1. \[ K = \frac{5}{2}pV = \frac{5}{2} \times 8 \times 10^4 \times \frac{1}{4} = 5 \times 10^4 \text{ J} \]

2. \[ \frac{3\lambda_1 D}{d} = \frac{4\lambda_2 D}{d} \]
\[ 3\lambda_1 = 4\lambda_2 \]
\[ 3(590 \text{ nm}) = 4\lambda_2 \]
\[ \lambda_2 = \frac{3(590 \text{ nm})}{4} = 442.5 \text{ nm} \]

3. \[ W_{\text{el}} = q (V_f - V_i) (-100 \times 1.6 \times 10^{-19}) (-4 - 10) = -16 \times 10^{-17} \times (-14) = 2.24 \times 10^{-16} \text{ J} \]

4. \[ W = \frac{\hbar c}{\lambda} \Rightarrow K_{\text{me}} = \frac{1240}{400} = 1.68 = 1.42 \text{ eV} \]

5. \[ Y = \frac{F}{A} \Rightarrow \frac{\Delta I}{I} = \frac{F}{AY} \]
\[ \Delta I = \frac{R_1 I_1}{A_1 Y_1} = \frac{R_2 I_2}{A_2 Y_2} \Rightarrow \frac{I_1}{A_1 Y_1} = \frac{I_2}{A_2 Y_2} = \frac{2}{3} \Rightarrow I = 9I \]

6. \[ Q = 24 + 18 = 42 \mu C \]
\[ E = \frac{KQ}{r^2} \]
\[ \Rightarrow E = \frac{9 \times 10^9 \times 42 \times 10^{-6}}{(30)^2} = 420 \text{ N/C} \]
7. 
\[ t = 80 \text{ min} = 4 \ T_A = 2T_B \]
\[ \therefore \text{no. of nuclei of A decayed} = N_0 - \frac{N_h}{2^4} = \frac{15N_h}{16} \]
\[ \therefore \text{no. of nuclei of B decayed} = N_0 - \frac{N_0}{2^2} = \frac{3N_0}{4} \]
\[ \text{required ratio} = \frac{5}{4} \]

8. 
\[ T \text{ will be max where product of PV is max.} \]
\[ P = \frac{P_0}{V_0} V + 3P_0 \]
\[ PV = \frac{P_0}{V_0} V^2 + 3P_0 V = x \text{ (say)} \]
\[ \frac{dx}{dV} = 0 \Rightarrow V = \frac{3V_0}{2} \]
\[ P = \frac{3P_0}{2} \]
\[ \Rightarrow T = \frac{PV}{nR} = \frac{9P_0V_0}{4nR} \]

9. 
\[ V_0 = \sqrt{\frac{GM}{R}} \text{ or } \sqrt{gR} \]
\[ V_e \sqrt{\frac{2GM}{R}} \text{ or } \sqrt{2gR} \]
\[ \therefore \text{Increase in velocity} = \sqrt{gR} \left[ \sqrt{2} - 1 \right] \]

10. 
Output of OR gate is 0 when all inputs are 0 and output is 1 when atleast one of the input is 1.
Observing output x:- It is 0 when all inputs are 0 and it is 1 when atleast one of the inputs is 1.
\[ \therefore \text{OR gate} \]
11. Gaussian surface at distance \( r \) from center

\[
\frac{Q + \int \frac{A}{r} 4\pi r^2 \, dr}{\varepsilon_0} = E 4\pi r^2
\]

\[
E = \frac{Q + 2\pi Ar^2 - 2\pi Aa^2}{4\pi r^2 \varepsilon_0}
\]

make \( E \) independent of \( r \) then

\[
Q - 2\pi a^2 A = 0 \Rightarrow A = \frac{Q}{2\pi a^2}
\]

12. at time \( t_1 \):

\[
\frac{N}{N_0} = \left( \frac{1}{2} \right)^{\frac{t_1}{T_{1/2}}}
\]

\[
\frac{2}{3} = \frac{1}{2^{\frac{t_1}{T_{1/2}}}}
\]

...........(1)

at time \( t_2 \):

\[
\frac{N}{N_0} = \left( \frac{1}{2} \right)^{\frac{t_2}{T_{1/2}}}
\]

\[
\frac{1}{3} = \frac{1}{2^{\frac{t_2}{T_{1/2}}}}
\]

...........(2)

\[
\frac{1}{(1)} \Rightarrow 2 = \frac{2^{\frac{t_2}{T_{1/2}}}}{2^{\frac{t_1}{T_{1/2}}}}
\]

\[
2 = 2^{\frac{t_2 - t_1}{T_{1/2}}}
\]

\[
\frac{t_2 - t_1}{T_{1/2}} = 1
\]

\[
t_2 - t_1 = T_{1/2} = 50 \text{ days}
\]
13. (b): Time period of spring block system is given by, \[ T = 2\pi \sqrt{\frac{\text{mass of block}}{\text{spring constant}}} \]

