blood plasma in the form of HCO_3^- ions and 7% in dissolved state.

139. Answer (2)

Hint : Humans exhibit negative pressure breathing.

Sol. : Intra-pulmonary pressure must be less than the atmospheric pressure for inhalation.

140. Answer (3)

Hint : Opening of the larynx is called glottis.

Sol. : During deglutition food can enter from pharynx into the larynx. This is prevented by closure of glottis with epiglottis.

141. Answer (2)

Hint : RV cannot be exhaled.

Sol. : FRC = ERV + RV

VC = ERV + IRV + TV

TLC = TV + ERV + IRV + RV

142. Answer (3)

Hint : Expired air is a mixture of alveolar air and dead space air.

Sol. : The pO_2 in expired air is higher than pO_2 of alveolar air as the O_2 rich dead space air gets mixed with alveolar air during exhalation.

143. Answer (4)

Hint : Inhalation of industrial pollutants damages the lungs.

Sol. : Industrial pollutants damage and cause fibrosis of upper part of lungs (occupational lung diseases).

144. Answer (4)

Hint : Tissues have low O_2 requirement at rest.

Sol. : Under normal physiological conditions, HbO_2 dissociation is lesser, hence only 5 ml of O_2 per 100 ml of arterial blood is released to tissues.

145. Answer (3)

Hint : Dead space volume does not reach the alveoli.

Sol. : Out of 500 ml tidal volume, 150 ml air is called the dead space volume as it remains in the conduction zone of respiratory system and does not reach the alveoli.

Alveolar ventilation rate = (TV – dead space) × Respiratory rate

$\Rightarrow$ (500 – 150)ml × 14 = 4900 ml

146. Answer (3)

Hint : Cartilaginous rings also provide strength to ducts inside the lungs.

Sol. : The incomplete cartilaginous rings are present upto initial bronchioles.

147. Answer (4)

Hint : Tissues at rest produce less CO_2.

Sol. : At low metabolic rate, pCO_2 of tissues will be low, so the HbO_2 dissociation will be lesser.

148. Answer (2)

Hint : pCO_2 changes have more pronounced effects on respiration.

Sol. : The chemosensitive areas of brain as well as arteries are highly sensitive to CO_2 levels and H^+ ions.

149. Answer (3)

Hint : ANF is released in response to increased blood volume.

Sol. : RAAS restores the blood volume & osmolarity back to normal, so atria of heart release ANF to inhibit RAAS.

150. Answer (2)

Hint : Inner layer of Bowman's capsule facilitates filtration.

Sol. : Podocytes are specialized squamous cells of Bowman's capsules around the glomeruli.

151. Answer (3)

Hint : Cortex extends as columns between pyramids.

Sol. : The cortical extensions between medullary pyramids are renal columns of Bertini.

152. Answer (3)

Hint : BCOP opposes filtration.

Sol. : The colloids/proteins of blood constitute the blood colloidal osmotic pressure which prevents filtration through glomeruli.

153. Answer (3)

Hint : Blood capillaries of medulla are vasa recta.

Sol. : The loop of Henle of cortical nephrons do not reach deep into pyramids. Vasa recta are well developed in JG nephrons.

154. Answer (1)

Hint : 20% of cardiac output is filtered by kidneys per minute.

Sol. : $1/5^{th}$ of cardiac output is the renal blood flow (i.e. 1100-1200 ml/minute). 125 ml/min is the amount of filtrate formed.

155. Answer (4)

Hint : Identify the paired structure of excretory system.

Sol. : Neural mechanisms cause micturition reflex which is initiated by stretching of urinary bladder. Stretch receptors are absent in ureters.

156. Answer (1)

Hint : Urea & NaCl make the medullary interstitium highly osmotic.

Sol. : Movement of urea from collecting duct and electrolytes (Na^+, Cl^-) from ascending limb of Henle's loop into medulla raises the medullary osmolarity.

157. Answer (1)

Hint : RAAS helps in osmoregulation during dehydration.

Sol. : Dehydration reduces the blood volume in the body which reduces the GFR, stimulating the initiation of RAAS by the release of renin.

158. Answer (2)

Hint : Lack of insulin reduces glucose uptake by the body cells from blood.

Sol. : Diabetes mellitus occurs in insulin deficiency which results in loss of glucose through urine along with ketone bodies produced by cells during fat metabolism as they are unable to use glucose.

159. Answer (4)

Hint : Rh antibodies are formed in mother at the time of birth of the incompatible foetus.

Sol. : Rh +ve RBCs of 1st foetus induce formation of Rh antibodies in the mother and these will be harmful to second Rh +ve foetus.

The formation of these antibodies can be prevented by RhoGAM injection.

160. Answer (2)

Hint : Cuspid valves are present in atrio-ventricular septum.

Sol. : Bicuspid/mitral valves separate the left atrium from left ventricle.

161. Answer (3)

Hint : The cells which transport oxygen.

Sol. : Mature human RBC's are enucleated *i.e.*, they lack nuclei.

162. Answer (2)

Hint : The phase during which all chambers of heart are relaxed.

Sol. : Joint diastole lasts for 0.4 seconds, so 70% filling of ventricles occurs in this phase.

163. Answer (4)

Hint : ECG waves record depolarisation and repolarisation of cardiac muscles.

Sol. : T-wave represents the repolarisation of ventricles.

164. Answer (3)

Hint : Cardiac output can be moderated through ANS.

Sol. : Adrenaline from adrenal medulla and sympathetic nerves raise the heart rate and cardiac output.

165. Answer (2)

Hint : Heart attack can lead to cardiac arrest.

Sol. : Heart failure is sometimes called congestive heart failure because congestion of lungs is one of the symptom.

166. Answer (4)

Hint : Closure of heart valves produces sounds.

Sol. : 'Dubb' sound is higher pitched and is produced 0.3 seconds after the 'lubb' or first heart sound.

167. Answer (3)

Hint : Lymph lacks platelets but can clot.

Sol. : Serum is plasma minus clotting factors.

168. Answer (3)

Hint : Neutrophils and monocytes are both phagocytic.

Sol. : Both neutrophils and monocytes are similar in action as they engulf the foreign pathogens.

169. Answer (2)

Hint : AVN is the pacesetter of heart.

Sol. : SAN has the highest capacity of impulse generation *i.e.*, number of action potentials per minute.

170. Answer (2)

Hint : Filling of a heart chamber occurs during its relaxation.

Sol. : Atrial filling occurs both during ventricular systole as well as joint diastole (0.7 s).

171. Answer (2)

Hint : Portal circulation is present between liver and intestine.

Sol. : Blood from stomach, small intestine and large intestine is carried to liver through hepatic portal vein.

172. Answer (3)

Hint : Death of heart muscles causes chest pain.

Sol. : Reduced O_2 supply to heart muscles causes death of a part of the cardiac wall, resulting in Angina pectoris (pain in the chest radiating into left arm).

173. Answer (4)

Hint : The oxygenated and deoxygenated blood never mix during double circulation.

