Chapter_06

General Principles and Processes of Isolation of Elements

Practice Questions

1. What percentage of carbon is found in wootz steel?
(a) 2-2.5% *(b)* 1.0-1.9%
(c) 3-4.5% *(d)* 0.5-1%

2. Which of the following elements occurs in free state?
(a) Iodine *(b)* Sulphur
(c) Phosphorus *(d)* Magnesium

3. The ore that contains both iron and copper is
(a) malachite *(b)* azurite
(c) dolomite *(d)* copper pyrites

4. Which one of the following is a mineral of iron?
(a) Malachite *(b)* Cassiterite *(c)* Pyrolusite *(d)* Magnetite

5. The froth stabilisers among the following are
(a) pine oil *(b)* cresol
(c) aniline *(d)* Both (b) and (c)

6. An ore contains lead sulphide and zinc sulphide. If froth floatation process is used, these can be separated
(a) by using excess of pine oil
(b) by using collection and froth stabilisers
(c) by adjusting proportion of oil to water or using depressants
(d) by using some suitable solvent in which either lead sulphide or zinc sulphide is soluble.

7. Froth floatation process for the concentration of ores is an illustration of the practical application of
(a) absorption *(b)* adsorption
(c) sedimentation *(d)* coagulation

8. The ore which is concentrated by leaching process is
(a) cuprite *(b)* argentite
(c) sphalerite *(d)* haematite

9. Extraction of gold and silver involves leaching with CN^- ion. Silver is later recovered by
(a) liquation *(b)* distillation
(c) zone refining *(d)* displacement with Zn

10. Which of the following is not true in the context of roasting process?
(a) The ore is heated in a regular supply of air
(b) The sulphide ores of copper are heated in reverberatory furnace
(c) $2ZnS + 3O_2 \longrightarrow 2ZnO + 2SO_2$ is a reaction that involves roasting process
(d) Mg, Al and Zn oxides can be reduced by roasting process

11. If the sulphide ores of copper contains iron, then before heating, it is mixed with
(a) silica *(b)* coke
(c) carbon *(d)* coal

12. Sulphide ores are common for which of the following metals.
(a) Ag, Cu and Pb
(b) Ag, Cu and Sn
(c) Ag, Mg and Pb
(d) Al, Cu and Pb

13. Roasting of sulphides gives the gas X as a by-product. This is a colourless gas with choking smell of burnt sulphur and causes great damage to respiratory organs as a result of acid rain.
Its aqueous solution is acidic acts as a reducing agent and its acid has never been isolated.
The gas X is
(a) H_2S *(b)* SO_2
(c) CO_2 *(d)* SO_3

14. Auto-reduction is not involved in the extraction of
(a) copper *(b)* mercury *(c)* lead *(d)* aluminium

15. Given, $\Delta G_f^\circ (CuO) = -129.7\ kJ\ mol^{-1}$,
$\Delta G_f^\circ (H_2O) = -237.2\ kJ\ mol^{-1}$ and
$\Delta G_f^\circ (CO) = -137.2\ kJ\ mol^{-1}$
The better reducing agent for the reduction of CuO is
(a) H_2 *(b)* CO
(c) C *(d)* Any of these

16. In the graph of $\Delta_r G^\circ$ *vs* T for the formation of oxides,
(a) Cu_2O line is almost at the top
(b) lines (C, CO) and (C, CO_2) are at much higher positions in the graph
(c) Both (a) and (b)
(d) Neither (a) nor (b)

17. Considering Ellingham diagram, which of the following metals can be used to reduce alumina?
(a) Mg *(b)* Zn
(c) Fe *(d)* Cu

18. The reducing agent used to reduce iron oxide in blast furnace is
(a) silica *(b)* CO
(c) C *(d)* lime

19. Which of the following elements is present as the impurity to the maximum extent in the pig iron?
(a) Carbon *(b)* Silicon
(c) Phosphorus *(d)* Manganese

20. Silica is added to the copper pyrites ore, when taken in reverberatory furnace for extraction of Cu.
This is because
(a) it removes the impurity of iron oxide as slag
(b) it reacts with Cu_2O to form slag
(c) it reduces Cu_2O to Cu
(d) it helps in separation of Cu from Fe

21. In the extraction of copper from its sulphide ore, the metal finally obtained by the reduction of cuprous oxide with

(a) copper (I) sulphide (Cu_2S)
(b) sulphur dioxide (SO_2)
(c) iron sulphide (FeS)
(d) carbon monoxide (CO)

