Mineral

The compound of metal found in nature

Ore

The minerals from which metal can be economically and conveniently extracted

Native ores	Oxidised ores	Sulphide ores	Halide ores
Metal in free state	Oxides ZnO	Sulphides of metals	Halides of metals
Ag / Au / Pt	Oxysalts $FeCO_3$	Fe / Pb / Zn / Hg	Na / Mg

Some Important Ores of Metals

Box

2³ H & M 3⁴

Jwala OP → मेला Cu काला Zn सीधा Fe

Carb:

Fool's gold

Aluminium	Iron		Copper		Zinc	
Bauxite	Haematite	Fe_2O_3	Copper pyrite	$CuFeS_2$	Zinc blende	ZnS
$Al_2O_3 \cdot xH_2O$	Magnetite	Fe_3O_4	Copper glance	Cu_2S	*Sphalerite	
	Siderite	$FeCO_3$	Cuprite	Cu_2O	Calamine	$ZnCO_3$
	Iron pyrite	FeS_2	Malachite	$CuCO_3.Cu(OH)_2$	Zincite	ZnO

Lead : Galena PbS

Silver : Argentite Ag_2S

Mercury : Cinnabar HgS

Tin : Tinstone / Casseterite : SnO_2

Q. Calamine and Malachite respectively, are the ores of :

1st Sep 2021

A. Nickel and Aluminium

B. Zinc and Copper

C. Copper and Iron

D. Aluminium and Zinc

मैला Cu
काला Zn
सीधा Fe
} Carbonates

Q. Sulphide ion is soft base and its ores are common for metals.
(a) Pb (b) Al (c) Ag (d) Mg

22nd July 2021

A (a) and (c) only

B (a) and (d) only

C (a) and (b) only

D (c) and (d) only

Argentite : Ag_2S

PbS

Q.

Match List-I with List-II :

	List-I (Name of ore/mineral)		List-II (Chemical formula)
(a)	Calmine	(i)	ZnS
(b)	Malachite	(ii)	$FeCO_3$
(c)	Siderite	(iii)	$ZnCO_3$
(d)	Sphalerite	(iv)	$CuCO_3.Cu(OH)_2$

27th Aug 2021

Choose the most appropriate answer from the options given below :

A (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

B (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

C (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

D (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)

Q.

Match List-I with List-II :

	List-I		List-II
(a)	Haematite	(i)	$Al_2O_3 . xH_2O$
(b)	Bauxite	(ii)	Fe_2O_3
(c)	Magnetite	(iii)	$CuCO_3 . Cu(OH)_2$
(d)	Malachite	(iv)	Fe_3O_4

17th March 2021

Choose the most appropriate answer from the options given below :

A (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)

B (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

C (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

D (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

Metallurgy

Crushing → Concentration → Isolation → Purification

Gangue → SiO_2

Earthy or undesired materials

Flux, Impurity and Slag

Types of Flux

Acidic flux

SiO_2, P_2O_5

Basic flux

CaO, MgO

Ore + CaO (Imp.) + SiO_2 (Flux) → $CaSiO_3$ (Slag) + Pure Ore

Basic oxide: FeO (Imp.) + SiO_2 (Flux) → $FeSiO_3$ (Slag)

Flux: CaO + SiO_2 (Imp.) → $CaSiO_3$ (Slag)

Slag

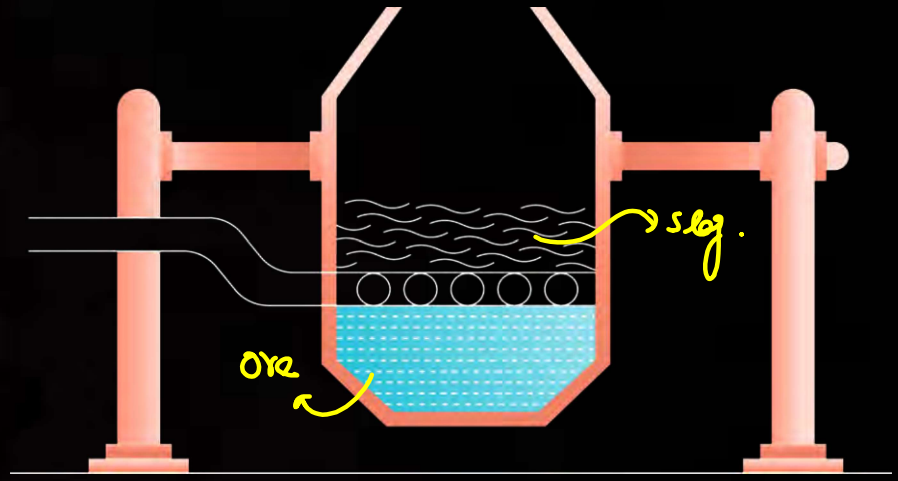
Fusible mass

Low melting point

Less density than molten metal

Immiscible with the molten metal / pure ore

Slag floats on the surface of the molten metal, protecting it from oxidation by the atmosphere and keeping it clean.



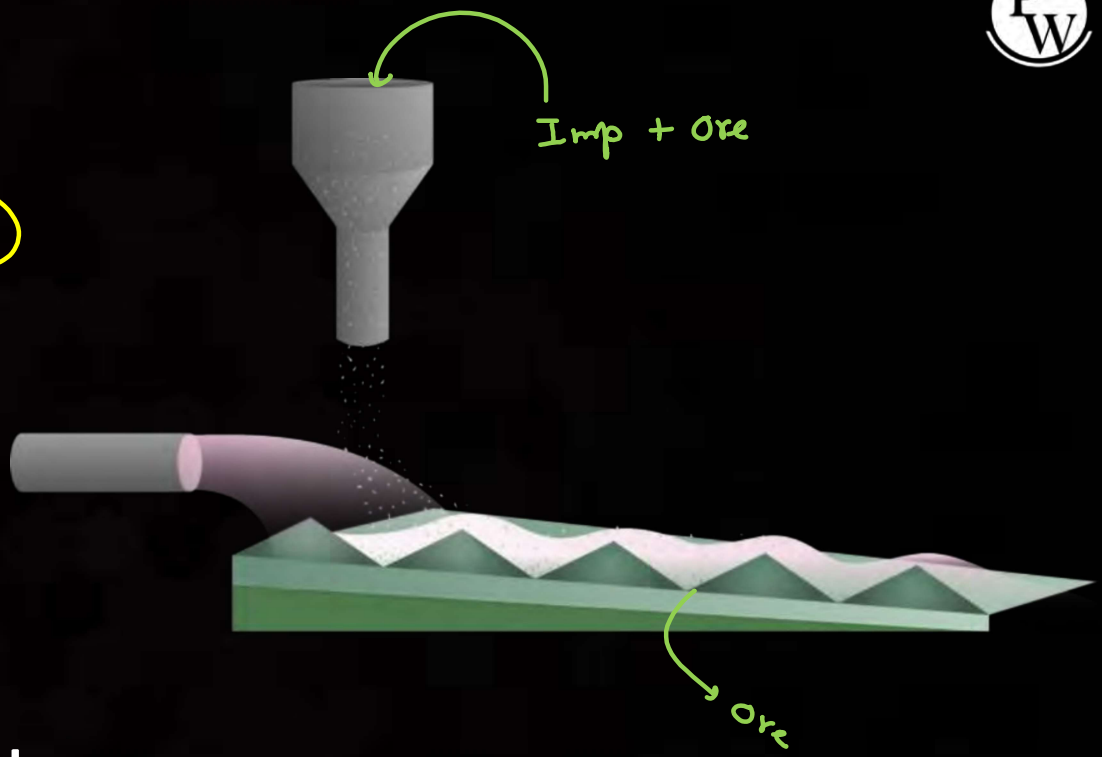
Bessemer convertor

Concentration

Hydraulic Washing

Basic Principle : Density Difference

Ores of heavy metals (Sn, Pb, Fe)



- Jet of water is passed from one side
- Crushed ore is poured from Hydraulic classifier
- Heavy ore particles gets settled down
- Lighter gangue particles are washed away

Concentration

Electromagnetic Separation

Basic Principle : Different Magnetic Properties

Jwala-mukhi

Ore + Impurity

Tinstone /Casseterite (SnO_2) + Wolframite ($FeWO_4$)

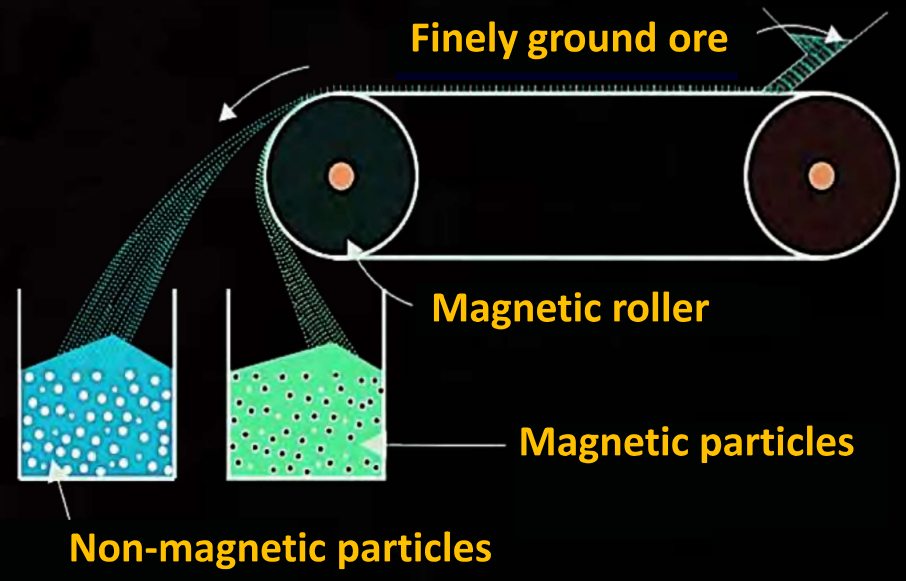
Fe^{+3} WO_4^{2-} magnetic

Impurity + Ore

Chromite ($FeO \bullet Cr_2O_3$) + Silica → Non-Mag.

