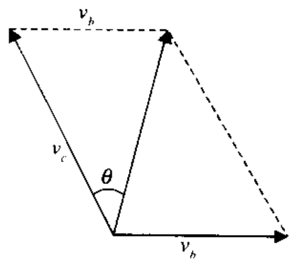
1. (d): $f = am^X k^y$ (i) Dimensions of frequency $f = [M^0 L^0 T^{-1}]$

Dimensions of constant $a = [M^0 L^0 T^0]$
Dimensions of mass $m = [M]$
Dimensions of spring constant $k = [MT^{-2}]$
Putting these values in equation (i), we get
$[M^0 L^0 T^{-1}] = [M]^X [MT^{-2}]^y$
Applying principle of homogeneity of dimensions, we get
$x + y = 0$ (ii) $-2y = -1$ (iii) or $y = \frac{1}{2}, x = -\frac{1}{2}$

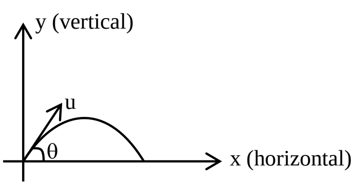
2. **(b)**
Drift $(\Delta x) = (v_{b,x})\,\Delta t$
$= (v_{br}\cos\theta + v_r)\Delta t$
for $\Delta x = 0$,
$v_r = -v_{br}\cos\theta$
$\Rightarrow (v_r)_{max} = v_{br}$
For, $v_r > v_{br}$ we cannot have zero drift. Hence (B) is correct.

3. **(a)**
When the car is exactly opposite, the man at least distance, the bag will reach him when thrown with velocity v_0.
$\sin\theta = \frac{v_b}{v_c} = \frac{10}{10\sqrt{2}} = \frac{1}{\sqrt{2}}$
or $\theta = 45^0$



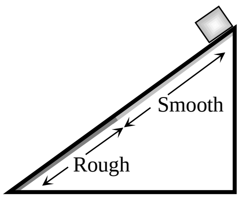
$\therefore$ total angle between v_c and v_b is 90 + 45
$= 135^0$

4. **(d)**



According to law of independence of directions motion of a body along three mutually perpendicular directions is independent of each other.

5. **(d)**
For upper half by the equation of motion
$v^2 = u^2 + 2as$
$v^2 = 0^2 + 2(g\sin\theta)l/2 = gl\sin\theta$
[As $u = 0, s = l/2, a = g\sin\theta$]
For lower half
$0 = u^2 + 2g(\sin\theta - \mu\cos\theta)\ l/2$ [As
$v = 0, s = l/2, a = g(\sin\theta - \mu\cos\theta)$]
$\Rightarrow 0 = gl\sin\theta + gl(\sin\theta - \mu\cos\theta)$ [As final velocity of upper half will be equal to the initial velocity of lower half]
$\Rightarrow 2\sin\theta = \mu\cos\theta \Rightarrow \mu = 2\tan\theta$



6. **(c)**
F = 2mv ω sin 600
$= 2 \times 2 \times 10^6 \times \frac{15 \times 2\pi}{24 \times 60 \times 60} \times \frac{\sqrt{3}}{2}$.
$= 3.6 \times 10^3$N.

7. **(c)**
After first hit $K.E_1 = e^2$ K.E
3/4 K.E = e^2 K.E $\Rightarrow e^2 = 3/4$
K.E. after third hit = $e^{2(3)}$. K.E = 27/64 (mgh)
$= \frac{27}{64}\left(\frac{1}{2}.10.4\right)$
$= 27\left(\frac{5}{16}\right) = \frac{135}{16}$ = 8.44 J

8. **(a)**
3mx = m (2 – x) ; 3x = 2 – x ; 4x = 2 ; x = 0.5 m

9. **(c)**
$V_e = \sqrt{\frac{2GM_e}{R_e}}$ = 11.2 km/s
Now M' = $2M_e$ & R' = $R_e/2$
so $V_e' = \sqrt{\frac{2G(2M_e)}{(R_e/2)}} = 2\sqrt{\frac{2GM_e}{R_e}}$ = 2 × 11.2
= 22.4 km/s

10. (a)

g = $\frac{4}{3}\pi R\rho G$

9.8 = $\frac{4}{3}\pi \times (6400 \times 10^3) \times \rho \times (6.67 \times 10^{-11}) \Rightarrow \rho =$ 5.29×10^3 kg/m^3

11. (c) $l = \frac{FL}{AY} \Rightarrow l \propto \frac{L}{d^2} \Rightarrow \frac{l_1}{l_2} = \frac{L_1}{L_2} \times \left(\frac{d_2}{d_1}\right)^2 = \frac{1}{2} \times \left(\frac{1}{2}\right)^2 = \frac{1}{8}$

12. (c) $W = \frac{1}{2}\frac{YAl^2}{L} \Rightarrow 0.4 = \frac{1}{2} \times \frac{Y \times 1^{-6} \times (0.2 \times 10^{-2})^2}{1}$

$\therefore Y = 2 \times 10^{11} N/m^2$

13. (b)

Force by hydrostatic pressure

= P_{av} × Area = $\frac{1}{2}\rho gL \times L^2 = \frac{1}{2}\rho gL^3$

and centre of pressure is at height $\frac{L}{3}$.