22. In electrolytic refining method,

(a) the impure metal is made to act as anode
(b) a strip of the pure metal is used as cathode
(c) anode and cathode are kept in a suitable electrolytic bath containing soluble salt of the same metal
(d) All the above are true

23. The Mond process is used for the

(a) purification of Ni *(b)* extraction of Mo
(c) purification of Zr & Ti *(d)* extraction of Zn

24. Chromatographic method is based on the principle that

(a) different components of a mixture are differently adsorbed on an adsorbent
(b) same components of a mixture are differently adsorbed on an adsorbent
(c) different components of a mixture are differently absorbed on an absorbent
(d) None of the above

25. Stainless steel is rust proof because

(a) an oxide layer of chromium protects it.
(b) a stoichiometric compound is formed.
(c) interstitial compound is formed between Cr and Fe.
(d) galvanisation of iron takes place.

ANSWERS

1. (b)	**2.** (b)	**3.** (d)	**4.** (d)	**5.** (d)	**6.** (c)	**7.** (b)	**8.** (b)	**9.** (d)	**10.** (d)
11. (a)	**12.** (a)	**13.** (b)	**14.** (d)	**15.** (a)	**16.** (a)	**17.** (a)	**18.** (b)	**19.** (a)	**20.** (a)
21. (a)	**22.** (d)	**23.** (a)	**24.** (a)	**25.** (b)					

Hints & Solutions

1. (*b*) Wootz steel contains high proportion of carbon that ranges between 1.0% and 1.9%.

2. (*b*) A few elements like carbon, sulphur, gold and noble gases occur in free state. Iodine, phosphorus and magnesium are reactive and found in combined state.

3. (*d*) Zincite (ZnO) and cuprite (Cu_2O) are the examples of oxide ores while copper glance (Cu_2S) is an example of sulphide ores.

4. (*d*) The chemical formulas of the minerals given in the options are as follows :
Malachite-$CuCO_3 \cdot Cu(OH)_2$, Cassiterite-SnO_2
Pyrolusite-MnO_2, Magnetite-Fe_3O_4
Thus, magnetite is a mineral of iron.

6. (*c*) The given ore contains lead sulphide and zinc sulphide. It is possible to separate two sulphide ores by adjusting proportion of oil to water or by using depressants. The depressant used in the case of given ore is NaCN.

8. (*b*) Argentite and bauxite are the ores of less reactive and highly reactive metals and are soluble in some suitable reagent, that's why these are concentrated by leaching. Thus, among the given ores, the one which is concentrated by leaching process.

9. (*d*) Extraction of gold and silver involves leaching with CN^- ion. Silver is later recovered by displacement of zinc (Zn).

In the metallurgy of silver or gold, the respective metal is leached with a dilute solution of NaCN or KCN in the presence of air to obtain the metal complex in solution. From the complex, metal is obtained through the displacement reaction. In general,

$$4M(s) + 8CN^-(aq) + 2H_2O(aq) + O_2(g) \longrightarrow 4[M(CN)_2]^-(aq) + 4OH^-(aq)$$

$$2[M(CN)_2]^-(aq) + Zn(s) \rightarrow [Zn(CN)_4]^{2-}(aq) + 2M(s)$$

M = Ag or Au

This method is known as MacArthur-Forrest cyanide process.

10. (*d*) Due to comparatively higher reactivity, oxides of Mg, Al and Zn can not be reduced by roasting process. In case of such oxides electrolytic process is used.

11. (*a*) If the sulphide ores of copper ore contains iron, it is mixed with silica before heating. Iron oxide 'slags off' as iron silicate and copper is produced in the form of copper matte which contains Cu_2S and FeS.

12. (*a*)

Element	Ores	Name
Ag	Ag_2S	Argentite
Cu	$CuFeS_2$	Copper pyrites
Pb	PbS	Galena
Sn	SnO_2	Cassiterite
Mg	$MgCO_3 \cdot CaCO_3$	Dolomite
Al	$Al_2O_3 \cdot xH_2O$	Bauxite

Thus, sulphide ores are common for the metals Ag, Cu and Pb.