Sol. : Oxygenated blood from lungs returns to left atrium while deoxygenated blood from the body returns to right atrium.

174. Answer (1)

Hint : Blood groups are determined by surface antigens of RBCs.

Sol. : Persons with 'O' blood group lack antigens on RBCs and only a person with 'O' blood group can act as a donor in this case.

175. Answer (3)

Hint : Chordae tendineae help to prevent back flow of blood from ventricles to atria.

Sol. : Chordae tendineae connect cuspid valves to papillary muscles preventing reversal of cuspid valves towards atria during forceful ventricular systole.

176. Answer (1)

Hint : Cardiac output = Stroke volume × Heart rate.

Sol. : Stroke volume is the amount of blood pumped by each ventricle per beat.

177. Answer (3)

Hint : Defective filtration occurs in glomerulonephritis.

Sol. : Inflammation of glomeruli of kidney will lead to defective filtration which allows proteins and blood cells to pass in filtrate.

178. Answer (2)

Hint : Large amount of CO_2 is removed by lungs.

Sol. : Our lungs remove approximately 200 ml/min of CO_2 along with significant quantities of water per day.

179. Answer (3)

Hint : The outer covering of heart is protective and collagenous.

Sol. : Pericardium is the double layered outer sac over the heart while epicardium is the outer layer of the heart wall.

180. Answer (1)

Hint : The product of one step acts as a catalyst for the next step in a cascade process.

Sol. : Prothrombin is converted to thrombin by thrombokinase which, in turn, converts fibrinogens to fibrins.

❑ ❑ ❑

All India Aakash Test Series for Medical - 2020

TEST - 2 (Code-F)

Test Date : 17/11/2019

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

1. Answer (1)

Hint & Sol. : The moment of inertia of a uniform cylinder about its geometric axis is $\frac{1}{2}MR^2$.

2. Answer (2)

Hint : $p = \sqrt{2mK}$.

Sol. : $p_i = \sqrt{2mK_i}$

$K_f = 4K_i$

$p_f = \sqrt{2mK_f} = \sqrt{2m(4K_i)} = 2\sqrt{2mK_i}$

$p_f = 2p_i$

3. Answer (4)

Hint : $x_{com} = \frac{\sum m_i x_i}{\sum m_i}$; $y_{com} = \frac{\sum m_i y_i}{\sum m_i}$.

Sol. : $x_{com} = \frac{1(0)+3(0)+6(4)}{6+3+1} = \frac{24}{10} = 2.4$

$y_{com} = \frac{1(0)+3(4)+6(0)}{6+3+1} = \frac{12}{10} = 1.2$

Position of COM = (2.4, 1.2)

4. Answer (3)

Hint : Rate of change of angular momentum = Torque = $mg(x)$.

Sol. : Torque = $mg\left(\frac{R}{2}\right)$

$= mg\left(\frac{u^2\sin(2\theta)}{2g}\right)$

$= \frac{mgu^2}{2g} = \frac{1}{2}mu^2$

5. Answer (1)

Hint : Rotational $KE = \frac{1}{2}I\omega^2$

Translational $KE = \frac{1}{2}mv^2$.

Sol. : $v = \omega R$

$KE_{(Rotational)} = \frac{1}{2}I\omega^2 = \frac{1}{2}\left(\frac{2}{5}mR^2\right)\omega^2$

$= \frac{1}{5}mv^2$

$KE_{(Translational)} = \frac{1}{2}mv^2$

Ratio = $\frac{KE_{(Rotational)}}{KE_{(Rotational)} + KE_{(Translational)}}$

$= \frac{\frac{1}{5}mv^2}{\frac{1}{2}mv^2 + \frac{1}{5}mv^2} = \frac{2}{7}$

6. Answer (2)

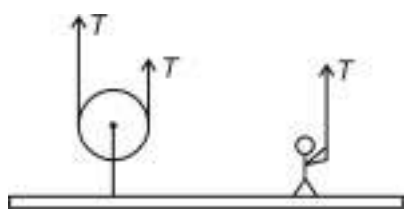
Hint & Sol. : Initially friction will be equal to the applied force. Later it becomes constant (kinetic friction).

7. Answer (4)

Hint : Net force on man plus platform system will be zero.

Sol. : Let force applied by man be F

$\therefore$ Tension = T



$3T = (25 + 50)$ g

$T = 25 \times 10 = 250$ N

8. Answer (2)

Hint : Spring force and Newton's II law of motion.

Sol. : Let compression in spring be x

For m_1

$F - kx = m_1a_1$

$80 - kx = 10 \times 4$

$\Rightarrow$ $kx = 40$ N

For m_2

$\Rightarrow$ $40 = m_2a_2$

$a_2 = \frac{40}{20} = 2$ m/s^2

9. Answer (3)

Hint : $\text{KE} = \frac{1}{2}I\omega^2$.

Sol. : $\frac{1}{2}I_A\omega_A^2 = \frac{1}{2}I_B\omega_B^2$

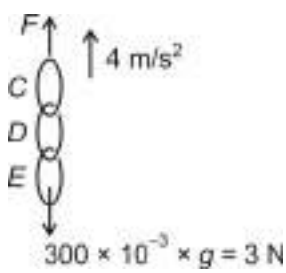
$\Rightarrow$ $\frac{1}{2}I_A(\omega)^2 = \frac{1}{2}I_B(2\omega)^2$

$I_A = 4I_B$

10. Answer (1)

Hint : $F_{net} = ma$.

Sol. : FBD of links C, D and E combined



$F - 3 = (0.3) \times 4$

$F = 3 + 1.2 = 4.2$ N

11. Answer (4)

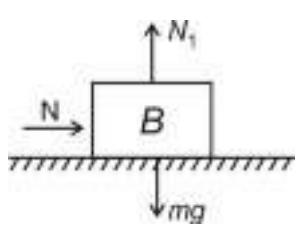
Hint : Newton's II law of motion.

Sol. : Acceleration of the system (a) = $\frac{F}{m_A + m_B}$

$= \frac{80}{4+12} = \frac{80}{16}$

$= 5$ m/s^2

FBD of block B



$N = m_Ba$

$N = 12 \times 5 = 60$ N

12. Answer (1)

Hint & Sol. : As internal forces cancel out in a system, according to Newton's III law of motion, they lead to no net force and hence no net change in momentum.

13. Answer (2)

Hint & Sol. : $dK = m\vec{v}\cdot d\vec{v}$

$dK = \vec{p}\cdot d\vec{v}$

14. Answer (1)

Hint : Work done by gravity = change in kinetic energy.

Sol. : Work done by gravity = (mg) × displacement

$\therefore$ Ratio of work done = Ratio of displacement

= 1 : 5

15. Answer (3)

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

Sol. : F = tension = $mg = 10 \times 10^3 \times 10 = 10^5$ N

$v = 0.6$ m/s

Power $= 6 \times 10^4$ W

$= 60$ kW

16. Answer (2)

Hint : Conservation of mechanical energy.