14. (b)

$P_A + \frac{1}{2}\rho v_A^2 = P_B + \frac{1}{2}\rho v_B^2$

$P_A - P_B = \frac{1}{2}\rho(v_B^2 - v_A^2)$

$0.02 \times 12000 \times 10 = \frac{1}{2} \times 1000\ (v_B^2 - 20.2)$

$4.8 = v_B^2 - 20.2 \Rightarrow v_B = 5$m/s

$\Rightarrow A_3.v_B = A_1v_1 + A_2v_2$

$\Rightarrow 30 = 4v_1 + 8$

$\Rightarrow 4v_1 = 22 \Rightarrow v_1 = \frac{22}{4} = 5.5$ m/s

15. (b) For water and ice mixing $\theta_{mix} = \frac{m_W\theta_W - \frac{m_iL_i}{c_W}}{m_i + m_W}$

$= \frac{20 \times 40 - \frac{5 \times 80}{1}}{5 + 20} = 16°C$

16. (a)

dQ = – dU

$nCdT = -nC_VdT$

$C = -C_V = -\frac{R}{\gamma - 1}$

$\boxed{C = \frac{R}{1-\gamma}}$

17. (d)

For an adiabatic process

$T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$

Given $T_2 = \frac{T_1}{2}$ and

$V_2 = 5.66\ V_1$

$\frac{T_1}{T_2} = \left(\frac{V_2}{V_1}\right)^{\gamma-1}$

$2 = (5.66)^{\gamma-1}$

or $\gamma = 1.458$

Hence gas is diatomic having f = 5.

$W = \frac{P_2V_2 - P_1V_1}{r-1}$ and $\frac{P_2V_2}{T_2} = \frac{P_1V_1}{T_1}$

$= \frac{\frac{5.66}{11.32}P_1V_1 - P_1V_1}{1.46-1}$

$P_2 = \frac{P_1}{11.32}$ and

$V_2 = 5.66\ V_1$

$= \frac{0.5\ P_1V_1}{0.46} = \left[\frac{25PV}{23}\right]$

18. (c)

$P = \frac{Q}{t} = A\sigma T^4 \quad \therefore \frac{P_1}{P_2} = \frac{A_1}{A_2} = \frac{r_1^2}{r_2^2} = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$

[If T = constant]

19. (b)

According to Newton's law of cooling

$\frac{\theta_1 - \theta_2}{t} \propto \left[\frac{\theta_1 + \theta_2}{2} - \theta\right]$

For first condition $\frac{62 - 61}{T} \propto \left[\frac{62 + 61}{2} - 30\right]$ .....(i)

and for second condition $\frac{46 - 45.5}{t} \propto \left[\frac{46 + 45.5}{2} - 30\right]$.(ii)

By solving (i) and (ii) we get t = T sec.

20. (a) $v_{max} = a\omega = a \times \frac{2\pi}{T} \Rightarrow a = \frac{v_{max} \times T}{2\pi}$

$a = \frac{1.00 \times 10^3 \times (1 \times 10^{-5})}{2\pi} = 1.59\ mm$

21. (a) P.E. $= \frac{1}{2}m\omega^2x^2$

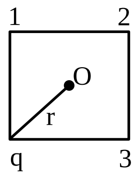
It is clear P.E. will be maximum when x will be maximum *i.e.*, at $x = \pm A$

22. (c)
From given equation k = 12.56
$\lambda = \frac{2\pi}{k} 0.5$ m direction = – y

23. (a)
$n\frac{\lambda}{2}$ = L where n = 1,2,3...........
using V = v λ
$v = \frac{nV}{2L}$, n = 1,2,3..........

24. (b)
$V_{centre} = \frac{k(8q)}{\frac{a\sqrt{3}}{2}} = \frac{16kq}{a\sqrt{3}}$
$= \frac{4q}{\pi\varepsilon_0 a\sqrt{3}}$

25. (b)



r = 1 cm
$\therefore V_0 = \frac{1}{1}+\frac{2}{1}+\frac{3}{1}+\frac{q}{1} = 0$
∴ q = – 6 esu

26. (b)
V = constant., *i* = constant. So *R* = constant
$\Rightarrow \frac{P_i l_i}{A_i} = \frac{\rho_{Cu} l_{Cu}}{A_{Cu}} \Rightarrow \frac{\rho_i l_i}{r_i^2} = \frac{\rho_{Cu} l_{Cu}}{r_{Cu}^2}$
$\Rightarrow \frac{r_i}{r_{Cu}} = \sqrt{\frac{\rho_i}{\rho_{Cu}}} = \sqrt{\frac{1.0\times10^{-7}}{1.7\times10^{-8}}} = \sqrt{\frac{100}{17}} \approx 2.4$

27. (d)
If suppose emf's of the cells are E_1 and E_2 respectively then
$E_1 + E_2 = x \times 6$ .... (i) [x = potential gradient)]
and $E_1 - E_2 = x \times 2$ ....(ii)
$\Rightarrow \frac{E_1+E_2}{E_1-E_2} = \frac{3}{1} \Rightarrow \frac{E_1}{E_2} = \frac{2}{1}$

28. (b)
Illumination = $P_{Consumed} = \frac{V^2}{R}$. Initially there were 40 bulbs in series so equivalent resistance was 40 *R*, finally 39 bulbs are in series so equivalent resistance becomes 39 *R*. Since resistance decreases so illumination increases with 39 bulbs.

