

Class: 12
Subject: Chemistry
Topic: General principles and isolation of elements
No. of Questions: 27

1. What happens when zinc oxide is treated with excess of sodium hydroxide solution?

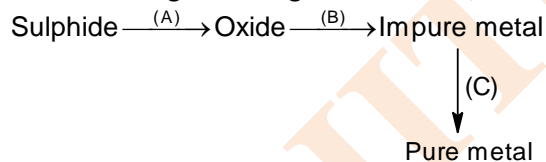
Sol. ZnO is dissolved as Zincate ion.
$$\text{ZnO} + 2\text{NaOH} \longrightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2\text{O}$$

2. To prevent the air oxidation of aqueous solutions of Sn^{2+} to Sn^{4+} , sometimes metallic tin is kept in contact with the Sn^{2+} . Suggest how this helps to prevent the oxidation.

Sol.
$$\text{Sn}^{4+} + \text{Sn} \longrightarrow 2\text{Sn}^{2+}$$

Hence Sn reduces Sn^{4+} to Sn^{2+} .

3. From the following metallurgical flow chart, identify steps A, B and C.



Sol. (A) Roasting
(B) Reduction by carbon or more electropositive metal
(C) Electrolysis

4. In what form carbon is present in white cast iron?

Sol. It is present as cementite i.e. Fe_3C .

5. Write down the chemical formula of the following ores.

- (i) Niccolite
- (ii) Spodumene
- (iii) Tinstone

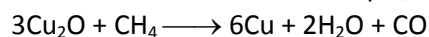
Sol. (i) NiAs
(ii) $\text{LiAl}(\text{SiO}_3)_2$
(iii) SnO_2

IIT Level Question

6. What is the main difference between cupellation and poling?

Sol. Both cupellation and poling are used for refining of metals. Cupellation is applied when impure metal contain impurities of other metals which forms volatile oxides. For example traces of lead are removed from silver by heating impure silver with a blast of air in a cupel (an oval shaped pan made up of bone ash) in which lead is oxidised to lead oxide (PbO) which being volatile escapes leaving behind pure silver.

Poling is used for refining of such metals which contain impurities of its own oxide. In this process, the molten impure metal is stored with green wooden poles. At the high temperature of the molten metal, wood liberates methane which reduces the oxide of the metal to free metal. For example,



7. A metal (A) with melting point 232°C when reacts with acid, dilute HNO_3 , produces (B) and a gas (C). (C) is brown coloured gas. (C) on reaction with water produces acids (D) and (E). (B) on heating decomposes to its oxide (F) which is a white coloured compound. Chloride of (A) will produce grey precipitate of (G) with mercurous chloride. Identify (A) to (G).

Sol. A : Sn
B : $\text{H}_2\text{Sn}_5\text{O}_{11} \cdot 4\text{H}_2\text{O}$
C : NO_2
D : HNO_2
E : HNO_3
F : SnO_2
G : Hg

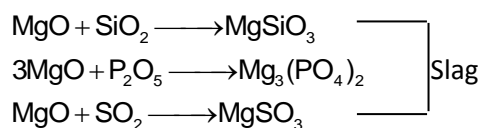
8. Match the following:

Column (I)	Column (II)
1. Pb_3O_4	a. Rust proofing
2. PbCrO_4	b. White lead
3. $\text{Pb}(\text{CO}_3)_2 \cdot \text{Pb}(\text{OH})_2$	c. Road signs
4. Ca_2PbO_4	d. Red lead

Sol. 1. (d)
2. (c)
3. (b)
4. (a)

9. Explain the following:
 (i) Why is chalcocite roasted and not calcined during recovery of copper?
 (ii) Zinc and not copper is used for the recovery of Ag from the complex $[\text{Ag}(\text{CN})_2]^-$.
 (iii) Magnesium oxide is used for the lining in steel making furnace.

