### ANSWERS

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1. Answer (1)
   **Hint:** Time of free fall & final velocity does not depend on the mass of object dropped.

2. Answer (2)
   **Hint:** Using dimension analysis.

   **Sol.:** \[ \text{Angular momentum} = \left( \frac{n}{2\pi} \right) [h] \]
   \[ \therefore \left( \frac{n}{2\pi} \right) = \text{dimensionless} \]
   Then \[ \text{Angular momentum} = \text{[Planck's constant]} \]

3. Answer (1)
   **Hint:** \( PV = nRT \)

   **Sol.:** Using \( PV = nR.T \) and \( P^3V^6 \) = constant.

   \[ T^3V^2 = \text{constant} \]

   For decreasing volume, temperature increases.

4. Answer (2)
   **Hint:** \( \vec{v}_{BA} = \vec{v}_B - \vec{v}_A \)

   **Sol.:** \( \vec{v}_{r/girl} = \vec{v}_r - \vec{v}_{girl} \)

   But \( \vec{v}_r \perp \vec{v}_{girl} \) then

   \[ \vec{v}_{girl} = \vec{v}_r^2 + \vec{v}_{girl}^2 \]

   \[ 5^2 = \vec{v}_r^2 + (3)^2 \]

   \[ \vec{v}_r = 4 \text{ km/h} \]

5. Answer (2)
   **Hint:** \( F = -kx \) and \( T = 2\pi \sqrt{\frac{m}{k}} \)

   **Sol.:** \( k = \frac{|F|}{|x|} = \frac{8 \text{ N}}{10 \text{ cm}} = \frac{80 \text{ N}}{m} \)

   \[ T = 2\pi \sqrt{\frac{m}{k}} = 2\pi \sqrt{\frac{0.8}{80}} = \frac{\pi}{5} \text{ s} \]

6. Answer (3)
   **Hint:** \( \frac{v_{wave}}{v_{particle}} = \frac{\omega / k}{\omega A} = \frac{1}{kA} \)

   **Sol.:** \( \frac{v_{wave}}{v_{particle}} = \frac{1000}{6 \times 40} = \frac{25}{6} \)

7. Answer (4)
   **Hint:** \( \Delta Q = nC_p\Delta T \)

   **Sol.:** \( \Delta Q = nC_p\Delta T \)

   \[ = 5\left(1 + \frac{5}{2}\right)R \times 30 \]

   \[ = 5\left(\frac{7}{2}\right)2 \times 30 \]

   \[ \Delta Q = 1050 \text{ cal} \]

8. Answer (4)
   **Hint:** \( [P] = [u] [Q] \)

   **Sol.:** \( [P] = [u] [Q] \)

   \[ = \left[ \frac{M^1}{L^3} \right] \left[ \frac{M^1L^2T^{-2}}{M^1} \right] \]

   \[ [P] = [M^4L^1T^{-2}] \]

   \[ = [\text{Force}] \]

9. Answer (2)
   **Hint:** \( P = \vec{F} \cdot \vec{v} \) and \( \vec{F} = m\ddot{\vec{v}} \)

   **Sol.:** \( \ddot{v} = 2t \hat{i} + 2\sqrt{t} \hat{j} \)

   then \( \vec{v} = t^2 \hat{i} + \frac{4}{3} t^{3/2} \hat{j} \)

   then \( P = \left( t \hat{i} + \sqrt{t} \hat{j} \right) \cdot \left( t^2 \hat{i} + \frac{4}{3} t^{3/2} \hat{j} \right) \)

   \[ = t^3 + \frac{4}{3} t^2 = 27 + \frac{4}{3} \times 9 \]

   \[ = 39 \text{ W} \]

10. Answer (3)
    **Hint:** \( |\Delta \vec{p}|_{\text{total}} = \text{area under the } F - t \text{ graph} \)

    **Sol.:** \( |\Delta \vec{p}|_{\text{total}} = A_1 + A_2 + A_3 \)

    \[ = \frac{1}{2} \times (2 \times 5) + (2 \times 20) - \frac{1}{2} \times 6 \times 10 \]

    \[ = 5 + 40 - 30 \]

    \[ |\Delta \vec{p}| = 15 \text{ N s} \]
11. Answer (3)

Hint: \( F = \frac{mv^2}{r} \)

Sol.: 
\[
\frac{F_A}{F_B} = \left( \frac{m_A}{m_B} \right) \left( \frac{v_A}{v_B} \right)^2 \left( \frac{r_A}{r_B} \right)
\]
\[
= \left( \frac{3m}{m} \right) \left( \frac{v}{3v} \right)^2 \left( \frac{r}{2r} \right)
\]
\[
= \frac{1}{6}
\]

12. Answer (2)

Hint: \( T = mg \) \( \therefore a = 0 \)

Sol.: \( T = (5 + 4) \times 10 = 90 \) N

13. Answer (4)

Hint: \( \frac{dQ}{dt} = \frac{kA}{\ell} \Delta T \) and \( Q = mL_f \)

Sol.: \( \frac{dQ}{dt} = \frac{kA}{\ell} \Delta T \)

\[
4 \times 3.36 \times 10^5 = K \times 1.6 \times 100 \times 3600
\]
\[
K = 0.023 \text{ Wm}^{-1}\text{C}^{-1}
\]

14. Answer (2)

Hint: Efficiency \( \eta = \frac{[W]}{[Q_L] + [W]} \)

Sol.: \( \frac{5}{100} = \frac{[W]}{[W] + 380} \)

19 \([W] = 380 \) J

\([W] = 20 \) J

15. Answer (1)

Hint: Application of Stefan’s law and Wien’s law

Sol.: \( T \propto \frac{1}{\lambda_m} \)

Power \( \propto \frac{1}{\lambda_m^4} \)

\[
\frac{P}{16} = \left( \lambda_m \right)^4
\]

\( \lambda_f = 2 \lambda_i \)

16. Answer (3)

Hint and Solution: For gaseous mixture

\[
f_{mix} = \frac{n_1 f_1 + n_2 f_2}{n_1 + n_2}
\]

17. Answer (4)

Hint: \( \Delta U = \frac{f}{2} n R (T_2 - T_1) \)

Sol.: \( \Delta U = \frac{3}{2} (P_2 V_2 - P_1 V_1) \)

\[
= \frac{3}{2} (3 \times 12 - 8 \times 8) \times 10^3
\]

\[
= \frac{3}{2} (36 - 64) \times 10^3 = -42 \text{ kJ}
\]

18. Answer (2)

Hint: \( g_d = g_h \)

Sol.: \( g \left( 1 - \frac{d}{R} \right) = g \left( 1 - \frac{2h}{R} \right) \)

\[
\frac{d}{R} = \frac{2h}{R}
\]

\( h = \frac{5}{2} \) km

19. Answer (1)

Hint: \( \Delta U = U_i - U_f \)

Sol.: \( \Delta U = \frac{-G M m}{3 R} - \frac{\left( \frac{G M m}{2 R} \right)}{2} \)

\[
= \frac{G M m}{R} \left( -\frac{1}{3} + \frac{1}{2} \right)
\]

\[
= \frac{G M m}{6 R} = \frac{1}{6} mg R
\]

20. Answer (3)

Hint: \( v_e = \sqrt{\frac{2 G M}{R}} \)

Sol.: \( v_e = \sqrt{\frac{2 G M}{R}} \)

\[
\left( 3 \times 10^8 \right)^2 = \frac{2 \times 6.67 \times 10^{-11} \times 2 \times 10^{30}}{R}
\]

\[
R = \frac{4 \times 6.67 \times 10^{19}}{9 \times 10^{16}}
\]

= 2964 m
21. Answer (3)

Hint : \( \frac{\Delta \theta}{\Delta t} = k(\theta_{\text{avg.}} - \theta_0) \)

Sol. : \( \frac{80 - 72}{66 - 72} = \frac{76 - \theta_0}{69 - \theta_0} \)

4 \((69 - \theta_0) = 3(76 - \theta_0) \)
\( \theta_0 = 12(23 - 19) \)
\( \theta_0 = 48^\circ C \)

22. Answer (4)

Hint : \( Y = \frac{F \ell}{A \Delta \ell} = \frac{F \ell^2}{\ell \Delta \ell} \)

[Y and \( \Delta \ell \) are same]

Sol. : \( F \propto \frac{1}{\ell^2} \)

\[ \frac{F_1}{F_2} = \left( \frac{\ell_2}{\ell_1} \right)^2 = \frac{(\ell + \ell)}{2} \]

\( F_2 = \frac{4}{9} F \)

23. Answer (2)

Hint : \( v = \sqrt{\frac{GM}{(R + h)}} \)

Sol. : \( v = \sqrt{\frac{GM}{(R + h)}} = R \sqrt{\frac{g}{R + h}} \)

= \( 6.4 \times 10^6 \sqrt{\frac{9.8}{(6.4 + 1.6) \times 10^5}} \)

= \( 6.4 \times 10^3 \sqrt{\frac{9.8}{8}} \)

= 7 km/s

24. Answer (3)

Hint : \( |\Delta P| = B \frac{\Delta V}{V} \)

Sol. : \( |\Delta P| = 2.5 \times 10^3 \times \frac{0.01}{100} \)

= \( 2.5 \times 10^3 \times 1 \times 10^{-4} \)
\( |\Delta P| = 250 \text{ kPa} \)

25. Answer (3)

Hint : Equating pressure

Sol. :

As \( \rho_{\text{Hg}} y = \rho_{l} g(4) \)

\[ y = \frac{4 \times 3.4}{13.6} \]

\( y = 1 \text{ cm} \)
Now \( h = 4 - 1 = 3 \text{ cm} \)

26. Answer (4)

Hint : \( R = (n^3) r \) and \( v \propto r^2 \)

Sol. : \( R = (n^3) r \)

\( = (27)^{\frac{1}{3}} r \)
\( R = 3r \)

Terminal velocity \( \propto r^2 \)

\[ v_{\text{big}} = \left( \frac{R}{r} \right)^2 v_{\text{small}} \]

\( = 3^2 \times 4 \text{ cm/s} \)
\( v_{\text{big}} = 36 \text{ cm/s} \)

27. Answer (2)

Hint : \( W_{\text{app}} = W_{\text{real}} - F_{\text{buoyancy}} \)

Sol. : 1st case : \( 50 = 250 \ - \rho_l \frac{250}{\rho_s} \)

\[ \frac{\rho_l}{\rho_s} 250 = 200 \]
\[ \frac{\rho_l}{\rho_s} = \frac{4}{5} \]

2nd case : \( 150 = 250 \ - \rho_{\text{rel}} \frac{250}{\rho_s} \)

\[ \frac{250}{\rho_{\text{rel}}} = 100 \]
\[ \rho_{\text{rel}} = 2.5 \]
\[ \rho_{\text{rel}} = 2 \]
28. Answer (1)
   Hint: \( \Delta Q = \Delta U + P\Delta V \)
   Sol.: \( \Delta U = 1134 + 10^5(835.5 - 0.5) \times 10^{-6} \)
   \( \Delta U = 1134 - 83.5 \)
   \( \Delta U = 1050.5 \text{ J} \)

29. Answer (4)
   Hint: \( \mu g = |\text{slope of } v-t \text{ graph}| \)
   Sol.:
   \[
   \mu = \frac{180}{16} = 0.5
   \]

30. Answer (1)
   Hint: Resolution of vectors.
   Sol.:
   \[
   \begin{align*}
   F_{\text{res}} &= 2F \cos 37^\circ \\
   &= 2 \times 10 \times \frac{4}{5} \\
   &= 16 \text{ N}
   \end{align*}
   \]

31. Answer (1)
   Hint: Concept of conservation of momentum and mechanical energy.
   Sol.:
   \[
   v = \sqrt{2gl} \\
   H = \frac{2gl}{8g} \\
   \therefore H = \frac{l}{4}
   \]

32. Answer (4)
   Hint: \( KE = \frac{1}{2} |p||v| \)
   Sol.: \( 50 = \frac{1}{2} \times 5 \times v \)
   \( v = 20 \text{ m/s} \)

33. Answer (3)
   Hint: \( \vec{F}_{\text{net}} = M_{\text{Total}} \vec{a}_{\text{net}} \)
   Sol.: \( 2T - (m + M)g = (m + M)a \)
   \[
   \begin{align*}
   a &= \frac{30000 - 15000}{1500} \\
   &= 10 \text{ m/s}^2
   \end{align*}
   \]
   Now, \( T' - mg = ma \)
   \[
   \begin{align*}
   T' &= m(g + a) \\
   &= 100 (10 + 10) \\
   &= 2000 \text{ N}
   \end{align*}
   \]

34. Answer (3)
   Hint: \( P = Av^3 \rho \)
   Sol.:
   \[
   \begin{align*}
   Force, \quad F &= v \left( \frac{dm}{dt} \right) = Av^2 \rho \left( \frac{dm}{dt} \right) = Av \rho \\
   \Rightarrow \text{For same pipe, } v &\propto P^\frac{1}{3} \\
   \Rightarrow v' &= 2^\frac{1}{3} v \\
   \end{align*}
   \]
   \[
   \begin{align*}
   \text{So, } \frac{dm'}{dt} &= Av' \rho = 2^\frac{1}{3} \left( \frac{dm}{dt} \right) \\
   \end{align*}
   \]

35. Answer (4)
   Hint: \( \tau = \vec{r} \times \vec{F} \)
   Sol.:
   \[
   \tau = 4F \frac{a}{\sqrt{2}} = 2\sqrt{2} Fa \\
   \tau = 2 \text{ N m}
   \]

36. Answer (1)
   Hint: \( M = \int \lambda dx \)
   Sol.:
   \[
   \begin{align*}
   \lambda &= \frac{dm}{dx} = 3x + 2 \\
   M &= \int dm = \int \left( \frac{2}{3}x + 2 \right) dx \\
   &= \left[ \frac{3x^2}{2} + 2x \right]_0 \\
   &= \left( \frac{3 \times 4}{2} + 4 \right) \\
   &= 10 \text{ kg}
   \end{align*}
   \]
37. Answer (4)

**Hint and Solution:** In case of uniform gravity near the surface of the earth centre of gravity and mass are the same point.