Here, mass of block = \((M + m)\); spring constant, \(k = \frac{mg}{X}\)

At equilibrium, \((M + m)g = k(X_o + X)\) or, \(mg = kX\)
(Initially, \(Mg = kX_o\))

\[ \therefore T = 2\pi \sqrt{\frac{(M + m)}{mg}} = 2\pi \sqrt{\frac{(M + m)X}{mg}} \]

14. (d): Amplitude of a damped oscillator at any instant \(t\) is \(A = A_0 e^{-bt/2m}\), where \(A_0\) is the original amplitude.

When \(t = 2\) s, \(A = \frac{A_0}{3}\)
\[ \therefore \frac{A_0}{3} = A_0 e^{-2b/2m} \text{ or } \frac{1}{3} = e^{-b/m} \]  ...(i)

When \(t = 6\) s, \(A = \frac{A_0}{n}\) \[ \therefore \frac{A_0}{n} = A_0 e^{-6b/2m} \]

or \(\frac{1}{n} = e^{-3b/m} = (e^{-b/m})^3 = \left(\frac{1}{3}\right)^3 \)  (Using (i))

\[ \therefore n = 3^3 \]

15. (a): Mass per unit length of the string,
\[ \mu = \frac{m}{L} = \frac{3 \text{ kg}}{25 \times 10^{-2} \text{ m}} = 12 \text{ kg m}^{-1} \]

Speed of the wave on the string is
\[ v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{400 \text{ N}}{12 \text{ kg m}^{-1}}} = 5.77 \text{ m s}^{-1} \]

Time taken by disturbance to reach the other end
\[ t = \frac{L}{\nu} = \frac{25 \times 10^{-2} \text{ m}}{5.77 \text{ m s}^{-1}} = 0.043 \text{ s} \]

16. (3)
17. (b): Radius of \( n^{th} \) orbit in hydrogen like atoms is
\[
r_n = \frac{a_0 n^2}{Z}
\]
where \( a_0 \) is the Bohr's radius
For hydrogen atom, \( Z = 1 \)
\[
\therefore \quad r_1 = a_0 \quad (\therefore \ n = 1 \text{ for ground state})
\]
For Be\(^{+}\), \( Z = 4 \)
\[
\therefore \quad r_n = \frac{a_0 n^2}{4}
\]
According to given problem,
\[
r_1 = r_n
\]
\[
a_0 = \frac{n^2 a_0}{4} \quad \Rightarrow \quad n = 2
\]

18. (d): Here, \( \lambda = 660 \text{ nm} = 660 \times 10^{-9} \text{ m} \)
\( t = 60 \text{ ms} = 60 \times 10^{-3} \text{ s}; \ P = 0.5 \text{ kW} = 500 \text{ W} \)
\( h = 6.62 \times 10^{-34} \text{ J s}, \ n = ? \)
As, \( P = \frac{E}{t} = \frac{\hbar c}{\lambda t} \); \( \therefore \quad n = \frac{\hbar \lambda t}{hc} \)
\[
n = \frac{500 \times 660 \times 10^{-9} \times 60 \times 10^{-3}}{6.62 \times 10^{-34} \times 3 \times 10^8}
\]
\( \therefore \quad n = 10^{20} \)

19. Optioc (3)

20. (d): Here relative velocity of the train w.r.t. other train \( = V - v \)
Hence, \( 0 - (V - v)^2 = 2ax \) or \( a = -\frac{(V - v)^2}{2x} \)
\( \therefore \quad \text{Minimum retardation} = -\frac{(V - v)^2}{2x} \)

21. (b): Let, the free-fall time be \( t \).
\[
\Delta y = v_0 y + \frac{1}{2}gt^2 \quad \Rightarrow \quad t = \sqrt{\frac{2\Delta y}{g}} = \sqrt{\frac{2(10 \text{ m})}{10 \text{ m s}^{-2}}} = \sqrt{2} \text{ s}
\]
Thus, the magnitude of the average angular velocity
\[
\omega_{avg} = \frac{(2.5 \text{ rev})(2\pi \text{ rad rev}^{-1})}{\sqrt{2} \text{ s}} = \frac{5\pi}{\sqrt{2}} \text{ rad s}^{-1}
\]
22. Option (1)

\[ x_{cm} = \frac{m_1x_1 + m_2x_2 + m_3x_3 + \ldots \ldots m_nx_n}{m_1 + m_2 + m_3 + \ldots \ldots + m_n} \]

\[ = \frac{(m)(\ell) + (2m)(2\ell) + (3m)(3\ell) + \ldots \ldots + (nm)(n\ell)}{m + 2m + 3m + \ldots \ldots + nm} \]

\[ = \frac{m\ell(1^2 + 2^2 + 3^2 + \ldots \ldots + n^2)}{m(1+2+3+\ldots + n)} \]

\[ \ell = \frac{n(n+1)(2n+1)}{6} \]

\[ \frac{n(n+1)}{3} \]