29. (b)
$\frac{H_1}{H_2} = \frac{m_1 s_1}{m_2 s_2} = \frac{\rho_1 V_1 s_1}{\rho_2 V_2 s_2}$

30. (b)
Particles is moving undeflected in the presence of both electric field as well as magnetic field so it's speed
$v = \frac{E}{B} \Rightarrow B = \frac{E}{v} = \frac{10^4}{10} = 10^3 Wb/m^2$.

31. (c)
Magnetic field due to wire
$B = \frac{\mu_0 I}{2\pi r} = \frac{4\pi\times10^{-7}}{2\pi} \times \frac{30}{2\times10^{-2}} = 3 \times 10^{-4}$ T
This magnetic field will be perpendicular to external magnetic field. ∴ Net magnetic field $B = \sqrt{B^2 + B_0^2}$
$= \sqrt{(3\times10^{-4})^2 + (4\times10^{-4})^2}$
$= 5 \times 10^{-4}$ T

32. (d)
Suppose distances of points *X* and *Y* from magnet are *x* and *y* respectively then According to question $B_{axial} = B_{equatorial}$
$\Rightarrow \frac{\mu_0}{4\pi}.\frac{2M}{x^3} = \frac{\mu_0}{4\pi}.\frac{M}{y^3} \Rightarrow \frac{x}{y} = \frac{2^{1/3}}{1}$

33. (b)
By using $T = 2\pi\sqrt{\frac{I}{MB_H}} = 2\pi\sqrt{\frac{I}{MB\cos\phi}}$
$\Rightarrow T \propto \frac{1}{\sqrt{B\cos\phi}} \Rightarrow \frac{T_1}{T_2} = \sqrt{\frac{B_2}{B_1}\times\frac{\cos\phi_2}{\cos\phi_1}} \Rightarrow \frac{60/20}{60/15}$
$= \sqrt{\frac{B_2}{B_1}\times\frac{\cos 60}{\cos 30}} \Rightarrow \frac{B_1}{B_2} = \frac{16}{9\sqrt{3}}$.

34. (b)
We know for air cored solenoid $L = \frac{\mu_0 N^2 A}{l}$
In case of soft of iron core it's self-inductance
$L' = \frac{\mu_0 \mu_r N^2 A}{l}$; $L' = \mu_r L$. So here L' = 900 × 0.18 = 162 *mH*
Note : The self-inductance of a solenoid may be increased by inserting a soft iron core. The function of the core is to improve the flux linkage between the turns of the coil.

35. (c)

$\phi = f(\sin\theta) \rightarrow$ function of $\sin\theta$

$\therefore E = -\frac{d\phi}{dt} = f(-\cos\theta) \rightarrow$ function of –ve $\cos\theta$. Hence correct graph is (C)

36. (d)

Time difference T.D. $= \frac{T}{2\pi} \times \phi \Rightarrow$ T.D.

$= \frac{T}{2\pi} \times \frac{\pi}{3} = \frac{T}{6} = \frac{1}{6\nu} = \frac{1}{6 \times 60} = \frac{1}{360}\, sec$

37. (c)

$R = 100\ \Omega$

$X_L = 2\pi fL$

$X_C = \frac{1}{2\pi fC}$

$Z = \sqrt{R^2 + (X_L - X_C)^2}$

38. (a) Any charge in the universe is given by

$q = ne \Rightarrow e = \frac{q}{n}$ (where n is an integer)

$q_1 : q_2 : q_3 : q_4 : q_5 : q_6 :: n_1 : n_2 : n_3 : n_4 : n_5 : n_6$

$6.563 : 8.204 : 11.5 : 13.13 : 16.48 : 18.09 :: n_1 : n_2 : n_3 : n_4 : n_5 : n_6$

Divide by 6.563

$1 : 1.25 : 1.75 : 2.0 : 2.5 : 2.75 :: n_1 : n_2 : n_3 : n_4 : n_5 : n_6$

Multiplied by 4

$4 : 5 : 7 : 8 : 10 : 11 :: n_1 : n_2 : n_3 : n_4 : n_5 : n_6$

$$e = \frac{q_1 + q_2 + q_3 + q_4 + q_5 + q_6}{n_1 + n_2 + n_3 + n_4 + n_5 + n_6} = \frac{73.967 \times 10^{-19}}{45}$$