38. Answer (2)

**Hint and Solution:** In case of pure rolling there is no loss of mechanical energy so

\[ K_{hollow} = K_{solid} \]

39. Answer (1)

**Hint:** Impulse = Change in momentum

**Sol.:**

\[ 15 = 3 \times v_{cm} \]

\[ v_{cm} = 5 \text{ m/s} \]

40. Answer (3)

**Hint:** \[ \tau = I \alpha \]

**Sol.:**

The point A is the point of zero acceleration then consider pure rotation about point A.

\[ \tau = I \alpha \]

\[ mg \frac{\ell}{2} = \frac{m\ell^2}{3} \alpha \]

\[ \frac{3g}{2} \frac{\ell}{\ell} = \alpha \]

\[ a = \alpha R \]

\[ a = \frac{3g}{2 \times 2} = 7.5 \text{ m/s}^2 \]

41. Answer (2)

**Hint:** Condition for destructive interference

**Sol.:** Path difference \((3\ell - 2\ell)\)

\[ = (2n-1) \frac{\lambda}{2} \]

\[ \lambda = 2 \ell \frac{2}{3}, 2 \ell \frac{2}{5}, 2 \ell \frac{2}{7}, \ldots \]

or \[ \lambda = 2 \ell \frac{2}{3}, 2 \ell \frac{2}{5}, 2 \ell \frac{2}{7}, \ldots \]

\[ \lambda = \frac{2\ell}{5} \]

42. Answer (4)

**Hint:** \[ f_0 = \frac{v}{4\ell} \]

43. Answer (3)

**Hint:** \[ f_{app} = f_0 \left( \frac{v_0}{v_0 - v_s} \right) \]

\[ 2000 (320 - 40 \cos 60^\circ) = f_0(320) \]

\[ \frac{2000 \times (320 - 20)}{320} = f_o \]

\[ f_0 = \frac{600 \times 10^3}{320} = 1875 \text{ Hz} \]

44. Answer (2)

**Hint:** \[ \vec{v} = \frac{dx}{dt} \hat{i} + \frac{dy}{dt} \hat{j} \]

**Sol.:**

\[ v_x = \frac{dx}{dt} = 8t \]

\[ v_y = \frac{dy}{dt} = \frac{d(3t - 5)}{dt} = 3 \]

\[ \vec{v} = v_x \hat{i} + v_y \hat{j} = \left( 8t \hat{i} + 3 \hat{j} \right) \]

45. Answer (4)

**Hint:** \[ \vec{L}_A = -\vec{L}_B \neq 0 \]

**Sol.:** \[ \vec{L}_A \text{ and } \vec{L}_B \text{ are opposite in direction} \]

Here, \[ \vec{L}_A = -\vec{L}_B \]

So, \[ \vec{L}_A \neq \vec{L}_B \]

and \[ |\vec{L}_A| = |\vec{L}_B| \]
46. Answer (2)
   **Hint:** Molar mass of water is 18 g mol\(^{-1}\)
   **Sol.:** Volume of 1 g water = 1 cm\(^3\)
   Volume of 18 g water = 18 cm\(^3\) = 18 mL

47. Answer (1)
   **Hint:** No. of orbitals in a subshell = 2l + 1

48. Answer (2)
   **Hint:** \(\Delta x \cdot \Delta p \geq \frac{\hbar}{4\pi}\)
   **Sol.:** \(\Delta p = \sqrt{\frac{\hbar}{8\pi}}\)
   \(\Delta v = \frac{1}{m} \sqrt{\frac{\hbar}{8\pi}}\)

49. Answer (2)
   **Hint:** Highest is the positive charge on isoelectronic ions, smaller will be its size.

50. Answer (1)
   **Hint:** 13th group elements have only 3 valence electrons.
   **Sol.:** Boron has incomplete octet in B(OH)\(_3\).

51. Answer (4)
   **Hint:** Rate of effusion of a gas is inversely proportional to square root of its molar mass.
   **Sol.:** \(\frac{r_{\text{unknown}}}{r_{\text{He}}} = \sqrt{\frac{M_{\text{He}}}{M_{\text{unknown}}}}\)
   \(\frac{t_{\text{He}}}{t_{\text{unknown}}} = \sqrt{\frac{M_{\text{He}}}{M_{\text{unknown}}}}\) \(\quad (\because r \propto \frac{1}{\text{time}})\)
   \(\frac{1}{4} = \sqrt{\frac{4}{M_{\text{unknown}}}}\)
   \(M_{\text{unknown}} = 16 \times 4 = 64\)

52. Answer (2)
   **Hint:** In vacuum, \(P_{\text{ext}} = 0\)
   **Sol.:** \(W = -P_{\text{ext}}(V_2 - V_1)\)
   \(W = 0 \quad (\because P_{\text{ext}} = 0)\)

53. Answer (2)
   **Hint:** For fusion, \(\Delta S = \frac{n\Delta H_{\text{fusion}}}{T_{\text{fusion}}}\)
   **Sol.:** \(\Delta S_{\text{fusion}} = \frac{n\Delta H_{\text{fusion}}}{T_{\text{fusion}}}\)
   \(\Delta S_{\text{fusion}} = \frac{140 \times 10^3}{350} = \frac{140 \times 1000}{350}\)
   \(= 400 \text{ J/K-mol}\)

54. Answer (4)
   **Hint:** \(K_p = K_c(RT)^\Delta n_g\)
   **Sol.:** \(\Delta n_g = 2 - 1 = 1\)
   \(K_p = K_c(RT)\)
   \(\frac{K_p}{K_c} = RT\)

55. Answer (4)
   **Hint:** Basicity of hydroxides increases down the group.

56. Answer (1)
   **Hint:** An element in a compound in its highest oxidation state cannot act as reducing agent.

57. Answer (1)
   **Hint:** 20 Volume \(H_2O_2\) means, 1 L \(H_2O_2\) solution on decomposition gives 20 L oxygen gas at NTP.
   **Sol.:** \(\because 1000 \text{ mL} 20 \text{ V} H_2O_2 \text{ gives} = 20 \text{ L} O_2 (g)\)
   \(\therefore 30 \text{ mL} 20 \text{ V} H_2O_2 \text{ gives} = \frac{20 \times 30}{1000} = 0.6 \text{ L} O_2(g)\)

58. Answer (4)
   **Hint:** Smaller the size of ion, greater will be its hydration.
   **Sol.:** Larger is the size of ion, smaller will be its hydration and smaller will be its hydrated size and maximum will be its mobility.

59. Answer (1)
   **Hint:** Tin oxides, \(\text{SnO}\) and \(\text{SnO}_2\) are amphoteric oxides.
   **Sol.:** \(\text{CO} : \text{Neutral oxide}\)
   \(\text{SnO} : \text{Amphoteric oxide}\)
   \(\text{SnO}_2 : \text{Amphoteric oxide}\)
   \(\text{Al}_2\text{O}_3 : \text{Amphoteric oxide}\)
60. Answer (3)
Hint: Greater the number of hyperconjugating structures, more stable will be the carbonium ion.
Sol.: \( \text{tert-butyl carbonium ion has 9 } \alpha \)-H atoms.

61. Answer (3)
Hint: \( \text{FeBr}_3 \) is a Lewis acid and \( \text{Br}_2 \) is Lewis base.
Sol.: 

62. Answer (4)
Hint: Bhopal gas tragedy was caused by methyl isocyanate (\( \text{CH}_3\text{NCO} \)).

63. Answer (3)
Hint: Molarity = \( \frac{\text{Number of moles}}{\text{Volume of solution (L)}} \)
Sol.: 

64. Answer (3)
Hint: Orbital angular momentum = \( \sqrt{l(l+1)} \hbar \)
Sol.: For ‘p’ orbital, \( l = 1 \)
Angular momentum = \( \sqrt{2} \hbar \)

65. Answer (1)
Hint: For ‘p’ orbitals value of ‘l’ is 1
Sol.: \( m_l = -1, 0, +1 \)
\( m_l = 0 \) represents only ‘1’ orbital.

66. Answer (1)
Hint: Due to stable configuration of Be and N, they have negative electron affinity.
Sol.: \( \text{F > O > N > Be} \)

67. Answer (3)
Hint: Dipole moment is a vector quantity
Sol.: \( \text{CH}_4, \mu_{\text{net}} = 0 \)
\( \text{XeF}_4, \mu_{\text{net}} = 0 \)
\( \text{NH}_3, \mu_{\text{net}} = 1.46 \text{ D} \)
\( \text{PCl}_3\text{F}_2, \mu_{\text{net}} = 0 \)

68. Answer (4)
Hint: In hybridization, only sigma bonds and lone pair(s) present on central atom are considered.

69. Answer (3)
Hint: Bond order = \( \frac{N_b - N_a}{2} \)
Sol.: \( \text{O}^+, \text{B.O.} = 2.5 \)
\( \text{NO}, \text{B.O.} = 2.5 \)
\( \text{C}_2, \text{B.O.} = 2.0 \)
\( \text{N}_2^+, \text{B.O.} = 2.5 \)

70. Answer (2)
Hint: Density of ideal gas, \( d = \frac{\text{PM}}{\text{RT}} \)
Sol.: 

71. Answer (1)
Hint: \( \Delta H = \Delta U + \Delta n_g \text{ RT} \)
\( \text{and } \Delta G = \Delta H - T \Delta S \)
Sol.: For reaction \( 2\text{A}(l) \rightarrow 4\text{B}(g) \)
\( \Delta n_g = 4 - 0 = 4 \)
\( \Delta H = \Delta U + \Delta n_g \text{ RT} = 1.2 \times 10^3 + 4 \times 2 \times 300 \)
\( = 3.6 \times 10^3 \text{ cal} \)
\( \Delta G = 3.6 \times 10^3 - 300 \times 10 \)
\( = 3.6 \times 10^3 - 3 \times 10^3 = 0.6 \times 10^3 = 600 \text{ cal} \)

72. Answer (4)
Hint: \( \Delta S = nC_v \ln \left( \frac{T_2}{T_1} \right) + nR \ln \left( \frac{V_2}{V_1} \right) \)
Sol.: At constant temperature, \( T_1 = T_2 \)
\( \Delta S = nR \ln \left( \frac{V_2}{V_1} \right) \)

73. Answer (3)
Hint: Mixture of weak acid and its salt with strong base act as acidic buffer.
Sol.: Mixture of \( \text{H}_2\text{SO}_4 \) (strong acid) and \( \text{Na}_2\text{SO}_4 \) (salt of strong acid with strong base) is not an acidic buffer.
74. Answer (2)
   **Hint:** Equilibrium constant remains unchanged with increase or decrease of concentration of species present at equilibrium at a constant temperature.
   
   \[ K_{\text{eq}} = [\text{Ca}^{2+}]^3[\text{PO}_4^{3-}]^2 \]
   
   **Sol.:**
   \[ [\text{Ca}^{2+}]^3[\text{PO}_4^{3-}]^2 = \left(\frac{\text{Ca}^{2+}}{2}\right)^3[\text{PO}_4^{3-}]^2 \]
   
   \[ 8[\text{PO}_4^{3-}] = 2\sqrt{2}[\text{PO}_4^{3-}] \]

75. Answer (4)
   **Hint:** \( E_{\text{red}}^0 = -E_{\text{ox}}^0 \)
   
   **Sol.:**
   \[ E_{\text{cell}}^0 = 1.81 - (-0.44) = 1.81 + 0.44 \]
   \[ = 2.25 \text{ V} \]

76. Answer (2)
   **Hint:** Electron withdrawing group at para position enhances acidity of phenol.
   
   **Sol.:** - \( \text{NO}_2 \) present at para position in p-nitrophenol increases acidity of phenol.

77. Answer (3)
   **Hint:** Nascent oxygen is responsible for bleaching action of \( \text{CaOCl}_2 \).
   
   **Sol.:**
   \[ \text{OCl}^- + \text{H}_2\text{O} \rightarrow \text{HOCl} + \text{OH}^- \]
   unstable
   
   \[ \rightarrow \text{HCl} + [\text{O}] \]

78. Answer (3)
   **Hint:** In diamond, carbon is \( sp^3 \) hybridized and its structure is tetrahedral.
   
   **Sol.:** Solid \( \text{H}_2\text{BO}_3 \): 2-D Hexagonal structure
   (\( \text{BN}_x \)): Graphite like structure
   \( \text{SiC} \): Diamond like structure
   \( \text{B}_2\text{N}_3\text{H}_6 \): Planar structure

79. Answer (3)
   **Hint:** In cyclic silicates two oxygen atoms are shared per tetrahedron with other units
   
   **Sol.:** \( \text{SiO}_2 \): 3D Silicate
   \( \text{Si}_2\text{O}_5^7 \): Pyrosilicates
   \( \text{Si}_2\text{O}_5^7 \): Cyclic silicates
   \( \text{Si}_2\text{O}_5^7 \): Sheet silicates