23. (c): Force acting on the charge \( q \) in the electric field of intensity \( E \), i.e., \( F = qE \)

If \( v \) is the velocity acquired by the particle in moving through a distance \( x \) after starting from rest \( v_0 = 0 \), then from \( v^2 - v_0^2 = 2ax \), we get \( v^2 = 2ax \)

or \( v^2 = 2\left(\frac{qE}{m}\right)x \)

\[ \therefore a = \frac{F}{m} = \frac{qE}{m} \]

Thus, kinetic energy of the particle, i.e,

\[ KE = \frac{1}{2}mv^2 = \frac{1}{2}m \left(\frac{2qEx}{m}\right) = qEx \]

24. (c): Each sphere possesses potential energy due to its own charge

\[ U_1 = U_2 = \frac{1}{2} \frac{q^2}{C} = \frac{q^2}{8\pi\varepsilon_0r} \]

Mutual potential energy of each sphere due to electric field of other

\[ U'_1 = U'_2 = \frac{q^2}{4\pi\varepsilon_0R} \]

\[ \therefore \] Total potential energy of the system of two spheres,

\[ U = (U_1 + U_2) + (U'_1 + U'_2) = \frac{2q^2}{8\pi\varepsilon_0r} + \frac{2q^2}{4\pi\varepsilon_0R} \]

\[ U = \frac{q^2}{4\pi\varepsilon_0} \left[ \frac{1}{r} + \frac{2}{R} \right] \]
25. (a): Here,

Resistance of the galvanometer, \( G = 100 \, \Omega \)

Current for full scale deflection, \( I_g = 30 \, mA \)

\[ = 30 \times 10^{-3} \, A \]

In order to work this galvanometer as a voltmeter of range 30 V (i.e. \( V = 30 \, V \)), let resistance \( R \) be added in series with it. It is given by

\[ R = \frac{V}{I_g} - G = \frac{30 \, V}{30 \times 10^{-3} \, A} - 100 \, \Omega \]

\[ = 1000 \, \Omega - 100 \, \Omega = 900 \, \Omega \]

26. (b): Horizontally: \( T_2 \cos 60^\circ = T_1 \cos 30^\circ \)

\[ \Rightarrow T_2 = T_1 \sqrt{3} \]

Vertically: \( T_2 \sin 60^\circ + T_1 \sin 30^\circ = 150 \)

Thus \( T_1 = 75 \, N \) and \( T_2 = 75\sqrt{3} \, N \)

27. (c): Two bodies under mutual internal forces always meet at their CM. From theorem of moment of masses, we can write

\[ 50 \, x = 70 \, (6 - x) \Rightarrow 120 \, x = 420 \Rightarrow x = 3.5 \, m \]

28. (b): \( v_3 \frac{dm}{dt} = m(g + a) \)

\[ 800 \frac{dm}{dt} = 5000(10 + 20) \Rightarrow \frac{dm}{dt} = 187.5 \, \text{kg s}^{-1} \]

29. (b): For rope: \( F = T_2 \)

For pulley B: \( 2 \, T_2 = T_1 \)

For pulley A: \( 2 \, T_1 = W = 100 \)

Using above eqns.

\[ F = \frac{100}{4} = 25 \, N \]

30. (c): Torque of a force about a point is zero only when the line of action of the force passes through that point.
31.

\[ (c) \text{: As } d\theta = \frac{x}{D} = \frac{1.22\lambda}{d}, \therefore x = \frac{1.22\lambda d}{D} \]

\[ = 1.22(500 \times 10^{-9} \text{ m})(400 \times 10^{-3} \text{ m}) = 48.8 \text{ m} \approx 50 \text{ m} \]

\[ (5 \times 10^{-3} \text{ m}) \]

32.

