SAIVEERA ACADEMY – REVOLUTION FOR LEARNING
COIMBATORE - 8098850809
FIRST MID TERM MODEL TEST

Std : 12th **Time :** 2 hrs
Subject : Chemistry   **Marks** : 70

Part – A

Answer all the questions   **15 × 1 =15**

1.Identify the ore which is not ore of copper
a)Cuprite   b)Azurite   c) Cerrusite   d)Malachite

2.Extraction of silver by leaching with sodium cyanide is ……… reaction
a)Oxidation   b)Redox   c)Reduction   d)None of these

3.Find the metal which cannot be reduced by carbon
a)zinc   b)aluminium   c)Manganese   d)Chromium

4. Which one of the following ores is best concentrated by froth – floatation method?
a) Magnetite   b) limonite   c) Cassiterite   d)sphalerite

5. Which of the following is sp^2 hybridised?
a) Silicones   b) graphene   c) diamond   d) dry ice

6. The element that does not show catenation among the following p-block elements is
a) Tellurium   b)Thallium   c) selenium   d) germanium

7. The geometry at which carbon atom in graphite are bonded to each other is
a) Tetrahedral   b) hexagonal   c) Octahedral   d) none of these

8. Which of the following statements is correct?
a) Beryl is a chain silicate
b) Mg_2SiO_4 is an pyrosilicate
c) Feldspar is not aluminosilicate
d)Spodumene is chain silicates

9.The general electronic configuration of Pnictogens
a)ns^{2}np^6 b)ns^{2}np^5 c)ns^{2}np^4 d)ns^{2}np^3

10. The radius of an atom is 200pm, if it crystallizes in a face centered cubic lattice, the length of the edge of the unit cell is
a) 565.6pm   b) 848.5pm   c) 884.5pm   d) 484.5pm

11. The ratio of close packed atoms to tetrahedral hole in cubic packing is
a) 1:1   b) 1:2   c) 2:1   d) 1:4

12. The vacant space in sc lattice unit cell is
a) 48%   b) 23%   c) 32%   d) 26%

13. The crystal with a metal excess defect is
a) NaCl   b) FeO   c) AgBr   d) FeS

14. The rate constant of a reaction is 5.8×10^{-18} mol lit^{-1}s^{-1}. The order of the reaction is
a) First order   b) zero order   c) Second order   d) Third order

15. If 93.75% of a first order reaction was completed in 60 minutes , 50% of the same reaction under the same conditions would be completed in
a) 20 minutes   b) 30 minutes   c) 35 minutes   d) 15 minutes

Part- B

6 × 2 =12

Answer six questions . Question No.24 is compulsory .
Answer any five from remaining

16. Give the basic requirement for vapour phase refining.
17. Give the limitations of Ellingham diagram.
18. Why AlCl$_3$ behaves like a lewis acid.
19. How will you identify borate radical?
20. Describe briefly allotropism in p- block elements with specific reference to carbon.
21. An atom crystallizes in bcc crystal lattice and has a density of 10 gcm^{-3} with a radius of atom is 43.3 pm. calculate the number of atoms present in 1 g of crystal.
22. Give any two characteristics of ionic crystals
23. How do nature of the reactant influence rate of reaction with an example
24.Find the activation energy for the reaction $2HI \rightarrow H_2 + I_2$ at 400 K when the fraction of effective collision is 4×10^{-18} **(log 4 = 0.602 , 8.314 × 400 = 3325.6)** Calculate the fraction of effective collision of reactants .

Part- C

6 × 3 =18

Answer six questions . Question No.32 is compulsory .
Answer any five from remaining

25. What are the various steps involved in extraction of pure metals from their ores? & Give the uses of zinc.
26. Describe the role of the following in the process mentioned.
(i) Silica in the extraction of copper. (ii) Cryolite in the extraction of aluminium.
(iii) Iodine in the refining of Zirconium. (iv) Sodium cyanide in froth floatation.
27. (A) Predict the conditions under which (i) Aluminium might be expected to reduce magnesia. (ii) Magnesium could reduce alumina. (B).It is possible to reduce Fe$_2$O$_3$ by coke at a temperature around 1200K
28. What is catenation ?.How does carbon satisfy the conditions necessary for catenation.