80. Answer (2)
   **Hint:** Radical which does not contain \( \alpha \)-hydrogen atom will not show hyperconjugation.

81. Answer (4)
   **Hint:** In presence of organic peroxide, anti-Markovnikov's effect is shown by HBr only.
   
   **Sol.:**
   \[ \text{CH}_3 - \text{CH} = \text{CH}_2 + \text{HBr} \rightarrow \text{CH}_3 - \text{CH} = \text{CH}_2\text{Br} \]
   \[ \text{CH}_3 - \text{CH} = \text{CH}_2 + \text{HCl} \rightarrow \text{CH}_3 - \text{CH} - \text{CH}_3 \]

82. Answer (3)
   **Hint:** Fully eclipsed conformation of \( \text{n-butane} \) is least stable.

83. Answer (2)
   **Hint:** From stoichiometry of reaction,
   \[ \frac{n_{\text{Re}_2\text{O}_7}}{17} = \frac{n_{\text{CO}}}{17} \]
   
   **Sol.:**
   \[ \text{Re}_2\text{O}_7 + 17\text{CO} \rightarrow \text{Re}_2(\text{CO})_7 + 7\text{CO}_2 \]
   
   \[ \frac{n_{\text{Re}_2\text{O}_7}}{5} = \frac{\text{mass of CO}}{\frac{484}{28 \times 17}} \]
   
   Mass of CO = \[ \frac{4.92 \text{ g}}{4.92 \text{ g}} \]

84. Answer (4)
   **Hint:** Wavelength of transition from \( n_2 \rightarrow n_1 \) line is,
   \[ \frac{1}{\lambda} = RZ^2 \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \]
   
   **Sol.:** For \( 4 \rightarrow 2 \) transition in \( \text{He}^+ \)
   \[ \frac{1}{\lambda} = R \times 4 \left( \frac{1}{2^2} - \frac{1}{4^2} \right) \]
   ... (i)
   
   For \( n \rightarrow 4 \) transition, in \( \text{Be}^{3+} \)
   \[ \frac{1}{\lambda} = R \times 4^2 \left( \frac{1}{4^2} - \frac{1}{n^2} \right) \]
   ... (ii)
   
   For equal value of wavelength
   \[ R \times 4 \left( \frac{1}{2^2} - \frac{1}{4^2} \right) = R \times 4^2 \left( \frac{1}{4^2} - \frac{1}{n^2} \right) \]
   
   \[ \Rightarrow R \times 4 \left( \frac{1}{4} - \frac{1}{n^2} \right) = R \times 4 \left( \frac{1}{2} - \frac{1}{n^2} \right) \]
   
   Hence, \( \frac{n}{2} = 4 \)
   
   \[ n = 8 \]
85. Answer (2)

**Hint:** Enthalpy change when 1 mole of solute is dissolved in excess of solvent is called enthalpy of solution.

**Sol.**:

(i) \( \text{XY(s)} \rightarrow \text{X}^+(g) + \text{Y}^-(g), \Delta H = 700 \text{ kcal/mol} \)

(ii) \( \text{X}^+(g) + \text{H}_2\text{O(l)} \rightarrow \text{X}^+(aq), \Delta H = -800 \text{ kcal/mol} \)

(iii) \( \text{Y}^-(g) + \text{H}_2\text{O(l)} \rightarrow \text{Y}^-(aq), \Delta H = -600 \text{ kcal/mol} \)

Reaction, \( \text{XY(s)} + \text{H}_2\text{O(l)} \rightarrow \text{X}^+(aq) + \text{Y}^-(aq) \)

is obtained by addition of reaction (i), (ii) and (iii)

So, \( \Delta H_{\text{sol}} = +700 - 800 - 600 = -700 \text{ kcal/mol} \)

86. Answer (3)

**Hint:** Percentage of bromine

\[
\text{Percentage of bromine} = \frac{80 \times \text{wt. of AgBr} \times 100}{188 \times \text{wt. of compound}}
\]

**Sol.**:

Percentage of bromine

\[
= \frac{80 \times 0.188 \times 100}{188 \times 0.25} = 32\%
\]

87. Answer (3)

**Hint:** Saytzeff alkene is major product

**Sol.**:

\[
\text{PhCH}_2\text{CHCH}_3 \xrightarrow{\text{conc. } \text{H}_2\text{SO}_4, \Delta} \text{Ph} \xrightarrow{(i) \text{Zn/H}_2\text{O}} \text{PhCHO} + \text{CH}_3\text{CHO}
\]

88. Answer (2)

**Hint:** Excess nitrate in drinking water causes blue baby syndrome.

89. Answer (3)

**Hint:** In presence of \( \text{B}_2\text{H}_6/\text{THF} \) and \( \text{H}_2\text{O}_2/\text{OH}^- \) anti Markovnikov addition of \( \text{H}_2\text{O} \) takes place without rearrangement.

**Sol.**:

\[
\text{PhCH} = \text{CH} = \text{CH} = \text{CH}_3 \xrightarrow{(i) \text{B}_2\text{H}_6/\text{THF}} \text{PhCH} \xrightarrow{(ii) \text{H}_2\text{O}_2/\text{OH}^-} \text{PhCH} \text{OH}
\]

90. Answer (3)

**Hint:** Species containing \((4n + 2)\pi\) electrons will be aromatic.

**Sol.**:

In Pyrrole the lone pair of nitrogen is involved in resonance leading to \(6\pi\) electrons delocalization. Hence, it is aromatic species.

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**[BIOLOGY]**

91. Answer (2)

**Hint:** In multicellular organisms, growth and reproduction are not synonymous.

**Sol.**:

Both are mutually exclusive events but they are linked.

92. Answer (3)

**Hint:** Middle lamella is a pectate layer.

**Sol.**:

Middle lamella is chiefly made up of calcium and magnesium pectate.

93. Answer (2)

**Hint:** This plastid is meant for storage of food.

**Sol.**:

Plastid, which is non-pigmented and lacks granum is leucoplast.

94. Answer (1)

**Hint:** At Anaphase I there is beginning of reduction of chromosome number.

**Sol.**:

Metaphase I – Double metaphasic plate

Diploptene – Synaptonemal complex dissolves

Metaphase – Single metaphasic plate

95. Answer (1)

**Hint:** ABA is known as stress hormone.

**Sol.**:

ABA is responsible for closure of stomata, therefore considered as natural anti-transpirant.

\( \text{GA}_3 \) — helps in seed germination.

Cytokinin — Richmond-Lang effect

ABA — Precursor is violaxanthin

96. Answer (2)

**Hint:** These fungi are commonly known as club fungi.

**Sol.**:

Few members of basidiomycetes are wood decomposers. Secondary mycelium is long lived, show clamp connection for proper distribution of dikaryons at the time of cell division. Sexual spores are basidiospores produced exogenously on basidia.

97. Answer (4)

**Hint:** Thorns are woody pointed structures and are modification of stem.

**Sol.**:

Thorns are modified axillary buds. Thus, thorns are modification of stems.
98. Answer (2)  
**Hint:** Tricarpellary ovary is found in monocot families.  
**Sol.:** Tricarpellary, syncarpous, superior ovary, trilocular with many ovules and axile placentation are features of family Liliaceae.

99. Answer (2)  
**Hint:** In roots, pericycle forms lateral roots and in dicot they also help in formation of vascular cambium. Root cells lack chlorophyll.  
**Sol.:** In roots pericycle is parenchymatous. Monocots lack collenchyma. Thick walled sclerenchymatous pericycle is seen in dicot stem.

100. Answer (2)  
**Hint:** In homosporous species of pteridophytes, prothallus is found which is monoecious gametophytic body.  
**Sol.:** *Lycopodium* and *Dryopteris* are homosporous. Therefore in *Dryopteris* prothallus is monoecious.

101. Answer (2)  
**Hint:** The cell walls of diatoms contain silica.  
**Sol.:** The wall of diatoms are not easily destructible due to silica impregnation in cell wall. In viroids, RNA is of low molecular weight. *Neurospora* is used in the study of biochemical and genetic work. Bacterial cell wall is made up of peptidoglycan.

102. Answer (4)  
**Hint:** Transduction was demonstrated by Zinder & Lederberg in typhoid causing bacterium.  
**Sol.:** Transduction is transfer of DNA from donor to recipient bacterium by a bacteriophage. Transduction was demonstrated with the help of bacterium *Salmonella typhimurium*. *Azotobacter* is a free living aerobic bacterium.

103. Answer (1)  
**Hint:** Passive absorption takes place in rapidly transpiring plants, thus negative pressure develops in the xylem.  
**Sol.:** During active absorption of water by roots a positive pressure develops known as root pressure. Active transport is an uphill transport because substances are transported against their concentration gradient. Germination of seeds of *Pinus* requires mycorrhizal association.

For a solution at atmospheric pressure $\psi_w = \psi_s$.

104. Answer (2)  
**Hint:** Water moves from high to low water potential.

105. Answer (1)  
**Hint:** Increased level of K$^+$ and malate ions form potassium malate in vacuole of guard cell which increases its osmotic concentration.  
**Sol.:** In guard cells, increased osmotic concentration leads to endosmosis of water. Consequently guard cells become turgid and stomata get open.

106. Answer (3)  
**Sol.:** “Pressure flow hypothesis” is the most accepted mechanism proposed for the translocation of sugars from source to sink. It was proposed by E. Munch.

107. Answer (2)  
**Hint:** Root pressure develops when pumping of water into xylem channel is active.  
**Sol.:** Pumping of water into xylem channel remains active due to metabolic activity of root. A positive hydrostatic pressure develops in xylem of root known as root pressure.

108. Answer (3)  
**Hint:** Given figure is of *Fucus*, which is a brown alga.  
**Sol.:** Carrageen is a hydrocolloid of cell wall of red algae. Red algae are known as deepest dweller because they can survive deep in the sea.

109. Answer (4)  
**Hint:** *Chlorella* and *Spirulina* are used by space travellers as food supplements.  
**Sol.:** Alage are primary producers. Pyrenoids are analogous to leucoplasts of higher plants as they contain protein & starch. Phenetics uses numerical method for evaluation of similarities and differences between species with the help of computers.

110. Answer (2)  
**Hint:** Two molecules of acetyl CoA enters the Krebs’ cycle and produces 6 NADH$_2$ and 2 FADH$_2$ in two turns.
111. Answer (2)

**Hint:** Conversion of fats into carbohydrate is known as gluconeogenesis.

**Sol.:** Gluconeogenesis takes place through glyoxylic acid cycle in germinating fatty seeds. Enzymes for glyoxylic acid cycle are found in glyoxysomes.

112. Answer (4)

**Hint:** Nitrate is not used by plants as such. It is reduced via two steps (Nitrate assimilation) into NH₃.

**Sol.:**
- A – Nitrate reductase.
- B – NADH₂
- C – NAD⁺H⁺
- D – Nitrite reductase
- E – PS I

113. Answer (4)

**Hint:** From one molecule of N₂, two molecules of ammonia are produced, which requires 16 ATP.

**Sol.:** Thus, for production of each NH₃ molecule 8 ATP are required.

Nitrogenase is made up of Mo – Fe protein.

114. Answer (4)

**Hint:** Photorespiration does not produce ATP or NADPH.

**Sol.:** It is known as C₂ cycle because first product phosphoglycolate is 2C compound. Sugar is not synthesised. It is a wasteful process.

115. Answer (1)

**Hint:** It is significant in the production of certain greenhouse crops.

**Sol.:** Greenhouse crops like tomatoes and bell pepper, if allowed to grow in CO₂ enriched atmosphere increases their yields. This is known as CO₂ fertilization effect.

116. Answer (3)

**Hint:** Sudden sharp rise in the rate of respiration at the time of ripening in fleshy fruits is called respiratory climactic. Ethylene is a ripening agent.

**Sol.:** ABA (Abscissic Acid) exhibits physiological effects such as closure of stomata,

Acceleration of abscission of flower & fruits etc.

It is antagonist to gibberellin (Anti GA) and also known as stress hormone.

Respiratory climactic is an effect of ethylene.

117. Answer (2)

**Hint:** Vascular cambium is partly primary and partly secondary in origin in dicot stem.

**Sol.:** Vascular cambium = Fascicular + Interfascicular cambium

1° in origin

2° in origin

118. Answer (4)

**Hint:** In such flowers ovary is superior.

**Sol.:** If position of ovary in a flower is highest and other parts are situated below it then it is called hypogynous flower.

119. Answer (3)

**Sol.:** Primary cell wall is the cell wall of young plant cell which is capable of growth and diminishes as the cell matures.

120. Answer (2)

**Hint:** The complex formed by a pair of synapsed homologous chromosomes is called a bivalent. Pollen grains are haploid.

**Sol.:** n = 20 chromosomes then 2n = 40 chromosomes

40 chromosomes will form 20 pairs and there will be 20 bivalents.

121. Answer (1)

**Hint:** In opposite phyllotaxy, a pair of leaves arise at each node and lie opposite to each other.

**Sol.:** This pattern of arrangement of leaves is found in Calotropis.

122. Answer (4)

**Hint:** In unicellular member of ascomycetes, ascus formation occurs but no ascocarp formation takes place.

**Sol.:** Saccharomyces (yeast) is a unicellular ascomycetes in which ascus formation occurs but fruiting body (ascocarp) is not formed.

