HINTS & SOLUTONS
CHEMISTRY

1. In diamond, one carbon atom is attached to four carbon atoms tetrahedrally

2. $NaCO_3$ is strong base than $NaHCO_3$. NaCl is natural salt, while HCl is an acid.

3. HCl is stronger acid than oxalic acid $(H_2C_2O_4)$ since oxalic acid is an organic acid. So HCl will donate H^+ ion, while $H_2C_2O_4$ will accept H^+ ion and so conjugate acid of $H_2C_2O_4$ is $H_3C_2O_4^+$

4. Marble consists of $CaCO_3$. Gypsum is $CaSO_4 . 2H_2O$

5. The reaction in which same element from same molecule will oxidised as well as reduced is called disproportionation. P_4 oxidised to NaH_2PO_2 and P_4 reduced to PH_3

6. Lithium has lowest density in alkali metal group.

7. K_2CO_3 is soluble in H_2O and K_2CO_3 is thermally stable compound.

8. Alkali and alkaline earth metals are highly reactive, they react with carbon to form carbide i.e. they reduce carbon.

9. Ag and Au forms solution complex with NaCN, while impurities do not.

Q. No. 10-12

$$\underset{A}{CaCO_3} \xrightarrow{\Delta} \underset{B}{CaO} + CO_2$$

$$CaO + H_2O \longrightarrow Ca(OH)_2$$

$$Ca(OH)_2 + 2NH_4Cl \longrightarrow CaCl_2 + 2\underset{D}{NH_3} + 2H_2O$$

$$NH_3 + H_2O \longrightarrow \underset{E}{NH_4OH}$$

$$NH_4OH + CO_2 \longrightarrow \underset{F}{NH_4HCO_3}$$

$$NH_4HCO_3 + NaCl \longrightarrow \underset{G}{NaHCO_3} \xrightarrow{\Delta} Na_2CO_3 + CO_2 + H_2O$$

13. Anodising produces protective layer of Al_2O_3 on surface of aluminium to protect it from corrosion

14. Metal oxide with why high melting point are reduced by thermite process.

15. Thermite mixture contains $\rightarrow$ Fe_2O_3 + Al

1. Fact
2. Fact

MATHEMATICS

1. A

Sol. $\frac{a}{b} = \frac{\log_{10} 25}{\log_{10} 36} = \log_{36} 25$

$\Rightarrow \frac{a}{b} = \log_6 5$

$\Rightarrow \frac{b}{a} = \log_5 6$

$\Rightarrow 6^{a/b} = 6^{\log_6 5}$ $\qquad 5^{b/a} = 5^{\log_5 6}$

$\Rightarrow 6^{a/b} = 5$

$\Rightarrow 6^{a/b} + 5^{b/a} = 5 + 6 = 11$

2. (C)

$f(x) = 150\,(6x^2 + x - 1)\,(x - 3)^3 = 2 \times 3 \times 5^2\,(2x + 1)\,(3x - 1)\,(x - 3)^3$.

$9(x) = 84(x - 3)^2\,(8x^2 + 6x + 1) = 22 \times 3 \times 7\,(x - 3)^2(2x + 1)\,(4x + 1)$.

HCF = $2 \times 3\,(2x + 1)\,(x - 3)^2$.

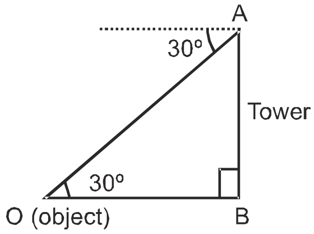
$\therefore$ exponent of $(2x + 1)$ is 1.

3. (C)

Hint : $\tan 30^\circ = \frac{AB}{OB}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{75\text{m}}{OB}$

$\Rightarrow OB = 75\sqrt{3}\,\text{m}$



4. (D)

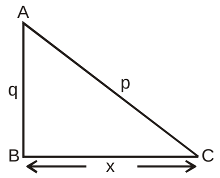
Sol.

