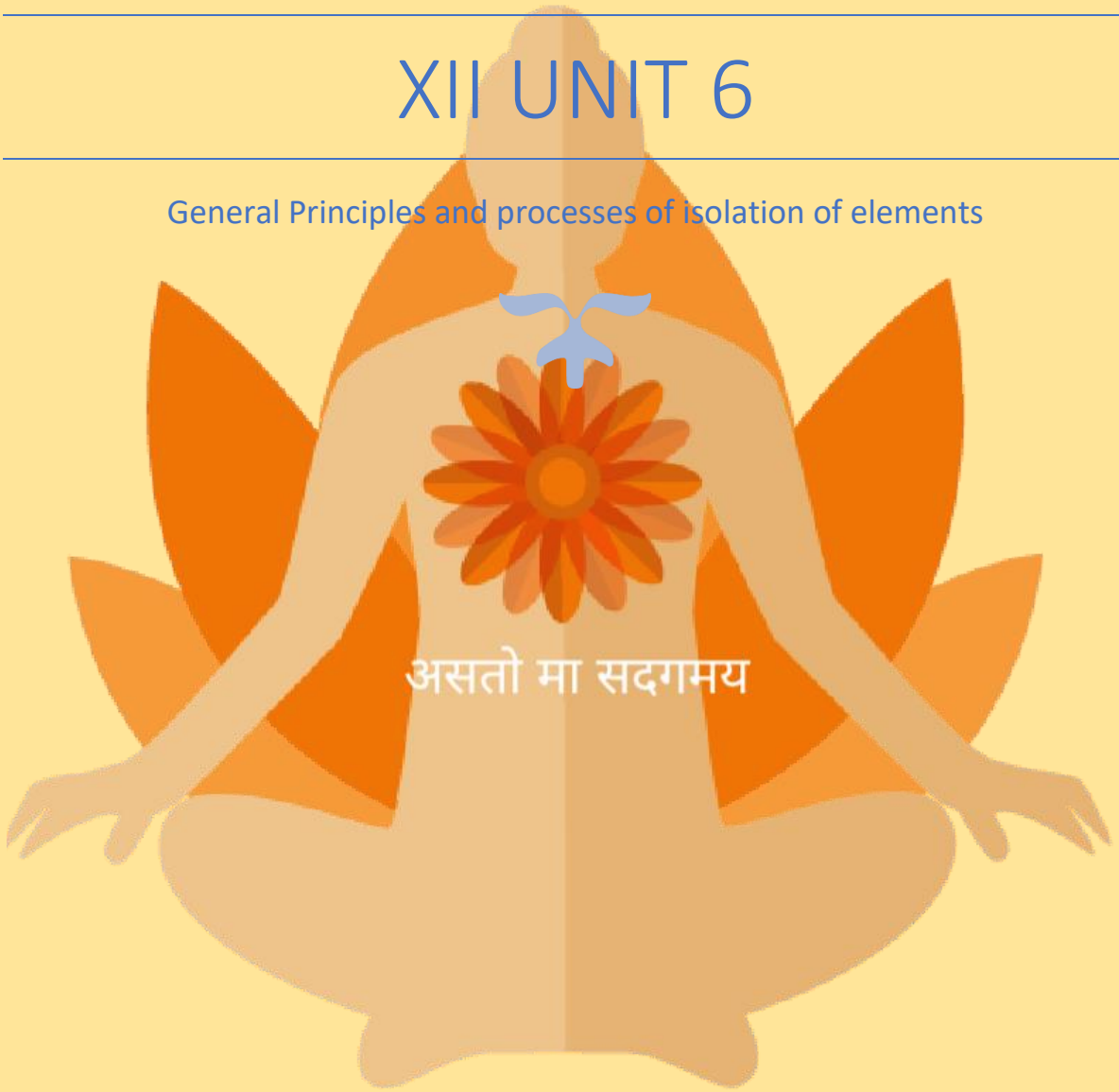
XII UNIT 6

General Principles and processes of isolation of elements



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Short & Long Question Answer - Isolation of Elements

Q.1 What is slag?

Ans. It is easily fusible material fusible material, which is formed when gangue still
present in roasted ore combines with the flux.
e.g. CaO (flux) + SiO_2 (gangue) $\rightarrow CaSiO_3$ (slag)

Q.2 Which is better reducing agent at 983K, carbon or CO?

Ans. CO, (above 983K CO being more stable & does not act as a good reducing agent but
carbon does.)

Q.3 At which temperature carbon can be used as a reducing agent for Foe?

Ans. Above 1123 K, carbon can reduce FeO to Fe.

Q.4 What is the role of graphite rods in electrometallurgy of aluminum?

Ans. Graphite rods act as anode, are attacked by oxygen to form CO2 and so to be replace
time to time.

Q.5 What is the role of cryolite in electrometallurgy of aluminum?

Ans. alumina cannot be fused easily because of high melting point. Dissolving of alumina
in cryolite furnishes Al^{3+} ions, which can be electrolyzed easily.

Q.6 What are depressants?

Ans. It is possible to separate two sulphide ore by adjusting proportion of oil to water in
froth flotation process by using a substance known as depressant. e.g. NaCN is used to
separate ZnS and PbS.

Q.7 Copper can be extracted by hydrometallurgy but not Zn. Why?