Magnetite (Fe_3O_4)

Pyrolusite (MnO_2)



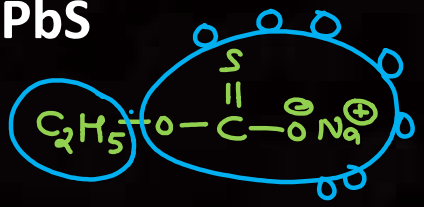
Concentration

Forth floatation process

ore + Imp.

Basic Principle : Difference in Wettability

Cu_2S ZnS FeS_2 PbS



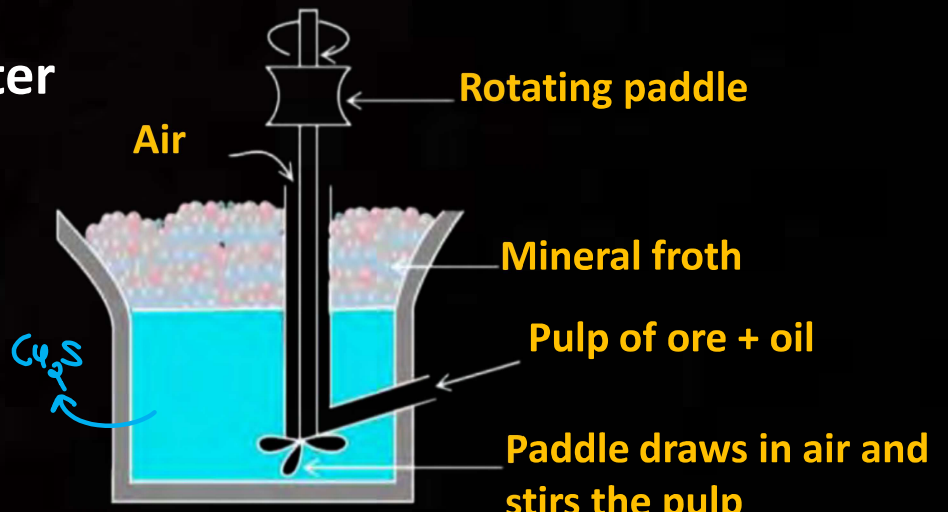
Frothers Pine oil

Collectors Potassium ethyl xanthate

To enhance non-wettability of ore in water

Sulphide ore is wetted by oil and moves upward in the form of froth

Gangue particles are wetted by water and settles down at bottom



Froth stabilizers Aniline, Cresol

Forth floatation process

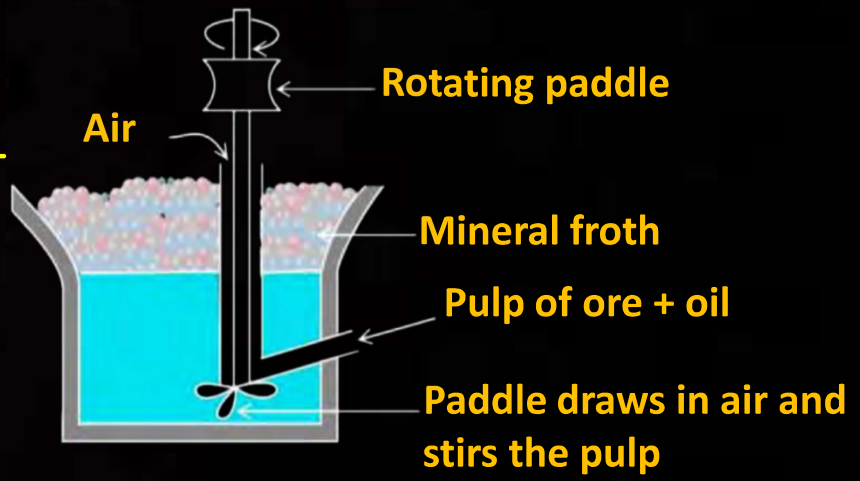
When a mixture of sulphide ores is present
Galena (PbS)
Zinc blende (ZnS)

Depressant — $NaCN$, Na_2CO_3

Cu_2S

$PbS + NaCN \longrightarrow X$

$ZnS + NaCN \longrightarrow 2Na^{\oplus}[Zn(CN)_4]^{2-}$



This **complex is wetted with water** and prevented coming into the froth.

While **PbS comes into forth** because it cannot react with NaCN.

Q. Given below are two statements :

Statement I: Sphalerite is a sulphide ore of zinc and copper glance is a sulphide ore of copper.

Statement II: It is possible to separate two sulphide ores by adjusting proportion of oil to water or by using 'depressants' in a forth flotation method.

Choose the most appropriate answer from the options given below :

26th Aug 2021

A. Statement I is true but Statement II is false

B. Both Statement I and Statement II are true

C. Statement I is false but Statement II is true

D. Both Statement I and Statement II are false

Concentration

Leaching (Al / Ag / Au)

Basic Principle : Difference in solubility

When metal is more soluble than impurities present in its ore.

MAF Cyanide Process (Ag/Au) Leaching Solvent : $NaCN_{(aq.)}$

$$Ag + Imp. \xrightarrow[O_2]{NaCN} Na^{\oplus}[Ag(CN)_2]^{\ominus} \xrightarrow{Zn} Ag\downarrow + 2Na^{\oplus}[Zn(CN)_4]^{2-}$$

($Zn \rightarrow Zn^{+2} + 2e^-$)

$$Au + Imp \xrightarrow[O_2]{NaCN} Na^{\oplus}[Au(CN)_2]^{\ominus} \xrightarrow{Zn} Au\downarrow + 2Na^{\oplus}[Zn(CN)_4]^{2-}$$

Hydro-metallurgy of Ag_2S

$$Ag_2S + Imp \xrightarrow{NaCN} Na^{\oplus}[Ag(CN)_2]^{\ominus} \xrightarrow{Zn} ?$$

($Na_2S \xrightarrow{O_2}$ ////)

Extraction of Metal

Concentrated Ore $\xrightarrow[\text{Roasting}]{\text{Calcination}}$ Metal Oxide $\xrightarrow{\text{Reduction}}$ Metal

Calcination

$CaCO_3 \xrightarrow{\Delta} CaO + CO_2\uparrow$

$Fe_2O_3 \cdot 3H_2O \xrightarrow{\Delta} 3H_2O\uparrow + Fe_2O_3$

$ZnCO_3 \xrightarrow{\triangle} ZnO + CO_2\uparrow$

$FeCO_3 \xrightarrow{\triangle} FeO + CO_2\uparrow$

$CaCO_3 \cdot MgCO_3 \xrightarrow{\triangle} CaO + MgO + CO_2\uparrow$

(Dolomite) $D_0 = 2$ (Group)

Impurity : Organic matter

Reverberatory furnace

Removal of volatile impurities

Ore becomes porous

Roasting

$Cu_2S \xrightarrow{O_2} SO_2\uparrow + Cu_2O$

$ZnS \xrightarrow{O_2} ZnO + SO_2\uparrow$

* Some times roasting may not bring about complete oxidation.

$CuFeS_2 \xrightarrow{O_2} Cu_2S + FeO + SO_2\uparrow$

Impurity

As $\xrightarrow{O_2} As_2O_3\uparrow$

Sb $\xrightarrow{O_2} Sb_2O_3\uparrow$

S $\xrightarrow{O_2} SO_2\uparrow$

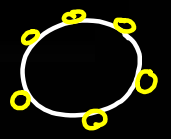
$P_4 \xrightarrow{O_2} P_xO_y\uparrow$

Self Reduction in Roasting

Pb Cu Hg

The reduction in which species reacts with itself to form new species

$Cu_2S + O_2 \longrightarrow SO_2\uparrow + Cu_2O \xrightarrow{Cu_2S} SO_2\uparrow + Cu$



Copper having blisters of SO_2 gas on its surface is called as blister copper.