$x^2 = p^2 - q^2$

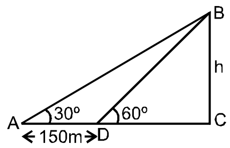
$= (p - q)\,(p + q)$

$x = \sqrt{p + q}$

$= \sqrt{2q + 1}$



5. (D)



Sol. In ΔACB, $\quad \tan 30^\circ = \frac{h}{150 + CD}$

In ΔDCB, $\quad \tan 60^\circ = \frac{h}{CD}$

$\Rightarrow \quad CD = \frac{h}{\sqrt{3}}$

i.e. $\quad \frac{1}{\sqrt{3}} = \frac{h}{150 + \frac{h}{\sqrt{3}}}$

$\sqrt{3}h = 150 + \frac{h}{\sqrt{3}} \Rightarrow h = 75\sqrt{3}\,\text{m}$

6. (C)

Sol. $\sqrt{3}\,\text{cosec}20 - \text{Sec}20$

$\Rightarrow \tan 60\ \text{cosec}20 - \sec 20$

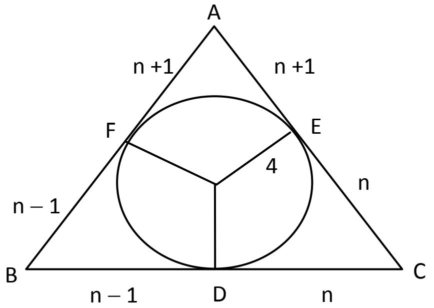
$= \frac{\sin(60 - 20)}{\frac{1}{4}{}^\circ 2\sin 20\cos 20} = \frac{4\sin 40}{\sin 40} = 4$

7. (D)

8. (D)

9. (A)

10. Area of a triangle = r × s



$\sqrt{s(s-a)(s-b)(s-c)}$ = 4 × 3n

Solving we get n = 7

Sides are BC = 13, AC = 15, AB = 14.

11. $\angle DFE = \frac{\angle A + \angle B}{2} = \frac{\pi - \angle C}{2}$

Similarly $\angle DEF = \frac{\pi - \angle B}{2}$

$\angle EDF = \left(\frac{\pi - \angle A}{2}\right)$

12. $\cot\left(\frac{A}{2}\right) = \frac{8}{4}$

$\cot\left(\frac{B}{2}\right) = \frac{6}{4}$

$\cot\left(\frac{C}{2}\right) = \frac{7}{4}$

13. (A)

Sol. In ΔABC, AD is the bisector of C is

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

$\Rightarrow \frac{4}{3} = \frac{6}{AC}$

AC = 4.5

14. (B)

Sol. Let BD = x cm, then DC = (6 – x) can since AD is the bisector of < n

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

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

x = 2.5

15. (D)

Sol. AE is the bisector of $\angle CAD$

$\frac{AB}{AC} = \frac{BE}{CE} = \frac{10}{6} = \frac{12+x}{x}$

10x = 72 + 6x $\Rightarrow$ x = 18

PART-B

1. A– q; B–p,s; C–p ; D–p,r

(A) $2^{\log_{2\sqrt{2}} 15} = 2^{\frac{2}{3}\log_2 15} = (15)^{\frac{2}{3}} =$ irrational

(B) $\sqrt[3]{5^{\frac{1}{\log_7 5}}+\frac{1}{\sqrt{-\log_{10} 0.1}}}=\sqrt[3]{8}=2=$ rational & prime

(C) $\frac{\log 5}{\log 3}\times\frac{3\log 3}{2\log 5}=\frac{3}{2}=\text{rational}$

(D) $(\log_{10} x)^2=2+\log_{10} x$

Let $\log_{10}x = t$

$\Rightarrow t^2-t-2=0 \Rightarrow t = 2$ or $t = -1$

$\therefore$ x = 100 or x = $\frac{1}{10}$

$\therefore$ Product of roots = 10.

2. A-S ; B-P ; C-Q ; D-R

Sol. (A) $\text{cosec}2\theta + \cot 2\theta \cos 2\theta = \frac{1+\cos^2 2\theta}{\sin 2\theta}=\frac{2-\sin^2 2\theta}{\sin 2\theta}=\frac{2-K^2}{K}$

(B) $\left(\frac{1+\tan\theta}{1-\tan\theta}\right)^2=\frac{1+\sin 2\theta}{1-\sin 2\theta}=\frac{1+k}{1-k}$

(C) $\sin 2\theta-\frac{1}{2}(1+\cos 4\theta)=\sin 2\theta-\cos^2 2\theta=k^2+k-1$

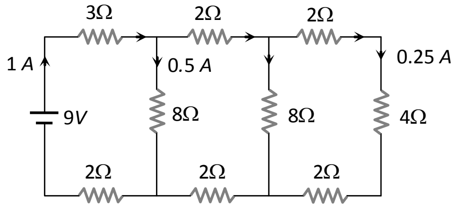
(D) $\sin 6\theta = 3\sin 2\theta - 4\sin^3 2\theta = 3k - 4k^3$

PHYSICS

1. D

Equivalent resistance of the circuit $R = 9\Omega$

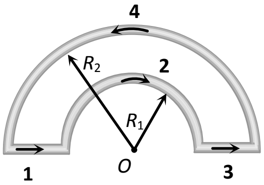
$\therefore$ Main current $i = \frac{V}{R} = \frac{9}{9} = 1A$



After proper distribution, the current through 4Ω resistance is 0.25 *A*.

