HINTS & SOLUTIONS
CHEMISTRY

1. Cinnabar is HgS

2. pH = 12

$\left[H^+\right]=10^{-12}\left(\because pH=-\log\left[H^+\right]\right)$

No. of moles of = $M\times V$

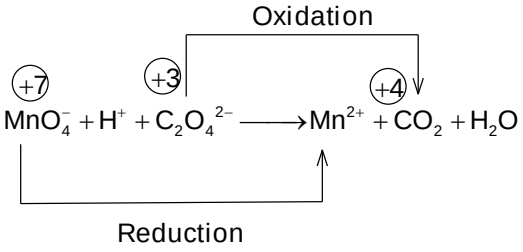
$= 10^{-12}\times10^{-3}=10^{-15}$

No. of H^+ ions = $10^{-15}\times6.022\times10^{23}$

$= 6.022\times10^{8}$

3. $Al_2(SO_4)_3+H_2O\longrightarrow \underset{\text{weak base}}{Al(OH)_3}+\underset{\text{Strong acid}}{H_2SO_4}$

So solution is acidic

4. 

Reduction

$\left[MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O\right]\times 2$

Oxidation

$\left[C_2O_4^{2-} \longrightarrow 2CO_2 + 2e^-\right]\times 5$

$2MnO_4^- + 16H^+ + 5C_2O_4^{2-} \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$

5. This process is based on difference in fusibility of the metal and impurities. When impurities are less fusible than metal, metal, liquation is used

7. BF_3 can accept a lone pair of electrons so it acts as a Lewis acid

10. $\underset{\text{Flux}}{CaCO_3}+\underset{\text{Gangue}}{SiO_2}\rightarrow \underset{\text{Slag}}{CaSiO_3}$

11. Reduction of metal oxide by carbon is known as smelting

12. $\underset{\text{molten}}{NaCl}\longrightarrow Na^+ + Cl^-$

At anode

$2Cl^{\ominus}\longrightarrow Cl_2 + 2e^{\ominus}$

At cathode

$Na^+ + e^- \longrightarrow \underset{\text{pure metal}}{Na}$

13. One of the objective of making alloy is to increase the resistance to corrosion

15. Duralumin (alloy of Al, Cu & traces of Mg and Mn) is used to make aircrafts pressure cooker

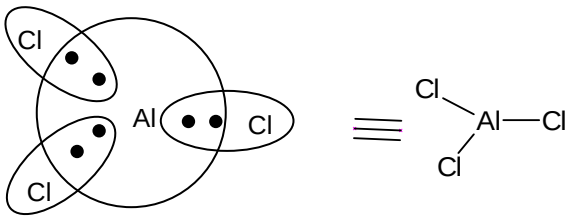
MATCH THE COLUMN
PART-B

1. (i) $Zn + \underset{\text{Steam}}{H_2O} \longrightarrow ZnO + H_2$

(ii) $Na_2O + H_2O \longrightarrow NaOH$

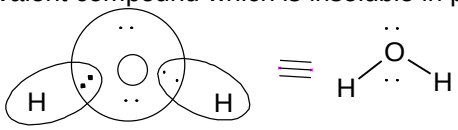
(iii) $F_2 + H_2O \longrightarrow HF + O_2$

(iv) $Cl_2 + Al \longrightarrow AlCl_3$



2. (i) CCl_4 is a covalent compound which is insoluble in polar solvent

(ii) $H_2O \Rightarrow$



(iii) $KCl + H_2O \longrightarrow K^+ + Cl^{\ominus}$

KCl conducts electricity in polar solvent due to formation of ions. It is a ionic compound, so has higher melting point.

(iv) Graphite is a covalent compound which has high melting point and it is insoluble in polar solvent.

MATHEMATICS

1. A

$\sec\theta+\tan\theta=2$

$\frac{1}{\cos\theta}+\frac{\sin\theta}{\cos\theta}=2$

$5\sin^2\theta+2\sin\theta-3=0$

$\sin\theta=-1,\frac{3}{5}$

2. A

$\tan2\theta=\frac{2\tan\theta}{1-\tan^2\theta}$

Let $\theta=\frac{45}{2},2\theta=45$

$\tan\theta=\frac{-2\pm\sqrt{2^2-4(1)(-1)}}{2(1)}=\sqrt{2}-1$

3. B

Apply basic proportionality theorem

Apply Pythagoras theorem to find AC.

Then apply basic proportionality theorem, i.e.,

CE/EB = CD/DA

4. C

Triangle PDR, QDP and QPR are similar.

Triangles AED and EFB are similar.

5. A

$\log a+\log b-\log c=\log\left(\frac{ab}{c}\right)$

and $\log1=0.$

6. D

Adding 1 on both sides

and the 1 on the left side is expressed as $\log_{x+y}(x+y)$.