Ans. The E^0 of Zn is lower than that of Cu thus Zn can displace Cu^{2+} ion from its solution.
On other hand side to displace Zn from Zn^{2+} ion, we need a more reactive metal than it.

Q.8 Give name and formula of important ore of iron.

Ans. Haematite - Fe_2O_3 , Magnetite -Fe_3O_4 , Iron pyrites FeS_2 .

Q.9 Give name and formula of important ore of Copper.

Ans. Copper pyrites $CuFeS_2$, Malachite $CuCO_3$. Cu (OH) $_2$, Cuprite Cu_2O.

Q.10 Give name and formula of important ore of Zinc.

Ans. Zinc blende - ZnS, Calamine- $ZnCO_3$, Zincite - ZnO

Q.11 Describe the method of refining of nickel.

Ans. In the Mond Process, Ni is heated in a stream of CO forming a volatile complex, which then decomposes at higher temperature to give Ni.
At 330-350K: - Ni + 4CO $\rightarrow$ Ni (CO) $_4$

At 450-470K $Ni(CO)_4 \rightarrow Ni + 4\ CO$

Q.12 What is Zone Refining? Explain with example.

Ans. Zone refining is a method of obtaining a metal in very pure state. It is based on the principal that impurities are more soluble in molten state of metal than solidified state.

In this method, a rod of impure metal is moved slowly over circular heater. The portion of the metal being heated melts & forms the molten zone. As this portion of the rod moves out of heater, it solidified while the impurities pass into molten zone. The process is repeated to obtain ultrapure metal and end of rod containing impure metal cutoff.

Q.13 Write the principal of electro-refining.

Ans. In this method of purification impure metal is made Anode and pure metal is made the cathode. On passing electricity, pure metal is deposited at the cathode while the impurities dissolve dissolve in solution as anode mud. E.g. electro- refining of copper:-

At Cathode: - $Cu^{2+} + 2e \rightarrow Cu$

At Anode: - $Cu \rightarrow Cu^{2+} + 2e$

Q.14 Write difference between calcinations and roasting.

Ans. Roasting: It is used to convert sulphide ores into oxides. Roasting involves strong heating of iron ore in the presence of excess air. For example, copper sulphide in copper glance ore is converted into copper (I) oxide by heating it in the presence of oxygen.

$$\underset{Copper(I)sulphide}{2Cu_2S(s)} + \underset{Oxygen}{3O_2(g)} \xrightarrow{Roasting} [\ \underset{Copper(I)oxide}{2Cu_2O(s)} + \underset{Sulphur\ dioxide}{2SO_2(g)}\uparrow$$

Calcination: It is used to convert carbonate ores into oxides. Calcination involves strong heating of the ore in the absence of air. For example, calamine ore, which is chemically zinc carbonate, is converted into zinc oxide by heating it in the absence of air.

$$\underset{\text{Calamine ore}}{2ZnCO_3(s)} \xrightarrow{Calcination} \underset{Zinc\ oxide}{2ZnO(s)} + \underset{Carbon\ dioxide}{2CO_2(g)}\uparrow$$

Q.15 Describe the method of refining of Zirconium and Titanium.

Ans. Van Arkel process is used for obtaining ultrapure metal. The impure metal is converted into volatile compound, which then decomposes electrically to get pure metal. At 850K: - Zr impure) + $2\ I_2 \rightarrow ZnI_4$

At 2075K:- $ZnI_4 \rightarrow Zr$ (pure) + $2\ I_2$

Q.16 Out of C & CO, which is better reducing agent for ZnO?

Ans. Since free energy of formation of CO from C is lower at temperature above 1120K
while that of CO_2 from carbon is lower above 1323K than free energy of formation of
ZnO. However, the free energy of formation of CO_2 from CO is always higher than that of
ZnO. Hence, C is better reducing agent of ZnO.

Q.17 The value of ΔfG^0 for Cr_2O_3 is -540kJ/mole & that of Al_2O_3 is -827kJ/mole. Is the reduction of Cr_2O_3 possible with aluminium?

Ans. The desired conversion is
$4\ Al + 2Cr_2O_3 \rightarrow 2Al_2O_3 + 4Cr$
It is obtained by addition of following two reactions:-
$4Al + 3O_2 \rightarrow 2\ Al_2O_3\ \Delta f\ G^0 = -827 kJ/mole$
$2Cr_2O_3 \rightarrow 4Cr + 3O_2\ \Delta f\ G^0 == + 540\ kJ/mole$
Therefore, A G0 for desired reaction is -827+540=-287, as a result reduction is possible.

Q.18 Why copper matte is put in silica lined converter?

Ans. Copper matte consists of Cu_2S and FeS. When blast of air is passed through molten
matte in silica- lined converter, FeS present in matte is oxidized to FeO, which combines
with silica to form slag.
I. $2FeS + 3O_2 \rightarrow 2FeO + 2\ SO_2$,
II. $FeO + SiO_2 \rightarrow FeSiO_3$(slag),
III. $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$,
IV. $2Cu_2O + 2Cu_2S \rightarrow 6Cu + SO_2$

Q.19 What is meant by term chromatography?

Ans. Chromato means Colour and graphy means writing because the method was first
used for separation of coloured substance. It is based on selective distribution of various
constituents of a mixture between two phases, a stationary phase and a moving phase. The stationary phase can be either solid or liquid on solid support.