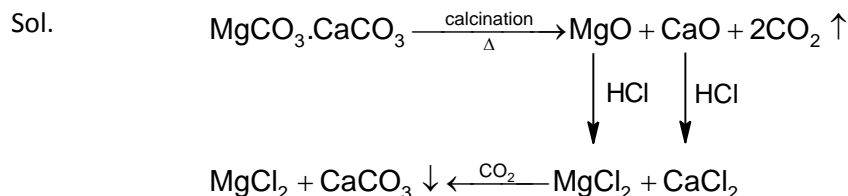
- Sol. (i) As chalcocite is a sulphide ore and it is to be converted into oxide, thus roasting is done instead of calcinations.
 (ii) Zinc is used for the recovery of Ag from $[\text{Ag}(\text{CN})_2]^-$ because Zn is cheaper than copper and is more powerful reducing agent in comparison to copper.
 (iii) Magnesium oxide acts as a flux to remove impurities of Si, P and sulphur through slag formation



10. Assign suitable terms to the following:
 (i) Materials which can withstand very high temperature without melting and softening.
 (ii) Sulphide ores are generally heated in a stream of air.
 (iii) The substances used for the removal of gangue from the ores in the form of slags.
 (iv) Two metals which are manufactured by the electrolysis of their fused salts.
 (v) Two metals used for reduction in metallurgical processes.

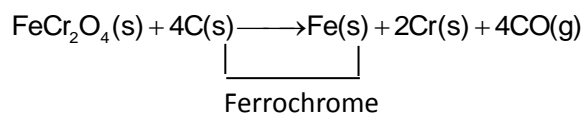
- Sol. (i) Refractory materials
 (ii) Roasting
 (iii) Fluxes
 (iv) Sodium, Calcium
 (v) Aluminium, magnesium, iron or sodium

11. Dolomite can also be treated to get MgCl_2 which in turn is electrolysed to get Mg (Dow natural brine process). Give reactions of this process.

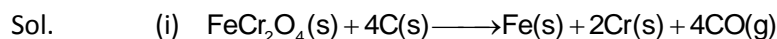


On passing CO_2 into aq. MgCl_2 and CaCl_2 solution, CaCO_3 is precipitated leaving MgCl_2 soluble.

12. Ferrochrome, an iron-chromium alloy used in making stainless steel, is produced by reducing chromite (FeCr_2O_4) with coke:-



- (i) How many kilograms of chromium can be obtained by the reaction of 236 kg of chromite with an excess of coke?
 (ii) How many litres of CO at 25°C and 740 mm Hg are obtained as a by-product?



224 kg of chromite gives = 104 kg of Cr

$$236 \text{ kg of chromite gives} = \frac{104 \times 236}{224} \text{ kg of Cr}$$

$$= 109.57 \text{ kg Cr}$$

- (ii) 224 kg chromite gives = 112 kg CO

$$\text{Thus, } 236 \text{ kg chromite gives} = \frac{112 \times 236}{224} \text{ kg CO}$$

$$= 118 \text{ kg CO} = 4214.2857 \text{ mol}$$

As $PV = nRT$

$T = 298 \text{ K}$

$$P = \frac{740}{760} \text{ atm}$$

$$\therefore V = \frac{nRT}{P} = \frac{4214.28 \times 0.0821 \times 298 \times 760}{740}$$

$$= 105.89 \times 10^3 \text{ Litres}$$

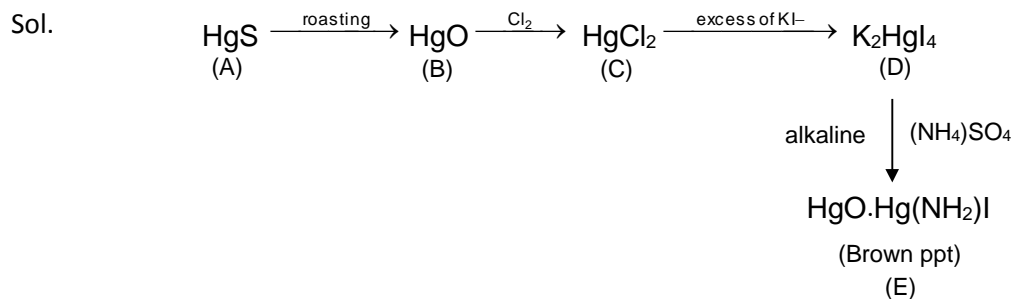
13. Explain the term Nitriding?