(a) : The refractive index, \( n_2 \) (from medium 1 to medium 2) is

\[ n_2 = \frac{\text{speed of light in medium 1} (v_1)}{\text{speed of light in medium 2} (v_2)} \]

\[ = \frac{\text{wavelength of light in medium 1} (\lambda_1)}{\text{wavelength of light in medium 2} (\lambda_2)} \]

Now, \( n_2 = \frac{n_2}{n_1} = \frac{5}{4} \)

\[ v_1 = 2.0 \times 10^{-8} \text{ m s}^{-1} \]

\[ \lambda_1 = 500 \text{ nm} \]

\[ \therefore \frac{5}{4} = \frac{2.0 \times 10^{-8} \text{ m s}^{-1}}{v_2} = \frac{500 \text{ nm}}{\lambda_2} \]

Hence, \( \lambda_2 = 400 \text{ nm} \)

\[ v_2 = 1.6 \times 10^{-8} \text{ m s}^{-1} \]

33.

(c) : Shift in fringe pattern = \( \frac{(\mu - 1)tD}{d} \)

or \[ 20 \left( \frac{\lambda D}{d} \right) = \frac{(\mu - 1)tD}{d} \]

\[ \therefore \mu = 1 + \frac{20\lambda}{t} = 1 + \frac{20(5.0 \times 10^{-7})}{2.5 \times 10^{-5}} = 1.4 \]

34.

(a) : For X, energy = 200 \times 7.4 = 1480 \text{ MeV}

For A, energy = 110 \times 8.2 = 902 \text{ MeV}

For B, energy = 80 \times 8.1 = 648 \text{ MeV}

Therefore, energy released

\[ = (902 + 648) - 1480 = 70 \text{ MeV} \]

35.

(2): As we know according to equation of continuity, when cross section of duct decreases, the velocity of flow of liquid increases and in accordance with Bernoulli’s theorem in a horizontal pipe, the place where speed of liquid is maximum, the value of pressure is minimum. Hence the second graph correctly represents the variation of pressure.
36.

(a): \( v_x = 8t - 2 \)

or \( \frac{dx}{dt} = 8t - 2 \)

or \( \int_{t_1}^{t_2} dx = \int_{2}^{t} (8t - 2)dt \)

or \( x - 14 = \left[4t^2 - 2t\right]_2^{t} = 4t^2 - 2t - 12 \)

or \( x = 4t^2 - 2t + 2 \) ... (i)

Further, \( v_y = 2 \)

or \( \frac{dy}{dt} = 2 \) : : \( \int_{4}^{t} dy = \int_{2}^{t} 2dt \)

or \( y - 4 = \left[2t\right]_2^{t} = 2t - 4 \) or \( y = 2t \)

or \( t = \frac{y}{2} \) ... (ii)

Substituting the value of \( t \) from eq. (ii) in eq. (i)
we have \( x = y^2 - y + 2 \)

37.

(d): \( r_1 = \frac{2r}{3} \) and \( r_2 = \frac{r}{3} \)

\( \omega \) will be same for both the stars.

\[
K_1 = \frac{1}{2} I_1 \omega^2 \quad \text{and} \quad K_2 = \frac{1}{2} I_2 \omega^2
\]

\[
\therefore \quad \frac{K_1}{K_2} = \frac{I_1}{I_2} = \frac{mr_1^2}{2mr_2^2} = \frac{m\left(\frac{2r}{3}\right)^2}{2m\left(\frac{r}{3}\right)^2} = 2
\]

\( L_1 = I_1 \omega \quad \text{and} \quad L_2 = I_2 \omega \)

\( \therefore \quad \frac{L_1}{L_2} = \frac{I_1}{I_2} = 2 \)

38.

(c): Here, \( n = \frac{360}{60} = 6 \) bullets s\(^{-1}\),

\( v = 600 \text{ m s}^{-1}, \ m = ? \)

Power of gun = Power of bullets

\[
5.4 \times 10^3 = \frac{1}{2} (nm)v^2 \Rightarrow 2 \times 5400 = 6 \times m (600)^2
\]

or \( m = \frac{2 \times 5400}{6 \times 600 \times 600} = \frac{1}{200} \text{ kg} = \frac{1000}{200} \text{ g} = 5 \text{ g} \)
39. (a): Total resistance of the circuit
\[ R = 6 + 4 = 10 \, \Omega \]
Capacitive reactance
\[ X_C = \frac{1}{\omega C} = \frac{1}{2000 \times 5 \times 10^{-6}} = 10 \, \Omega \]
Inductive reactance
\[ X_L = \omega L = 2000 \times 5 \times 10^{-3} = 10 \, \Omega \]
\[ Z = \sqrt{R^2 + (X_L - X_C)^2} = 10 \, \Omega \]
Amplitude of current
\[ I_0 = \frac{V_0}{Z} = \frac{20}{10} = 2 \, A \]

40. (a): Given, electric field associated with an electromagnetic wave,
\[ \vec{E} = i \cdot 40 \cos(kx - 6 \times 10^8 t) \]
Comparing the given equation with \( \vec{E} = E_0 \cos(kx - \omega t) \), we have
\[ \omega = 6 \times 10^8 \, s^{-1}, \nu = c = 3 \times 10^8 \, m \, s^{-1} \]
\[ k = \frac{\omega}{\nu} = \frac{6 \times 10^8}{3 \times 10^8} = 2 \, m^{-1} \]