29. Write a short note on hydroboration & Write a note on Fisher Tropsch synthesis.

30. Distinguish between hexagonal close packing and cubic close packing

31. Give the differences between order and molecularity of a reaction.

32. **KF crystallizes in fcc structure like sodium chloride with unit cell edge length of 538pm. calculate the density of the crystal**

33. Hydrolysis of methyl acetate in aqueous solution has been studied by titrating the liberated acetic acid against sodium hydroxide. The concentration of an ester at different temperatures is given below.Prove that it follows first order kinetics .

t (min)	0	20	40	α
V (mL)	20.2	25.6	29.5	50.4

Part – D

 Answer all five questions $5 \times 5 = 25$

34.(a) Explain zone refining process with an example

<div align="center">Or</div>

   (b). Explain the principle of electrolytic refining with an example.

35.(a). Explain the electrometallurgy of aluminium

<div align="center">Or</div>

    (b). Write a short note on electrochemical principles of metallurgy.

36.(a) Describe the structure of diborane.

<div align="center">Or</div>

   (b).**Complete the following reactions & balance it**

(i) $2B + ? \rightarrow Na_3BO_3 + H_2O$ (ii) $Na_2B_4O_7 + H_2SO_4 + ? \rightarrow Na_2SO_4 + 4H_3BO_3$

(iii)) $BF_3 + H_2O \rightarrow ?$ (iv) $BF_3 + NaH \xrightarrow{450K} ?$ (v) $B + NaOH \rightarrow ?$

37.(a). Calculate the percentage efficiency of packing in case of body centered cubic crystal & Write any two difference between crystalline solids and amorphous solids

<div align="center">Or</div>

   (b).Explain AAAA and ABABA and ABCABC type of three dimensional packing with the help of neat diagram.

38.(a). Describe the graphical representation of first order reaction & Explain the rate determining step with an example.

<div align="center">Or</div>

    (b). The selection of reducing agent depends on the thermodynamic factor: Explain with an example.& What is the difference between minerals and ores?

Practice isn't the thing
you do once you're good .
It's the thing you do that
makes you do that makes you good

SAIVEERA ACADEMY 8098850809 12TH CHEMISTRY FIRST MID TERM KEY

Part – A

1.c)Cerrusite
2.b)redox reaction
3.b)Aluminium
4.d)Sphalerite(Zinc blende – ZnS)
5.b)Graphene – sp^2
6.b0Thallium
7.b)hexagonal
8.d)Spodumene is chain silicate
9.d)ns^2np^3
10. a)565.6 pm
$a = 2\sqrt{2}$ r
$\quad = 2 \times 1.414 \times 200$
$\quad = 565.6$
11.b)1:2
12.48% (packing efficiency is 52.31%)
13.a)NaCl
14.b)Zero order
Rate constant for zero order is
mol lit^{-1}s^{-1}
15.d) minutes
at the end of $4t_{1/2}$ = 93.75 % decomposes
$4t_{1/2}$ = 60 minutes
$t_{1/2}$ = 15 minutes

Part – B

16.Metal should form volatile compound with reagent
    volatile compound decomposes to pure metal
17. does not tell anything about the rate of the reaction
does not give any idea about the possibility of other reactions that might be taking place
The interpretation of ΔG is based on the assumption that the reactants are in equilibrium with the product which is not always true.

18. forms addition compounds with ammonia, phosphine and carbonyl chloride etc... Eg. $AlCl_3.6NH_3$
$AlCl_3 + NH_3 \quad \rightarrow \quad [Al(NH_3)Cl_3]$
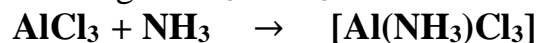
19.When boric acid or borate salt is heated with ethyl alcohol in presence of conc. sulphuric acid, an ester, trialkylborate is formed. The vapour of this ester burns with a green edged flame and this reaction is used to identify the presence of borate.