$= 1.641 \times 10^{-19}\, C$

(**Note:** If you take 45.0743 in place of 45, you will get the exact value)

39. (d) $E = W_0 + K_{max}; E = \frac{12375}{3000} = 4.125\ eV$

$\Rightarrow K_{max} = E - W_0 = 4.125\ eV - 1\ eV = 3.125\ eV$

$\Rightarrow \frac{1}{2} mv_{max}^2 = 3.125 \times 1.6 \times 10^{-19}\ J$

$\Rightarrow v_{max} = \sqrt{\frac{2 \times 3.125 \times 1.6 \times 10^{-19}}{9.1 \times 10^{-31}}} = 1 \times 10^6\, m/s$

40. (c)

According to Bohr model time period of electron $T \propto n^3$

$\Rightarrow \frac{T_2}{T_1} = \frac{n_2^3}{n_1^3} = \frac{2^3}{1^3} = \frac{8}{1}$

$\Rightarrow T_2 = 8T_1$.

41. (c)

$E = -3.4\, Z^2$, energy in second orbit.

42. (d)

$i_c = \beta i_b = \beta \times \frac{V_i}{R_i} = 50 \times \frac{0.01}{1000} = 500 \times 10^{-6}\, A = 500\, \mu A$

43. (d)

Rectifier is used to convert AC into DC.

44. (a)

$d = \sqrt{2Rh}$

$N = \pi d^2 \sigma$

$= 2\pi Rh\, \sigma$

$= 2 \times 3.14 \times 6400 \times 0.1 \times 1000$

$= 2 \times 3.14 \times 6.4 \times 10^5$

$= 39.5 \times 10^5$

45. (a)

Output is available only when both inputs are available.

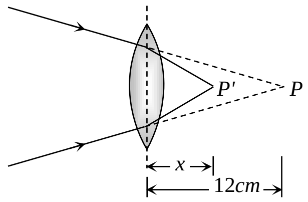
46. (d)

From the figure shown it is clear that

For lens : u = 12 cm and v = x = ?

By using $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\Rightarrow \frac{1}{+16} = \frac{1}{x} - \frac{1}{+12} \Rightarrow x = 48$ cm



47. (c)

Refraction at P.

$\frac{\text{Sin } 60^0}{\text{Sin } r_1} = \sqrt{3}$

$\Rightarrow \text{Sin} r_1 = \frac{1}{2}$

$\Rightarrow r_1 = 30^0$

Since $r_2 = r_1$

$\therefore r_2 = 30^0$

Refraction at Q $\frac{\text{Sin } r_2}{\text{Sin } i_2} = \frac{1}{\sqrt{3}}$ Putting $r_2 = 30^0$ we obtain

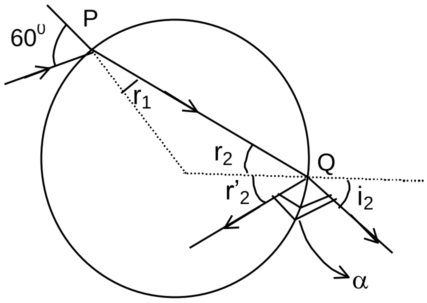
$i_2 = 60^0$

Reflection at Q

$r_2' = r_2 = 30^o$

$\therefore \alpha = 180^0 - (r_2' + i_2)$

$= 180^0 - (30^0+60^0) = 90^0$



48. (b)

By using $A = \sqrt{a_1^2 + a_2^2 + 2a_1a_2\cos\phi}$

$\Rightarrow A = \sqrt{(4)^2 + (3)^2 + 2\times 4\times 3\cos\frac{\pi}{3}} = \sqrt{37} \approx 6$.

49. (b)

SBy using phase difference $\phi = \frac{2\pi}{\lambda}(\Delta)$

For path difference λ, phase difference $\phi_1 = 2\pi$ and for path difference $\lambda/4$, phase difference $\phi_2 = \pi/2$.

Also by using $I = 4I_0\cos^2\frac{\phi}{2} \Rightarrow \frac{I_1}{I_2} = \frac{\cos^2(\phi_1/2)}{\cos^2(\phi_2/2)}$

$\Rightarrow \frac{k}{I_2} = \frac{\cos^2(2\pi/2)}{\cos^2\left(\frac{\pi/2}{2}\right)} = \frac{1}{1/2} \Rightarrow I_2 = \frac{k}{2}$.

50. (c)

Since the circular frame is massless so we will consider moment of inertia of four masses only.

$I = ma^2 + 2ma^2 + 3ma^2 + 2ma^2 = 8ma^2$ .....(i)

Now from the definition of radius of gyration $I = 8mk^2$....(ii)

comparing (i) and (ii) radius of gyration $k = a$.

CHEMISTRY

1. (a)

25 mL of HCl solution requires 30 mL of 0.1 M Na_2CO_3 solution.