$HgS + O_2 \xrightarrow{-SO_2\uparrow} HgO \xrightarrow{HgS} SO_2\uparrow + Hg$

$PbS + O_2 \longrightarrow SO_2\uparrow + PbO \xrightarrow{PbS} Pb + SO_2\uparrow$

$SO_2 \xrightarrow{[O]} SO_3 \xrightarrow{H_2O} H_2SO_4$

Large volume of SO_2 obtained is used to prepare H_2SO_4 in industry.

Q. Consider two chemical reactions (A) and (B) that take place during metallurgical process :

(A) $ZnCO_{3(s)} \xrightarrow{\Delta} ZnO(s) + CO_2(g)$: Cal

(B) $2ZnS(s) + 3O_{2(g)} \xrightarrow{\Delta} 2ZnO_{(s)} + 2SO_{2(g)}$: Roasting.

The correct option of names given to them respectively is :

20th July 2021

A. (A) Is calcination and (B) is roasting

B. Both (A) and (B) are producing same product so both are roasting

C. Both (A) and (B) are producing same product so both are calcination

D. (A) is roasting and (B) is calcination

Smelting

The process of converting metal oxide into metal using a suitable reducing agent

Reducing agents : C , CO , Al

Carbon can be used to reduce a number of oxides and because of the low cost and availability of coke this method is widely used.

$C \longrightarrow CO$

$CO \longrightarrow CO_2\uparrow$

Reduction with carbon :

$PbO + C \longrightarrow CO\uparrow + Pb$

$Fe_2O_3 + C \longrightarrow CO\uparrow + Fe$

$ZnO + C \longrightarrow CO\uparrow + Zn$

$SnO_2 + C \longrightarrow CO\uparrow + Sn$

Reduction with CO :

$Fe_2O_3 + CO \longrightarrow Fe_3O_4 + CO_2\uparrow$

$Fe_3O_4 + CO \longrightarrow FeO + CO_2\uparrow$

$PbO + CO \longrightarrow Pb + CO_2\uparrow$

$CuO + CO \longrightarrow Cu + CO_2\uparrow$

Ellingham Diagram

Graph b/w ΔG & T

$\Delta G = \Delta H - T\Delta S$

$y = c + mx$

slope = $-\Delta S$

Thermodynamic principle of metallurgy

$2C_{(s)} + O_{2\,(g)} \longrightarrow 2CO_{(g)}$

ΔS = ⊕ve

slope = ⊖ve

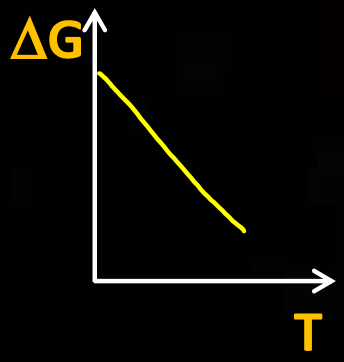
$2CO_{(g)} + O_{2(g)} \longrightarrow 2CO_{2\,(g)}$

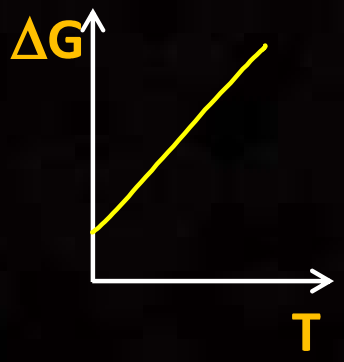
ΔS = ⊖ve

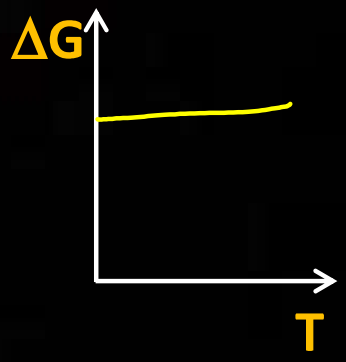
slope = ⊕ve

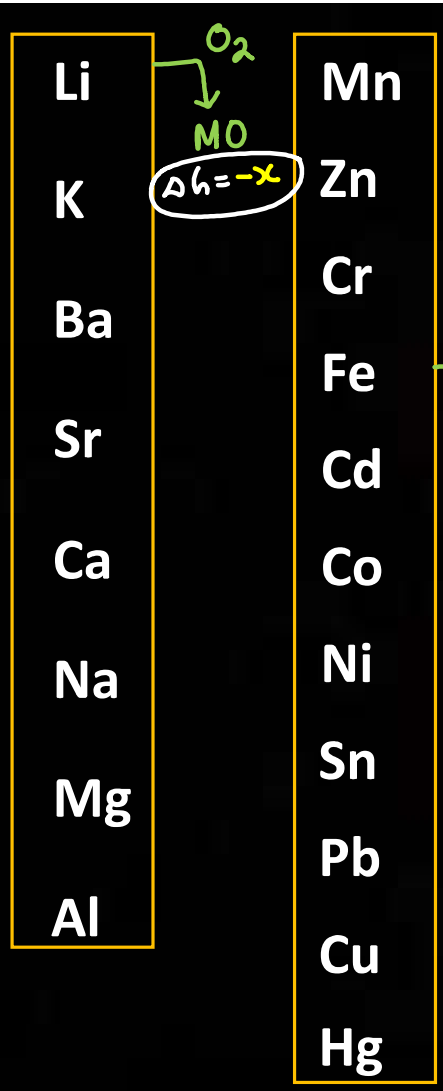
$C_{(s)} + O_{2\,(g)} \longrightarrow CO_2$

ΔS = zero

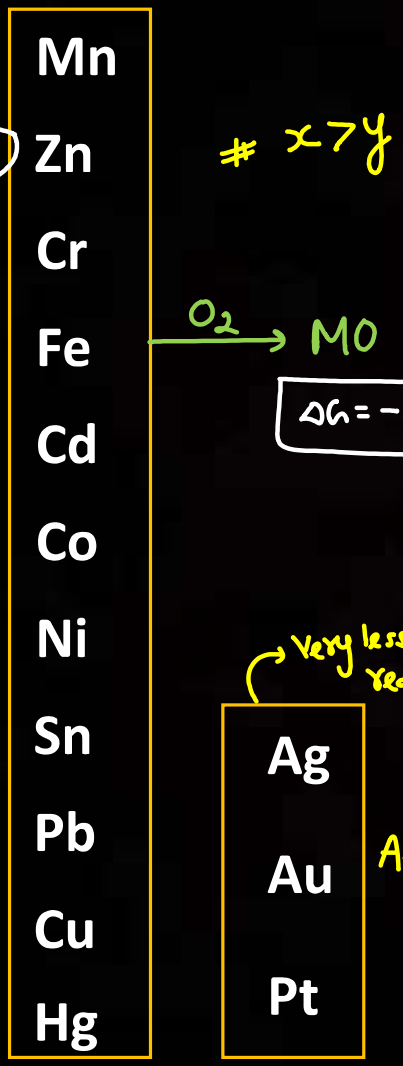








O_2 → MO, $\Delta G = -x$

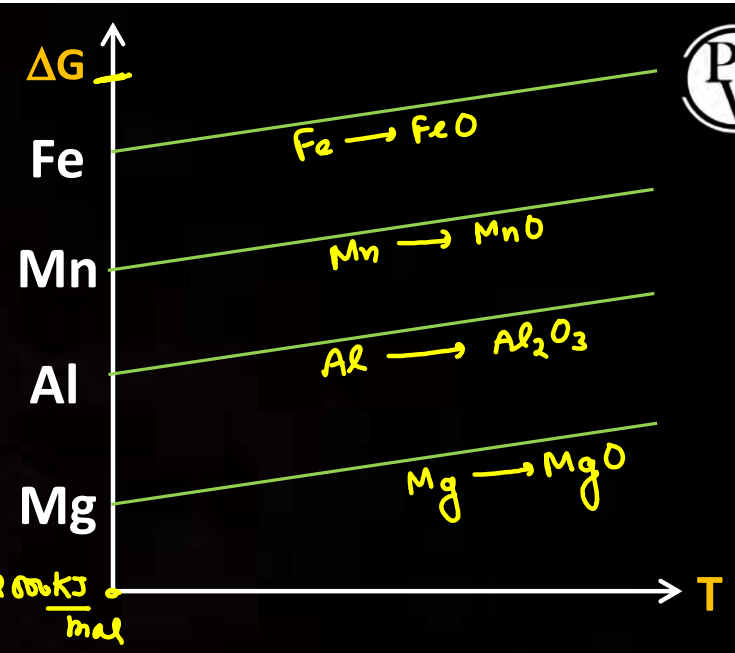


$\# \; x > y$

O_2 → MO, $\Delta G = -y$

Very less reactive

$Ag_2O \rightarrow Ag + \frac{1}{2}O_2$



$Mn_3O_4 \xrightarrow{Al} Al_2O_3 + Mn$

$Fe_2O_3 \xrightarrow{Al} Al_2O_3 + Fe$

$Cr_2O_3 \xrightarrow{Al} Al_2O_3 + Cr$

Reductions of the oxide of the upper line is feasible by the element represented by the lower line. If the difference is large, the reduction is easier.

