1. (a)Name the three classes in which elements are classified. Which was the first metal used by man?

(b) Name the metal and non-metal present in abundance in the earth crust.

Solution:

(a) The three classes in which elements are classified are – metals, non-metals and metalloids. The first metal that was used by man was Copper. Copper was used to make weapons, utensils and for multiple purposes back in those days.

(b) The most abundant metal present in the earth's crust is Aluminum and the most abundant non-metal present in the earth's crust is Oxygen

2. Name the metal which is a constituent of:

(a) blood pigment (b) plant pigment

Solution:

The metal which is a constituent of the following are:

(a) Blood pigment – iron is a component of haemoglobin

(b) Plant pigment – magnesium is found in chlorophyll

3. State the position of the following in the periodic table:

(a) Alkali metals (b) Alkaline earth metals (c) Halogens (d) Aluminum

Solution:

The position of the following in the periodic table are:

(a) Alkali metals – they are the elements belonging to Group I in the periodic table. They are known to form strong alkalis with water. The outer electronic configuration of these elements is ns1

(b) Alkaline earth metals – they are the elements belonging to Group II. The electronic configuration of these metals is ns2

(c) Halogens – These are the elements belonging to Group 17^{th} in the periodic table. The electronic configuration is ns2 np5

(d) Aluminum – It belongs to the Boron family, 13^{th} group from the periodic table. The electronic configuration is ns2 np1

4. Why do gold ornaments look new even after several years of use?

Solution:

Ornaments made out of gold appear new even after several years of usage, this is because, gold is less reactive. This can be observed in the reactivity series, it is placed low. Hence when gold comes in contact with atmospheric air or water it does not react, causes no corrosion. This is the reason why it looks new and does not lose its glitter and shine even after years.

5. Explain the following terms:

(a) ore (b) Gangue (c) Metallurgy

Solution:

(a) Ore – These are the minerals from which metals are extracted on a commercial scale at a relatively lower cost with least efforts.
(b) Gangue – Matrix or gangue are the earthly impurities that are typically mixed with minerals of metals. Example – sand, mud, soil limestone
(c) Metallurgy – it is a stream of science which deals with the extraction of metals in their purest form from their ores that are found occurring naturally in the environment

6. Which metal can be extracted from each one of the following ores:
(a) bauxite (b) calamine (c) haematite
Solution:
The metals that can be extracted from each one of the following ores are as follows:
(a) Bauxite - Aluminum
(b) Calamine - Zinc
(c) Haematite - Iron

7. Give the principles of:
(a) Hydrolytic method
(b) Froth floatation process
(c) Electromagnetic separation
Solution:
The principles of the following are:

Method	**Principle**
Hydrolytic method	The main criterion is the difference in densities of the ore and the gangue
Froth floatation process	The procedure depends on the preferential wettability of the gangue particles by water and that ore with pine oil
Electromagnetic separation	Magnetic properties of the ore

8. (a) Name the methods by which concentrated ore is converted to metallic oxide
(b) State three objectives achieved during the roasting of ores.
Solution:
(a) The methods by which concentrated ore is converted into metallic oxides are calcination and roasting. Concentrated ores are converted to their oxides as oxides are easier to reduce to metals. Hence these two methods are used to convert depending on the nature of the ores.
(b) Roasting is a process wherein concentrated ore is heated to a high temperature in the presence of air. The three objectives achieved during the roasting of ores are:
- Removal of moisture
- Oxidization of organic matter and its removal
- It makes the ore porous and hence causes the ores to get heated uniformly

9. Name
(a) the process involved in
(i) dressing of the ores (ii) refining of the ores

(b) two metallic oxides which cannot be reduced by carbon, carbon monoxide or hydrogen

Solution:

(a) The processes involved in:

(i) Dressing of ores are:

- Hydraulic washing
- Magnetic separation
- Froth floatation
- Chemical method/Leaching

(ii) Refining of ores are:

- Distillation
- Liquation
- Electro refining

(b) The two metallic oxides that cannot be reduced by carbon, carbon monoxide or hydrogen are oxides of sodium and potassium.

10. Why does iron or zinc does not occur freely in nature?

Solution:

Both iron and zinc are highly reactive hence do not occur in nature in their free states. Their sulphides, oxides and carbonates - their compounds of metals occur in nature.

11. What do you observe when hydrogen is passed over heated copper oxide?

Solution:

When hydrogen gas is made to pass over the heated copper oxide (CuO), the black coating present on the surface tends to change to a reddish-brown shade due to the occurrence of reverse reaction thereby producing copper. The latter reaction is known as redox reaction or oxidation-reduction reaction

12. (a)Name an ore of zinc
(b) Which process is applied to concentrate it?
(c) How is concentrated ore changed to oxide?

Solution:

(a) One ore of zinc is Zinc blende. Its chemical name is Zinc sulphide and its formula is ZnS.