41. (c): The energy saved is kinetic energy of bricks.
Percentage of energy saved
\[ = \frac{\frac{1}{2}mv^2}{mgh + \frac{1}{2}mv^2} \times 100\% \]
\[ = \frac{\nu^2}{2gh + \nu^2} \times 100\% \]
\[ = \frac{12^2}{2 \times 9.8 \times 12 + 12^2} \times 100\% = 38\% \]

42. (d): The rate of flow of heat through the rod,
\[ H = kA \left( \frac{dT}{dx} \right) = k \left( \frac{\pi D^2}{4} \right) \left( T_1 - T_2 \right) / l, \]
\[ H \propto D^2 / l \]
Thus,
\[ \frac{H_1}{H_2} = \left( \frac{D_1}{D_2} \right)^2 \left( \frac{l_2}{l_1} \right) = \left( \frac{1}{2} \right)^2 \left( \frac{1}{2} \right) = \frac{1}{8} \]
43. 

(c) Velocity of sound in a gas, \( v = \sqrt{\frac{\gamma RT}{M}} \) 
For the same temperature 

\[ v \approx \sqrt{\frac{\gamma}{M}} \]

\[ \therefore \frac{v_{H_2}}{v_{He}} = \sqrt{\frac{M_{He}}{M_{H_2}}} = \sqrt{\frac{7}{5} \times \frac{4}{3} \times \frac{5}{2} = \frac{\sqrt{42}}{5} } \]

44. 

(a) According to Newton's law of cooling 

\[ \frac{T_1 - T_2}{t} = K \left( \frac{T_1 + T_2}{2} - T_s \right) \]

where \( T_s \) is the surrounding temperature.

For the first case,

\[ T_1 = 91^\circ C, \ T_2 = 79^\circ C, \ T_s = 25^\circ C, \ t = 2 \text{ min} \]

\[ \therefore \frac{91^\circ C - 79^\circ C}{2 \text{ min}} = K \left( \frac{91^\circ C + 79^\circ C}{2} - 25^\circ C \right) \]

or \[ \frac{12^\circ C}{2 \text{ min}} = K(60^\circ C) \] ... (i)

For the second case,

\[ T_1 = 91^\circ C, \ T_2 = 79^\circ C, \ T_s = 5^\circ C, \ t = ? \]

\[ \therefore \frac{t}{t} = K \left( \frac{91^\circ C + 79^\circ C}{2} - 5^\circ C \right) \]

or \[ \frac{12^\circ C}{t} = K(80^\circ C) \] ... (ii)

Dividing eqn. (i) by eqn. (ii), we get 

\[ \frac{t}{2 \text{ min}} = \frac{60^\circ C}{80^\circ C} \text{ or } t = \frac{3}{4} (2 \text{ min}) = \frac{3}{2} \text{ min} \]

45. 

(a) 

\[ A \quad \overline{A} \quad B \quad \overline{Y} \]

The Boolean expression for output \( Y \) is 

\[ Y = \overline{A} \cdot \overline{B} \quad \text{(by de Morgan's theorem)} \]

\[ = A + B = A + B \]

which is Boolean expression for OR gate. Thus the combination represents OR gate.
46. (2)

Molarity of Na₂CO₃ solution

\[ \frac{2.65 \times 1000}{105} \times \frac{1000}{250} = 0.1 \text{ M} \]

\[ M_1V_1 = M_2V_2 \]

\[ 10 \times 0.1 = 1000 \times M_1 \]

\[ M_2 = 0.001 \text{ M} \]

47. (3)

48. (1)

The IUPAC name of \([\text{Pt}(\text{NH}_3)_4\text{Cl}_4]\) is hexammine platinum(IV) chloride.

49. (1)

50. (2)

\[ \text{CO}_{(g)} + \text{Cl}_{(g)} \rightleftharpoons \text{COCl}_2(\text{g}) \]

\[ K_c = \frac{[\text{COCl}_2]}{[\text{CO}][\text{Cl}]} \]

\[ = \frac{0.14}{1.2 \times 10^{-2} \times 5.4 \times 10^{-2}} = 216.05 \]

\[ K_p = K_c(RT) \Delta n \]

\[ \Delta n_g = -1 \]

\[ K_p = K_c(RT)^{-\Delta n_g} = \frac{K_c}{RT} \]

\[ K_p = \frac{216.05}{0.0821 \times 347} = 7.584 \]