Sol. : Let maximum extension = x

At maximum extension, speed of block = 0

$-mg(x) + \frac{1}{2}kx^2 = 0$

$\Rightarrow$ $x = \frac{2mg}{k} = \frac{2\times10\times10}{400} = 0.5$ m

17. Answer (4)

Hint & Sol. : As the body moves towards ground, the potential energy decreases. Since the body accelerates, the kinetic energy increases.

18. Answer (2)

Hint : $\Delta\text{KE} = \frac{1}{2}\frac{m_1m_2}{m_1+m_2}(u_1-u_2)^2(1-e^2)$.

Sol. : $\Delta\text{KE} = \frac{1}{2}\frac{(6\times6)}{(6+6)}\{10\}^2\left\{1-\left(\frac{1}{4}\right)^2\right\}$

$= \frac{1125}{8}$ J

19. Answer (3)

Hint & Sol. : In stable equilibrium, the potential energy is minimum.

20. Answer (1)

Hint : $\vec{v} = \vec{\omega} \times \vec{r}$

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

$= 4\hat{k} - \hat{k} = 3\hat{k}$ m/s

21. Answer (2)

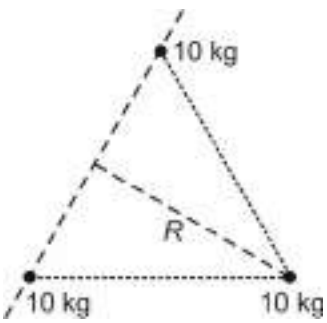
Hint & Sol. : Moment of inertia is not a vector quantity. According to parallel axis theorem, $I = I_{com} + md^2$.

$\therefore$ Minimum moment of inertia (among parallel axis) is about an axis passing through centre of mass

22. Answer (2)

Hint : Moment of inertia of a point mass = mR^2.

Sol. :



$R = \sqrt{2^2 - 1}$

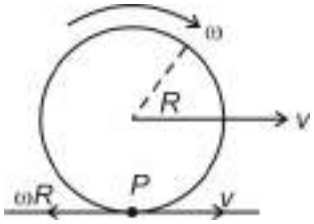
$= \sqrt{3}$

$I = 10(0)^2 + 10(0)^2 + 10\left(\sqrt{3}\right)^2$

$= 30$ kg m^2

23. Answer (2)

Hint & Sol. : For a body rolling purely on horizontal surface, the point of contact with the ground is instantaneously at rest



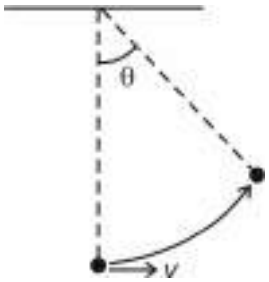
Net velocity of P

$v - \omega R = 0$

24. Answer (2)

Hint : Conservation of momentum.

Sol. :



Applying conservation of momentum

$mu = (2m)v$

$\Rightarrow \quad v = \frac{u}{2}$

Conservation of mechanical energy:

$$\frac{1}{2}(2m)\left(\frac{u}{2}\right)^2 = 2mgl(1 - \cos\theta)$$

$$1 - \cos\theta = \frac{u^2}{8gl}$$

$$\cos\theta = 1 - \frac{u^2}{8gl}$$

$$\Rightarrow \quad \theta = \cos^{-1}\left(1 - \frac{u^2}{8gl}\right)$$

25. Answer (3)

Hint : $\text{KE} = \frac{1}{2}mv_{cm}^2 + \frac{1}{2}I_{cm}\omega^2$.

Sol. : $\text{KE}_{(disc)} = \frac{1}{2}mv_0^2 + \frac{1}{2}\left(\frac{mR^2}{2}\right)\omega^2$

$$= \frac{1}{2}mv_0^2 + \frac{mR^2}{4}\left(\frac{v_0^2}{R^2}\right)$$

$$\text{KE}_{(disc)} = \frac{3}{4}mv_0^2$$

$v_{particle} = \sqrt{2}v_0$

$\Rightarrow \quad \text{KE}_{(particle)} = \frac{1}{2}m\left(\sqrt{2}v_0\right)^2$

$= mv_0^2$

$\text{KE}_{(net)} = \frac{3}{4}mv_0^2 + mv_0^2$

$= \frac{7}{4}mv_0^2$

26. Answer (2)

Hint : $\vec{v}_P = \vec{v}_{P/\text{com}} + \vec{v}_{\text{com}}$.

Sol. : $\vec{v}_{P/\text{com}} = 12 \times 2(-\hat{i}) = -24\hat{i}$

$\vec{v}_{\text{com}} = 6\hat{i}$

$\vec{v}_P = 6\hat{i} - 24\hat{i} = -18\hat{i}$ m/s

$|\vec{v}_P| = 18$ m/s

27. Answer (1)

Hint & Sol. : The theorem of perpendicular axes is applicable only for planar bodies.

28. Answer (4)

Hint : $\tau = I\alpha$, $I = mk^2$ (k : radius of gyration).

Sol. : $\tau = I\alpha = mk^2\alpha$

$36 = m(4^2)(9)$

$m = \dfrac{36}{4^2 \times 9}$ = 0.25 kg

29. Answer (4)

Hint & Sol. : Gravitational potential energy (U) can be negative as its value depends on zero potential energy reference frame chosen.

Kinetic energy $\left(K = \frac{1}{2}mv^2\right)$ is either zero or positive.

Mechanical energy ($U + K$) may be negative, positive or zero depending on value and sign of gravitational potential energy.

30. Answer (1)

Hint : Gravitational potential energy = mgy.

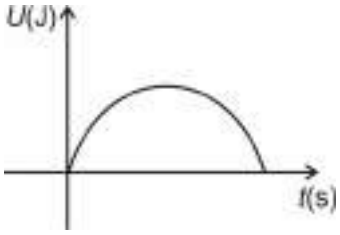
Sol. : $y = u\sin\theta t - \frac{1}{2}gt^2$

(symbols have their usual meanings)

$U = mgy = mg\left(u\sin\theta t - \frac{1}{2}gt^2\right)$

$\Rightarrow \quad U = At - Bt^2 \qquad \left\{\begin{matrix} A = mgu\sin\theta \\ B = \dfrac{mg^2}{2} \end{matrix}\right\}$

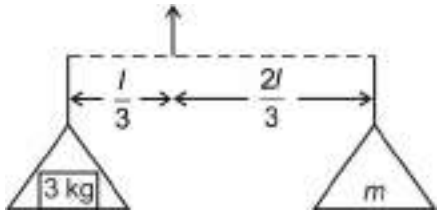
$\therefore$ U v/s t is a downward parabolic graph



31. Answer (2)

Hint : Rotational equilibrium.

Sol. :



$3g\left(\frac{l}{3}\right) = mg\left(\frac{2l}{3}\right)$

$3 = 2m$

$\Rightarrow \quad m = \frac{3}{2}$ = 1.5 kg

32. Answer (3)

Hint : Work-energy theorem.