Ellingham Diagram

$C + O_2 \longrightarrow CO_2$

$2C + O_2 \longrightarrow 2CO$

$2CO + O_2 \longrightarrow 2CO_2$

LTR : $\Delta G = -x$

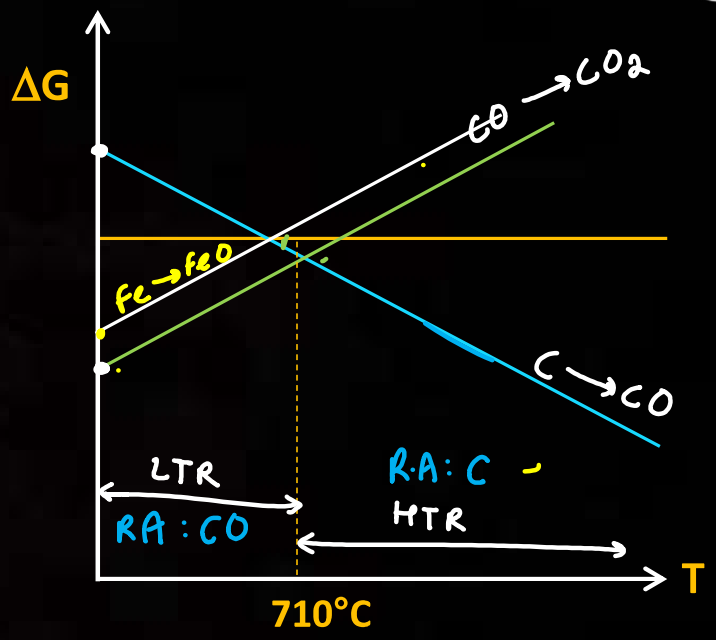
$CO \longrightarrow CO_2$

R.A.

HTR : $\Delta G = -y$

$C \longrightarrow CO$

R.A.



Reaction is Feasible ?

$FeO + C \not\longrightarrow CO + Fe$ (LTR)

$FeO + C \longrightarrow CO + Fe$ (HTR)

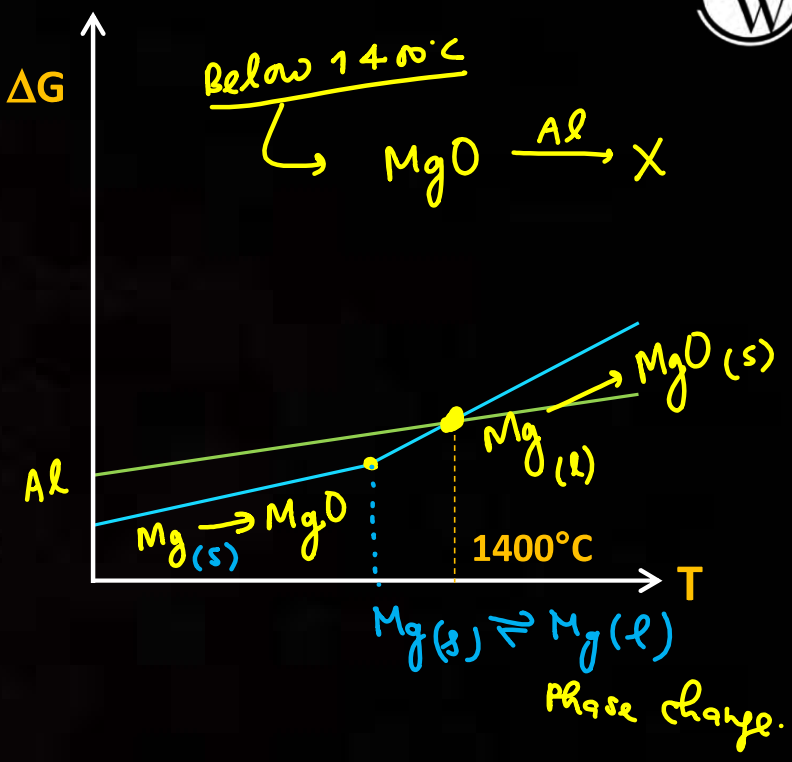
$FeO + CO \longrightarrow CO_2 + Fe$ (LTR)

$FeO + CO \longrightarrow CO_2 + Fe$ (HTR)

Ellingham Diagram

$2Mg_{(s)} + O_{2(g)} \longrightarrow 2MgO_{(s)}$

$Al + O_2 \longrightarrow Al_2O_3$



At the point of intersection of the Al_2O_3 and MgO curves the ΔG^0 becomes ZERO for the reaction .

Above 1400 °C which reaction is Feasible ?