51. (3)

\[ \text{Ca(HCO}_3\text{)}_{102g} + \text{Ca(OH)}_{24g} \rightarrow 2\text{CaCO}_3 + 2\text{H}_2\text{O} \]

100 mL of pond water has \(\text{Ca(HCO}_3\text{)}_{2} \)

\[ = 1.62 \text{ mg} = 1.62 \times 10^{-3} \text{ g} \]
60,000\,\text{mL} \text{ has } \text{Ca(HCO}_3\text{)}_2 = \frac{1.62 \times 10^{-1}}{100} \times 60000 = 0.972 \, \text{g}

162 \, \text{g of Ca(HCO}_3\text{)}_2 \text{ requires } \text{Ca(OH)}_2 = 74 \, \text{g}

0.972 \, \text{g of Ca(HCO}_3\text{)}_2 \text{ requires } \text{Ca(OH)}_2

\frac{74}{162} \times 0.972 = 0.444 \, \text{g}

52. (3)

53. (3)

From Faraday second law:

\[ \frac{m_\text{an}}{m_\text{H}_2} \times \frac{E_\text{an}}{E_\text{H}_2} \]

\[ m_\text{H}_2 = \frac{2}{22.4} \times 2.24 = 0.2 \, \text{g} \]

\[ m_\text{an} = \frac{83.5}{2} \times 0.2 = 63.5 \, \text{g} \]

54. (2)

\[ \log K = \log \Delta - \frac{E_i}{2.303 \, RT} \]

When a graph is plotted between log K and \( \frac{1}{T} \) for first order reaction a straight line is obtained and the slope of the line is equal to \( \frac{E_i}{2.303 \, R} \)

55. (2)

If a compound contains at least one \( \alpha \)-H-atom with respect to ketone group. It can show keto-enol tautomerism. Therefore

\[ \text{COCH}_3 \text{ and } \text{CO} - \text{CH}_3 - \text{CO} \]

show keto-enol tautomerism.

56. (2)

Tetragonal system has the unit cell dimensions as

\[ a = b = c, \; \alpha = \beta = \gamma = 90^\circ \]
57. (2)  
The structure of $\text{OF}_2$ molecule is as  
\[
\begin{array}{c}
\text{O} \\
\text{F} \\
\text{F}
\end{array}
\]
Hence, it has 2 bond pairs and 8 lone pair.

58. (2)  
\[
\begin{array}{c}
\text{Cl} \\
\text{Cl} \\
\text{Cl}
\end{array}
\]
\[
\begin{array}{c}
\text{C} \\
\text{CH}_2 \\
\text{CH}_3 \\
\text{Cl}
\end{array}
\]
\[
\begin{array}{c}
\text{Cl} \\
\text{Cl}
\end{array}
\]
CCl$_3$ is an electron withdrawing group causing 
\(\pi\)-electron shift from $\text{C}_1$ to $\text{C}_2$ and addition is 
opposite to markownikoff’s rule.

59. (3)

60. (3)
\[
2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2
\]
Mercerous oxide dissolves in mercury which loses 
it's meniscus and sticks to the glass (tailing of 
mercury).

61. (1)

Iodex ointment contains iodeform which liberates 
I$_2$ slowly.

62. (2)

On burning in oxygen Li metal forms monoxide, 
Li$_2$O.

63. (3)

64. (3) Cetyl trimethyl ammonium chloride is a cationic detergent hence it is used as germicide.
Order of a reaction can be fraction or zero or complete positive and negative number.

\[ 
\Delta E = h = \frac{hc}{\lambda}, \\
\lambda = \frac{hc}{\Delta E} = \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{4.4 \times 10^{-11}} \\
= 4.52 \times 10^{-15} \text{ m} 
\]

For NaCl type structure,
Distance between \( A^+ \) and \( B^- \)
\[ = \frac{1}{2} \times \text{edge length} \\
= \frac{1}{2} \times 400 = 200 \text{ pm} \\
\]

Radius of cation = 75 pm
Radius of anion = 200 - 75 = 125 PM

Electrode potential = -0.3 V
The electrode reaction may be given as
\[ 2H^+_{\text{aq}} + 2e^- \rightarrow H_2_{\text{g}} \\
E = E^* - \frac{0.059}{2} \log \frac{1}{[H^+]} \\
-0.3 = 0 - \frac{0.059}{2} (-2 \log[H^+]) \\
-0.3 = -0.059 \text{ pH} \\
pH = \frac{0.3}{0.059} \\
pH = 5.085 \]
71. (2)

72. (3)

\[ \text{LiAlH}_4 \text{ reduces both ester and carbonyl group.} \]
\[ \text{NaBH}_4/\text{CH}_3\text{OH reduces only carbonyl group.} \]

73. (4)

74. (1)

75. (2)

76. (4)

Ferrocene is a sandwich complex compound in which all the five C-atoms of cyclopentadiene anion are linked to the metal through \( \pi \)-bonds.