$\because N_1V_1 = N_2V_2$

$\therefore 25 \times N_1 = 30 \times 0.2 (0.1\ M\ Na_2CO_3 = 0.2\ N Na_2CO_3)$

$N_1 = \frac{6}{25} = 0.24\ N$

Now, HCl solution is titrated with NaOH solution.

$M_1V_1 = M_2V_2$; 0.24 N HCl = 0.24 M HCl

$\therefore V \times 0.24 \times 1 = 30 \times 0.2 \times 1 \Rightarrow V = 25$ mL

2. (a)

$2 \times$ mole of Urea $\equiv$ mole of NH_3 ... (1)

mole of NH_3 = mole of HCl ... (2)

$\therefore$mole of $HCl = 0.02$mole

3. (d)

KE = hν – hν$_0$

Given KE = 6.63×10^{-19}

ν = 3×10^{15} Hz

4. (b)

$\frac{\lambda_y}{\lambda_x} = \frac{m_xv_x}{m_yv_y} \Rightarrow \frac{\lambda_y}{1} = \frac{m_xv_x}{(0.25m_X)(0.75V_X)} = \frac{16}{3}$.

5. (b)

Resultant dipole moment of C – X dipoles in 1, 4 position is zero. The resultant of other two C – X dipoles in 3,5- position $= \sqrt{(1.5)^2 + (1.5)^2 + 2\times 1.5^2 \times \cos 120^o} = 1.5$ D

6. (b)

The conditions required for the formation of an ionic bond.

(i) Ionization enthalpy [M(g) $\rightarrow$ M^+(g) + e^-] of electropositive element must be low.

(ii) Negative value of electron gain enthalpy [X (g) + e^- $\rightarrow$ X^-(g)] of electronegative element should be high.

7. (a) Equimolar solutions show same colligative properties i.e. equal elevation in boiling point and equal depression in freezing point.

8. (b) $p = K_Hx$ higher the value of K_H at a given pressure lower is the solubility of the gas in the liquid.

9. (b) At sufficiently low temperature, the thermal energy is low and intermolecular forces bring the particles so close that they cling to one another and occupy fixed positions. The particle can still oscillate about their mean positions and the substance exists in solid state.

10. (a) For bcc, Z = 2

$d = \frac{Z \times M}{a^3 \times N_A}$

$d = \frac{2\times 50}{(300\times 10^{-10})^3 \times 6.023\times 10^{23}} = 6.2 g\,cm^{-3}$

11. (c)

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ i.e. $\frac{V_1}{300} = \frac{V_2}{500}$; $V_2 = \frac{5}{3}V = 1.66\ V$

Volume escaped $= 1.66\ V - V = 0.66\ V = 66\%$ of V

12. (b)

$P_2V_2 = n Z_2 RT_2$

$150 \times 200 = n \times 0.8 \times 0.082 \times 600$

or $n = \dfrac{150 \times 200}{0.8 \times 0.082 \times 600} = 762.2 \text{ mole} \equiv 24.39 \text{ kg}$

13. (b) $\dfrac{N_X}{N_Y} = \dfrac{t_{1/2}(X)}{t_{1/2}(Y)}, t_{1/2}(X) = \dfrac{4.9 \times 10^{-4}}{2 \times 10^{-6}} = 245$ days.

14. (d) Tritium $({}_1H^3)$ consist of 1 proton and 2 neutrons.

15. (d)

Using the equation,

$$\log \frac{(K_p)_{40^\circ C}}{(K_p)_{25^\circ C}} = \frac{\Delta H}{2.303 R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right),$$

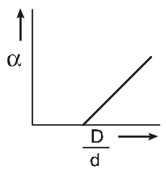
we get $\log 4 = \dfrac{\Delta H}{2.303 \times 8.314}\left(\dfrac{1}{273+25} - \dfrac{1}{273+40}\right)$

$\therefore \ \Delta H = 71.67 \, kJ \, mol^{-1}$

16. (b)

$\alpha = \left[\dfrac{D-d}{d}\right]$; $\alpha = \left[\dfrac{D}{d} - 1\right]$; $\left(\dfrac{D}{d}\right) = \alpha + 1.$

$\alpha = \dfrac{D-d}{(n-1)d}$; $\alpha = \dfrac{D-d}{d}$; $\alpha = \left(\dfrac{D}{d}\right) - 1.$



The point at which $\alpha = 0$.

17. (b)

$K_{sp} = [Zn^{2+}][S^{2-}]$

$[S^{2-}] = \dfrac{10^{-21}}{0.01} = 10^{-19}$

for $K_{a_1} . K_{a_2} = \dfrac{[H^+]^2[S^{2-}]}{[H_2S]}$

$10^{-20} = \dfrac{[H^+]^2 \times 10^{-19}}{0.1} \Rightarrow [H^+] = 0.1$

or pH = 1

18. (a)

100 ml of N/10 NaOH = 50 ml of N/5 HCl.They exactly neutralise 50 ml of N/5 HCl. Hence pH of resulting solution = 7.