2. A

In the following figure, magnetic fields at *O* due to sections 1, 2, 3 and 4 are considered as B_1, B_2, B_3 and B_4 respectively.



$B_1 = B_3 = 0$

$B_2 = \frac{\mu_0}{4\pi}.\frac{\pi i}{R_1} \otimes$

$B_4 = \frac{\mu_0}{4\pi}.\frac{\pi i}{R_2} \odot$ As $| B_2 | > | B_4 |$

So $B_{net} = B_2 - B_4 \Rightarrow B_{net} = \frac{\mu_0 i}{4}\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \otimes$

3. B

$r = \frac{mv}{qB} \Rightarrow r \propto mv$ (*q* and *B* are constant)

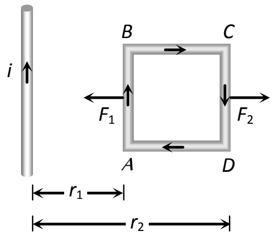
$\because r_A > r_B \Rightarrow m_A v_A > m_B v_B$

4. C

$\because r_1 < r_2$

So $F_1 > F_2$

$\Rightarrow F_{net} = (F_1 - F_2)$ towards the wire.



5. D

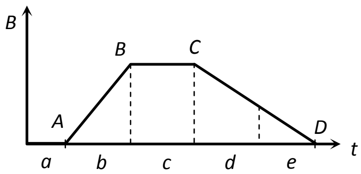
When loop enters in field between the pole pieces, flux linked with the coil first increases (constantly) so a constant emf induces, when coil entered completely within the field, no flux change so $e = 0$.

When coil exit out, flux linked with the coil decreases, hence again emf induces, but in opposite direction.

6. B

Induced emf $e = A\frac{dB}{dt}$

i.e. $e \propto \frac{dB}{dt}$ (= slope of $B - t$ graph)



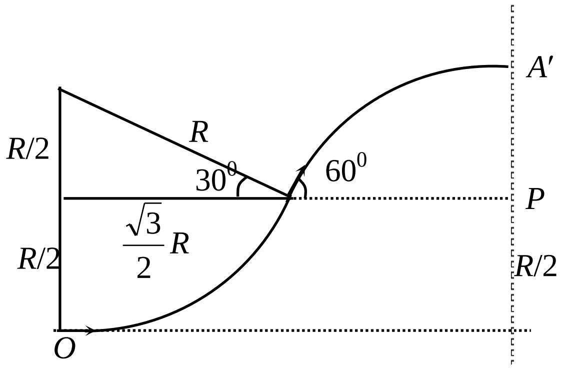
In the given graph slope of *AB* > slope of *CD*, slope in the *'a'* region = slope in the *'c'* region = 0, slope in the *'d'* region = slope in the *'e'* region $\neq 0$. That's why $b > (d = e) > (a = c)$

7. A

As filament of bulb and line wire are in series, hence current through both is same. Now, because $H = \frac{i^2 Rt}{4.2}$ and resistance of the filament of the bulb is much higher than that of line wires, hence heat produced in the filament is much higher than that in line wires.

8. A
The force on a charged particle moving in a uniform magnetic field always acts in direction perpendicular to the direction of motion of the charge. As work done by magnetic field on the charge is zero, [$W = FS\cos\theta$], so the energy of the charged particle does not change.
9. D
When switch *S* is closed, bul*b C* is short circuited, so voltage *V* distributes only in two parts *i.e.* voltage on Bulb *A* and *B* increases as compared previously. Hence illumination of Bulb *A* and *B* increases.
10. B
11. C
12. C

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

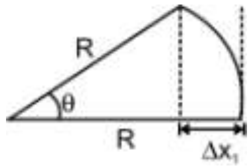
Now, $PA' =$ maximum height $= \frac{v^2 \sin^2\theta}{2a} = 3.75m$

$\therefore$ 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
$F = q(v \times B)$ or $|F| = qvB\sin\theta$
F will be maximum. when $\theta = 90^o$
14. D
$R = \frac{mv}{qB} = 50cm$



$\sin\theta = \frac{30}{50} \Rightarrow \theta = 370$
$\Delta x_1 = R(1-\cos\theta) = 0.1\,m$
15. D
1. A–R; B–P; C–S; D – Q
(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.
2. A–P; B–S; C-P; D–Q
$P = \frac{v^2}{R} \Rightarrow R_4 < R_3 = R_1 < R_2$