123. Answer (4)

**Hint:** Protists may be autotrophic as well as heterotrophic.

**Sol.:** In autotrophic mode of nutrition, protists are photosynthetic.
124. Answer (3)
   **Sol.** In plants, symptoms like mosaic formation, leaf rolling and curling, yellowing and vein clearing, dwarfining and stunted growth are due to viral infections.

125. Answer (2)
   **Hint:** Deuteromycetes reproduce generally by non-motile, exogenous, asexual spores.
   **Sol.** Those non-motile, exogenous asexual spores are conidia.

126. Answer (3)
   **Hint:** This enzyme helps in the transfer of phosphate from ATP to fructose-6-phosphate.
   **Sol.** This enzyme is phosphofructokinase. It is also known as pace-maker enzyme of EMP pathway.

127. Answer (1)
   **Hint:** Such flowers have radial symmetry.
   **Sol.** In actinomorphic flowers, symmetry is radial.

128. Answer (2)
   **Hint:** Thick cell wall of heterocyst is impermeable to oxygen.
   **Sol.** Heterocyst is specialised for nitrogen fixation under anaerobic condition with the help of enzyme nitrogenase. Heterocysts lack PS II.

129. Answer (3)
   **Hint:** Lichens are indicators of air pollution.
   **Sol.** Lichens cannot tolerate air pollution, especially SO₂ pollution.

130. Answer (1)
   **Sol.** In bryophytes, spores get disseminated by wind.

131. Answer (2)
   **Hint:** Herbaria are used as quick source of reference and keys are artificial analytical devices for taxonomical studies.
   **Sol.** Botanical gardens are ex-situ conservation strategies of plants. Monograph contains information of any one taxon.

132. Answer (2)
   **Hint:** Cork or phellem is formed by the redifferentiation of the outer cells of the cork cambium.
   **Sol.** Cork is dead layer and becomes impervious to water due to deposition of suberin in the cell wall.

133. Answer (1)
   **Hint:** In gymnosperms, pollen grains are carried by air currents.
   **Sol.** In gymnosperms, means of pollination is air current and due to presence of archegonia, they are archegoniates.

134. Answer (3)
   **Hint:** Mycorrhizal association enhances supply of nitrogen to plant. It is not related to nitrogen fixation.
   **Sol.** This association increases surface area of absorption of plants and enhances supply of minerals like N, P, S etc. Fungi obtain shelter from this association.

135. Answer (2)
   **Sol.** Smallest angiosperm is *Wolfia*. It is almost microscopic.

136. Answer (4)
   **Hint:** Nephridia are excretory structures of annelids.
   **Sol.:** Proboscis gland is excretory structure of hemichordates like *Balanoglossus*. Malpighian tubules are excretory structure of insects. Ctenidia are found in molluscs. They perform both respiration and excretion. Flame cells are excretory structures of flatworms.

137. Answer (4)
   **Hint:** Hormones from hypothalamus are carried to anterior pituitary via hypophyseal portal vein.
   **Sol.:** ADH is produced by neurosecretory cells of hypothalamus and are carried to posterior pituitary via nerve tract.

138. Answer (4)
   **Hint:** Mast cells contain granules which produce histamine, heparin and serotonin.
   **Sol.:**
   A → Macrophages → Phagocytic cells
   B → Fibroblasts → Secrete collagen fibres
   C → Collagen fibres → Provide strength to tissue
   D → Mast cells → Secrete histamine, heparin (anti-coagulant) and serotonin

139. Answer (2)
   **Hint:** Left shift in oxygen dissociation curve indicates high affinity of haemoglobin for oxygen.
   **Sol.:** Low pCO₂, high pH, high pO₂ increases the affinity of haemoglobin for oxygen, while low pO₂, high pCO₂, high 2,3 BPG and low pH decrease the affinity of haemoglobin for oxygen causing right shift of oxygen dissociation curve.

140. Answer (4)
   **Hint:** T wave represents the return of ventricles from excited to normal state.
   **Sol.:**
   P wave : Atrial depolarisation.
   QRS complex : Ventricular depolarisation.
   T wave : Marks the end of ventricular systole.
141. Answer (4)

**Hint:** Neuroglia cells make up more than one half of volume of neural tissue.

**Sol.:** Neurons are electrically excitable cells of neural tissue. Neurons and muscle fibres have the ability to respond to certain stimuli by producing electrical signals called action potentials. Hence, are called electrically excitable cells.

142. Answer (3)

**Hint:** These enzymes catalyse the cleavage of substrate into two parts, without the use of water.

**Sol.:** Lyases are responsible for the formation of double bond \( X - Y + C = C \)

- Joining of \( C - O, C - S, C - N \) and bond is done by ligases
- Hydrolysis of peptide bonds is done by hydrolases

143. Answer (4)

**Hint:** Synovial joints are present between carpals (wrist bone).

**Sol.:** Gliding joints are present in carpals and tarsals. Ball and socket joint is present between humerus and pectoral girdle. Pivot joint is present between atlas and axis vertebrae. Fibrous joints are present between the bones of cranium.

144. Answer (4)

**Hint:** Respiratory capacities are sum of various respiratory volumes.

**Sol.:**
- Residual volume = 1100 ml - 1200 ml
- Vital capacity = ERV + TV + IRV = 3500 ml - 4500 ml
- Functional residual capacity = ERV + RV = 2500 ml
- Expiratory capacity = TV + ERV = 1500 ml - 1600 ml.

145. Answer (4)

**Hint:** During muscle contraction, the length of I-band decreases.

**Sol.:** During muscle contraction, thin filaments slide over thick filaments towards M-line. As a result, Z-lines are drawn towards each other leading to a decrease in length of sarcomere.

146 Answer (4)

**Hint:** Both animal show metamorphosis during their development.

**Sol.:** Frog has closed while cockroach has open circulatory system. Cockroach is uricotelic and frog is ureotelic. Dorsal nerve is a characteristic feature of chordates. Both frog and cockroach exhibit indirect development.

147. Answer (3)

**Hint:** Compound epithelium is present at the location which are more prone to wear and tear.

**Sol.:** Ciliated cuboidal epithelium is present in smaller bronchioles. Compound epithelium is present in skin, pharynx, buccal cavity etc.

148. Answer (3)

**Hint:** Castle’s intrinsic factor helps in absorption of vitamin \( B_{12} \).

**Sol.:** Parietal/oxyntic cells secrete HCl and Castle’s intrinsic factor. HCl converts \( Fe^{3+} \) into \( Fe^{2+} \) which makes the absorption of iron possible. Intrinsic factor is important for absorption of Vit \( B_{12} \). Damage to parietal cells will lead to deficiency of Vit \( B_{12} \) and \( Fe^{2+} \) which play an important role in maturation of RBCs and formation of haemoglobin respectively, thus causing anemia.

149. Answer (1)

**Hint:** Identify the structure responsible for balancing.

**Sol.:** Nephridia help in excretion and osmoregulation in case of annelids. Statocysts are structures for balance in an organism. Green glands are excretory structures in \( Palaemon \).

150. Answer (2)

**Hint:** In this disease, liver is affected.

**Sol.:** Jaundice is a digestive disorder. Concentration of bile pigment like bilirubin, increases in blood causing yellowness in skin and eye.

151. Answer (3)

**Hint:** Earthworm exhibits direct development.

**Sol.:** There is no larval stage in life cycle of earthworm. It exhibits external fertilisation as fusion of gametes and further developmental stages occur in the cocoon.

152. Answer (2)

**Hint:** Structure also known as malpighian body.

**Sol.:** Renal corpuscle consists of glomerulus along with Bowman’s capsule and situated in renal cortex.

153. Answer (1)

**Hint:** Intrapulmonary pressure decreases during inspiration.

**Sol.:** In normal respiration, contraction of diaphragm and external intercostal muscles increases the volume of thoracic cavity leading to a decrease in intrapulmonary pressure.
154. Answer (3)
   **Hint:** Nucleotide acts as energy currency of a cell.
   **Sol.:** Adenosine triphosphate (ATP) acts as energy currency of cell. Glycerol, phosphate group, fatty acids and choline are present in lecithin. Glycogen is also known as animal starch. Glycine is the simplest amino acid. Given structures represent glycerol, glucose, adenylic acid and glycine respectively.

155. Answer (3)
   **Hint:** Cellular respiration generates ATP
   **Sol.:** At cellular level, O$_2$ is used to breakdown glucose into CO$_2$, water and generates ATP which is used to provide energy for various processes.

156. Answer (2)
   **Hint:** Hypothalamus regulates our body temperature.
   **Sol.:** Corpus callosum is tract of nerve fibres which connects one cerebral hemisphere to another. Thalamus acts as a major coordinating centre for sensory and motor signalling.

157. Answer (3)
   **Hint:** Sympathetic nervous system regulates the activity of heart in situations of emergency.
   **Sol.:** Stimulation from parasympathetic nervous system causes a decrease in heart rate and cardiac output. By increasing the duration of individual cardiac cycle, it causes decrease in heart rate i.e. number of cardiac cycles in a minute.

158. Answer (2)
   **Hint:** Homeotherms are able to maintain a constant body temperature.
   **Sol.:** Members of class Aves and Mammalia are endotherms. Chelone, Naja, Calotes and Chameleon are reptiles and they are poikilotherms.

159. Answer (2)
   **Hint:** Different colours are perceived depending on activation of different types of cones cells.
   **Sol.:** When all red, green and blue cones are stimulated simultaneously a sensation of white light is produced.

160. Answer (2)
   **Hint:** Ascending limb of loop of Henle is impermeable to water.
   **Sol.:** Cortical nephrons lack vasa recta. Selective secretion of electrolytes occurs in DCT and collecting duct. Under the influence of ADH, maximum reabsorption of water occurs in PCT (60 – 70%), followed by DCT (20%) and then loop of Henle(15%).

161. Answer (3)
   **Hint:** Maximum reabsorption of nutrients occurs in PCT of nephron.
168. Answer (2)
   *Hint:* Glycogen is a homopolysaccharide.
   *Sol.:* Increasing order of various macromolecules is an animal cell is.
   \[
   \text{Lipids} < \text{Carbohydrates} < \text{Nucleic acid} < \text{Proteins}
   \]
   2% 3% 5 – 7% 10 – 15%

169. Answer (3)
   *Hint:* During aestivation and hibernation, metabolic rate of frog is greatly reduced.
   *Sol.:* During aestivation and hibernation, energy requirement of frog is greatly reduced and it also tries to conserve as much energy as possible. So frog respires through skin during hibernation and aestivation where exchange of gases occur via simple diffusion.

170. Answer (4)
   *Hint:* Identify the hormones of pituitary gland.
   *Sol.:* ACTH, TSH, ADH, LH, FSH, oxytocin, MSH etc. are pituitary gland hormones, while glucagon and insulin are pancreatic hormones. Thyroxine is produced by thyroid gland. Thymosin is produced by thymus gland.

171. Answer (3)
   *Hint:* Melanin is responsible for pigmentation of skin.
   *Sol.:* Pineal gland secretes melatonin which regulates 24 hour diurnal rhythm of our body. Adrenaline is an emergency hormone and prolactin helps in milk production.

172. Answer (4)
   *Hint:* Identify a reptile.
   *Sol.:* Testudo (tortoise) is an oviparous organism. Scoliodon (Dog fish), Balaenoptera (Whale) and Trichinella are viviparous organisms.

173. Answer (2)
   *Hint:* Cockroach shows indirect development.
   *Sol.:* There is no larva in the life cycle of cockroach.
   Egg → Nymph (young) → Imago. Nymph is not called larva but is considered as immature adult.
   In silver fish, ametabolous development occurs.

174. Answer (3)
   *Hint:* Aromatic compounds have benzene ring.
   *Sol.:* Tyrosine [Y] has benzene ring in its side chain and is an aromatic amino acid. Serine [S] is an alcoholic amino acid, Cysteine [C] is a sulphur containing amino acid while Glutamic acid (E) is an acidic amino acid.

175. Answer (1)
   *Hint:* Identify the hormone which causes vasodilation.
   *Sol.:* Atrial Natriuretic factor (ANF) is released in response to an increase in blood volume and pressure. ANF can cause vasodilation and thereby decrease the blood pressure.

176. Answer (4)
   *Hint:* Erythroblastosis foetalis can occur due to Rh incompatibility between mother and foetus.
   *Sol.:* When mother is Rh –ve and father is Rh +ve; then there is a possibility that foetus can be Rh +ve. In that case, mother’s body starts producing antibodies against foetal RBCs causing destruction of foetal RBCs, leading to erythroblastosis foetalis.

177. Answer (2)
   *Hint:* Humans have four different types of teeth which are embedded in bony jaw.
   *Sol.:* Humans have two sets of teeth in their life time i.e. deciduous and permanent teeth. We have four different types of teeth i.e. canines, incisors, premolars and molars, thus we have heterodont dentition. These teeth are embedded in the socket of jaw bone i.e. thecodont.

178. Answer (2)
   *Hint:* After death, the body becomes rigid due to sustained contraction of muscles.
   *Sol.:* After death due to depletion of ATP, the cross bridge formed between actin and myosin head is not able to break. As a result, the muscle fibre remain in contracted state leading to rigidity of body i.e. Rigor mortis.