77. (1)

Ammonium dichromate on heating gives \( \text{N}_2 \) gas which is also given by heating of \( \text{NH}_4\text{NO}_2 \).

\[ (\text{NH}_4)_2\text{Cr}_2\text{O}_7 \rightarrow \text{Cr}_2\text{O}_3 + 4\text{H}_2\text{O} + \text{N}_2 \uparrow \]
\[ \text{NH}_4\text{NO}_2 \xrightarrow{\Delta} 2\text{H}_2\text{O} + \text{N}_2 \uparrow \]

78. (3)

Hence, 4 chiral compound are formed.
79. (2)

Deviations from ideal behaviour are expressed in terms of compressibility factor,

\[ Z = \frac{PV}{nRT} \]

For positive deviations,

\[ Z > 1 \]

80. (3)

In Kjeldahl's method nitrogen containing organic compound is heated with \( H_2SO_4 \) in presence of copper salt as catalyst to convert nitrogen to \( NH_4SO_4 \).

81. (4)

\[
\begin{align*}
\text{CH}_3 & \quad \downarrow \\
\text{H} & \quad \text{N} \quad \text{C} \quad \text{CH}_2 \quad \text{CH}_3 \\
\text{CH}_3 & \quad \text{CH}_3 \\
\text{CH}_3 & \\
\end{align*}
\]

3-(N, N-dimethyl) amino 3-methylpentane.

82. (2)

S₂ and reaction is most favourable for tertiary substrate.

\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_3 \\
\text{Cl} & \quad \downarrow \\
\text{H}_2\text{O} & \quad \text{CH}_3 \\
\text{3° Carbocation} & \quad \text{(Most stable)} \\
\end{align*}
\]

83. (4)

\[
\begin{align*}
\text{CH}_3 & \quad \text{O} \quad \text{HO} \\
\text{O} & \quad \text{COONa} \quad \text{COOH} \\
\end{align*}
\]
84. (3)

\[
\begin{align*}
\text{CH}_3\text{NC} \xrightarrow{\text{H}_2\text{O}} & \text{CH}_3\text{NH}_2 + \text{HCOOH} \\
\text{O} & \\
\text{CHCl}_3 \xrightarrow{\text{NaOH}} & \text{H-CONA} \xrightarrow{\text{H}_2\text{O}} \text{HCOOH} \\
\text{CCl}_4 \xrightarrow{\text{H}_2\text{O}} & \text{no hydrolysis}
\end{align*}
\]

85. (4)

(4n + 2) = 6 is not followed

(4n + 2) = 6 is followed. The complete delocalisation of π-electrons takes place. Hence, this is aromatic.

(4n + 2) = 6 is not followed.

86. (3)

Yellow powder is sulphur. Colourless gas (X) having octahedral structure is SF\(_6\). Colourless gas (Y) is SF\(_4\).

\[
\begin{align*}
\text{S} + 3\text{F}_2 \xrightarrow{\text{Yellow powder}} & \text{SF}_6 \\
(\text{X}) & \text{colourless gas} \\
3\text{SCl}_2 + 4\text{NaF} \xrightarrow{\text{Y Colourless gas}} & \text{SF}_4 + \text{S}_2\text{Cl}_2 + 4\text{NaCl}
\end{align*}
\]

87. (4)

88. (3)

In Van-Arkel method, the metal is converted into its stable volatile iodide which is then decomposed at higher temperature to pure metal and I\(_2\).

\[
\begin{align*}
\text{Ti} + 2\text{I}_2 \xrightarrow{\text{773K}} & \text{TiI}_4 \xrightarrow{\text{873K}} \text{Ti} + 2\text{I}_2
\end{align*}
\]
89. \( \frac{1}{6} = \frac{1}{2^n} \) 
\[ \therefore \frac{N}{N_0} = \frac{1}{2^n} \]
\[ n = 3 \]
\[ t = 10 \times 3 = 30 \text{ days.} \]

90. (2)

The rate of first order reaction is expressed as

\[ A \quad \rightarrow \quad \text{Products} \]

\[ \text{Rate} = \frac{d[A]}{dt} \]

\[ \text{Rate} = k[A] \]

and the rate constant \( k \) is expressed as

\[ k = \frac{2.303}{t} \log \frac{[A_0]}{[A_t]} \]

\[ k = \frac{t}{2.303} \log \frac{[A_1]}{[A_{e}]} \]