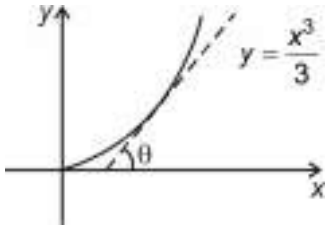
Sol. : Since the initial kinetic energies of both blocks are same. The work done on both blocks by the forces must be same.

$\Delta K = \vec{F}.\vec{S}$

33. Answer (2)

Hint : Acceleration = $g\sin\theta$ (θ is slope angle).

Sol. :



Slope = $\tan(\theta) = \frac{dy}{dx} = x^2$

$\Rightarrow \quad \left.\frac{dy}{dx}\right|_{x=1} = 1$

$\theta = 45°$

$\sin\theta = \frac{1}{\sqrt{2}}$

$a = \frac{g}{\sqrt{2}}$

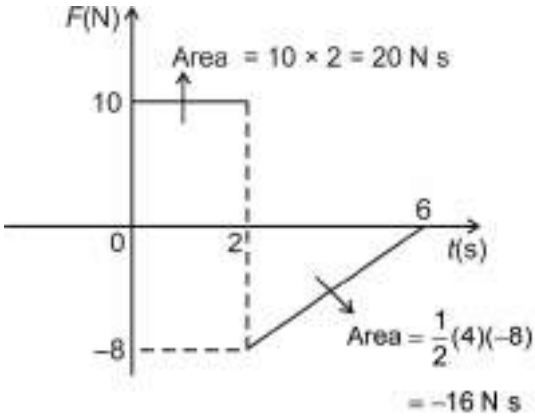
34. Answer (4)

Hint & Sol. : Since there is no external force on the system, velocity of centre of mass remains constant.

35. Answer (1)

Hint : Δp = area under *F-t* graph.

Sol. :



Total area = 20 – 16 = 4 N s

= 4 kg m s^{-1}

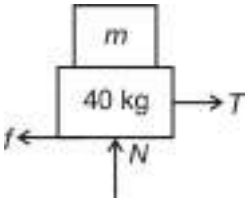
Momentum change/mass = $\frac{4}{2}$ = 2 m/s

36. Answer (3)

Hint : Maximum value of static friction = μN.

Sol. :

$\Rightarrow$ T = 20 g = 200 N



$T = f$

$\Rightarrow$ $T \le \mu N$

$T \le \mu(40 + m)g$

$200 \le 0.25\,(40 + m)(10)$

$\frac{20}{0.25} \le 40 + m$

40 kg $\le m$

37. Answer (3)

Hint : Conservation of mechanical energy.

Sol. : $mg\frac{l}{2} = \frac{1}{2}I\omega^2$

$mg\frac{l}{2} = \frac{1}{2}\left(\frac{ml^2}{3}\right)\omega^2$

$\sqrt{\frac{3g}{l}} = \omega$

$\omega = \sqrt{\frac{30}{0.3}} = 10$ rad/s

38. Answer (1)

Hint : Newton's second law of motion.

Sol. : Let tension in string be T

$50 - T = 5a$

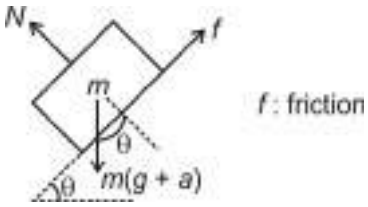
$T - 10 = 10a$

$\Rightarrow$ $a = \frac{40}{15} = \frac{8}{3}$ m/s^2

39. Answer (4)

Hint : $\theta = \tan^{-1}(\mu)$ is angle of repose.

Sol. : *FBD* of block from frame of reference of the elevator.



$m(g + a)\cos\theta = N$

$m(g + a)\sin\theta = f$

Dividing $\Rightarrow$ $\frac{f}{N} = \tan(\theta)$ $\Rightarrow$ $f = \mu N$

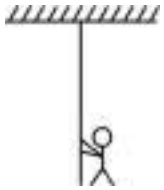
Since the value of friction = μN is possible.

$\therefore$ Block will remain at rest.

40. Answer (3)

Hint : Newton's second law of motion.

Sol. :



$mg - T = ma$

$$a = \frac{mg - T}{m}$$

$$a_{(\min)} = \frac{mg - mg/5}{m} = \frac{4g}{5} = 8 \text{ m/s}^2$$

41. Answer (4)

Hint : $F_{\min} = \frac{\mu mg}{\sqrt{\mu^2 + 1}}$, when $\theta = \lambda$

Sol. : $F_{\min} = \frac{1 \times 10 \times 10}{\sqrt{2}\sqrt{1^2 + \left(\frac{1}{\sqrt{2}}\right)^2}} = \frac{100}{\sqrt{3}}$ N

42. Answer (2)

Hint : Use parallel axis theorem.

Sol. : $I = \frac{2}{5}mR^2 + mR^2$

$= \frac{7}{5}mR^2$

43. Answer (2)

Hint : $\Delta U = -W_c$.

Sol. : $\Delta U = -(-3\hat{i}) \cdot (6\hat{i})$

$\Delta U = 18$ J

44. Answer (1)

Hint : Conservation of linear momentum and $e = 1$.

Sol. : Before collision

After collision

Conservation of linear momentum

$10 \times 4 = 10v_1 + 6v_2$

$\Rightarrow \quad 20 = 5v_1 + 3v_2$

Coefficient of restitution = $e = 1$

$v_2 - v_1 = 4$

$\Rightarrow \quad 5v_2 - 5v_1 = 20$

$v_2 = 5$ m/s

$v_1 = 1$ m/s

45. Answer (2)

Hint : $a = \frac{(m_2 - m_1)}{(m_2 + m_1)}g$.

Sol. : $a = \frac{(2-1)}{(2+1)}g = \frac{10}{3}$ m/s^2 for each blocks.

[CHEMISTRY]

46. Answer (3)

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

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

$= 10^{-5} \times [3 \times 10^{-5}]^3$

$= 27 \times 10^{-20} = 2.7 \times 10^{-19}$

47. Answer (3)

Hint : $C_2H_6(g) + \frac{7}{2}O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(l)$

Sol. : $\Delta_r H = 2\,\Delta_f H\{CO_2(g)\} + 3\Delta_f H\{H_2O(l)\} - \Delta_f H\{C_2H_6(g)\}$

$= 2 \times (-90) + 3 \times (-70) - (-20)$

$= -180 - 210 + 20$

$= -370$ kcal mol^{-1}

48. Answer (4)

Hint : Work done is path function.

49. Answer (3)

Hint : $\Delta_{sub}H = \Delta_{fus}H + \Delta_{vap}H$.

Sol. :

$X(s) \longrightarrow X(g)$, $\Delta H = 57.3$ kJ mol^{-1} …(i)

$X(l) \longrightarrow X(g)$, $\Delta H = 41.8$ kJ mol^{-1} …(ii)

Applying (i) – (ii)

$X(s) \longrightarrow X(l)$, $\Delta H = 57.3 - 41.8 = 15.5$ kJ mol^{-1}

50. Answer (1)

Hint : If $K_c > 10^3$, then the reaction proceeds nearly to completion.