7. A

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

$\sin\theta$ is positive in 1st and 2nd quadrant only

$\sin\theta=\frac{\pi}{6},\frac{5\pi}{6},\frac{13\pi}{6},17\frac{\pi}{6}.$

8. D

$\frac{AB}{AC}=\frac{BD}{DC}$

$\frac{8}{7}=\frac{8x}{7x}$

$8x+7x=10$

$15x=10$

$x=\frac{2}{3}$

$BD=\frac{16}{3},DC=\frac{14}{3}$

$\frac{AI}{ID}=\frac{AC}{CD}=\frac{21}{14}=\frac{3}{2}$

9. A

$(1-2)(1+2)+(3-4)(3+4)+.....(49-50)(49+50)+51^2$

$=-1[1+2.....+50]+51^2$

$=\frac{-50\times51}{2}+51^2$

$= 51 \times 25$

10 A

$\cot\alpha = \frac{x}{h}$

$\cot\beta = \frac{p+x}{h}$

$\cot\beta = \frac{p}{h} + \cot\alpha$

$\frac{1}{\tan\beta} - \frac{1}{\tan\alpha} = \frac{p}{h}$

$h = \frac{p\tan\alpha\tan\beta}{\tan\alpha - \tan\beta}$

11 B

$\sqrt{3} = \frac{h}{x}$

$\frac{1}{\sqrt{3}} = \frac{h}{x+150}$

$\frac{h}{\sqrt{3}} = h\sqrt{3} - 150$

$150\sqrt{3} = 2h \Rightarrow h = 75\sqrt{3} = 129.9 \approx 130$

12 D

$h = 125\sqrt{3}$

$\sin 30^\circ = \frac{ht}{hyp}$

$\frac{1}{2} = \frac{75\sqrt{3}}{hyp} \Rightarrow hyp = 150\sqrt{3}$

13. A

$\frac{6}{x} = \frac{4}{3} \Rightarrow x = 4.5$

14. B

$\frac{10}{14} = \frac{BD}{DC}$

$\frac{10}{14} = \frac{x}{6-x} \Rightarrow x = 2.5$

$BD = 2.5,\ BC = 3.5$

15. D

$\frac{10}{6} = \frac{12+x}{x} \Rightarrow x = 18$

PART-B

1. $A \rightarrow Q;\ B \rightarrow R;\ C \rightarrow P;\ D \rightarrow S$
2. $A \rightarrow S;\ B \rightarrow P;\ C \rightarrow R;\ D \rightarrow Q$

PHYSICS

1. C P100307

$q.V.B = mg\cos\theta$

$q(0 + g\sin\theta.t).B = mg\cos\theta$

$\therefore t = \dfrac{m\cot\theta}{qB}$

2. D P100307

From energy conservation

From P + 0 Q

$V = \sqrt{2gR\sin\theta}$

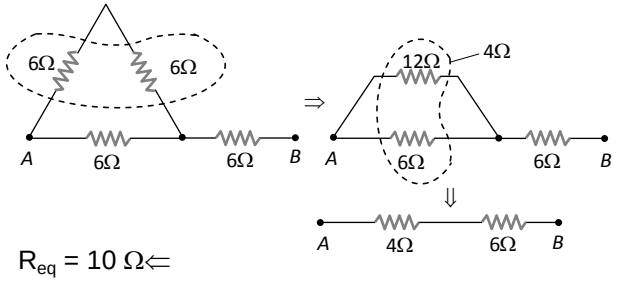
Force, equation into radial direction

$N + qvB - mg\sin\theta = \dfrac{mv^2}{R}$

$N = \left[3mg\sin\theta - qB\sqrt{2gR}\right]$

3. B P100208

Given resistance of each part will be



R_{eq} = 10 Ω⇐

4. D P100210

Current in the bulb $= \dfrac{P}{V} = \dfrac{4.5}{1.5} = 3A$

Current in 1 Ω resistance $= \dfrac{1.5}{1} = 1.5A$

Hence total current from the cell $i = 3 + 1.5 = 4.5A$

By using $E = V + ir \Rightarrow E = 1.5 + 4.5 \times (2.67) = 13.5V$

5. B P101606

Resistance of *CDarm* = 2*r* cos 72° = 0.62*r*

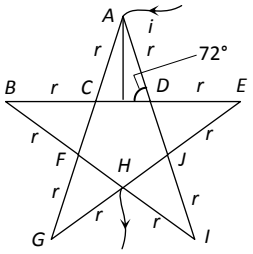
Resistance of CBFC branch

$\dfrac{1}{R} = \dfrac{1}{2r} + \dfrac{1}{0.62r} = \dfrac{1}{r}\left(\dfrac{2.62}{2 \times 0.62}\right)$