(1) $Mg + Al_2O_3 \longrightarrow MgO + Al$

(2) $MgO + Al \not\longrightarrow Al_2O_3 + Mg$

Q. The point of intersection and sudden increase in the slope, in the diagram given below, respectively, indicates :

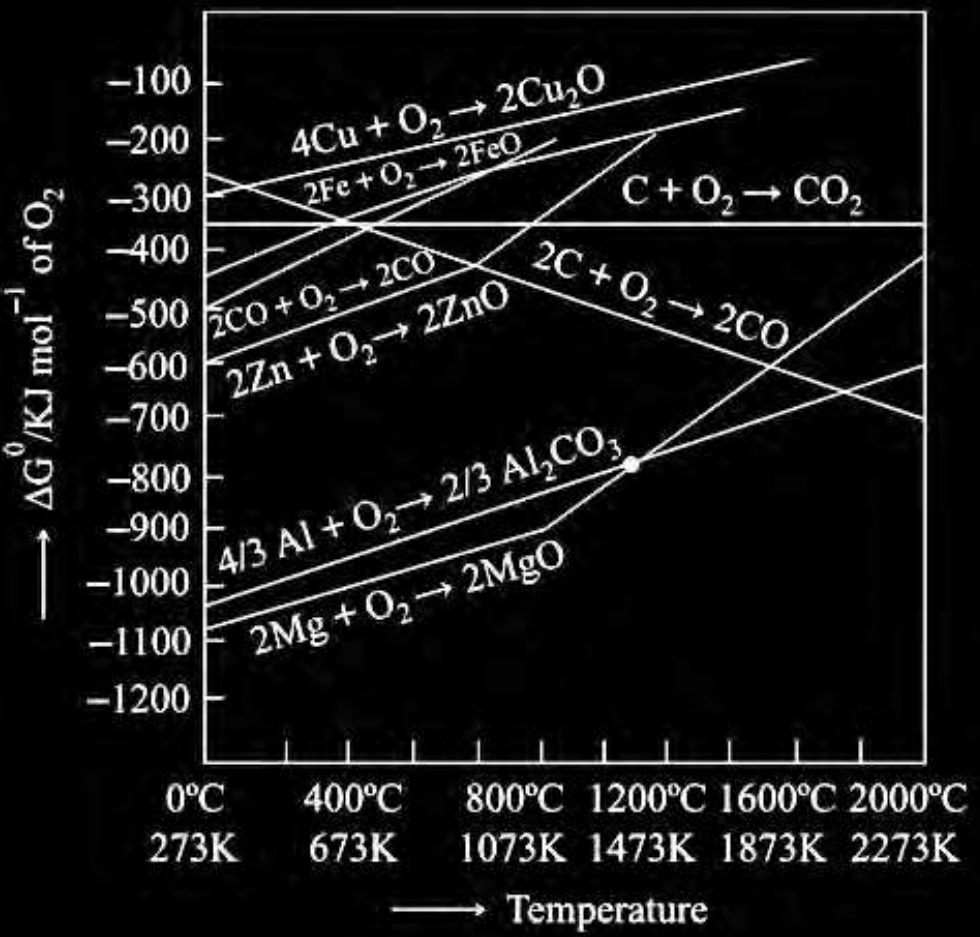
17th March 2021

A. $\Delta G > 0$ and decomposition of the metal oxide

B. $\Delta G < 0$ and decomposition of the metal oxide

C. $\Delta G = 0$ and reduction of the metal oxide

D. $\Delta G = 0$ and melting or boiling point of the metal oxide



Q. The statement is incorrect about Ellingham diagram is **27th July 2021**

A. provides idea about the reaction rate

B. provides idea about free energy change

C. provides idea about changes in the phases during the reaction

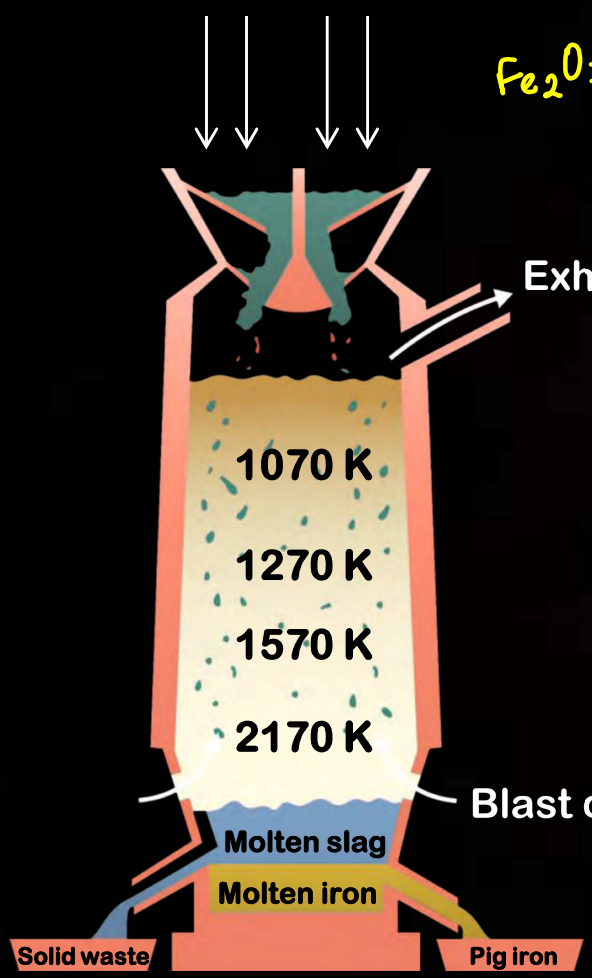
D. provides idea about reduction of metal oxide

$MO_{(s)} \longrightarrow M_{(\ell)}$

Q. Why is the reduction of a metal oxide easier if the metal formed is in liquid state at the temperature of reduction?

Blast Furnace

Met. of Fe



$Fe_2O_3 + CaCO_3 + C$

SiO_2 ← Imp. ← Fe_2O_3 $\xrightarrow{CO}$ Fe_3O_4 $\xrightarrow{CO}$ FeO

FeO $\xrightarrow{C}$ Fe (HTR)

FeO $\xrightarrow{CO}$ Fe (LTR)

$Fe_2O_3 + CO \longrightarrow Fe_3O_4 + CO_2\uparrow$

$Fe_3O_4 + CO \longrightarrow FeO + CO_2\uparrow$

$CaCO_3 \xrightarrow{\Delta} CaO + CO_2\uparrow$

(Flux) $CaO + SiO_2 \longrightarrow CaSiO_3$ (Slag)

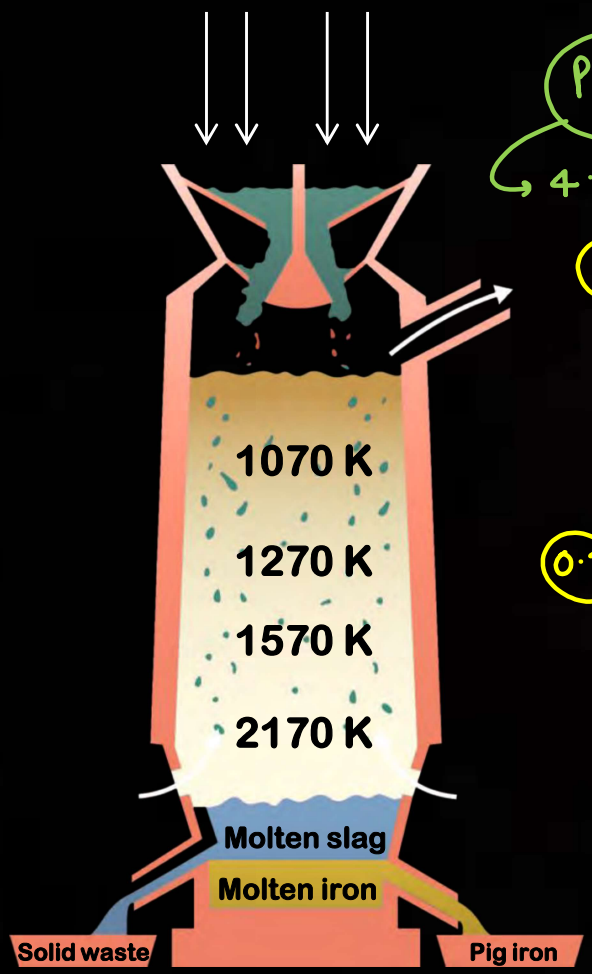
(Imp.) $FeO + CO \longrightarrow CO_2\uparrow + Fe$

$C + CO_2 \longrightarrow 2CO\uparrow$

$C + O_2 \longrightarrow CO_2$

(HTR) $FeO + C \longrightarrow CO + Fe$

Blast Furnace



Pig Iron

4·1· C

The iron obtained from Blast furnace contains about 4% carbon known as **pig iron** and cast into variety of shapes.

3·1·

Cast iron is different from pig iron and is made by melting pig iron with scrap iron and coke using hot air blast. It has slightly lower carbon content (about 3%) and is extremely hard and brittle.

0·1

Wrought iron or malleable iron is the **purest form of commercial iron and** is prepared from cast iron by oxidising impurities in a reverberatory furnace lined with haematite. This haematite oxidises carbon to carbon monoxide.

$$Fe_2O_3 + 3\,C \longrightarrow 2\,Fe + 3\,CO$$

Aluminothermic Process

Goldschmidt Process

Thermite mixture Oxide + Al-powder

Ignition mixture $BaO_2 + Mg$

Thermite reaction

$Cr_2O_3 \xrightarrow{Al} Cr$

$Mn_3O_4 \xrightarrow{Al} Mn$

$Fe_2O_3 \xrightarrow{Al} Fe$

$B_2O_3 \xrightarrow{Al} B$

Na/Mg Reduction

Group - 2

(#) $TiCl_4 + Mg \xrightarrow{\text{Kroll process}} 2MgCl_2 + Ti$

(#) $TiCl_4 + Na \xrightarrow{\text{IMI process}} 4NaCl + Ti$

Ist group

Na and Mg has high reducing power and high solubility of their halides in water so that the reduced metals can be washed free from impurities.

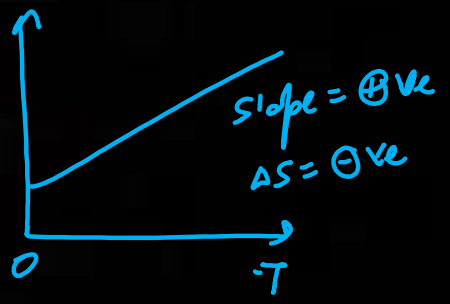
Q. Given below are two statements :

Statement I: The choice of reducing agents for metals extraction can be made by using Ellingham diagram, a plot of ΔG vs temperature.

Statement II: The value of ΔS increases from left to right in Ellingham diagram.

In the light of the above statements, choose the most appropriate answer from the options given below:

26th Aug 2021



A. Both Statement I and Statement II are true

B. Statement I is false but Statement II is true

C. Both Statement I and Statement II are false

D. Statement I is true but Statement II is false

Extraction of Al

Red Bauxite ($Al_2O_3 . 2H_2O$)

Impurity : Fe_2O_3 + Silicates

Bayer's process

Hall's process

(बे-हाल)

Bayer's Process

Leaching Agent : $NaOH_{(aq.)}$

Impurity : Ferric oxide + Silicates

$Al_2O_3 . 2H_2O + NaOH_{(aq.)} \longrightarrow Na[Al(OH)_4]$ → $NaAlO_2 \cdot 2H_2O$

$NaAlO_2 + H_2O \longrightarrow Al(OH)_3 \downarrow$

$Al(HO)_3 \xrightarrow{1200°C} Al_2O_3$

Hall's Process

$Na_2O \cdot CO_2$

Leaching Agent : Na_2CO_3

Impurity : Ferric oxide + Silicates

$Al_2O_3 . 2H_2O + Na_2CO_3 \longrightarrow 2NaAlO_2 + CO_2\uparrow$

$NaAlO_2 + CO_2 + H_2O \longrightarrow Na_2CO_3 + Al(OH)_3\downarrow$

($NaOH + Al(OH)_3$; H_2CO_3)

$Al(HO)_3 \xrightarrow{1200°C} Al_2O_3$

Extraction of Al

Serpeck's Process

White Bauxite ($Al_2O_3 . 2H_2O$)

Impurity : SiO_2

$$\overset{Al^{+3}}{\underline{Al_2O_3 . 2H_2O}} + C + \overset{N^{3-}}{\underline{N_2}} \xrightarrow{1800°C} \boxed{AlN} + CO\uparrow + H_2O\uparrow$$

$$AlN \xrightarrow[H^+/OH^-]{} + H_2O \longrightarrow Al(OH)_3\downarrow + NH_3\uparrow$$

$$SiO_2 + CO \longrightarrow \boxed{Si} + CO_2\uparrow$$

Silicon volatilizes at this temperature.