51. Answer (1)

Hint : $Cr_2O_7^{2-}$ does not act as self-indicator.

Sol. : MnO_4^- acts as the self-indicator in the titration of MnO_4^- and Fe^{2+}.

52. Answer (4)

Hint : Ideal gas equation, PV = nRT

Sol. : $P = \frac{1}{V}(nRT)$

$\Rightarrow$ P vs $\frac{1}{V}$ is straight line passing through origin

As slope increases $\Rightarrow$ nRT increases

$\Rightarrow$ T increases

$\Rightarrow$ $T_1 > T_2 > T_3$

Hence, only set possible is

T_1 = 800 K, T_2 = 600 K, T_3 = 100 K

53. Answer (1)

Hint : Third law permits the calculation of absolute value of entropy of pure crystalline substance.

54. Answer (3)

Hint : At equilibrium, $K_p = \frac{(p_Y)^2}{(p_{Y_2})}$

Sol. : $Y_2(g) \rightleftharpoons 2Y(g)$

At equilibrium $1-\alpha$ 2α, P_T = 1 atm

$$K_p = \frac{(p_y)^2}{(p_{y_2})} = \frac{\left(\frac{2\alpha}{1-\alpha+2\alpha}\times P_T\right)^2}{\left(\frac{1-\alpha}{1-\alpha+2\alpha}P_T\right)}$$

$$= \frac{(2\times 0.5)^2}{(1-0.5)}\left(\frac{1}{1+0.5}\right)^{2-1}(atm)^{2-1}$$

$$\Rightarrow K_p = \frac{1^2}{0.5}\times\left(\frac{1}{1.5}\right) = \frac{1}{0.75} = \frac{4}{3} = 1.33 \text{ atm}$$

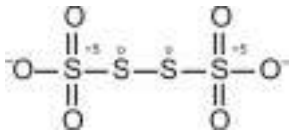
55. Answer (2)

Hint : Extensive property depends on quantity / amount of matter.

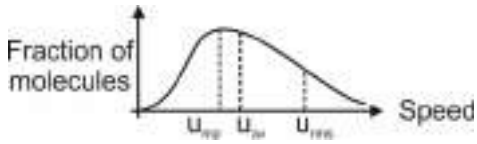
Sol. : Temperature is an intensive property.

56. Answer (1)

Hint : S — S linkage is present in $S_4O_6^{2-}$ ion.

Sol. : 

57. Answer (3)

Hint : 

Sol. : $u_{rms} > u_{av} > u_{mp}$

58. Answer (2)

Hint : At constant temperature, Boyle's law is applicable.

Sol. : $P_1V_1 = P_2V_2$

$\Rightarrow$ 10 bar × 2.27 L = 2 bar × V_2

$\Rightarrow$ V_2 = 11.35 L

59. Answer (2)

Hint : Salts having high value of K_{sp}, will be more soluble.

60. Answer (2)

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

Sol. : Reaction for which Δn_g is maximum, will have large difference of ΔH and ΔU.

61. Answer (4)

Hint : Oxidation number of Oxygen atom in H_2O_2 is –1

Sol. : $2H_2\overset{-1}{O_2}(aq) \longrightarrow \overset{0}{O_2}(g) + 2H_2\overset{-2}{O}(l)$

62. Answer (1)

Hint : The more negative standard electrode reduction potential implies increasing power of reducing nature of metal.

Sol. : Ascending order of reducing power

Ag	<	Hg	<	Zn	<	Mg	<	Na
+0.80 V		+0.79 V		–0.76 V		–2.37 V		–2.71 V

63. Answer (1)

Hint : Electron deficient species behaves as Lewis acid.

64. Answer (3)

Hint : Work done in reversible isothermal expansion $w = -2.303\ nRT\ \log\left(\frac{V_f}{V_i}\right)$

Sol. : w $= -2.303 \times 6 \times 8.314 \times 300 \log\left(\frac{60}{30}\right)$

$= -10.4$ kJ

65. Answer (2)

Hint : $p_{O_2} = \frac{n_{O_2}}{n_{O_2} + n_{Ne}} \times P_{total}$

Sol. : $p_{O_2} = \frac{\frac{32}{32}}{\frac{32}{32} + \frac{180}{20}} \times 100$

$= \left(\frac{1}{10}\right) \times 100 = 10$ atm

66. Answer (3)

Hint : Multiplying through a factor 'n' in equilibrium reaction, equilibrium constant becomes n^{th} power of initial value.

Sol. : $N_2(g) + O_2(g) \rightleftarrows 2NO(g)$, $K_1 = 64 \times 10^{-2}$

$\frac{1}{2}[(N_2(g) + O_2(g) \rightleftarrows 2\,NO(g)]$, $K_2 = (K_1)^{1/2}$

$= 8 \times 10^{-1} = 0.8$

67. Answer (4)

Hint : More the polarity of gas, more will be its critical temperature.

Sol. :

Molecule	T_C(K)
H_2	33.2
CO_2	304.1
O_2	154.3
NH_3	405.5

68. Answer (3)

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

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

$= 5.7 - 300 \times 40 \times 10^{-3}$

$= 5.7 - 12$

$= -6.3$ kcal mol^{-1}

69. Answer (2)

Hint : $\Delta_r H = \Sigma$ BE of reactants – Σ BE of products.

Sol. : $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, $\Delta_r H = -83$ kJ

$\Delta_r H = \{B.E\ (N \equiv N) + 3\ B.E.\ (H - H)\} - 6\ B.E.\ (N - H)$

$\Rightarrow -83 = 946 + (3 \times 435) - 6 \times B.E.\ (N - H)$

$\Rightarrow$ B.E. (N – H) = 389 kJ mol^{-1}

70. Answer (2)

Hint : K.E. $= n \times \frac{3}{2}RT$

Sol. : K.E. $= \frac{14}{28} \times \frac{3}{2} \times 8.314 \times (273 + 127)$

$= 2.5$ kJ

71. Answer (4)

Hint : $E^o_{cell} = E^o_{Sn^{2+}/Sn} - E^o_{Cd^{2+}/Cd}$

Sol. : $E^o_{cell} = -0.14 + 0.4$

$= 0.26$ V

72. Answer (4)

Hint : For a compound, net charge is zero.

Sol. : A_2BC_2 : Net charge $= 2 \times (1) + 4 + 2 \times (-3)$

$= 0$

73. Answer (1)

Hint : $\Delta S = \frac{q_{rev}}{T}$

Sol. : When heat is added to the system, molecular motion increases, hence entropy increases.

74. Answer (2)

Hint : Aqueous solution of salt of weak base and strong acid will undergo cationic hydrolysis.