179. Answer (3)
   *Hint:* Bile salts help in emulsification of fat.
   *Sol.:* A large lipid globule is broken down into small lipid globules by the action of bile salts. Lipase acts on these small lipid globules containing triglycerides and form diglycerides, monoglycerides and fatty acids.

180. Answer (4)
   *Hint:* Identify a unpaired bone of skull.
   *Sol.:* Sphenoid is a unpaired cranial bone while zygomatic, nasal and lacrimal are paired facial bones.
# All India Aakash Test Series for Medical-2020

## TEST - 7 (Code-D)

Test Date: 03/03/2019

### ANSWERS

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ANSWERS & HINTS

[PHYSICS]

1. Answer (4)
   Hint :  $|\vec{L}_A| = |\vec{L}_B| \neq 0$
   Sol. : $\vec{L}_A$ and $\vec{L}_B$ are opposite in direction
   Here, $\vec{L}_A = -\vec{L}_B$
   So, $\vec{L}_A \neq \vec{L}_B$
   and $|\vec{L}_A| = |\vec{L}_B|$

2. Answer (2)
   Hint : $\vec{v} = \frac{dx}{dt} \hat{i} + \frac{dy}{dt} \hat{j}$
   Sol. : $v_x = \frac{dx}{dt} = 8t$
   $v_y = \frac{dy}{dt} = \frac{d(3t - 5)}{dt} = 3$
   $\vec{v} = v_x \hat{i} + v_y \hat{j}$
   $= (8t \hat{i} + 3 \hat{j})$

3. Answer (3)
   Hint : $f_{app} = f_0 \left( \frac{v_0}{v_0 - v_s} \right)$
   Sol. : (Graph)

4. Answer (4)
   Hint : $f_0 = \frac{v}{4\ell}$

5. Answer (2)
   Hint : Condition for destructive interference
   Sol. : Path difference $(3\ell - 2\ell)$
   \[ = (2n - 1)\frac{\lambda}{2} \]
   $\ell = \frac{\lambda}{2}, \frac{3\lambda}{2}, \frac{5\lambda}{2}, \frac{7\lambda}{2}, \ldots$
   or $\lambda = 2\ell, \frac{2\ell}{3}, \frac{2\ell}{5}, \frac{2\ell}{7}, \ldots$
   $\lambda = \frac{2\ell}{5}$

6. Answer (3)
   Hint : $\tau = I \alpha$
   Sol. : (Graph)
   The point $A$ is the point of zero acceleration then consider pure rotation about point $A$.
   $\tau = I \alpha$
   $mg\ell = \frac{mt^2}{3} \alpha$
   $\frac{3g}{2\ell} = \alpha$
   $a = \alpha R$
   $a = \frac{3g}{2\ell} = 7.5 \text{m/s}^2$

7. Answer (1)
   Hint : Impulse = Change in momentum
   Sol. : $15 = 3 \times v_{cm}$
   $v_{cm} = 5 \text{m/s}$
8. Answer (2)

**Hint and Sol.** : In case of pure rolling there is no loss of mechanical energy so

\[ K_{\text{hollow}} = K_{\text{solid}} \]

9. Answer (4)

**Hint and Sol.** : In case of uniform gravity near the surface of earth centre of gravity and mass are the same point.

10. Answer (1)

**Hint** : \[ M = \int \lambda \, dx \]

**Sol.** : \[ \lambda = \frac{dm}{dx} = 3x + 2 \]

\[ M = \int_0^2 dm = \int_0^2 (3x + 2) \, dx \]

\[ = \left[ \frac{3x^2}{2} + 2x \right]_0^2 \]

\[ = \left( 3 \times \frac{4}{2} + 4 \right) \]

\[ = 10 \text{ kg} \]

11. Answer (4)

**Hint** : \[ \tau = \vec{r} \times \vec{F} \]

**Sol.** : \[ \tau = 4F \frac{a}{\sqrt{2}} = 2\sqrt{2} Fa \]

\[ \tau = 2 \text{ N m} \]

12. Answer (3)

**Hint** : \[ P = Av^3 \rho \]

**Sol.** : Force, \[ F = v \left( \frac{dm}{dt} \right) = Av^3 \rho \]

Power, \[ P = Fv = Av^4 \rho \]

\[ \Rightarrow \text{For same pipe, } v \propto P^{\frac{1}{4}} \]

\[ \Rightarrow v' = 2^\frac{1}{4} v \]

So, \[ \left( \frac{dm'}{dt} \right) = Av' \rho = 2^\frac{1}{4} \left( \frac{dm}{dt} \right) \]

13. Answer (3)

**Hint** : \[ \vec{F_{\text{net}}} = M_{\text{total}} \vec{a}_{\text{net}} \]

**Sol.** : \[ 2T - (m + M)g = (m + M)a \]

So, \[ a = \frac{30000 - 15000}{1500} \]

\[ = 10 \text{ m/s}^2 \]

Now, \[ T - mg = ma \]

\[ T = m(g + a) \]

\[ = 100 (10 + 10) \]

\[ T = 2000 \text{ N} \]

14. Answer (4)

**Hint** : \[ KE = \frac{1}{2} m v^2 \]

**Sol.** : \[ 50 = \frac{1}{2} \times 5 \times v \]

\[ v = 20 \text{ m/s} \]

15. Answer (1)

**Hint** : Concept of conservation of momentum and mechanical energy.

**Sol.** : 

\[ v = \sqrt{2g\ell} \]

\[ \frac{1}{2} (2m) \left( \frac{v}{2} \right)^2 = 2mgH \]

\[ H = \frac{2g\ell}{8g} \]

\[ \therefore \quad H = \frac{\ell}{4} \]

16. Answer (1)

**Hint** : Resolution of vectors.

**Sol.** : 

\[ F_{\text{res}} = 2F \cos 37^\circ \]

\[ = 2 \times 10 \times \frac{4}{5} \]

\[ = 16 \text{ N} \]

17. Answer (4)

**Hint** : \[ \mu g = |\text{Slope of } v - t \text{ graph}| \]

**Sol.** : \[ \mu (10) = \frac{80}{16} \]

\[ \mu = 0.5 \]
18. Answer (1)  
**Hint:** \( \Delta Q = \Delta U + P(\Delta V) \)  
**Sol.:**  
\[ 1134 = \Delta U + 10^5 (835.5 - 0.5) \times 10^{-6} \]  
\[ \Delta U = 1134 - 83.5 \]  
\[ \Delta U = 1050.5 \text{ J} \]

19. Answer (2)  
**Hint:** \( W_{app} = W_{real} - F_{buoyancy} \)  
**Sol.:**  
1st case:  
\[ \frac{\rho_f}{\rho_s} \times 250 = 200 \]  
\[ \frac{\rho_f}{\rho_s} = \frac{4}{5} \]  
2nd case:  
\[ \frac{250}{(\rho_s)_{rel}} = 100 \]  
\[ (\rho_s)_{rel} = 2.5 \]  
\[ (\rho_f)_{rel} = 2 \]

20. Answer (4)  
**Hint:** \( R = (n^3)r \) and \( v \propto r^2 \)  
**Sol.:**  
\[ R = (27)^\frac{1}{3} \text{ r} \]  
\[ R = 3 \text{ r} \]  
Terminal velocity \( \propto r^2 \)  
\[ v_{big} = \left(\frac{R}{r}\right)^2 v_{small} \]  
\[ = 3^2 \times 4 \text{ cm/s} \]  
\[ v_{big} = 36 \text{ cm/s} \]

21. Answer (3)  
**Hint:** Equating pressure  
**Sol.:**  
\[ \Delta \theta \Delta f = k(\theta_{avg} - \theta_0) \]
26. Answer (3)

Hint: \( v_e = \sqrt{\frac{2GM}{R}} \)

\[ (3 \times 10^8)^2 = \frac{2 \times 6.67 \times 10^{-11} \times 2 \times 10^{30}}{R} \]
\[ R = \frac{4 \times 6.67 \times 10^{19}}{9 \times 10^{16}} \]
\[ = 2964 \text{ m} \]

27. Answer (1)

Hint: \( \Delta U = U_f - U_i \)

\[ \Delta U = -\frac{G M m}{3R} - \left( -\frac{G M m}{2R} \right) \]
\[ = \frac{G M m}{R} \left( \frac{1}{3} + \frac{1}{2} \right) \]
\[ = \frac{G M m}{6R} = \frac{1}{6} m g R \]

28. Answer (2)

Hint: \( g_d = g_h \)

\[ g \left( 1 - \frac{d}{R} \right) = g \left( 1 - \frac{2h}{R} \right) \]
\[ \frac{d}{R} = \frac{2h}{R} \]
\[ h = \frac{5}{2} \text{ km} \]

29. Answer (4)

Hint: \( \Delta U = \frac{f}{2} n R(T_2 - T_1) \)

\[ \Delta U = \frac{3}{2} (P_2 V_2 - P_1 V_1) \]
\[ = \frac{3}{2} (3 \times 12 - 8 \times 8) \times 10^3 \]
\[ = \frac{3}{2} (36 - 64) \times 10^3 = -42 \text{ kJ} \]

30. Answer (3)

Hint and Solution: For gaseous mixture

\[ f_{\text{mix}} = \frac{n_1 f_1 + n_2 f_2}{n_1 + n_2} \]

31. Answer (1)

Hint: Application of Stefan’s law and Wien’s law

\[ T \propto \frac{1}{\lambda_m} \]

Power \( \propto \frac{1}{\lambda_m^4} \)

\[ P = \left( \frac{\lambda_f}{\lambda_i} \right)^4 \left( \frac{P}{16} \right) \]
\[ \lambda_f = 2\lambda_i \]

32. Answer (2)

Hint: Efficiency \( (\eta) = \left| \frac{W}{Q_L + |W|} \right| \)

\[ \frac{5}{100} = \frac{|W|}{|W| + 380} \]
\[ 19 |W| = 380 \text{ J} \]
\[ |W| = 20 \text{ J} \]

33. Answer (4)

Hint: \( \frac{dQ}{dt} = kA \frac{dT}{\ell} \) and \( Q = mL_f \)

\[ \frac{dQ}{dt} = kA \frac{dT}{\ell} \]
\[ 4 \times 3.36 \times 10^5 = K \times 1.6 \times 100 \times \frac{3600}{10^2} \]
\[ K = 0.023 \text{ Wm}^{-1}\text{°C}^{-1} \]

34. Answer (2)

Hint: \( T = mg \) \( (\because a = 0) \)

\[ T = (5 + 4) \times 10 \]
\[ = 90 \text{ N} \]

35. Answer (3)

Hint: \( F = \frac{m v^2}{r} \)

\[ \frac{F_A}{F_B} = \left( \frac{m_A}{m_B} \right) \left( \frac{v_A}{v_B} \right)^2 \left( \frac{f_B}{f_A} \right) \]
\[
\left(\frac{3m}{m}\right)\left(\frac{v}{3v}\right)^2\left(\frac{r}{2r}\right)
\]

\[
\frac{F_A}{F_B} = \frac{1}{6}
\]

36. Answer (3)

**Hint:** \(\Delta \bar{p}_{\text{total}} = \text{area under the } F - t \text{ graph}\)

**Sol.**:
\[
\Delta \bar{p} = A_1 + A_2 + A_3
\]
\[
= \frac{1}{2} \times (2 \times 5) + (2 \times 20) - \left(\frac{1}{2} \times 6 \times 10\right)
\]
\[
= 5 + 40 - 30
\]
\[
\Delta \bar{p} = 15 \text{ N s}
\]

37. Answer (2)

**Hint:** \(P = \bar{F} \cdot \bar{v} \quad \text{and} \quad \bar{F} = m \bar{a}\)

**Sol.**:
\[
\bar{a} = 2t \hat{i} + 2t \hat{j}
\]
\[
\bar{v} = t^2 \hat{i} + \frac{4}{3} t^{3/2} \hat{j}
\]
\[
\bar{P} = \left(t \hat{i} + \frac{4}{3} t^{3/2} \hat{j}\right) \left(t^2 \hat{i} + \frac{4}{3} t^{3/2} \hat{j}\right)
\]
\[
= t^3 + \frac{4}{3} t^2 = 27 + \frac{4}{3} \times 9
\]
\[
= 39 \text{ W}
\]

38. Answer (4)

**Hint:** \(\left[P\right] = [\mu] \left[\Omega\right]\)

**Sol.**:
\[
\left[P\right] = \left[M^1 \right] \left[L^1 T^{-2}\right] \left[M^1\right] = \left[M^1 L^1 T^{-2}\right] \left[M^1\right]
\]
\[
\left[P\right] = \left[M^1 L^1 T^{-2}\right] \left[M^1\right] = \left[M^1 L^1 T^{-2}\right] = \text{[Force]}
\]

39. Answer (4)

**Hint:** \(\Delta Q = nC_p \Delta T\)

**Sol.**:
\[
\Delta Q = nC_p \Delta T
\]
\[
= 5 \left(1 + \frac{5}{2}\right) R \times 30
\]
\[
= 5 \left(\frac{7}{2}\right) 2 \times 30
\]
\[
\Delta Q = 1050 \text{ cal}
\]

40. Answer (3)

**Hint:** \(\frac{V_{\text{wave}}}{V_{\text{particle}}} = \frac{\omega}{k} \cdot \frac{1}{\omega A} = \frac{kA}{kA}\)

**Sol.**:
\[
\frac{V_{\text{wave}}}{V_{\text{particle}}} = \frac{1000}{6 \times 40} = \frac{25}{6}
\]

41. Answer (2)

**Hint:** \(F = -kx \quad \text{and} \quad T = 2\pi \sqrt{\frac{m}{k}}\)

**Sol.**:
\[
\Rightarrow \frac{k}{|x|} = \frac{8}{10 \text{ cm}} = \frac{80}{m}
\]
\[
T = 2\pi \sqrt{\frac{m}{k}} = 2\pi \sqrt{\frac{0.8}{80}} = \frac{\pi}{5} \text{s}
\]

42. Answer (2)

**Hint:** \(\dot{V}_{BA} = \dot{V}_B - \dot{V}_A\)

**Sol.**:
\[
\dot{V}_{r\text{girl}} = V_r - V_{\text{girl}}
\]
But \(V_r \perp V_{\text{girl}}\) then
\[
V_{r\text{girl}}^2 = V_r^2 + V_{\text{girl}}^2
\]
\[
5^2 = V_r^2 + (3)^2
\]
\[
V_r = 4 \text{ km/h}
\]

43. Answer (1)

**Hint:** \(PV = nRT\)

**Sol.**:
Using \(PV = nRT\) and \(P \delta V^6 = \text{constant}\).
\[
T^3 V^2 = \text{constant}
\]
For decreasing volume, temperature increases.