$$Al(HO)_3 \xrightarrow{1200°C} Al_2O_3$$

Electrolytic Reduction (Hall-Heroult Process)

Fused Matrix Purified Al_2O_3 + Na_3AlF_6 (cryolite) / CaF_2 (fluorspar)

$3Na^{\oplus}$ $[AlF_6]^{3-}$

It lowers the melting point of the mixture and brings conductivity

Cathode

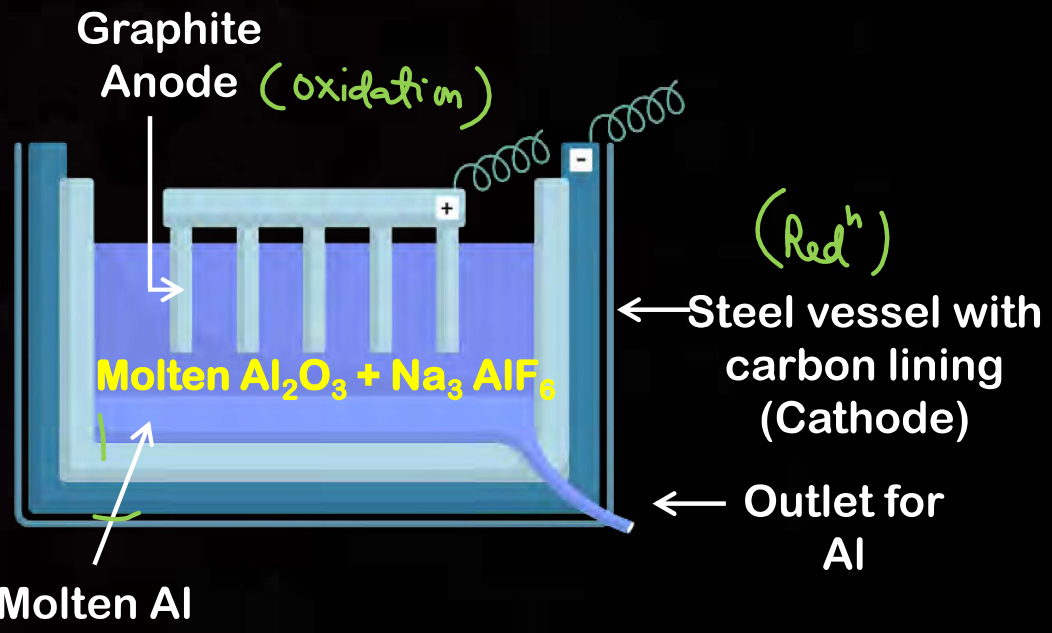
$Al^{3+} + 3e^- \longrightarrow Al$

Anode

$O^{2-} \longrightarrow O_2$

$Al_2O_3 + C \xrightarrow[(Anode)]{} Al + CO/CO_2$

Al^{+3} O^{2-}



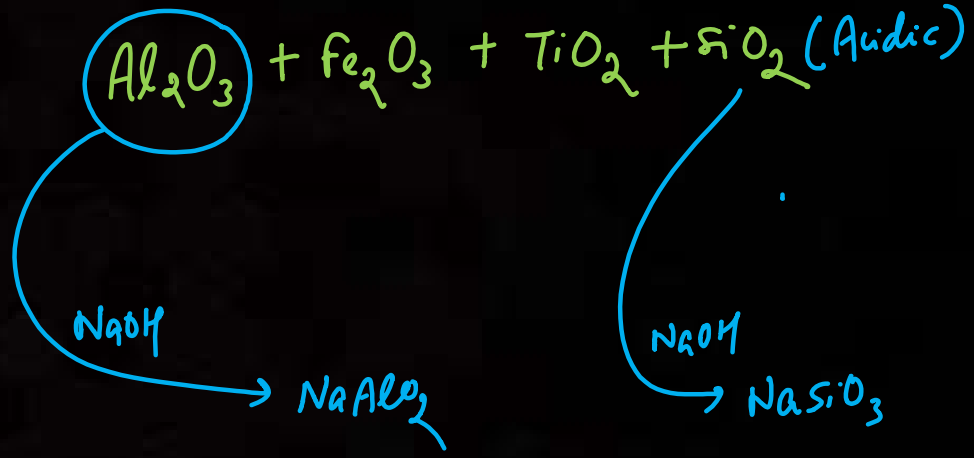
Q. In the leaching of alumina from bauxite, the ore expected to leach out in the process by reacting with NaOH is : 25th July 2021

A. TiO_2

B. Fe_2O_3

C. ZnO

D. SiO_2



Q. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Aluminium is extracted from bauxite by the electrolysis of molten mixture of Al_2O_3 with cryolite.

Reason (R): The oxidation state of Al in cryolite is +3.

In the light of the above statements, choose the most appropriate answer from the options given below:

31th Aug 2021

A. (A) is true but (R) is false

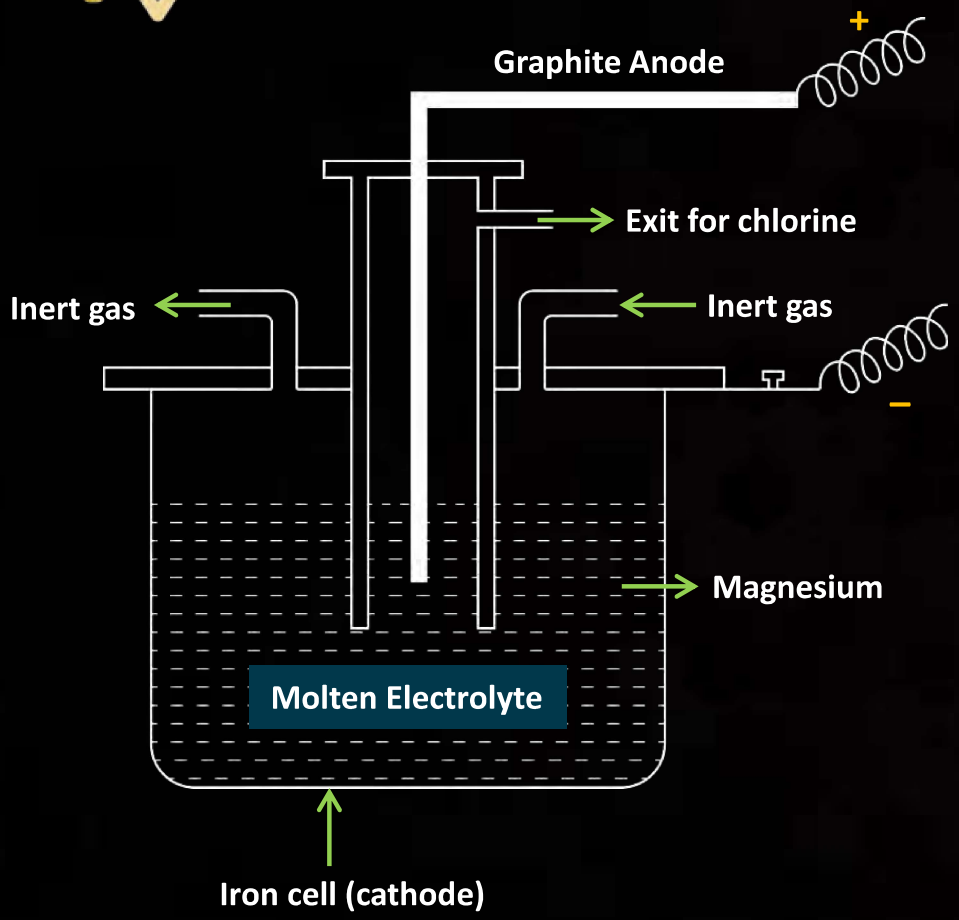
B. (A) is false but (R) is true

C. Both (A) and (R) are correct and (R) is the correct explanation of (A)

D. Both (A) and (R) are correct but (R) is not the correct explanation of (A)

Electrolysis of fused Anhyd. $MgCl_2$

Mg^{2+} $2Cl^{\ominus} \longrightarrow Cl_2\uparrow$



Cathode

$Mg^{2+} + 2e^- \longrightarrow$

Anode

$2Cl^- \longrightarrow$

Extraction of Cu

From Copper Pyrite $CuFeS_2$

Impurity : Silica

$CuFeS_2 + O_2 \longrightarrow Cu_2S + FeO + SO_2\uparrow$ (FeS → Basic oxide)