$4H_3BO_3 + 3 C_2H_5OH \xrightarrow{CONC\ H2SO4}$
$B(OC_2H_5)_3 + 3 H_2O$
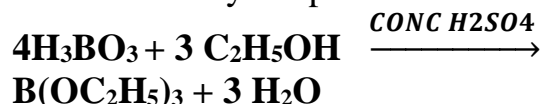
20. Some elements exist in more than one crystalline or molecular forms in the same physical state
Allotropes of carbon ;Diamond , graphite , fullerene , carbon nanotubes

21.ρ = 10 gcm^{-3} r = 43.3pm Number of atoms
ρ = 10 gcm^{-3} a = 100 pm Mass = 1 g
No of atoms in bcc unit cell = 2
$a = \frac{4}{\sqrt{3}}$ r $= \frac{4}{\sqrt{3}} \times 43.3$pm
 = 100 pm
Volume of unit cell a^3 = (100 x 10 $^{-10}$ cm)^3
= 10^{-24} gcm^{-3}
Number of atoms in 1g of crystal =
$\frac{Z \times M}{\rho a^3} = \frac{4 \times 1}{10^{-23}} = 4 \times 10^{23}$

22.Ionic solids have high melting points. In solids state it acts as insulators & they conduct electricity when dissolved in water.
They are hard & brittle.
23. The physical state of the reactant also plays an important role to influence the rate of reactions. Gas phase reactions are faster as compared to the reactions involving solid or liquid reactants
For example, reaction of sodium metal with iodine vapours is faster than the reaction between solid sodium and solid iodine.

24. $f = e^{\frac{-E_a}{RT}}$

Taking log on both sides

$\log f = -\frac{-E_a}{RT}$

$f = 4 \times 10^{-18}$

$\log(4 \times 10^{-18}) = -\frac{-E_a}{2.304 \times 400K}$

$-17.39 = -\frac{E_a}{2.303 \times 8.314 \times 400K}$

$17.39 \times 2.303 \times 400K \times 8.314 = E_a$

$E_a = \mathbf{137.32 \ kJ \ mol^{-1}}$

Part – C

25. (i) concentration of the ore
(ii) extraction of crude metal
(iii) refining of crude metal

Uses of zinc

Manufacture of paints, rubber, cosmetics
used in **galvanising** metals such as iron
and steel structures
produce die-castings in the automobile,
electrical and hardware industries

26.(i) Silica -remove slag during roasting
  (ii) Cryolite - Lowers melting point to
1173 K
  (iii)Iodine – To form volatile compound
which on heating decomposes to give zinc
  (iv)Sodium cyanide – selectively
prevent other metal sulphides from coming
to froth

27.A. (i).Above 1350^0C the standard Gibbs
free energy for formation of Al_2O_3 From
Al is less than that of MgO from Mg
.Therefore above 1350^0C Al can reduce
MgO
  (ii).Below 1350^0C only MgO can
reduce alumina
B. Ellingham diagram shows that at
1000k , the curves intersect .The
temperature above 1000K   C → CO line
below the Fe → Fe_2O_3 .

Around 1200K , Coke can reduce Fe_2O_3 .

28. Catenation is an ability of an element
to form chain of atoms
(i) the valency of carbon is 4 which is
greater than two,
(ii) carbon forms covalent bond with
themselves should have an ability to bond
with itself
(iii) Since C-C bond is strong due to
covalent bond

29. on Fisher tropsch synthesis.

    The reaction of carbon monoxide
with hydrogen at a pressure of less than 50
atm using metal catalysts at **500 - 700 K**
yields saturated and unsaturated
hydrocarbons
$nCO + (2n+1) H_2 \rightarrow C_nH_{(2n+2)} + nH_2O$
$nCO + 2n H_2 \rightarrow C_nH_{2n} + nH_2O$
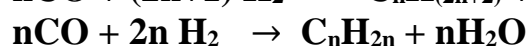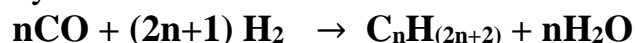
Diborane adds on to alkenes and alkynes in
ether solvent at room temperature. This
reaction is called hydroboration and is
highly used in synthetic organic chemistry,
especially for anti Markovnikov addition.
$B_2H_6 + 3RCH_2=CH_2R \rightarrow 2B(CH_2-CH_2R)_3 + 6H_2$
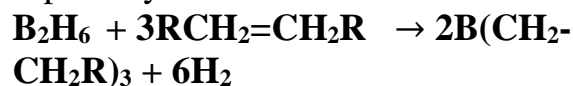
32. In fcc n = 4   a = 538pm to find ρ
 $\rho = \frac{nM}{a^3 N_A}$