Sol. : $NH_4Cl(aq) \longrightarrow \overset{\oplus}{N}H_4(aq) + \overset{\ominus}{C}l(aq)$

$\overset{\oplus}{N}H_4 + H_2O \rightleftharpoons NH_4OH + H^{\oplus}$

75. Answer (4)

Hint : $V_1M_1 = (V_1 + V_2)M_2$.

Sol. : Initial $[H^+] = 10^{-3}$ M; Final $[H^+] = 10^{-5}$ M

$1 \times 10^{-3} = (1 + V_2) \times 10^{-5}$

$V_2 = 100 - 1 = 99$ L

Hence volume of water added = 100 – 1 = 99 L.

76. Answer (1)

Hint : Molecules involving more H-bond will have less vapour pressure.

Sol. : $C_2H_5-O-C_2H_5 > CCl_4 > C_2H_5OH > H_2O$ (vapour pressure).

77. Answer (4)

Hint : HBr is a polar molecule.

Sol. : Dipole-dipole interaction energy between rotating polar molecules is proportional to $\frac{1}{r^6}$.

78. Answer (3)

Hint : $R = 8.314 \frac{J}{mol\text{-}K}$.

Sol. : $C_p - C_v = R$

79. Answer (3)

Hint : Acid having higher value of K_a will be more acidic.

80. Answer (1)

Hint : Conjugate acid is formed by addition of one H^+ while conjugate base is formed by release of one H^+.

81. Answer (2)

Hint : For spontaneous reaction $\Delta_r G < 0$.

Sol. : $\Delta_r G = \Delta_r H - T\Delta_r S < 0$,

Reaction will be spontaneous at all temperatures when $\Delta_r H$ is –ve and $\Delta_r S$ is +ve.

82. Answer (2)

Hint : Mass of pure solids do not affect pressure/ concentration of equilibrium.

Sol. : A decomposition reaction is endothermic. When temperature increases, equilibrium shifts in forward direction.

83. Answer (3)

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

Sol. : For reaction

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$

$\Delta n_g = 1$

So, $K_p = K_c(RT)$

or $K_p > K_c$

84. Answer (3)

Hint : F is most electronegative element.

Sol. : Oxidation state of F is always –1 in its compound.

85. Answer (1)

Hint $4Zn + NO_3^- + 7H_2O \longrightarrow 4Zn^{2+} + NH_4^+ + 10\ OH^-$

x = 4, y = 1, c = 10

86. Answer (3)

Hint : At identical T, P conditions

$$r \propto \frac{1}{\sqrt{\text{Molecular weight}}}$$

Sol. : $\frac{r_{O_2}}{r_{SO_2}} = \sqrt{\frac{64}{32}} = \sqrt{2} : 1$

87. Answer (2)

Hint : For H_2 gas, molecular attractive forces are insignificant.

Sol. : $P + \frac{a}{V^2} \approx P$

van der Waals equation for 1 mole of gas becomes

$P(V-b) = RT \quad \Rightarrow \quad PV - bP = RT$

$\Rightarrow \quad Z = 1 + \left(\frac{b}{RT}\right)P$

For Z vs P graph, Slope = $\frac{b}{RT}$

88. Answer (1)

Hint : For a reversible isothermal expansion of an ideal gas

$$\Delta S = nR \times 2.303 \log_{10}\left(\frac{V_f}{V_i}\right)$$

Sol. : $\Delta S = 2 \times 8.314 \times 2.303 \log_{10}\left(\frac{23.03}{2.303}\right)$

$= 38.29\ J\ K^{-1}$

89. Answer (4)

Hint : Hydrolysis of $RCOO^-$

$RCOO^-(aq) + H_2O(l) \rightleftharpoons RCOOH\ (aq) + OH^-(aq)$

Sol. : $K_h = \frac{K_w}{K_a(RCOOH)} = \frac{10^{-14}}{10^{-6}}$

$\Rightarrow \quad K_h = 10^{-8}$

90. Answer (4)

Hint : For basic buffer, $pOH = pK_b + \log \frac{[Salt]}{[Base]}$.

Sol. : $pOH = pK_b + \log\frac{[R\overset{+}{N}H_3]}{[RNH_2]}$

$= -\log 10^{-5} + \log\left(\frac{0.40}{0.60}\right) = 4.82$

pH = 14 – 4.82 = 9.18

[BIOLOGY]

91. Answer (1)

Sol. : Colchicine is obtained from *Colchicum autumnale* which is not a medicinal plant.

Medicinal plants-*Aloe*, Belladonna, Muliathi.

92. Answer (4)

Hint : Epipetalous stamens are found in members of Solanaceae family.

Sol. : Tomato have alternate phyllotaxy, epipetalous stamens and valvate aestivation of petals.

93. Answer (2)

Hint : Non-endospermous seeds are found in Fabaceae family.

Sol. : Castor is an endospermous seed.

Pea, bean, gram-non endospermous seeds.

94. Answer (1)

Hint : Mango and coconut are drupe fruits.

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

95. Answer (3)

Hint : This placentation is found in mustard.

Sol. : Ovary becomes two chambered due to formation of false septum in parietal placentation.

96. Answer (1)

Hint : In diadelphous condition, stamens are united in two bundles.

Sol. : Pea – diadelphous stamens

China rose – monoadelphous stamens

Citrus – polyadelphous stamens

97. Answer (3)

Sol. : One margin of a petal/sepal overlaps and other is overlapped in twisted aestivation.

98. Answer (2)

Hint : Flower with superior ovary is hypogynous.

Sol. : When female reproductive part occupies highest position then flower is called hypogynous with superior ovary.

99. Answer (3)

Hint : Chilli flower can be divided into two equal halves by any plane passing through the centre.

Sol. : *Datura* – actinomorphic, *Hibiscus* – bisexual flower, Maize – unisexual flower, Chilli – actinomorphic flower.

100. Answer (1)

Hint : Perianth is found in members of Liliaceae family.

Sol. : Tulip being a member of Liliaceae family has perianth.

101. Answer (2)

Hint : Androecium and gynoecium are the reproductive parts of flower.

Sol. : Calyx and corolla form accessory whorls of flower and do not take part directly in reproduction.

102. Answer (1)

Hint : Members of Fabaceae family have racemose inflorescence.

Sol. : Cymose inflorescence – *Dianthus, Solanum, Bougainvillea*.

Racemose inflorescence – Lupin

103. Answer (3)

Sol. : Venation – Arrangement of veins and veinlets

Floral symmetry – Arrangement of floral organs on thalamus of flower

Phyllotaxy – Pattern of arrangement of leaves on stem

Arrangement of flowers on floral axis is termed as inflorescence.

104. Answer (2)

Hint : Tendrils in peas, fleshy edible scale of onion and pitcher of plant are modified leaves.

Sol. : Tendrils in grapevines are the modifications of stem.

105. Answer (3)

Hint : *Alstonia* have whorled phyllotaxy.

Sol. : Guava – Opposite phyllotaxy

Sunflower – Alternate phyllotaxy.

106. Answer (4)

Sol. : Swollen leaf base is called pulvinus.