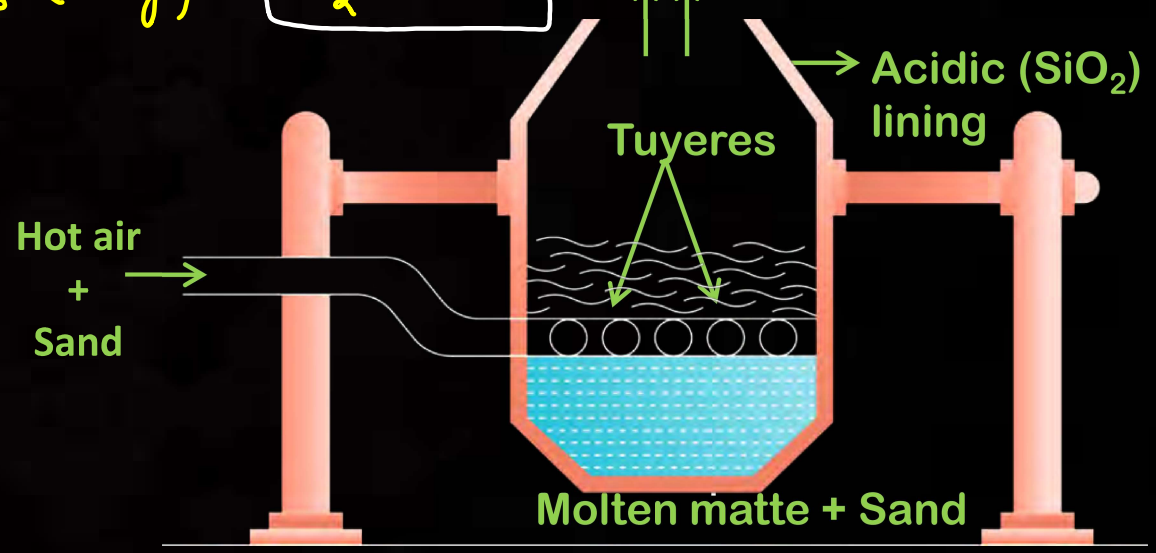
$Cu_2S + FeO + SiO_2 \longrightarrow FeSiO_3\ (Slag) + Cu_2S + FeS$ (2·1. matte, 98·1.)

$FeS + O_2 \longrightarrow SO_2\uparrow + FeO$

$FeO + SiO_2 \longrightarrow FeSiO_3\ (Slag)$

$Cu_2S + O_2 \longrightarrow Cu_2O$

$Cu_2O + Cu_2S \longrightarrow SO_2\uparrow + Cu$



Bessemer convertor

Q. The addition of silica during the extraction of copper from its sulphide ore

$FeO + SiO_2 \longrightarrow$ slag.

27th July 2021

A converts copper sulphide into copper silicate

B converts iron oxide into iron silicate

C reduces copper sulphide into metallic copper

D reduces the melting point of the reaction mixture

Q.

Match List-I with List-II : (Both having metallurgical terms)

	List-I		List-II
(a)	Concentration of Ag ore	(i)	Reverberatory furnace
(b)	Blast furnace	(ii)	Pig iron
(c)	Blister copper	(iii)	Leaching with dilute NaCN solution
(d)	Forth floatation method	(iv)	Sulfide ores

25th July 2021

Choose the most appropriate answer from the options given below :

A (a)-(iii), (b)-(ii), (c)-(i), (d)-(iv)

B (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

C (a)-(iv), (b)-(i), (c)-(iii), (d)-(ii)

D (a)-(iv), (b)-(iii), (c)-(iv), (d)-(i)

Refining

Removal of unwanted substance from impure metal

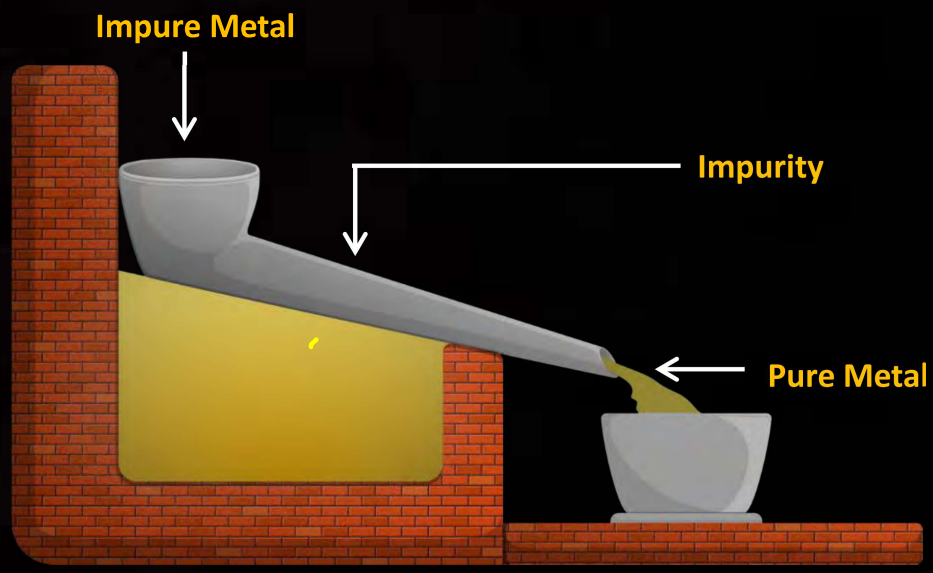
1. Liquation
2. Distillation
3. Electrolytic refining
4. Zone refining
5. Vapour phase refining
6. Chromatography
7. Polling

1. Liquation

Impurities have high melting point than metals

Used for metals having low melting point (Sn , Pb , Bi)

1. Crude metal is heated on sloping floor of a furnace
2. Fused metal flows down leaving behind infusible impurities



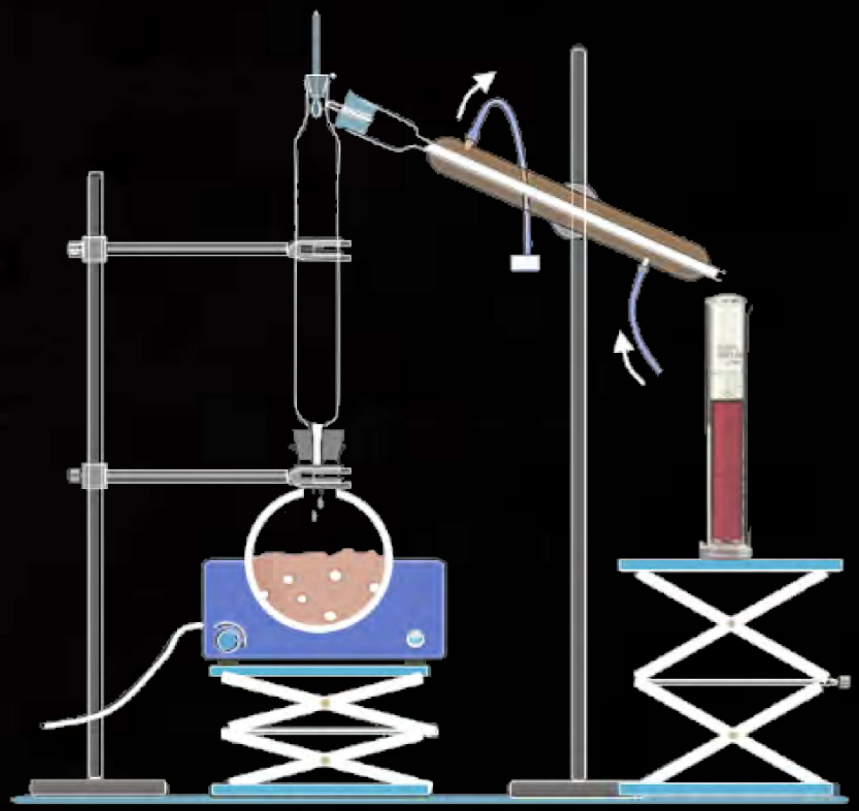
Reverboratory Furnace

2. Distillation

Fractional distillation is used when boiling point difference is less.

Low boiling point Zn , Hg , Cd → d^{10}

Distillation is used for the elements that are liquids at room temperature or can be converted to liquid at room temperature easily.