19. (c)

$\Delta_r H_T = \Delta_r H^0 + \displaystyle\int_{298}^{1298} \Delta_r C_P \, dT$ At 1298 K $\quad \Delta_r H = -40$ kJ – 5

$\Delta T = -40$ kJ – 5 × 1000 × 10^{-3} kJ

= – 45 kJ/mol

20. (b)

Combustion reaction of solid boron

$B(s) + \dfrac{3}{4} O_2(g) \longrightarrow \dfrac{1}{2} B_2O_3(s)$

$\Delta H^\circ_r = \Delta H^\circ_c \dfrac{1}{2} = \Delta H^\circ_f (B_2O_3, s) - \Delta H^\circ_f (B, s) - \dfrac{3}{4} \Delta H^\circ_f (O_2, g)$

ΔH_f° of element in stable state of aggregation is assumed to be zero.

$\Delta H^\circ_C = \dfrac{1}{2} \ \Delta H^\circ_f (B_2O_3, s)$

21. (b)

$r = K[A]^m [B]^n$

$\dfrac{1}{4} = 2^n$

$n = -2$

22. (d)

Rate $1 = k[A]^n [B]^m$

On doubling the concentration of A and halving the concentration of B

Rat $2 = k[2A]^n [B/2]^m$

Ratio between new and earlier rate.

$$\frac{k[2A]^n [B/2]^m}{k[A]^n [B]^m} = 2^n \times \left(\frac{1}{2}\right)^m = 2^{n-m}$$

23. (c)

At cathode: $4H^+ + \underset{(4F)}{4e^-} \rightarrow \underset{2\,moles}{2H_2}$ or 2 ×22.4 litres at S.T.P.

At anode: $2O^{2-} \rightarrow \underset{1\,mole}{O_2} + \underset{(4F)}{4e^-}$ or 22.4 litres at S.T.P.

$\therefore$ Total volume of the two gases produced at S.T.P. $= 2 \times 22.4 + 22.4 = 67.2 \, litres$

24. (d)

In cell (A) : Cathode reaction : $Cu^{2+} + 2e \longrightarrow Cu$

Anode reaction: $H_2O \longrightarrow 2H^+ + \dfrac{1}{2} O_2 + 2e$

In cell (B) : Cathode reaction : $Cu^{2+} + 2e \longrightarrow Cu$

Anode reaction: $Cu \longrightarrow Cu^{2+} + 2e$

In cell (C) : Cathode reaction : $2H_2O + 2e \longrightarrow H_2 + 2OH^-$

Anode reaction: $2Cl^- \longrightarrow Cl_2 + 2e$

25. (c)

CH_4 is reducing agent.

26. (b)

He volume of N_2 at STP required to cover the iron surface with monolayer = 8.15 ml gm^{-1}

Area occupied by single molecule = 16×10^{-18} cm^2
22400 ml of N_2 at STP contains = N_A molecule of N_2

$\therefore$ 8.15 .... = $\dfrac{8.15 \times N_A}{22400} = 2.19 \times 10^{20}$ molecule of N_2 Area occupied by 2.19×10^{20} molecule of N_2 = $2.19 \times 10^{20} \times 16 \times 10^{-18}$ cm^2 = 35.06×10^2 cm^2

surface area of the iron adsorbed = 0.35 m^2 gm^{-1}
In short

$$A = \frac{\text{Volume covered by the } N_2 \text{ molecule} \times N_A \times \text{Area occupied by single molecule}}{22400}$$

27. (c)
0.03 = weight of Hb in mg × 10 / 100
weight of Hb in mg = 0.30.

28. (c)

Radius $\propto \dfrac{1}{+\text{ve O.N.}}$

29. (d)
On descending a group, the atoms and ions increase in size. On moving from left to right the size decreases. Thus on moving diagonally the size remains nearly the same. They also have nearly same IE & EN values.

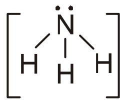
30. (b)
(Y) PbS reduces PbO to Pb ; it is called self-reduction.

31. (d)
(A) Cupellation is used when lead is present in traces.
(B) In argentiferous lead the silver is removed by Parke's process because silver has higher solubility in molten zinc than lead.
(C) Silver has higher solubility in molten zinc than lead and thus forms zinc-silver alloy from which zinc can be distilled off leaving behind the silver.
(d) Silver has higher solubility in molten zinc and thus forms zinc-silver alloy from which zinc can be distilled off leaving behind the silver.

32. (b) : In ice crystals, water molecules are linked through H - bonds in hollow hexagonal arrangement so, volume is large and density is less. In liquid state this hollow arrangement breaks into closer arrangement of molecules. Consequently, the density is increased in liquid state.