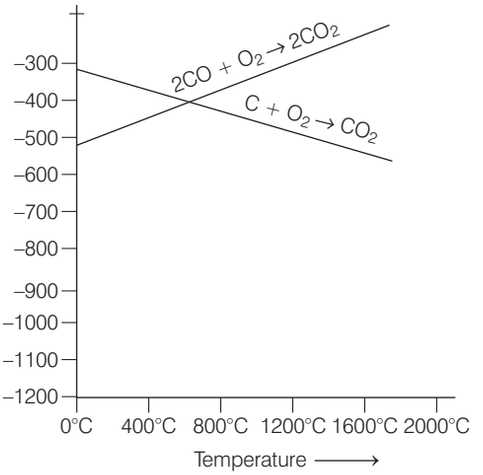
13. (*b*) Roasting of sulphides give SO_2 gas as a by-product.
The reaction is given as follows :

$$2M_2S + 3O_2 \xrightarrow{\Delta} 2M_2O + 2SO_2$$

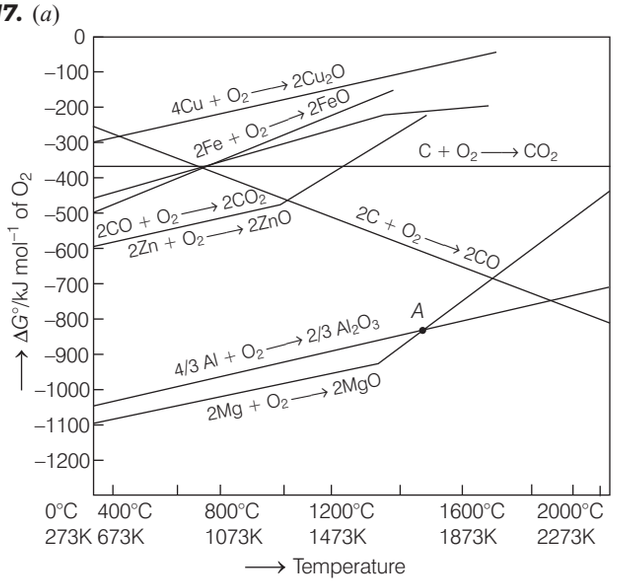
This gas exhibits all the characteristics given in the question.

14. (*d*) Less electropositive metals like copper, mercury and lead involve auto-reduction in their extraction process.
Auto-reduction is not involved in the extraction of aluminium as it is more electropositive.

16. (*a*) In the graph of $\Delta_r G°$ *vs* T for the formation of oxides, Cu_2O line is almost at the top. So, it is quite easy to reduce oxide ores of copper directly to the metal by heating with cake. The lines (C, CO) and (C, CO_2) are at much lower positions in the graph particularly after 500-600 K.



17. (*a*)



From the Ellingham diagram the plot for the formation of MgO intersects the plot for the formation of Al_2O_3 at around 1500°C. Thus, Mg can be use to reduce alumina at that temperature.

18. (*b*) Carbon monoxide is the reducing agent which reduces iron oxide (Fe_2O_3) to iron in the blast furnace.

$$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3O_2 \uparrow$$

19. (*a*) Pig iron contains about 4% carbon (major impurity) and other impurities (S, P, Si, Mn) in trace amounts.

20. (*a*) Silica is added to the copper pyrites ore when taken in reverberatory furnace for extraction of copper because silica removes the impurity of FeO present in the copper pyrites as slag ($FeSiO_3$).

21. (*a*) In the extraction of copper from its sulphide ore, the metal finally obtained with Cu_2S. Because when ore is subjected to roasting, some of it oxidised to Cu_2O which reacts with the remaining Cu_2S (sulphide ore) to give copper metal.

$$Cu_2S + 2Cu_2O \longrightarrow 6Cu + SO_2 \uparrow$$

22. (*d*) In electrolytic refining method, the impure metal is made to act as anode.

A strip of the same metal in pure form is used as cathode.

They are kept in a suitable electrolytic bath containing soluble salt of the same metal. The more basic metal remains in the solution and the less basic ones go to the anode mud.

Anode $M \longrightarrow M^{n+} + ne^-$

Cathode $M^{n+} + ne^- \longrightarrow M$

23 (*a*) Mond process is used in the purification of Ni. It is a vapour phase refining process.

It is based on the principle that Ni is heated in the presence of carbon monoxide to form nickel tetracarbonyl, which is a volatile complex. This complex is then decomposed by subjecting it to a higher temperature (450-470 K) to obtain pure nickel metal.