$a^3 = 538$ pm $= 1.57 \times 10^{-22}$ cm^3
$\rho = \frac{4 \times 58.8}{1.57 \times 10^{-22} \times 6.023 \times 10^{23}}$
  $= \mathbf{2.48 \ g \ cm^{-3}}$

33. k $= \frac{2.303}{t} \log \left(\frac{V_\alpha - V_0}{V_\alpha - V_t}\right)$

$V_\alpha - V_0 = 50.4 - 20.2 = 30.2$
t = 20 mins   V$_t$ = 20.2
k $= \frac{2.303}{20} \log \left(\frac{30.2}{50.4 - 25.6}\right)$
  $= 0.1151 \times 0.086$
  $= \mathbf{9.8 \times 10^{-3} \ min^{-1}}$

t = 40   V$_t$ = 29.5

$k = \frac{2.303}{40} \log \left(\frac{30.2}{50.4 - 29.5}\right)$

$= 0.0576 \times 0.1598$

$= \mathbf{9.20 \times 10^{-3} \ min^{-1}}$

k is found to be constant , so reaction is first order

30.

Hexagonal Close packing	Cubic Close packing
'ABA' arrangement is known as the hexagonal close packed (hcp) arrangement.	**'ABC' arrangement** is known as the hexagonal cubic close packing. (ccp) arrangement.
The spheres of the third layer is exactly aligned as first layer	The spheres of the third layer is not aligned with those of either the first or second layer.
The hexagonal close packing is based on hexagonal unit cells with sides of equal length	The cubic close packing is based on the face centered cubic unit cell.
Tetrahedral voids of the second layer are covered by the sphere of the third layer	octahedral voids of the second layer are covered by the sphere of the third layer
The unit cell of hexagonal close packing **has 6 spheres**.	The unit cell of cubic close packing has **4 spheres**
This type is found in metals like **Mg,Zn,**	This type is found in metals like **Cu, Ag**,

31.

Order of reaction	Molecularity of reaction
It is sum of the power of concentration terms involved in experimentally determined rate law	It is total number of reactant species involved in an elementary step
It can be zero or fractional or integer	It is always whole number , cannot be zero or fractional number
It is assigned for overall reaction	It is assigned for each elementary step of mechanism

Part – D

34.a. Zone refining

based on the principles of fractional crystallisation

When an impure metal is melted and allowed to solidify, the impurities will prefer to be in the molten region. i.e. impurities are more soluble in the melt than in the solid state metal.

the impure metal is taken in the form of a rod. One end of the rod is heated using a mobile induction heater

results in melting of the metal on that portion of the rod.

When the heater is slowly moved to the other end the pure metal crystallises while the impurities will move on to the adjacent

molten zone formed due to the movement of the heater.

As the heater moves further away, the molten zone containing impurities also moves along with it.

The process is repeated several times by moving the heater in the same direction again and again to achieve the desired purity level. This process is carried out in an inert gas atmosphere to prevent the oxidation of metals .

Elements such as germanium (Ge), silicon (Si) and galium (Ga) that are used as semiconductor are refined using this process.

(b) The crude metal is refined by electrolysis. It is carried out in an electrolytic cell containing aqueous solution of the salts of the metal of interest.

The rods of impure metal are used as anode and thin strips of pure metal are used as cathode.

The metal of interest dissolves from the anode, pass into the solution while the same amount of metal ions from the solution will be deposited at the cathode.

During electrolysis, the less electropositive impurities in the anode, settle down at the bottom and are removed as anode mud.

electrolytic refining of silver
Cathode : Pure silver
Anode : Impure silver rods
Electrolyte : Acidified aqueous solution of silver nitrate
When a current is passed through the electrodes the following reactions will take $\rightarrow$ place
Reaction at anode ; $Ag\ (s) \rightarrow\ Ag^+ + e^-$
Reaction at cathode ; $Ag^+ + e^- \rightarrow Ag\ (s)$
During electrolysis, at the anode the silver atoms lose electrons and enter the solution.
The positively charged silver cations migrate towards the cathode and get

discharged by gaining electrons and deposited on the cathode.