33. d
In basic medium, oxidising action of H_2O_2 $Mn^{2+} + H_2O_2 \rightarrow Mn^{44} + 2OH$
In basic medium, reducing action of H_2O_2 $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$
In acidic medium, oxidising action of H_2O_2 $PbS(s) + 4H_2O_2(aq) \rightarrow PbSO_4(s) + 4H_2O(\ell)$
Hence correct option (d)

34. (d)
Hydrogen can combine with other elements by losing, gaining and sharing of electrons
(i) Losing of electron: $H_2 + F_2 \longrightarrow 2H^+F^-$
(ii) Gaining of electrons: $2Na + H_2 \longrightarrow 2Na^+H^-$
(iii) Sharing of electrons: $N_2 + 3H_2 \xrightarrow[\text{500}^0\text{C Highpressure}]{\text{Fe+MO}}$



$$C + 2H_2 \xrightarrow{1200^0 C} CH_4$$

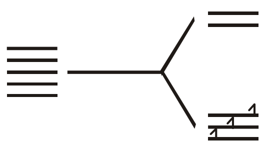
35. (a)
Setting of cement is an exothermic process, Hence cement structures have to be cooled during setting to develops interlocking needle like structure crystals of hydrate silicates.
$2CaO.SiO_2 + xH_2O \xrightarrow{\text{Hydration}} 2CaO.SiO_2.xH_2O$

36. (a)
This phenomenon is associated with the intervention of the 4f orbitals which must be filled before the 5d series of elements begin. The filling of 4f before 5d orbital results in a regular decrease in atomic radii called
Lanthanoid contraction. This is because of poor shielding of one of the 4 f-electrons by another in the sub-shell.

37. (a)
$6KMnO_4 + 10FeC_2O_4 + 24H_2SO_4 \longrightarrow 3K_2SO_4 + 6MnSO_4 + 5Fe_2(SO_4)_3 + 20CO_2 + 24H_2O$.

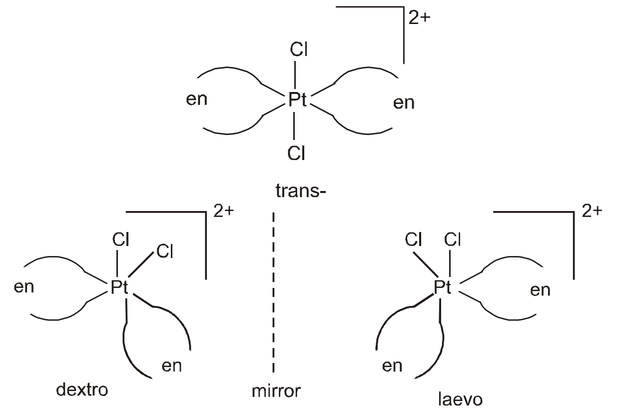
$\therefore \dfrac{3}{5}$ mole of $KMnO_4$ for one mole ferrous oxalate.

38. (c)
(A) Mo^{3+}, $4d^3$



$4d^3$ contains three unpaired electrons with strong field as well as with weak field ligand.
(B) It is inner orbital complex (d^2sp^3) and all six electrons are paired as $3d^6$ configuration has higher CFSE.

39. (c)



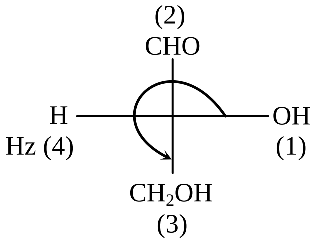
As trans isomer has symmetry elements it does not show optical isomerism.
(A), (C) and (D) are correct statements.

40. (d) $CrO_2Cl_2 \xrightarrow{NaOH} Na_2CrO_4 \xrightarrow[CH_3COOPb]{CH_3COOH}$

$[(CH_3COO)_2Pb] \xrightarrow{CrO_2Cl_2} \to \underset{\text{yellow ppt.}}{PbCrO_4}$

41. (b) Sr^{2+} give bright red colour to the flame

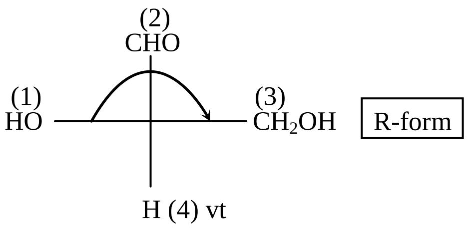
42. (c)



Anti clockwise

R-form

D-glyceroldehyde show R-configuration.
Compound **(c)** has R-configuration



43. (c)
$2(+2) + 2x + 7(-2) = 0$
$\therefore \quad x = +5$

44. (a)
Use reaction $C_{12}H_{22}O_{11} + 12O_2 \rightarrow 12CO_2 + 11H_2O$.

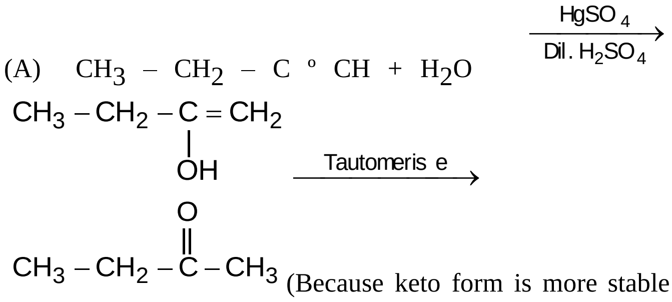
In 24 hr. moles of sucrose consumed $= \frac{34}{342} \times 24.$

$\therefore$ In 24 hr. moles of O_2 required

$= \frac{34}{342} \times 24 \times 12.$ (According to stoichiometry).