44. Answer (2)

**Hint:** Using dimension analysis.

**Sol.**:
\[
\text{[Angular momentum]} = \left[\frac{n}{2\pi}\right] [h]
\]
\[
\Rightarrow \left[\frac{n}{2\pi}\right] = \text{dimensionless}
\]
Then \([\text{Angular momentum}] = [\text{Planck's constant}]\)

45. Answer (1)

**Hint:** Time of free fall & final velocity does not depend on the mass of object dropped.
46. Answer (3)

**Hint**: Species containing \((4n + 2)\pi\) electrons will be aromatic.

**Sol.**: In Pyrrole the lone pair of nitrogen is involved in resonance leading to \(6\pi\) electrons delocalization. Hence, it is aromatic species.

47. Answer (3)

**Hint**: In presence of \(B_2H_6/\text{THF}\) and \(H_2O_2/OH^-\) anti-Markovnikov addition of \(H_2O\) takes place without rearrangement.

**Sol.**:

\[
\begin{align*}
\text{CH}_3\text{CH}=\text{CHCH}_3 & \xrightarrow{(i) \text{ B}_2\text{H}_6/\text{THF}} \text{CH}_3\text{CH} \equiv \text{CHCH}_3 \\
& \xrightarrow{(ii) \text{ H}_2\text{O}_2/\text{OH}^-} \text{CH}_3\text{CH} \equiv \text{CHCH}_3 \xrightarrow{\text{conc. H}_2\text{SO}_4} \text{CH}_3\text{CH} \equiv \text{CHCH}_3 \\
& \xrightarrow{(i) \text{ O}_3} \text{CH}_3\text{CH} \equiv \text{CHCH}_3 \\
& \xrightarrow{(ii) \text{ Zn/H}_2\text{O}_2} \text{PhCHO} + \text{CH}_3\text{CHO}
\end{align*}
\]

50. Answer (3)

**Hint**: Percentage of bromine

\[
\frac{80 \times \text{wt. of AgBr} \times 100}{188 \times \text{wt. of compound}}
\]

**Sol.**: Percentage of bromine

\[
= \frac{80 \times 0.188 \times 100}{188 \times 0.25} = 32\%
\]

51. Answer (2)

**Hint**: Enthalpy change when 1 mole of solute is dissolved in excess of solvent is called enthalpy of solution.

**Sol.**:

(i) \(\text{XY(s)} \rightarrow \text{X}^+(g) + \text{Y}^-(g), \Delta H = 700 \text{ kcal/mol}\)

(ii) \(\text{X}^+(g) + \text{H}_2\text{O(l)} \rightarrow \text{X}^+(aq), \Delta H = -800 \text{ kcal/mol}\)

(iii) \(\text{Y}^- (g) + \text{H}_2\text{O(l)} \rightarrow \text{Y}^-(aq), \Delta H = -600 \text{ kcal/mol}\)
56. Answer (2)
**Hint**: Radical which does not contain α-hydrogen atom will not show hyperconjugation.

57. Answer (3)
**Hint**: In cyclic silicates two oxygen atoms are shared per tetrahedron with other units

**Sol.**:
- SiO₂ – 3D Silicate
- Si₂O₆²⁻: Pyrosilicates
- (SiO₂⁻)ₙ: Cyclic silicates
- (Si₂O₅⁻)ₙ: Sheet silicates

58. Answer (3)
**Hint**: In diamond, carbon is \( sp^3 \) hybridized and its structure is tetrahedral.

**Sol.**:
- Solid \( \text{H}_3\text{BO}_3 \): 2-D Hexagonal structure
- (BN)ₓ: Graphite like structure
- SiC: Diamond like structure
- \( \text{B}_3\text{N}_3\text{H}_6 \): Planar structure

59. Answer (3)
**Hint**: Nascent oxygen is responsible for bleaching action of \( \text{CaOCl}_2 \).

**Sol.**:
\[ \text{OCl}^- + \text{H}_2\text{O} \rightarrow \text{HOCl} + \text{OH}^- \]
unstable

HCl + [O]

60. Answer (2)
**Hint**: Electron withdrawing group at para position enhances acidity of phenol.

**Sol.**:
- \( \text{NO}_2 \) present at para position in \( p \)-nitrophenol increases acidity of phenol.

61. Answer (4)
**Hint**: \( \Delta S = nC_v \ln \left( \frac{T_2}{T_1} \right) + nR \ln \left( \frac{V_2}{V_1} \right) \)

**Sol.**:
At constant temperature, \( T_1 = T_2 \)

\[ \Delta S = nR \ln \left( \frac{V_2}{V_1} \right) \]

62. Answer (2)
**Hint**: Equilibrium constant remains unchanged with increase or decrease of concentration of species present at equilibrium at a constant temperature.

\[ K = \text{[Ca}^{2+}]^3 \text{[PO}_4^{3-}]^2 \]

**Sol.**:
\[ \text{[Ca}^{2+}]^3 \text{[PO}_4^{3-}]^2 = \left( \frac{\text{Ca}^{2+}}{2} \right)^3 \left( \text{PO}_4^{3-} \right)^2 \]

63. Answer (3)
**Hint**: Radical which does not contain α-hydrogen atom will not show hyperconjugation.

**Sol.**:
Mixture of weak acid and its salt with strong base act as acidic buffer.

**Sol.**:
Mixture of \( \text{H}_2\text{SO}_4 \) (strong acid) and \( \text{Na}_2\text{SO}_4 \) (salt of strong acid with strong base) is not an acidic buffer.

64. Answer (4)
**Hint**: \( \Delta S = \frac{nC_v}{RT} \ln \frac{T_2}{T_1} \)

**Sol.**:
\[ \Delta S = \frac{nC_v}{RT} \ln \frac{T_2}{T_1} \]

65. Answer (1)
**Hint**: \( \Delta H = \Delta U + \Delta n_g \text{RT} \)
and \( \Delta G = \Delta H - T\Delta S \)

**Sol.**:
For reaction \( 2\text{A(l)} \rightarrow 4\text{B(g)} \)
\[ \Delta n_g = 4 - 0 = 4 \]
\[ \Delta H = \Delta U + \Delta n_g \text{RT} = 1.2 \times 10^3 + 4 \times 2 \times 300 \]
\[ = 3.6 \times 10^3 \text{ cal} \]
\[ \Delta G = 3.6 \times 10^3 - 300 \times 10 \]
\[ = 3.6 \times 10^3 - 3 \times 10^3 = 0.6 \times 10^3 = 600 \text{ cal} \]

66. Answer (2)
**Hint**: Density of ideal gas, \( d = \frac{PM}{RT} \)

**Sol.**:
\[ d = \frac{2 \text{ atm} \times 29 \text{ g/mol}}{0.0821 \left( \frac{\text{L} - \text{atm}}{\text{K} - \text{mol}} \right) \times 580 \text{ K}} \]
\[ = \frac{58 \text{ g/L}}{580 \times 0.0821} = \frac{1}{0.821} \text{ g/L} \]

67. Answer (3)
**Hint**: Bond order = \( \frac{(N_b - N_a)}{2} \)

**Sol.**:
\( \text{O}_2^+ \), B.O. = 2.5
\( \text{NO} \), B.O. = 2.5
\( \text{C}_2 \), B.O. = 2.5
\( \text{N}_2^+ \), B.O. = 2.5
68. Answer (4)
   **Hint:** In hybridization, only sigma bonds and lone pair(s) present on central atom are considered.
   **Sol.:** (Species) (Central atom's hybridization)
   \[
   \begin{align*}
   \text{B(OH)}_4^- & \rightarrow \text{sp}^3 \\
   \text{XeO}_4 & \rightarrow \text{sp}^3 \\
   \text{H}_2\text{O} & \rightarrow \text{sp}^3 \\
   \text{XeF}_2 & \rightarrow \text{sp}^3\text{d}
   \end{align*}
   \]

69. Answer (3)
   **Hint:** Dipole moment is a vector quantity
   **Sol.:**
   \[
   \begin{align*}
   \text{CH}_4, \mu_{\text{net}} &= 0 \\
   \text{XeF}_4, \mu_{\text{net}} &= 0 \\
   \text{NH}_3, \mu_{\text{net}} &= 1.46 \text{ D} \\
   \text{PCl}_3\text{F}_2, \mu_{\text{net}} &= 0
   \end{align*}
   \]

70. Answer (1)
   **Hint:** Due to stable configuration of Be and N, they have negative electron affinity.
   **Sol.:**
   \[
   \text{F} > \text{O} > \text{N} > \text{Be}
   \]

71. Answer (1)
   **Hint:** For 'p' orbitals value of 'l' is 1
   **Sol.:**
   \[
   \begin{align*}
   m_l &= -1, 0, +1 \\
   \therefore \text{m}_l = 0 \text{ represents only '1' orbital.}
   \end{align*}
   \]

72. Answer (3)
   **Hint:** Orbital angular momentum = \(\sqrt{l(l+1)}\hbar\)
   **Sol.:**
   For ‘p’ orbital, \(l = 1\)
   \[
   \text{Angular momentum} = \sqrt{2}\hbar
   \]

73. Answer (3)
   **Hint:** Molarity = \(\frac{\text{Number of moles}}{\text{Volume of solution(L)}}\)
   **Sol.:**
   \[
   \begin{align*}
   \text{Number of moles of sugar} &= \frac{3.011 \times 10^{23}}{N_A} = \frac{3.011 \times 10^{23}}{6.022 \times 10^{23}} = \frac{1}{2} \\
   \text{Molarity} &= \frac{\frac{1}{2}}{200} \text{M} = \frac{1}{4} = 2.5 \text{ M}
   \end{align*}
   \]

74. Answer (4)
   **Hint:** Bhopal gas tragedy was caused by methyl isocyanate (CH\(_3\)NCO).

75. Answer (3)
   **Hint:** FeBr\(_3\) is a Lewis acid and Br\(_2\) is Lewis base.
   **Sol.:**
   \[
   \text{FeBr}_3 + \text{Br} - \text{Br} \rightarrow \text{FeBr}_4^+ + \text{Br}^-
   \]

76. Answer (3)
   **Hint:** Greater the number of hyperconjugating structures, more stable will be the carbonium ion.
   **Sol.:** tert-butyl carbonium ion has 9 \(\alpha\)-H atoms.

77. Answer (1)
   **Hint:** Tin oxides, SnO and SnO\(_2\) are amphoteric oxides.
   **Sol.:**
   \[
   \begin{align*}
   \text{CO} &: \text{Neutral oxide} \\
   \text{SnO} &: \text{Amphoteric oxide} \\
   \text{SnO}_2 &: \text{Amphoteric oxide} \\
   \text{Al}_2\text{O}_3 &: \text{Amphoteric oxide}
   \end{align*}
   \]

78. Answer (4)
   **Hint:** Smaller the size of ion, greater will be its hydration.
   **Sol.:** Larger is the size of ion, smaller will be its hydration and smaller will be its hydrated size and maximum will be its mobility.