Sol. It is a process of heating mild steel containing 1 percent aluminium in an atmosphere of NH_3 at 550°C to 600°C . Both iron and aluminium reacts with nitrogen formed by the dissociation of NH_3 to form nitrides which produce a compact and hard surface. Sometime pure N_2 gas is diffused on the surface layer. Such steels are used for making cylinder bares.

14. Explain the difference between leaching and levigation.

Sol. Levigation involves removal of lighter particles by washing with water in specially designed tables, called Wilfley tables. While leaching is treatment of ore with suitable reagent which can selectively dissolve the ore in which impurities remain insoluble.

15. A sulfide ore (A) on roasting leaves a residue (B). (B) on heating with chlorine gives (C), soluble in water, addition of excess potassium iodide to a solution of (C) gives a solution (D). A brown precipitate (E) is formed when a solution of ammonium sulfate is added to an alkaline solution of (D). Identify (A) to (E).



16. (i) List three metals that are found in nature as oxide ores.
 (ii) If earth had the atmosphere that contained only O_2 and SO_2 and no CO_2 then what would be the composition of the minerals you would expect to find.

- Sol: (i) Fe as Fe_3O_4 , Ti as TiO_2 , Sn as SnO_2
 (ii) MSO_4 , MSO_3 , Oxide

17. An ore which does not contain oxygen is
 (A) bauxite (B) haematite
 (C) chalcopryite (D) calamine

- Sol: (C)
 Chalcopryite is a sulphide ore.

18. Match LIST-I, LIST-II and LIST - III.

LIST - I		LIST - II (Method of extraction)	LIST - III
(a)	Iron	Self reduction process	Cryolite
(b)	Silver	Electrolytic reduction	SiO_2
(c)	Copper	Carbon reduction	CaO
(d)	Aluminium	Cyanide process	None

Sol:

LIST - I		LIST - II (Method of extraction)	LIST - III
(a)	Iron	Carbon reduction process	CaO
(b)	Silver	Cyanide process	None
(c)	Copper	Self reduction process	SiO_2
(d)	Aluminium	Electrolytic process	Cryolite

19 The roasting of an ore of a metal usually results in conversion of the metal to the oxide. Why does the roasting of cinnabar, HgS, produce metallic mercury rather than an oxide of mercury?

Sol: $\text{HgS} \longrightarrow \text{HgO} \longrightarrow \text{Hg}$

Since Hg lies much below in the electrochemical series hence HgO is further reduced to Hg.

20. Ore dressing of iron is done by
(A) froth floatation process (B) magnetic separation
(C) hand picking (D) all of the above

Sol: (C)

21. Describe the method of refining of nickel.

Sol: 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.



22. What is zone refining?

Sol: 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 molten zone. The process is repeated to obtain ultrapure metal and end of rod containing impure metal cutoff.

23. What is Van –Arkel process?

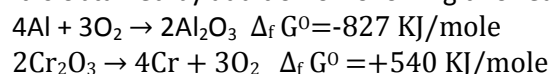
Sol: Van Arkel process is used for obtaining ultrapure metal. The impure metal is converted into volatile compound, which decomposes electrically to get pure metal.



24. The value of $\Delta_f G^\circ$ for Cr_2O_3 is -540KJ/mole & that of Al_2O_3 is -827 KJ/mole . Is the reduction Cr_2O_3 possible with aluminium?

Sol: The desired conversion is $4 \text{ Al} + 2\text{Cr}_2\text{O}_3 \rightarrow 2\text{Al}_2\text{O}_3 + 4\text{Cr}$

It is obtained by addition of following two reactions:-



Therefore, ΔG° for desired reaction is $-827+540 = -287$, as a result reduction is possible.

25. Why is reduction of metal oxide easier if metal formed is in liquid state at temperature of reduction.

Sol: The entropy of a substance is higher in liquid state than solid state. In the reduction of metal oxide, the entropy change will be positive if metal formed is in liquid state. Thus, the value of ΔG° becomes negative and reduction occurs easily.

26. What is meant by term chromatography?

Sol: 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.

27. Why copper matte is put in silica lined converter?

Sol: 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.