107. Answer (1)

Hint : In suckers lateral branches come out form soil.

Sol. : *Chrysanthemum* and pineapple are examples of sucker.

108. Answer (3)

Hint : In phylloclade, stem modifies for photosynthesis.

Sol. : Fleshy cylindrical stem of *Euphorbia* contains chlorophyll and performs photosynthesis called phylloclade.

109. Answer (2)

Hint : In pea, tendril is modification of leaf.

Sol. Stem tendrils are found in pumpkin, watermelon and cucumber.

110. Answer (2)

Sol. : Radish (storage root), *Rhizophora* (respiratory roots), Banyan tree (prop root), sugarcane (stilt root).

111. Answer (4)

Sol. : Root hairs are present in the region of maturation

112. Answer (3)

Hint : Tap roots are found in dicots.

Sol. : Fibrous roots are found in monocots not in dicots.

113. Answer (2)

Hint : Lichens are indicators of air pollution.

Sol. : Lichens are highly sensitive to SO_2 and cannot grow in SO_2 polluted area.

114. Answer (3)

Hint : Proteinaceous infectious particles cause 'Kuru' disease.

Sol. : Prions are proteinaceous infectious particles.

115. Answer (4)

Hint : PSTD is caused by a viroid.

Sol. : Viroids cause diseases in plants only.

116. Answer (1)

Sol. : Usually plant viruses have ss RNA as their genetic material.

117. Answer (2)

Hint : Envelope is optional structure in viruses.

Sol. : Outer protein coat of viruses is called capsid, made up of capsomeres. Viruses lack capsule.

118. Answer (3)

Sol. : First crystallization of virus-W. M. Stanley,

Discovery of virus-D. J. Ivanowsky.

Term virus-Pasteur.

Contagium vivum fluidum by M.W. Beijerinck

119. Answer (2)

Hint : UV rays and autoclave are used for sterilisation purpose.

Sol. : Viruses can be killed by autoclaving and UV rays.

120. Answer (4)

Sol. : Mycorrhizal roots lack root cap, root hairs and depend on fungal partner for the supply of H_2O, N, P and S. Roots provide shelter and nourishment to the fungal partner.

121. Answer (1)

Hint : *Alternaria, Colletotrichum and Trichoderma* belong to class Deuteromycetes.

Sol. : Members of Deuteromycetes lack sexual reproduction. Sexual reproduction in *Rhizopus* takes place by conjugation.

122. Answer (3)

Hint : Primary mycelium is monokaryotic and short lived in Basidiomycetes.

Sol. : Dikaryophase is dominant phase of life cycle in Basidiomycetes.

123. Answer (2)

Hint : Members of ascomycetes are called sac fungi.

Sol. : Ascus is the site of karyogamy and meiosis in sac fungi.

124. Answer (2)

Hint : Zygospores are formed by fusion of gametes.

Sol. : Zygospores are diploid sexual spores formed by members of Phycomycetes.

125. Answer (4)

Hint : Fungal body is called mycelium.

Sol. : Mycelium is made up of a network of hyphae.

126. Answer (2)

Hint : Dead diatoms are nearly indestructible.

Sol. : Silica deposited cell wall of diatoms make them indestructible.

127. Answer (2)

Hint : Body of *Euglena* is covered by proteinaceous covering.

Sol. : *Euglena* lacks cell wall rather its body is covered with pellicle.

128. Answer (3)

Hint : Slime moulds are connecting link of plants, animals and fungi.

Sol. : Diatoms : Lack flagella throughout the life.

Dinoflagellates : Have heterokont flagella.

Sporozoan : Endoparasite

129. Answer (2)

Hint : Streptomycin, erythromycin and chloramphenicol don't interfere synthesis of peptidoglycan.

Sol. : Penicillin interferes synthesis of cell wall. As *Mycoplasma* don't have cell wall they are insensitive to penicillin.

130. Answer (1)

Hint : Peptidoglycan is not found in some of the monerans.

Sol. : Archaebacteria lack peptidoglycan.

131. Answer (2)

Sol. : Ability of bacteria to pick up the DNA from solution is called competence.

132. Answer (4)

Hint : These bacteria lack enzymes for aerobic respiration.

Sol. : Obligate anaerobes show anaerobic mode of respiration only.

133. Answer (3)

Sol. : According to shapes, bacteria are classified into four groups: Cocci (spherical), Bacillus (Rod shaped), Vibrio (comma shaped) Spirillum (Spiral)

134. Answer (4)

Hint : Cytoplasmic streaming occurs only in eukaryotes.

Sol. : Since monerans are prokaryotes they do not show cytoplasmic streaming.

135. Answer (1)

Hint : Carl Woese noticed that members of Monera differ from each other.

Sol. : Monera was divided into two kingdoms Archaebacteria and Eubacteria by Carl Woese.

136. Answer (1)

Hint : The product of one step acts as a catalyst for the next step in a cascade process.

Sol. : Prothrombin is converted to thrombin by thrombokinase which, in turn, converts fibrinogens to fibrins.

137. Answer (3)

Hint : The outer covering of heart is protective and collagenous.

Sol. : Pericardium is the double layered outer sac over the heart while epicardium is the outer layer of the heart wall.

138. Answer (2)

Hint : Large amount of CO_2 is removed by lungs.

Sol. : Our lungs remove approximately 200 ml/min of CO_2 along with significant quantities of water per day.

139. Answer (3)

Hint : Defective filtration occurs in glomerulonephritis.

Sol. : Inflammation of glomeruli of kidney will lead to defective filtration which allows proteins and blood cells to pass in filtrate.

140. Answer (1)

Hint : Cardiac output = Stroke volume × Heart rate.

Sol. : Stroke volume is the amount of blood pumped by each ventricle per beat.

141. Answer (3)

Hint : Chordae tendineae help to prevent back flow of blood from ventricles to atria.

Sol. : Chordae tendineae connect cuspid valves to papillary muscles preventing reversal of cuspid valves towards atria during forceful ventricular systole.

142. Answer (1)

Hint : Blood groups are determined by surface antigens of RBCs.

Sol. : Persons with 'O' blood group lack antigens on RBCs and only a person with 'O' blood group can act as a donor in this case.

143. Answer (4)

Hint : The oxygenated and deoxygenated blood never mix during double circulation.

Sol. : Oxygenated blood from lungs returns to left atrium while deoxygenated blood from the body returns to right atrium.

144. Answer (3)

Hint : Death of heart muscles causes chest pain.

Sol. : Reduced O_2 supply to heart muscles causes death of a part of the cardiac wall, resulting in Angina pectoris (pain in the chest radiating into left arm).

145. Answer (2)

Hint : Portal circulation is present between liver and intestine.

Sol. : Blood from stomach, small intestine and large intestine is carried to liver through hepatic portal vein.

146. Answer (2)

Hint : Filling of a heart chamber occurs during its relaxation.

Sol. : Atrial filling occurs both during ventricular systole as well as joint diastole (0.7 s).