79. Answer (1)
   **Hint:** 20 Volume H\(_2\)O means, 1 L H\(_2\)O solution on decomposition gives 20 L oxygen gas at NTP.
   **Sol.:**
   \[
   \begin{align*}
   \therefore 1000 \text{ mL } 20 \text{ V } \text{H}_2\text{O}_2 \text{ gives } &= 20 \text{ L } \text{O}_2 (\text{g}) \\
   \therefore 30 \text{ mL } 20 \text{ V } \text{H}_2\text{O}_2 \text{ gives } &= \frac{20 \times 30}{1000} \text{ L } \text{O}_2 (\text{g}) \\
   &= 0.6 \text{ L } \text{O}_2 (\text{g})
   \end{align*}
   \]

80. Answer (1)
   **Sol.:** An element in a compound in its highest oxidation state cannot act as reducing agent.

81. Answer (4)
   **Hint:** Basicity of hydroxides increases down the group.

82. Answer (4)
   **Hint:** \(K_p = K_c(\text{RT})^{\Delta n_g}\)
   **Sol.:**
   \[
   \begin{align*}
   \Delta n_g &= 2 - 1 = 1 \\
   K_p &= K_c(\text{RT}) \\
   \frac{K_p}{K_c} &= \text{RT}
   \end{align*}
   \]

83. Answer (2)
   **Hint:** For fusion, \(\Delta S = \frac{n\Delta H_{\text{fusion}}}{T_{\text{fusion}}}\)
   **Sol.:**
   \[
   \begin{align*}
   \Delta S_{\text{fusion}} &= \frac{n\Delta H_{\text{fusion}}}{T_{\text{fusion}}} \\
   &= \frac{140 \times 10^3}{350} = \frac{140 \times 1000}{350} = 400 \text{ J/K-mol}
   \end{align*}
   \]
84. Answer (2)

**Hint:** In vacuum, $P_{ext} = 0$

**Sol.:** $W = -P_{ext}(V_2 - V_1)$

$W = 0$ (i.e., $P_{ext} = 0$)

85. Answer (4)

**Hint:** Rate of effusion of a gas is inversely proportional to square root of its molar mass.

**Sol.:**

$$t_{\text{unknown}} = \sqrt{\frac{M_{\text{He}}}{M_{\text{unknown}}}}$$

$$t_{\text{unknown}} = \sqrt{\frac{M_{\text{He}}}{M_{\text{unknown}}}} \quad (: \quad r \propto \frac{1}{\text{time}})$$

$$\frac{1}{4} = \sqrt{\frac{4}{M_{\text{unknown}}}}$$

$M_{\text{unknown}} = 16 \times 4 = 64$

86. Answer (1)

**Hint:** 13th group elements have only 3 valence electrons.

**Sol.:** Boron has incomplete octet in $\text{B(OH)}_3$.

87. Answer (2)

**Hint:** Highest is the positive charge on isoelectronic ions, smaller will be its size.

88. Answer (2)

**Hint:** $\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$

**Sol.:** $\therefore \Delta x = 2\Delta p$

$$(2\Delta p) \cdot (\Delta p) = \frac{h}{4\pi}$$

$$\Delta p = \sqrt{\frac{h}{8\pi}}$$

$$\Delta v = \frac{1}{m} \sqrt{\frac{h}{8\pi}}$$

89. Answer (1)

**Hint:** No. of orbitals in a subshell = $2l + 1$

90. Answer (2)

**Hint:** Molar mass of water is $18 \text{ g mol}^{-1}$

**Sol.:**

Volume of 1 g water = 1 cm$^3$

Volume of 18 g water = 18 cm$^3$ = 18 mL

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**[BIOLOGY]**

91. Answer (2)

**Sol.:** Smallest angiosperm is Wolfia. It is almost microscopic.

92. Answer (3)

**Hint:** Mycorrhizal association enhances supply of nitrogen to plant. It is not related to nitrogen fixation.

**Sol.:** This association increases surface area of absorption of plants and enhances supply of minerals like N, P, S etc.

Fungi obtain shelter from this association.

93. Answer (1)

**Hint:** In gymnosperms, pollen grains are carried by air currents.

**Sol.:** In gymnosperms, means of pollination is air current and due to presence of archegonia, they are archegoniates.

94. Answer (2)

**Hint:** Cork or phellem is formed by the re-differentiation of the outer cells of the cork cambium.

**Sol.:** Cork is dead layer and becomes impervious to water due to deposition of suberin in the cell wall.

95. Answer (2)

**Hint:** Herbaria are used as quick source of reference and keys are artificial analytical devices for taxonomical studies.

**Sol.:** Botanical gardens are ex-situ conservation strategies of plants.

Monograph contains information of any one taxon.

96. Answer (1)

**Sol.:** In bryophytes, spores get disseminated by wind.

97. Answer (3)

**Hint:** Lichens are indicators of air pollution.

**Sol.:** Lichens cannot tolerate air pollution, especially SO$_2$ pollution.

98. Answer (2)

**Hint:** Thick cell wall of heterocyst is impermeable to oxygen.

**Sol.:** Heterocyst is specialised for nitrogen fixation under anaerobic condition with the help of enzyme nitrogenase. Heterocysts lack PS II.
99. Answer (1)
   **Hint:** Such flowers have radial symmetry.
   **Sol.** In actinomorphic flowers, symmetry is radial.

100. Answer (3)
   **Hint:** This enzyme helps in the transfer of phosphate from ATP to fructose-6-phosphate.
   **Sol.** This enzyme is phosphofructokinase. It is also known as pace-maker enzyme of EMP pathway.

101. Answer (2)
   **Hint:** Deuteromycetes reproduce generally by non-motile, exogenous, asexual spores.
   **Sol.** Those non-motile, exogenous asexual spores are conidia.

102. Answer (3)
   **Sol.** In plants, symptoms like mosaic formation, leaf rolling and curling, yellowing and vein clearing, dwarfing and stunted growth are due to viral infections.

103. Answer (4)
   **Hint:** Protists may be autotrophic as well as heterotrophic.
   **Sol.** In autotrophic mode of nutrition, protists are photosynthetic.

104. Answer (4)
   **Hint:** In unicellular member of ascomycetes, ascus formation occurs but no ascocarp formation takes place.
   **Sol.** Saccharomyces (yeast) is a unicellular ascomycetes in which ascus formation occurs but fruiting body (ascocarp) is not formed.

105. Answer (1)
   **Hint:** In opposite phyllotaxy, a pair of leaves arise at each node and lie opposite to each other.
   **Sol.** This pattern of arrangement of leaves is found in Calotropis.

106. Answer (2)
   **Hint:** The complex formed by a pair of synapsed homologous chromosomes is called a bivalent. Pollen grains are haploid.
   **Sol.**
   
   \[
   \begin{align*}
   n & = 20 \text{ chromosomes} \\
   2n & = 40 \text{ chromosomes} \\
   40 \text{ chromosomes} & \text{ will form 20 pairs and there will be 20 bivalents.}
   \end{align*}
   \]

107. Answer (3)
   **Sol.** Primary cell wall is the cell wall of young plant cell which is capable of growth and diminishes as the cell matures.

108. Answer (4)
   **Hint:** In such flowers ovary is superior.
   **Sol.** If position of ovary in a flower is highest and other parts are situated below it then it is called hypogynous flower.

109. Answer (2)
   **Hint:** Vascular cambium is partly primary and partly secondary in origin in dicot stem.
   **Sol.**
   
   \[
   \begin{align*}
   \text{Vascular cambium} & = \text{Fascicular vascular cambium} \downarrow \\
   & = \text{Interfascicular vascular cambium} \downarrow \\
   & 1^\circ \text{ in origin} \quad 2^\circ \text{ in origin}
   \end{align*}
   \]

110. Answer (3)
   **Hint:** Sudden sharp rise in the rate of respiration at the time of ripening in fleshy fruits is called respiratory climactic. Ethylene is a ripening agent.
   **Sol.** ABA (Abscissic Acid) exhibits physiological effects such as closure of stomata, Acceleration of abscission of flower & fruits etc. It is antagonist to gibberellin (Anti GA) and also known as stress hormone. Respiratory climactic is an effect of ethylene.

111. Answer (1)
   **Hint:** It is significant in the production of certain greenhouse crops.
   **Sol.** Greenhouse crops like tomatoes and bell pepper, if are allowed to grow in CO$_2$ enriched atmosphere increases their yields. This is known as CO$_2$ fertilization effect.

112. Answer (4)
   **Hint:** Photorespiration does not produce ATP or NADPH.
   **Sol.** It is known as C$_2$ cycle because first product phosphoglycolate is 2C compound. Sugar is not synthesised. It is a wasteful process.

113. Answer (4)
   **Hint:** From one molecule of N$_2$, two molecules of ammonia are produced, which requires 16 ATP.
   **Sol.** Thus, for production of each NH$_3$ molecule 8 ATP are required. Nitrogenase is made up of Mo – Fe protein.

114. Answer (4)
   **Hint:** Nitrate is not used by plants as such. It is reduced via two steps (Nitrate assimilation) into NH$_3$.
   **Sol.**
   
   A – Nitrate reductase.
   B – NADH$_2$
   C – NAD$+H_2$O
   D – Nitrite reductase
   E – PS I
115. Answer (2)
Hint: Conversion of fats into carbohydrate is known as gluconeogenesis.
Sol.: Gluconeogenesis takes place through glyoxylate cycle in germinating fatty seeds. Enzymes for glyoxylate cycle are found in glyoxysomes.

116. Answer (2)
Hint: Two molecules of acetyl CoA enters the Krebs’ cycle and produces 6 NADH and 2 FADH₂ in two turns.
Sol.: From one NADH → 3 ATP and from one FADH₂ → 2 ATP
Therefore 6 NADH → (6 × 3) = 18 ATP
2 FADH₂ → (2 × 2) = 4 ATP
22 ATP

117. Answer (4)
Hint: *Chlorella* and *Spirulina* are used by space travellers as food supplements.
Sol.: Algae are primary producers. Pyrenoids are analogous to leucoplasts of higher plants as they contain protein & starch. Phenetics uses numerical method for evaluation of similarities and differences between species with the help of computers.

118. Answer (3)
Hint: Given figure is of *Fucus*, which is a brown alga.
Sol.: Carrageenan is a hydrocolloid of cell wall of red algae. Red algae are known as deepest dweller because they can survive deep in the sea.

119. Answer (2)
Hint: Root pressure develops when pumping of water into xylem channel is active.
Sol.: Pumping of water into xylem channel remains active due to metabolic activity of root. A positive hydrostatic pressure develops in xylem of root known as root pressure.

120. Answer (3)
Sol.: “Pressure flow hypothesis” is the most accepted mechanism proposed for the translocation of sugars from source to sink. It was proposed by E. Munch.

121. Answer (1)
Hint: Increased level of K⁺ and malate ions form potassium malate in vacuole of guard cell which increases its osmotic concentration.
Sol.: In guard cells, increased osmotic concentration leads to endosmosis of water. Consequently guard cells become turgid and stomata get open.

122. Answer (2)
Hint: Water moves from high to low water potential.
Sol.: \( \psi_w = \psi_s + \psi_p \)
In cell A, \( \psi_w = -9 + (+4) = -5 \) bar
In cell B, \( \psi_w = -10 + (+4) = -6 \) bar
In cell C, \( \psi_w = -10 + (+6) = -4 \) bar
So, C has maximum water potential followed by A & then B.
Thus water will move from cell ‘C’ to cell A & B and from cell ‘A’ to B.

123. Answer (1)
Hint: Passive absorption takes place in rapidly transpiring plants, thus negative pressure develops in the xylem.
Sol.: During active absorption of water by roots a positive pressure develops known as root pressure. Active transport is an uphill transport because substances are transported against their concentration gradient. Germination of seeds of *Pinus* requires mycorrhizal association.
For a solution at atmospheric pressure \( \psi_w = \psi_s \)

124. Answer (4)
Hint: Transduction was demonstrated by Zinder & Lederberg in typhoid causing bacterium.
Sol.: Transduction is transfer of DNA from donor to recipient bacterium by a bacteriophage. Transduction was demonstrated with the help of bacterium *Salmonella typhimurium*. *Azotobacter* is a free living aerobic bacterium.

125. Answer (2)
Hint: The cell walls of diatoms contain silica.
Sol.: The wall of diatoms are not easily destructible due to silica impregnation in cell wall. In viroids, RNA is of low molecular weight. *Neurospora* is used in the study of biochemical and genetic work. Bacterial cell wall is made up of peptidoglycan.

126. Answer (2)
Hint: In homosporous species of pteridophytes, prothallus is found which is monoecious gametophytic body.
Sol.: *Lycopodium* and *Dryopteris* are homosporous. Therefore in *Dryopteris* prothallus is monoecious.
127. Answer (2)

**Hint**: In roots, pericycle forms lateral roots and in dicot they also help in formation of vascular cambium. Root cells lack chlorophyll.

**Sol.**: In roots pericycle is parenchymatous. Monocots lack collenchyma. Thick walled sclerenchymatous pericycle is seen in dicot stem.

128. Answer (2)

**Hint**: Tricarpellary ovary is found in monocot families.

**Sol.**: Tricarpellary, syncarpous, superior ovary, trilocular with many ovules and axile placentation are features of family Liliaceae.

129. Answer (4)

**Hint**: Thorns are woody pointed structures and are modification of stem.

**Sol.**: Thorns are modified axillary buds. Thus, thorns are modification of stems.

130. Answer (2)

**Hint**: These fungi are commonly known as club fungi.

**Sol.**: Few members of basidiomycetes are wood decomposers. Secondary mycelium is long lived, show clamp connection for proper distribution of dikaryons at the time of cell division. Sexual spores are basidiospores produced exogenously on basidia.

131. Answer (1)

**Hint**: ABA is known as stress hormone.

**Sol.**: ABA is responsible for closure of stomata, therefore considered as natural anti-transpirant.

$GA_3$ — helps in seed germination.

Cytokinin — Richmond-Lang effect

ABA — Precursor is violaxanthin

132. Answer (1)

**Hint**: At Anaphase I there is beginning of reduction of chromosome number.

**Sol.**: Metaphase I – Double metaphasic plate

Diplotene – Synaptonemal complex dissolves

Metaphase – Single metaphasic plate

133. Answer (2)

**Hint**: This plastid is meant for storage of food.

**Sol.**: Plastid, which is non-pigmented and lacks granum is leucoplast.

134. Answer (3)

**Hint**: Middle lamella is a pectate layer.

**Sol.**: Middle lamella is chiefly made up of calcium and magnesium pectate.

135. Answer (2)

**Hint**: In multicellular organisms, growth and reproduction are not synonymous.

**Sol.**: Both are mutually exclusive events but they are linked.

136. Answer (4)

**Hint**: Identify a unpaired bone of skull.

**Sol.**: Sphenoid is a unpaired cranial bone while zygomatic, nasal and lacrimal are paired facial bones.

137. Answer (3)

**Hint**: Bile salts help in emulsification of fat.

**Sol.**: A large lipid globule is broken down into small lipid globules by the action of bile salts. Lipase acts on these small lipid globules containing triglycerides and form diglycerides, monoglycerides and fatty acids.