35.(a). Hall-Herold process:
electrolysis is carried out in an iron tank lined with carbon which acts as a cathode.
The carbon blocks immersed in the electrolyte -anode.
A 20% solution of alumina, obtained from the bauxite ore is mixed with molten cyrolite and is taken in the electrolysis chamber.
About 10% calcium chloride is also added to the solution.
calcium chloride - lower the melting point of the mixture.
The fused mixture is maintained at a temperature of above 1270 K.
The chemical reactions involved in this process are as follows.

Write the equation given in the book
Write the Net electrolysis reaction given in the book

(b)

The reduction of oxides of active metals such as sodium, potassium etc., by carbon is thermodynamically not feasible.
Such metals are extracted from their ores by using electrochemical methods.
the metal salts are taken in a fused form or in solution form

The metal ion present can be reduced by treating it with some suitable reducing agent or by electrolysis
ΔG^0 = -nFE^0
n - Number of electrons involved in the reduction process,
F - Faraday
E^0 - electrode potential of the redox couple.
When E^0 – Postive ΔG^0 – Negative So reaction spontaneous

redox reaction is planned in such a way that the e.m.f of the net redox reaction is positive.

When a more reactive metal is added to the solution containing the relatively less reactive metal ions, the more reactive metal will go into the solution.

36.a

*In diborane **two BH₂** units are linked by two bridged hydrogens.

　*It has **eight B-H bonds.**

　* Diborane has only **12 valance electrons** and are not sufficient to form normal covalent bonds.

　*The four terminal B-H bonds are normal covalent bonds (**two centre - two electron bond or 2c-2e bond**).

　*The remaining four electrons have to used for the bridged bonds. i.e. **two three centred B-H-B** bonds utilise two electrons each.

　* In diborne, the boron is sp_3 hybridised. Three of the four sp_3 hybridised orbitals contains single electron and the fourth orbital is empty.

　* Two of the half filled hybridised orbitals of each boron overlap with the two hydrogens to form four terminal 2c-2e bonds, leaving one empty and one half filled hybridised orbitals on each boron.

　*The Three centre - two electron bonds), B-H-B bond formation involves overlapping the half filled hybridised orbital of one boron, the empty hybridised orbital of the other boron and the half filled 1s orbital of hydrogen.

Refer diagram given in text book

b. (i) $2B + 6NaOH \rightarrow 2Na_3BO_3 + 3H_2O$

(ii) $Na_2B_4O_7 + H_2SO_4 + H_2O \rightarrow Na_2SO_4 + 4H_3BO_3$

(iii) $BF_3 + 3H_2O \rightarrow H_3BO_3 + 3HF$

(iv) $2BF_3 + 6NaH \xrightarrow{450K} B_2H_6 + 6NaF$

(v) $2B + 6NaOH \rightarrow 2Na_3BO_3 + 3H_2O$

37.a
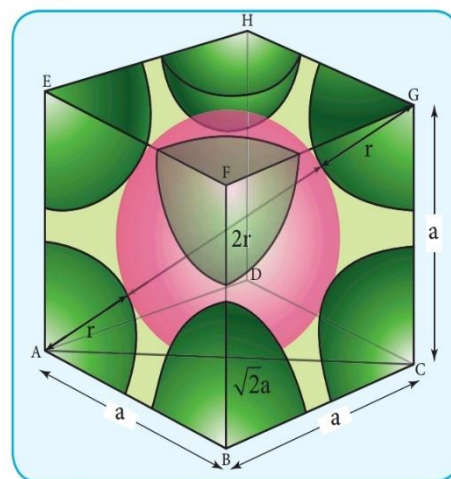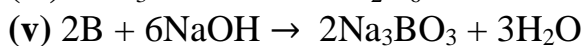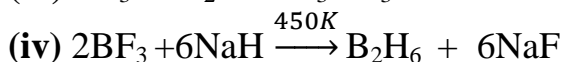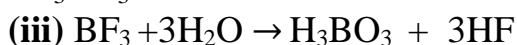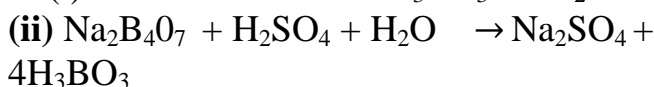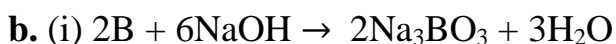
In ΔABC