(b) The process that is applied to concentrate it is froth floatation process

(c) The concentrated ore is changed to oxide by heating Zinc blende (ZnS) in the presence of excess air. The reaction is as follows:

$$2ZnS + 3O_2 \overset{800^\circ C}{\rightarrow} 2ZnO + 2SO_2$$

13. An ore on being heated in air forms sulphorous anhydride. Write the process used for the concentration of this ore.

Solution:

The process used for the concentration of this ore is froth floatation. This process depends on the preferential wettability of the gangue particles by water and that of the ore with pine oil.

13. (a) Define roasting. Name an ore on which roasting is done. Give balanced equation.
(b) Define calcination. Give an example and equation for calcination.

Solution:

(a) Roasting is a process wherein concentrated ore is heated to a high temperature in the presence of air. An ore on which roasting is carried out is Zinc blende (ZnS) to yield its oxide, zinc oxide
(b) (ZnO). The equation is as follows:

$$2ZnS + 3O_2 \overset{800^\circ C}{\rightarrow} 2ZnO + 2SO_2$$

(c) It is the process of heating concentrated ores such as carbonate or hydrated oxide in the absence of air to a high temperature. The temperature must be insufficient in melting the ore.
Example – Metal carbonates decompose to give metal oxides

$$ZnCO_3 \rightarrow ZnO + CO_2$$

14. Choose the correct option:
(a) The metal other than aluminum, which has a strong affinity for oxygen is:
(A) Copper
(B) Magnesium
(C) Silver
(D) Gold
(b) A metallic oxide which cannot be reduced by normal reducing agents:
(A) Zinc oxide
(B) Magnesium oxide
(C) Copper (II) oxide
(D) Iron (III) oxide

Solution:

(a) Answer is (B) Magnesium
(b) Answer is (A) Zinc oxide

15. Fill in the blanks:
(a) Usually _____ (sulphide/carbonate) ores are subjected to _____ (calcination/roasting) which is done in the absence of air
(b) Zinc blende is converted to oxide by _____ (roasting/calcination) process.
(c) Froth floatation process is generally used to concentrate _____ ores (sulphides/carbonate)

Solution:

(a) Carbonate, calcination
(b) Roasting
(c) Sulphides

16. State the position of aluminum in the periodic table.

Solution:

Aluminum, the most abundant metal in the earth's crust has the following position in the periodic table – Period 3, Group IIIA (13)

17. (a) Give the chemical names and formulae of main ores of (i) aluminum (ii) iron (iii) zinc
(b) Which impurities are present in bauxite?
(c) What is red mud, how is it removed?

Solution:

(a) The chemical names and formulae of the main ores are as given below:

Aluminum ores		
Name of the ore	**Chemical name**	**Formula**
Cryolite	Sodium aluminum oxide	Na_3AlF_6
Bauxite	Hydrated aluminum oxide	$Al_3O_3.2H_2O$
Iron ores		
Name of the ore	**Chemical name**	**Formula**
Brown heamatite	Hydrated ferric oxide	$2Fe_2O_3.3H_2O$
Red heamatite	Anhydrous ferric oxide	Fe_2O_3
Zinc ores		
Name of the ore	**Chemical name**	**Formula**
Zinc blende	Zinc sulphide	ZnS
Zincite	Zinc oxide	ZnO

(b) Close to 60% of the bauxite ore is composed of aluminum oxide. The other constituents are ferric oxide, sand and titanium oxide

(c) Red mud is referred to the insoluble impurities. It consists of sand, ferric oxide etc that are removed by filtration.

18. For each substance listed below, explain its significance in the extraction of aluminium:
(a) bauxite
(b) sodium hydroxide
(c) Cryolite
(d) Graphite

Solution:

The significance of each is as listed below:

Name of the substance	**Significance in extraction of aluminum**
Bauxite	Aluminum is extracted from the bauxite ore as close to 60% of the bauxite ore is composed of aluminum oxide
Sodium hydroxide	In order to obtain pure aluminum oxide, the ore from which aluminum is extracted is first treated with sodium hydroxide solution
Cryolite	It is used to reduce the fusion temperature and increases conductivity
Graphite	Used in the electrolytic reduction as thick graphite rods

19. What is an alloy? How do the properties of an alloy differ from its constituents?

Solution:

An alloy is a homogenous mixture of two or more metals or one of or more metals with a few non-metallic elements.

The properties of an alloy are different from its constituents. For instance, gold is too delicate and soft for usage without a slight percentage of copper. The bell metal is more sonorous than tin or copper. A small percentage of molybdenum enhances the wear resistance and toughness of steel. An alloy of cobalt, nickel and aluminum can lift a mass 60 times more than its own mass. The elements added in addition enhances the toughness, wear resistance and other such characteristics.

20. What is amalgam? State its use with an example.

Solution:

An amalgam is a mixture or an alloy of mercury with many metals or an alloy of silver, gold, zinc, sodium also with some non-metals.

An example is an amalgam with a mixture of mercury and a silver tin alloy which is used as a dental amalgam.