138. Answer (2)

**Hint**: After death, the body becomes rigid due to sustained contraction of muscles.

**Sol.**: After death due to depletion of ATP, the cross bridge formed between actin and myosin head is not able to break. As a result, the muscle fibre remain in contracted state leading to rigidity of body i.e. Rigor mortis.

139. Answer (2)

**Hint**: Humans have four different types of teeth which are embedded in bony jaw.

**Sol.**: Humans have two sets of teeth in their life time i.e. deciduous and permanent teeth. We have four different types of teeth i.e. canines, incisors, premolars and molars, thus we have heterodont dentition. These teeth are embedded in the socket of jaw bone i.e. thecodont.

140. Answer (4)

**Hint**: Erythroblastosis foetalis can occur due to Rh incompatibility between mother and foetus.

**Sol.**: When mother is Rh –ve and father is Rh +ve; then there is a possibility that foetus can be Rh +ve.

In that case, mother’s body starts producing antibodies against foetal RBCs causing destruction of foetal RBCs, leading to erythroblastosis foetalis.

141. Answer (1)

**Hint**: Identify the hormone which causes vasodilation.

**Sol.**: Atrial Natriuretic factor (ANF) is released in response to an increase in blood volume and pressure. ANF can cause vasodilation and thereby decrease the blood pressure.
142. Answer (3)
   **Hint:** Aromatic compounds have benzene ring.
   **Sol.:** Tyrosine \([Y]\) has benzene ring in its side chain and is an aromatic amino acid. Serine \([S]\) is an alcoholic amino acid, Cysteine \([C]\) is a sulphur containing amino acid while Glutamic acid \((E)\) is an acidic amino acid.

143. Answer (2)
   **Hint:** Cockroach shows indirect development.
   **Sol.:** There is no larva in the life cycle of cockroach. Egg → Nymph (young) → Imago. Nymph is not called larva but is considered as immature adult.
   In silver fish, ametabolous development occurs.

144. Answer (4)
   **Hint:** Identify a reptile.
   **Sol.:** *Testudo* (tortoise) is an oviparous organism. *Scyllioidon* (Dog fish), *Balaenoptera* (Whale) and *Trichinella* are viviparous organisms.

145. Answer (3)
   **Hint:** Melanin is responsible for pigmentation of skin.
   **Sol.:** Pineal gland secretes melatonin which regulates 24 hour diurnal rhythm of our body. Adrenaline is an emergency hormone and prolactin helps in milk production.

146. Answer (4)
   **Hint:** Identify the hormones of pituitary gland.
   **Sol.:** ACTH, TSH, ADH, LH, FSH, oxytocin, MSH etc. are pituitary gland hormones, while glucagon and insulin are pancreatic hormones. Thyroxine is produced by thyroid gland. Thymosin is produced by thymus gland.

147. Answer (3)
   **Hint:** During aestivation and hibernation, metabolic rate of frog is greatly reduced.
   **Sol.:** During aestivation and hibernation, energy requirement of frog is greatly reduced and it also tries to conserve as much energy as possible. So frog respires through skin during hibernation and aestivation where exchange of gases occur via simple diffusion.

148. Answer (2)
   **Hint:** Glycogen is a homopolysaccharide.
   **Sol.:** Increasing order of various macromolecules is an animal cell is.

   | (A) | (B) | (C) | (D) |
   | Lipids | Carbohydrates | Nucleic acid | Proteins |
   | 2% | 3% | 5 – 7% | 10 – 15% |

149. Answer (2)
   **Hint:** Pressure difference across filtration membrane is nearly 10 mm Hg.
   **Sol.:** 
   \[ NFP = (GHP) - (BCOP + CHP) \]
   \[ 60 - (30 + 20) \]
   \[ 10 \text{ mmHg} \]

150. Answer (2)
   **Hint:** Vertebrates have bony or cartilaginous vertebral column.
   **Sol.:** *Petromyzon* has cartilaginous vertebral column; while *Ascidia* lacks vertebral column. Leeches have open circulatory system. Both amphibians and reptiles have three chambered heart. Dorsal nerve cord is a characteristic feature of chordates.

151. Answer (3)
   **Hint:** Various enzymes are present in saliva.
   **Sol.:** Digestion of carbohydrate begins in buccal cavity by the action of salivary amylase and ends in small intestine by action of various disaccharidases.

152. Answer (4)
   **Hint:** Application of threshold stimulus generates action potential in a neuron.
   **Sol.:** When a threshold stimulus is applied on particular segment of axon, then it becomes depolarised due to the change in permeability of membrane. This change in permeability of axonal membrane leads to increase in influx of \(\text{Na}^+\) ions. Neurilemma is the cell membrane of Schwann cells.

153. Answer (1)
   **Hint:** Identify the diseases caused by hyposecretion of adrenal cortex, ADH and thyroxine.
   **Sol.:** Cretinism and Myxedema are caused due to deficiency of thyroxine. Addison’s disease is caused due to the deficiency of glucocorticoids and mineralocorticoids. Diabetes insipidus is caused by deficiency of ADH. Acromegaly is caused by hypersecretion of growth hormone after puberty. Cushing’s Syndrome and Conn’s Syndrome are caused due to excessive production of cortisol and aldosterone respectively.

154. Answer (2)
   **Hint:** Identify the cranial nerves which carry impulses from sense organs to CNS.
   **Sol.:** Olfactory (I), optic (II) and Auditory (VIII) are sensory cranial nerves, while Oculomotor (III) Trochlear (IV), Spinal accessory (XI) and Hypoglossal (XII) are motor cranial nerves. Cranial nerve V, VII, IX and X are mixed cranial nerves.
155. Answer (3)

**Hint:** Maximum reabsorption of nutrients occurs in PCT of nephron.

**Sol.**: PCT is lined by brush bordered cuboidal epithelium. Microvilli present on the surface of epithelium increase the surface area for reabsorption.

156. Answer (2)

**Hint:** Ascending limb of loop of Henle is impermeable to water.

**Sol.**: Cortical nephrons lack vasa recta. Selective secretion of electrolytes occurs in DCT and collecting duct. Under the influence of ADH, maximum reabsorption of water occurs in PCT (60 – 70%), followed by DCT (20%) and then loop of Henle (15%).

157. Answer (2)

**Hint:** Different colours are perceived depending on activation of different types of cones cells.

**Sol.**: When all red, green and blue cones are stimulated simultaneously a sensation of white light is produced.

158. Answer (2)

**Hint:** Homeotherms are able to maintain a constant body temperature.

**Sol.**: Members of class Aves and Mammalia are endotherms. *Chelone, Naja, Calotes* and *Chameleon* are reptiles and they are poikilotherms.

159. Answer (3)

**Hint:** Sympathetic nervous system regulates the activity of heart in situations of emergency.

**Sol.**: Stimulation from parasympathetic nervous system causes a decrease in heart rate and cardiac output. By increasing the duration of individual cardiac cycle, it causes decrease in heart rate i.e. number of cardiac cycles in a minute.

160. Answer (2)

**Hint:** Hypothalamus regulates our body temperature.

**Sol.**: Corpus callosum is tract of nerve fibres which connects one cerebral hemisphere to another. Thalamus acts as a major coordinating centre for sensory and motor signalling.

161. Answer (3)

**Hint:** Cellular respiration generates ATP

**Sol.**: At cellular level, $O_2$ is used to breakdown glucose into $CO_2$, water and generates ATP which is used to provide energy for various processes.

162. Answer (3)

**Hint:** Nucleotide acts as energy currency of a cell.

**Sol.**: Adenosine triphosphate (ATP) acts as energy currency of cell. Glycerol, phosphate group, fatty acids and choline are present in lecithin. Glycogen is also known as animal starch. Glycine is the simplest amino acid. Given structures represent glycerol, glucose, adenyllic acid and glycine respectively.

163. Answer (1)

**Hint:** Intrapulmonary pressure decreases during inspiration.

**Sol.**: In normal respiration, contraction of diaphragm and external intercostal muscles increases the volume of thoracic cavity leading to a decrease in intrapulmonary pressure.

164. Answer (2)

**Hint:** Structure also known as malpighian body.

**Sol.**: Renal corpuscle consists of glomerulus along with Bowman’s capsule and situated in renal cortex.

165. Answer (3)

**Hint:** Earthworm exhibits direct development.

**Sol.**: There is no larval stage in life cycle of earthworm. It exhibits external fertilisation as fusion of gametes and further developmental stages occur in the cocoon.

166. Answer (2)

**Hint:** In this disease, liver is affected.

**Sol.**: Jaundice is a digestive disorder. Concentration of bile pigment like bilirubin, increases in blood causing yellowness in skin and eye.

167. Answer (1)

**Hint:** Identify the structure responsible for balancing.

**Sol.**: Nephridia help in excretion and osmoregulation in case of annelids. Statocysts are structures for balance in an organism. Green glands are excretory structures in *Palaemon*.

168. Answer (3)

**Hint:** Castle’s intrinsic factor helps in absorption of vitamin $B_{12}$.

**Sol.**: Parietal/oxyntic cells secrete HCl and Castle’s intrinsic factor. HCl converts $Fe^{3+}$ into $Fe^{2+}$ which makes the absorption of iron possible. Intrinsic factor is important for absorption of Vit $B_{12}$. Damage to parietal cells will lead to deficiency of Vit $B_{12}$ and Fe$^{2+}$ which play an important role in maturation of RBCs and formation of haemoglobin respectively, thus causing anemia.

169. Answer (3)

**Hint:** Compound epithelium is present at the location which are more prone to wear and tear.

**Sol.**: Ciliated cuboidal epithelium is present in smaller bronchioles. Compound epithelium is present in skin, pharynx, buccal cavity etc.
170. Answer (4)

Hint: Both animal show metamorphosis during their development.

Sol.: Frog has closed while cockroach has open circulatory system. Cockroach is uricotelic and frog is ureotelic. Dorsal nerve is a characteristic feature of chordates. Both frog and cockroach exhibit indirect development.

171. Answer (4)

Hint: During muscle contraction, the length of I-band decreases.

Sol.: During muscle contraction, thin filaments slide over thick filaments towards M-line. As a result, Z-lines are drawn towards each other leading to a decrease in length of sarcomere.

172. Answer (4)

Hint: Respiratory capacities are sum of various respiratory volumes.

Sol.:
Residual volume = 1100 ml - 1200 ml
Vital capacity = ERV + TV + IRV
= 3500 ml - 4500 ml
Functional residual capacity = ERV + RV = 2500 ml
Expiratory capacity = TV + ERV = 1500 ml - 1600 ml.

173. Answer (4)

Hint: Synovial joints are present between carpals (wrist bone).

Sol.: Gliding joints are present in carpals and tarsals. Ball and socket joint is present between humerus and pectoral girdle. Pivot joint is present between atlas and axis vertebrae. Fibrous joints are present between the bones of cranium.

174. Answer (3)

Hint: These enzymes catalyse the cleavage of substrate into two parts, without the use of water.

Sol.: Lyases are responsible for the formation of
\[ \text{double bond} \quad C \rightarrow C \rightarrow X - Y + C = C \]
- Joining of C—O, C—S, C—N and bond is done by ligases
- Hydrolysis of peptide bonds is done by hydrolases

175. Answer (4)

Hint: Neuroglia cells make up more than one half of volume of neural tissue.

Sol.: Neurons are electrically excitable cells of neural tissue. Neurons and muscle fibres have the ability to respond to certain stimuli by producing electrical signals called action potentials. Hence, are called electrically excitable cells.

176. Answer (4)

Hint: T wave represents the return of ventricles from excited to normal state.

Sol.:
P wave : Atrial depolarisation.
QRS complex : Ventricular depolarisation.
T wave : Marks the end of ventricular systole.

177. Answer (2)

Hint: Left shift in oxygen dissociation curve indicates high affinity of haemoglobin for oxygen.

Sol.: Low pCO₂, high pH, high pO₂ increases the affinity of haemoglobin for oxygen, while low pO₂, high pCO₂, high 2,3 BPG and low pH decrease the affinity of haemoglobin for oxygen causing right shift of oxygen dissociation curve.

178. Answer (4)

Hint: Mast cells contain granules which produce histamine, heparin and serotonin.

Sol.:
A → Macrophages → Phagocytic cells
B → Fibroblasts → Secrete collagen fibres
C → Collagen fibres → Provide strength to tissue
D → Mast cells → Secrete histamine, heparin (anti-coagulant) and serotonin

179. Answer (4)

Hint: Hormones from hypothalamus are carried to anterior pituitary via hypophyseal portal vein.

Sol.: ADH is produced by neurosecretory cells of hypothalamus and are carried to posterior pituitary via nerve tract.

180. Answer (4)

Hint: Nephridia are excretory structures of annelids.

Sol.: Proboscis gland is excretory structure of hemichordates like Balanoglossus. Malpighian tubules are excretory structure of insects. Ctenidia are found in molluscs. They perform both respiration and excretion. Flame cells are excretory structures of flatworms.