91. The living world (4) Pg No. 3, 4, 5

92. Environmental issues (3) Pg No. 271 and figure 16.1

93. Sexual reproduction in angiosperms (3) Pg No. 21, 22 and 25

94. Molecular basic of inheritance (3) Pg. 99, 6.1.2 and figure 6.4

95. Microbes in human welfare (2) Secondary (biological) Treatment

96. Reproduction in organsions (3) Pg no. 16 fig no. 18

97. Plant growth and development (3) Pg no. 245, 15.2

98. Mineral nutrition (2) Pg no. 198

99. Principles of inheritance and variation (3) Pg no. 70 Fig 5.1

100. Transport in plants (2)Pg no. 177 Fig 11.2

101. Organisms and populations (1) Pg no. 219 1st paragraph

102. Photosynthesis in higher plants (2) Pg no. 213 Fig 13.6

103. Strategies for enhancement in food production (1) Pg no. 173, wheat and rice
104. Anatomy of flowering plants (1) Pg no. 85,
105. Cell cycle and cell division (3) Pg no. 167
106. Molecular basis of inheritance (4) Pg no. 17
107. Respiration in plants (3) Pg no. 228, 209 232 and 233
108. Environmental issue (1) Outside text hole factual question
109. Transport in plants (2) Pg no. 186, 11.3.2.1
110. Cell the unit of life (1) Concepts 8.5.2, 8.5.3.2, 8.5.3.4
111. Respiration in plants (2) Pg no. 232 fig 14.3
112. Ecosystem (4) Pg no. 244
113. Morphology of flowering plants (4) Pg no. 72
114. Cell the unit of life (4) Concepts : 8.5.2, 8.5.3.4, 8.5.5
115. Principles of inheritance and variation (4) Pg no. 91
116. Plant kingdom (2) Pg no. 42, 3.6
117. Photosynthesis in plants (3) Pg no. 216 and 217
118. Biological classification (2) Pg no. 23 Fig 2.5
119. Microbes in human welfare (1) Pg no. 184
120. Cell cycle and cell division (1) Pg no. 168, 10.4.1
121. Ecosystem (3) Pg no 243, 3rd paragraph
122. Sexual reproduction in angiosperms (1) Pg no. 35, fig 2.14
123. Anatomy of flowering plants (4) Pg no. 96, 6.4.1.4
124. Plant growth and development (3) Pg no. 249, 15.4.3.3
125. Plant kingdom (1) Pg no. 32 and 33, 3.1.1, 3.1.2 and 3.1.3
126. Morphology of flowering plants (2) Pg no. 75, fig 5.16
127. Photosynthesis in higher plants (3) Pg no. 222, 13.10.1
128. Organism and populations (3) Pg no. 227, figure 13.4
129. Cell the unit of life (2) Pg no. 139, fig 8.12
130. Strategies for enhancement in food production (3) Pg no. 177 2nd last paragraph
131. Respiration in plants (2) Out of textbook Factual Question
132. Morphology of flowering plants (2) Pg no. 75, 5.5.1.3
133. Principles of inheritance and variation (3) Pg no. 85, 86
134. Plant growth and development (3) Pg no. 249, 15.4.3.2
135. Biodiversity and conservation (4) Pg no. 260, 15.1
136. Mineral nutrition (2) Pg no. 118, 12.2.3
137. Molecular basis of inheritance (4) Pg no. 107 Fig 68
138. Sexual reproduction in angiosperms (2) Pg no. 30
139. Biodiversity and conservation (4) Pg no. 267, last paragraph Outside textbook
140. Biological classification (2) Pg no. 27
141. pseudounipolar neuron
142. DNA fragments move towards anode in electrophoresis.
144. No capillaries in cockroach, alary muscles are 12 pairs, heart is on mid-dorsal side.
146. MUFA are essential fatty acids
147. Carboxypeptidase is not a lipolytic enzyme
151. Pneumothorax will develop as air will be filled into the thoracic cavity around the lungs.
157. Ionic gradient across membrane is maintained by Na\(^+\) - K\(^+\) pump which transport 3Na\(^+\) out the cell and 2K\(^+\) inside.
160. ANDi is a genetically modified rhesus monkey.
161. Cochlea is for hearing
162. Thymus is considered as throne of immunity.
164. Prostate secrete 30-40% while seminal vesicle secrete 60-70% of semen
169. Saheli is once a week pill.
171. Non-random or selective mating disturbs HWE
172. Cytotoxic or killer T cells are responsible for Cell mediated immunity
176. Echinoderms possess mesodermally derived endoskeleton.
177. Schistosoma is ‘blood fluke’
178. Euspongia is porifera having cellular level organization.
180. Stratified squamous epithelium has only top layer of squamous cells while lower most layer of columnar cells. Also buccal cavity, pharynx, tongue, oesophagus have non-keratinized epithelia.