$AC^2 = AB^2 + BC^2$

$AC = \sqrt{AB^2 + BC^2}$

$AC = \sqrt{a^2 + a^2} = \sqrt{2a^2} = \sqrt{2}\,a$

In ΔACG

$AG^2 = AC^2 + CG^2$

$AG = \sqrt{AC^2 + CG^2}$

$AG = \sqrt{\left(\sqrt{2}a\right)^2 + a^2}$

$AG = \sqrt{2a^2 + a^2} = \sqrt{3a^2}$

$AG = \sqrt{3}\,a$

i.e., $\sqrt{3}a = 4r$

$r = \dfrac{\sqrt{3}}{4}a$

∴ Volume of the sphere with radius 'r'

$= \dfrac{4}{3}\pi r^3$

$= \dfrac{4}{3}\pi\left(\dfrac{\sqrt{3}}{4}a\right)^3$

$= \dfrac{\sqrt{3}}{16}\pi a^3$ ...(1)

Number of spheres belong to a unit cell in bcc arrangement is equal to two and hence the total volume of all spheres

$= 2 \times \left(\dfrac{\sqrt{3}\,\pi\,a^3}{16}\right) = \dfrac{\sqrt{3}\,\pi\,a^3}{8}$

Dividing (2) by (3)

Packing fraction $= \dfrac{\left(\dfrac{\sqrt{3}\,\pi\,a^3}{8}\right)}{(a^3)} \times 100$

$= \dfrac{\sqrt{3}\,\pi}{8} \times 100$

$= \sqrt{3}\,\pi \times 12.5$

$= 1.732 \times 3.14 \times 12.5$

$= 68\,\%$

i.e., 68 % of the available volume is occupied. The available space is used more efficiently than in simple cubic packing.

any two differences of crystalline and amorphous

b) (i) AAAA type:

Linear arrangement of spheres in one direction is repeated in two dimension i.e., more number of rows can be generated identical to the one dimensional arrangement such that all spheres
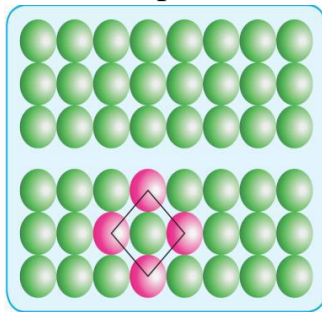
of different rows align vertically as well as horizontally.

If we denote the first row as A type arrangement, then the above mentioned packing is called AAA type, because all rows are identical as the first one.
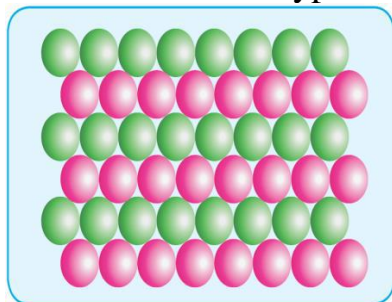
In this arrangement each sphere is in contact with **four** of its neighbours.

(ii) ABAB.. Type:

In this type, the second row spheres are arranged in such a way that they fit in the depression of the first row .

The second row is denoted as B type.

The third row is arranged similar to the first row A, and the fourth one is arranged similar to second one. i.e., the pattern is repeated as ABAB….

In this arrangement each sphere is in contact with **6** of its neighbouring spheres

(iii) ABCABC type arrangement – ccp structure

The third layer may be placed over the second layer in such a way that all the spheres of the third layer fit in octahedral voids.