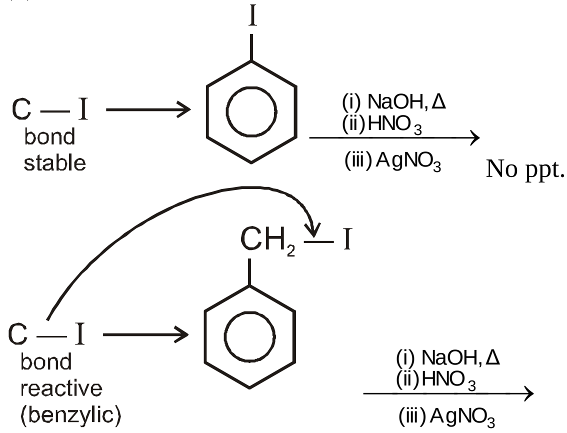
mass of O_2 required $= \frac{34}{342} \times 24 \times 12 \times 32 = 916.2\,\text{gm}.$

45. (a)



(Because keto form is more stable than enol)

46. (a)



47. (b)

By reaction with one mole of $CH_3-\overset{\overset{O}{||}}{C}-Cl$ with one $-NH_2$ group the molecular mass increases with 42 unit. Since the mass increases by (390 – 180) = 210 hence the number of $-NH_2$ groups is 5.

$$R-NH_2 + CH_3-\overset{\overset{O}{||}}{C}-Cl \xrightarrow[(-HCl)]{}$$

$$R-NH-\overset{\overset{O}{||}}{C}-CH_3$$

48. (c) $C_2H_5-\underset{\underset{O}{||}}{C}-CH_3 + I_2 + NaOH \rightarrow C_2H_5CO_2^-Na^+ + CHI_3$

$C_2H_5CO_2^-Na^+ \xrightarrow{H^+} C_2H_5COOH + Na^+$

49. (c)
pK_a values are
a = 7.4 c = 4.9 e = 6.8
b = 5.2 d = 0.79

50. (b)
In alkaline medium the zwitter ion will lose a proton & migrate towards anode due to net negative charge

BIOLOGY

1. (d)

2. (b)

3. (c)

4. (b)
5. (b)
6. (c)
7. (d)

8. (b)
9. (b)
10. (a)
11. (c)
12. (b)
13. (c)

14. (*b*) Uric acid is the least toxic among ammonia and urea, thus needs very little amount of water for its excretion from the body.
15. (*d*) The functioning of kidney is regulated by the following

l Hypothalamus by ADH or vasopressin hormone.
l JGA by renin-angiotensin mechanism.
l Heart by ANF (Atrial Natriuretic Factor).

16. (*c*) The neural and endocrine system together coordinate and work in synchronised fashion. The neural system sense stimulus through neurons and endocrine system provides chemical integration through hormones.

17. (d)
18. (*d*) The middle ear contains three ossicles namely malleus, incus and stapes. These are attached to one another in a chain-like fashion.

19. (a)
20. (c)
21. (a)
22. (b)
23. (a)
24. (c)
25. (c)
26. (d)
27. (b)
28. (b)
29. (a)
30. (b)
31. (a)

32. (c)

33. (b)

34. (d)

35. (d)
36. (a)
37. (c)
38. (c)
39. (c)
40. (c)
41. (a)
42. (a)
43. (a)
44. (b)
45. (c)
46. (b)

47. (a)
48. (d)
49. (c)
50. (*b*) In a normal ECG, P-wave represents atrial depolarisation, QRS complex-ventricular depolarization and T-wave signifies ventricular repolarisation. Therefore, atrial repolarisation is not represented in an electrocardiogram (ECG).
1. (d)
2. (a)
3. (a)

4. (d)

5. (c)

6. (d)

7. (c)
8. (d)
9. (c)

10. (c)
11. (a)

12. (a)
13. (d)

14. (d)

15. (b)
16. (c)
17. (d)
18. (b)

19. (a)

20. (b)

21. (c) The most preferred organ for tissue culture is shoot tip. The major advantages of shoot tip culture are that these can be freely exchanged being stable, easy to regenerate and virus free.

22. B

23. (a) Appropriate recombinant *E. coli* clones carrying genes for human insulin prepared by genetic engineering, can be used as factories for synthesis of insulin. On 5th July 1983, an American firm, *Eli Lilly*, *launched* first genetically engineered human insulin (humulin).

24. (a)
25. (c)
26. (d)
27. (a)
28. (b)
29. (c)
30. (b)
31. (d)

32. (a)

33. (b)
34. (d)

35. (b)

36. (c)
37. (b)
38. (d)

39. (a)

40. (c)

41. (c)

42. (c)

43. (a)
44. (b)
45. (a)
46. (d)

47. (d)
48. (a)
49. (d)
50. (c)