$\dfrac{1}{R} = \dfrac{2.62}{1.24r} \therefore R = \dfrac{1.24r}{2.62}$

Equivalent $R' = 2R + r = 2 \times \dfrac{1.24r}{2.62} + r$

$= r\left(\dfrac{2.48}{2.62} + 1\right) = 1.946r$



Because the star circuit is symmetrical about the line *AH*

∴ Equivalent resistance between *A* and *H*

$\dfrac{1}{R_{eq}} = \dfrac{1}{R'} + \dfrac{1}{R'} \Rightarrow R_{eq} = \dfrac{R'}{2} = \dfrac{1.946}{2} r = 0.973r$

6. B P100308

As *x* increases so $\dfrac{dB}{dt}$ increases *i.e.* induced emf (*e*) is negative. When loop completely entered in the magnetic field, emf = 0

When it exit out *x* increases but $\dfrac{dB}{dt}$ decreases *i.e.e* is positive.

7. B P100307

$r = \dfrac{mv}{qB} \Rightarrow r \propto P$

Particle excutes circular motion so direction of velocity changes so momentum is not constant.

8. A P100206

Here, $E = 2V,\ 1 = \frac{2}{2} = 1A$ and $r = 1\Omega$

Therefore, $V = E - ir = 2 - 1 \times 1 = 1V$

9. C P101708

Presence of magnetic flux cannot produce current.

10. B P100307

11. C P100307

12. C P100307

Sol. 10 & 11

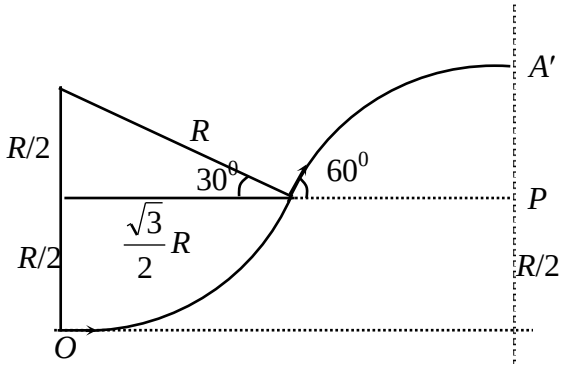
In magnetic field

$R = \frac{mv}{qB} = 1m$

$T = \frac{2\pi m}{qB} = 0.2\ \pi$

In electric field

Acceleration $a = \frac{qE}{m} = 10\ m/s^2$



Now, $PA' =$ maximum height $= \frac{v^2 \sin^2\theta}{2a} = 3.75m$

$\therefore$ y-co-ordinate of A' is 4.25 m

$T' =$ time elapsed in $\vec{E}$ is half the time of flight $= \frac{v\sin\theta}{a} = \frac{\sqrt{3}}{2}$

$\therefore$ time $t = \frac{T}{6} + T' = 0.97$ sec

12. Here the proton has no acceleration so $E = B = 0$.

When $E = 0$ but $B \neq 0$, but parallel to the motion of proton, there will be no force acting.

When $E \neq 0$ and $B \neq 0$ and *E, B* and motion of proton (v) are mutually perpendicular, there may be no net force. Forces due to *E* and *B* cancel each other.

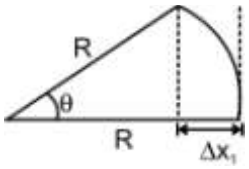
13. C P100307

$F = q(v \times B)$ or $|F| = qvB\sin\theta$

F will be maximum. when $\theta = 90^o$

14. D P100307

$R = \frac{mv}{qB} = 50cm$



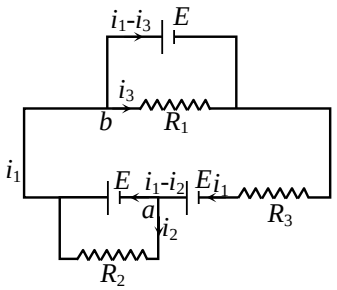
$\sin\theta = \frac{30}{50} \Rightarrow \theta = 370$

$\Delta x_1 = R(1 - \cos\theta) = 0.1\,m$

15. D P100307

1. (A) – P; (B) – Q; (C) – S; (D) – R P100206

On solving by KVL we get, $i_1 = \frac{E}{R}, i_2 = -\frac{E}{R}$



$i_3 = \frac{E}{R}$

$\Rightarrow \; i_1 - i_2 = \frac{2E}{R}$ and $i_1 - i_3 = 0$

So reading of ammeter A_1 is E/R = 4/3

A_2 is $2E/R$ = 8/3, A_3 is zero and ΔV_{ab} = 4V

2. (A)-R, (B) - P, (C) - S, (D) – Q P100307

(A) Initially an electric force acts on particle and after entering in magnetic field, a magnetic force acts on particle. So correct option is (R)

(B) Electric and magnetic force acts on particle at 90º to each other so motion of particle is parabola.

(C) Magnetic and electric force act perpendicular to velocity of particle, so motion is parabolic

(D) Motion of particle is helical.