147. Answer (2)

Hint : AVN is the pacesetter of heart.

Sol. : SAN has the highest capacity of impulse generation *i.e.*, number of action potentials per minute.

148. Answer (3)

Hint : Neutrophils and monocytes are both phagocytic.

Sol. : Both neutrophils and monocytes are similar in action as they engulf the foreign pathogens.

149. Answer (3)

Hint : Lymph lacks platelets but can clot.

Sol. : Serum is plasma minus clotting factors.

150. Answer (4)

Hint : Closure of heart valves produces sounds.

Sol. : 'Dubb' sound is higher pitched and is produced 0.3 seconds after the 'lubb' or first heart sound.

151. Answer (2)

Hint : Heart attack can lead to cardiac arrest.

Sol. : Heart failure is sometimes called congestive heart failure because congestion of lungs is one of the symptom.

152. Answer (3)

Hint : Cardiac output can be moderated through ANS.

Sol. : Adrenaline from adrenal medulla and sympathetic nerves raise the heart rate and cardiac output.

153. Answer (4)

Hint : ECG waves record depolarisation and repolarisation of cardiac muscles.

Sol. : T-wave represents the repolarisation of ventricles.

154. Answer (2)

Hint : The phase during which all chambers of heart are relaxed.

Sol. : Joint diastole lasts for 0.4 seconds, so 70% filling of ventricles occurs in this phase.

155. Answer (3)

Hint : The cells which transport oxygen.

Sol. : Mature human RBC's are enucleated *i.e.*, they lack nuclei.

156. Answer (2)

Hint : Cuspid valves are present in atrio-ventricular septum.

Sol. : Bicuspid/mitral valves separate the left atrium from left ventricle.

157. Answer (4)

Hint : Rh antibodies are formed in mother at the time of birth of the incompatible foetus.

Sol. : Rh +ve RBCs of 1st foetus induce formation of Rh antibodies in the mother and these will be harmful to second Rh +ve foetus.

The formation of these antibodies can be prevented by RhoGAM injection.

158. Answer (2)

Hint : Lack of insulin reduces glucose uptake by the body cells from blood.

Sol. : Diabetes mellitus occurs in insulin deficiency which results in loss of glucose through urine along with ketone bodies produced by cells during fat metabolism as they are unable to use glucose.

159. Answer (1)

Hint : RAAS helps in osmoregulation during dehydration.

Sol. : Dehydration reduces the blood volume in the body which reduces the GFR, stimulating the initiation of RAAS by the release of renin.

160. Answer (1)

Hint : Urea & NaCl make the medullary interstitium highly osmotic.

Sol. : Movement of urea from collecting duct and electrolytes (Na^+, Cl^-) from ascending limb of Henle's loop into medulla raises the medullary osmolarity.

161. Answer (4)

Hint : Identify the paired structure of excretory system.

Sol. : Neural mechanisms cause micturition reflex which is initiated by stretching of urinary bladder. Stretch receptors are absent in ureters.

162. Answer (1)

Hint : 20% of cardiac output is filtered by kidneys per minute.

Sol. : $1/5^{th}$ of cardiac output is the renal blood flow (i.e. 1100-1200 ml/minute). 125 ml/min is the amount of filtrate formed.

163. Answer (3)

Hint : Blood capillaries of medulla are vasa recta.

Sol. : The loop of Henle of cortical nephrons do not reach deep into pyramids. Vasa recta are well developed in JG nephrons.

164. Answer (3)

Hint : BCOP opposes filtration.

Sol. : The colloids/proteins of blood constitute the blood colloidal osmotic pressure which prevents filtration through glomeruli.

165. Answer (3)

Hint : Cortex extends as columns between pyramids.

Sol. : The cortical extensions between medullary pyramids are renal columns of Bertini.

166. Answer (2)

Hint : Inner layer of Bowman's capsule facilitates filtration.

Sol. : Podocytes are specialized squamous cells of Bowman's capsules around the glomeruli.

167. Answer (3)

Hint : ANF is released in response to increased blood volume.

Sol. : RAAS restores the blood volume & osmolarity back to normal, so atria of heart release ANF to inhibit RAAS.

168. Answer (2)

Hint : pCO_2 changes have more pronounced effects on respiration.

Sol. : The chemosensitive areas of brain as well as arteries are highly sensitive to CO_2 levels and H^+ ions.

169. Answer (4)

Hint : Tissues at rest produce less CO_2.

Sol. : At low metabolic rate, pCO_2 of tissues will be low, so the HbO_2 dissociation will be lesser.

170. Answer (3)

Hint : Cartilaginous rings also provide strength to ducts inside the lungs.

Sol. : The incomplete cartilaginous rings are present upto initial bronchioles.

171. Answer (3)

Hint : Dead space volume does not reach the alveoli.

Sol. : Out of 500 ml tidal volume, 150 ml air is called the dead space volume as it remains in the conduction zone of respiratory system and does not reach the alveoli.

Alveolar ventilation rate = (TV – dead space) × Respiratory rate

$\Rightarrow$ (500 – 150)ml × 14 = 4900 ml

172. Answer (4)

Hint : Tissues have low O_2 requirement at rest.

Sol. : Under normal physiological conditions, HbO_2 dissociation is lesser, hence only 5 ml of O_2 per 100 ml of arterial blood is released to tissues.

173. Answer (4)

Hint : Inhalation of industrial pollutants damages the lungs.

Sol. : Industrial pollutants damage and cause fibrosis of upper part of lungs (occupational lung diseases).

174. Answer (3)

Hint : Expired air is a mixture of alveolar air and dead space air.

Sol. : The pO_2 in expired air is higher than pO_2 of alveolar air as the O_2 rich dead space air gets mixed with alveolar air during exhalation.

175. Answer (2)

Hint : RV cannot be exhaled.

Sol. : FRC = ERV + RV

VC = ERV + IRV + TV

TLC = TV + ERV + IRV + RV

176. Answer (3)

Hint : Opening of the larynx is called glottis.

Sol. : During deglutition food can enter from pharynx into the larynx. This is prevented by closure of glottis with epiglottis.

177. Answer (2)

Hint : Humans exhibit negative pressure breathing.

Sol. : Intra-pulmonary pressure must be less than the atmospheric pressure for inhalation.

178. Answer (4)

Hint : 20-25% CO_2 is transported as carbaminohaemoglobin.

Sol. : 70% CO_2 is transported via blood plasma in the form of HCO_3^- ions and 7% in dissolved state.

179. Answer (1)

Hint : Hb has affinity for both CO_2 and O_2.

Sol. : High pCO_2 and low pO_2 in tissues favour binding of CO_2 to haemoglobin. CO_2 travels in blood in bicarbonate form. CO_2 is transported as carbaminohaemoglobin.

180. Answer (2)

Hint : TV + ERV.

Sol. : Expiratory capacity is the sum of tidal volume and expiratory reserve volume *i.e.* the amount of air which can be breathed out normally followed by a forced exhalation.

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