This arrangement of the third layer is different from other two layers (a) and (b), and hence, the third layer is designated (c). If the stacking of layers is continued in abcabcabc… pattern, then the arrangement is called cubic close packed (ccp) structure
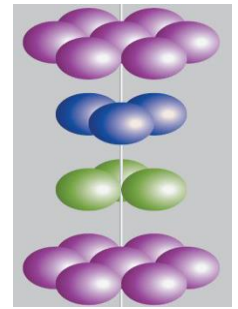
38.a. Reaction in which rate of the reaction depends on the concentrations of one of the reactant only is called first order reaction

A → **Products**

Rate = k [A]

$\frac{-d[A]}{dt}$ = k [A]

$\frac{-d[A]}{[A]}$ = k dt

Integrate the above equation between the limits of [A_0] at t = 0 and [A] at t = t ,

- $\int_{[A_0]}^{[A]} \frac{d[A]}{[A]} = k \int_{0}^{t} dt$

ln $\frac{[A_0]}{A}$ = kt …………..(1)

This equation is in natural logarithm. To convert it into usual logarithm with base 10, we have to multiply the term by 2.303

k = $\frac{2.303}{t}$ log [A_0] / [A] ………(2)
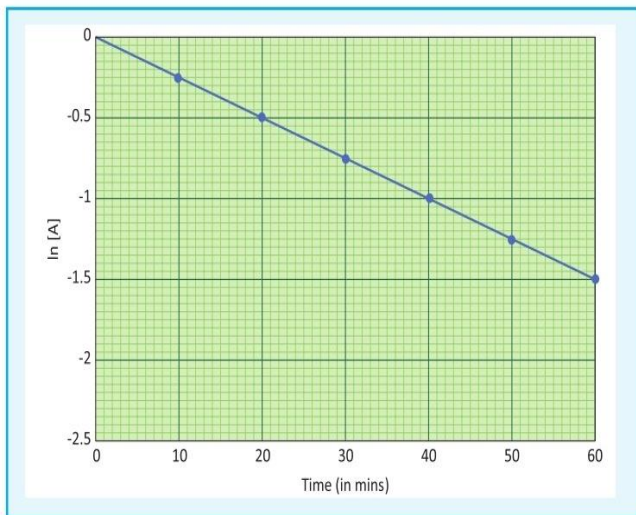
Equation (1) can be rewritten as

ln[A_0] - ln[A] = kt

y = mx + c

If we follow the reaction by measuring the concentration of the reactants at regular time interval't', a plot of ln[A] against 't' yields a **straight line with a negative slope which passes through origin for first order reaction** .

By taking slope k can be found out
For first order reaction k is constant

Decomposition of hydrogen peroxide catalysed by I^-
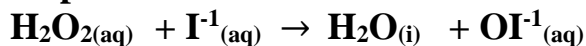
$$2H_2O_{2(aq)} \rightarrow 2H_2O_{(i)} + O_{2(g)}$$

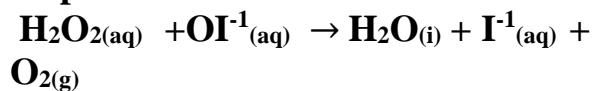It is experimentally found that the reaction is first order with respect to both H_2O & I^- which indicates that I^- is also involved in the reaction.

The mechanism involves the following steps

Step : 1

$$H_2O_{2(aq)} + I^{-1}_{(aq)} \rightarrow H_2O_{(i)} + OI^{-1}_{(aq)}$$

Step : 2

$$H_2O_{2(aq)} + OI^{-1}_{(aq)} \rightarrow H_2O_{(i)} + I^{-1}_{(aq)} + O_{2(g)}$$

Overall reaction is

$$2H_2O_{2(aq)} \rightarrow 2H_2O_{(i)} + O_{2(g)}$$

These two reactions are elementary reactions. Adding equation (1) and (2) gives the overall reaction.

Step 1 is the rate determining step, since it involves both H_2O_2 & I^-, the overall reaction is bimolecular.

(b) A suitable reducing agent is selected based on the thermodynamic considerations

For reduction of metal oxide with a reducing agent occurs only when free energy change is negative

For example

For Reduction of ZnO by carbon monooxide ΔG is positive so it is non spontaneous

But Reduction of ZnO by coke ΔG is negative so it is spontaneous .

Mineral	Ore
A naturally occurring substance obtained by mining which contains the metal in free state or in the form of compounds	Ore that contains a high percentage of metal, from which it can be extracted conveniently and economically
All minerals are not ores	All ores are minerals
It contain low percentage of metal	It contain high percentage of metal
Ex : china clay is mineral of aluminium	Ex: bauxite is an ore of aluminium