Q. The metal that can be purified economically by fractional distillation method is :

20th July 2021

A. Fe

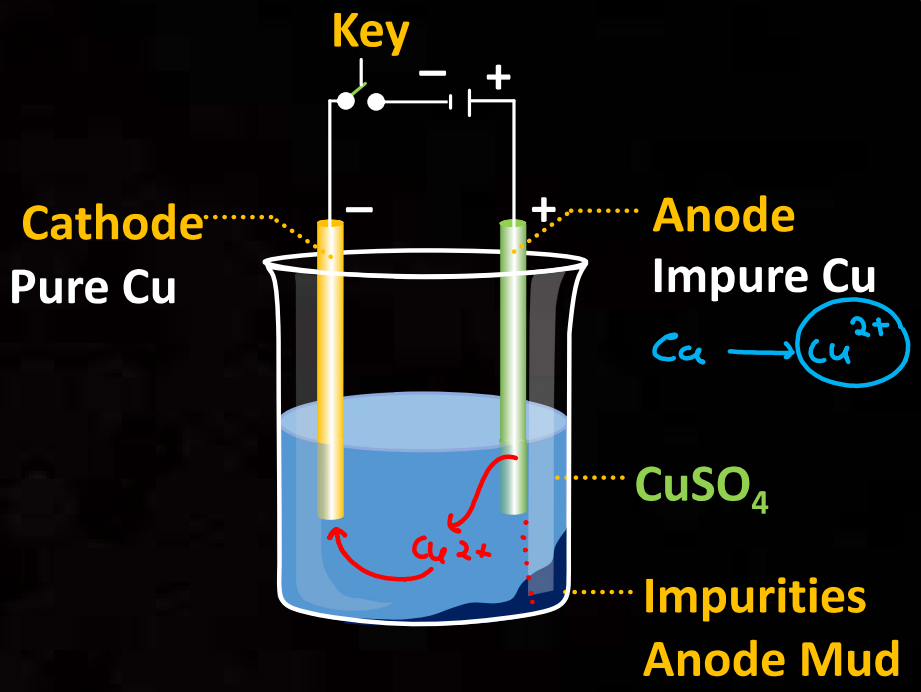
B. Zn

C. Cu

D. Ni

3. Electrolytic Refining

Used to refine elements like Cu and Zn

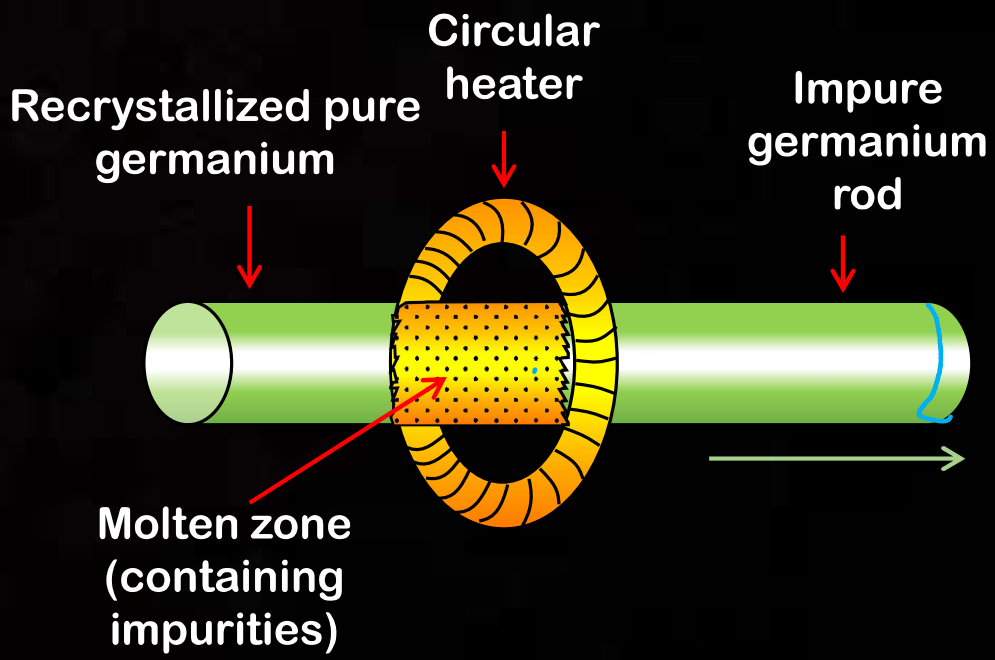


4. Zone Refining

Highly pure semiconductors
(Ge, Si, Be, Ga, In)

An impure molten metal on gradual cooling will deposit crystals of pure metal

Impurities will be left in the remaining part of molten metal.



5. Vapour Phase Refining

$$\text{Metal}_{(s)} \xrightarrow{X_2} \text{Volatile Compound}_{(g)} \xrightarrow{\Delta} \text{Pure Metal}$$

1. Monds Process

Jwala ap.

$$\underset{(s)}{Ni} + \underset{(g)}{CO} \xrightarrow{50^\circ C} Ni(CO)_4 \xrightarrow[(s)]{200^\circ C} Ni + 4CO\uparrow$$

2. Van Arkel Method

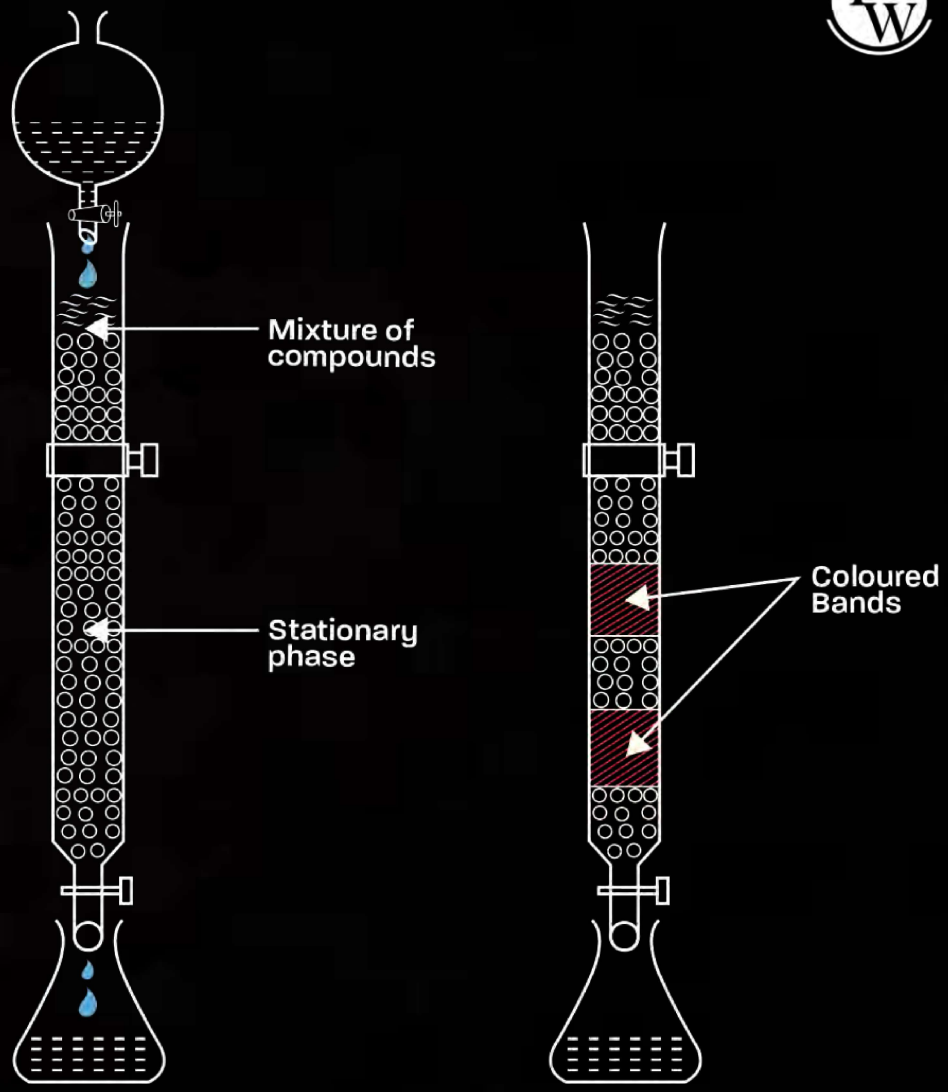
$$Ti + I_2 \xrightarrow{100^\circ C} TiI_4 \xrightarrow{1400^\circ C} Ti + 2I_2$$

$$Zr + I_2 \xrightarrow{100^\circ C} ZrI_4 \xrightarrow{heat} Zr + 2I_2$$

6. Chromatographic Methods

Different components of a mixture are differently adsorbed on an adsorbent.

Useful for purification of the elements which are available in minute quantities and the impurities are not very different in chemical properties from the element to be purified.



7. Poling Process

1. Purification of impure copper (Cu + Cu_2O)

Green wood → Hydrocarbons → CH_4

$$Cu_2O + CH_4 \longrightarrow Cu + CO_2\uparrow + H_2O\uparrow$$

2. Purification of impure tin

Green wood → Hydrocarbons → CH_4

$$SnO_2 + CH_4 \longrightarrow Sn + H_2O\uparrow + CO_2\uparrow$$

Q. Which refining process is generally used in the purification of low melting metals?

27th Aug 2021

A. Chromatographic method

B. Liquation

C. Electrolysis

D. Zone refining

Q.

Match List-I with List-II :

	List-I		List-II
(a)	Mercury	(i)	Vapour phase refining
(b)	Copper	(ii)	Distillation refining
(c)	Silicon	(iii)	Electrolytic refining
(d)	Nickel	(iv)	Zone refining

18th March 2021

Choose the most appropriate answer from the options given below :

A (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

B (a)-(iii), (b)-(iv), (c)-(iii), (d)-(i)

C (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

D (a)-(i), (b)-(iv), (c)-(ii), (d)-(iii)

Q. The method used for the purification of Indium is :

25th Feb 2021

A. Zone refining

B. Vapour phase refining

C. Liquation

D. Van Arkel method