Very Short Answer Type Questions

[1 Mark]

Q. 1. Why are metals good conductors of electricity?

Ans. Metals are good conductors of electricity because they contain free electrons. These free electrons move easily through the metal and conduct electric current.

Q. 2. Which property of graphite is utilised in making electrodes?

Ans. Graphite is a good conductor of electricity. Due to this property, graphite is utilized in making electrodes.

Q. 3. Which of the following metals will melt at body temperature?
Gallium, Magnesium, Caesium, Aluminium

Ans. Gallium and caesium will melt at 37°C (body temperature).

Q. 4. Name two metals that do not react with water at all.

Ans. Lead and copper.

Q. 5. What happens when calcium is treated with water?

Ans. Calcium reacts less violently with water and bubbles of hydrogen gas stick to its surface.

Q. 6. Generally, non-metals are not lustrous. Name a non-metal which is lustrous.

Ans. Iodine

Q.7. What is the nature of non-metal oxide?

Ans. Non-metal oxides are acidic or neutral in nature.

Q. 8. What is the nature of metal oxides?

Ans. Metal oxides are basic in nature.

Q. 9. Why do copper objects develop a green coating in air?

Ans. Copper reacts with moist carbon dioxide in the air and gains a green coating of basic copper carbonate.

Q. 10. Why do silver articles become black on prolonged exposure to air?

Ans. Sulphur compounds such as hydrogen sulphide gas (H_2S) present in the air when combine with the silver articles, form a black coating of silver sulphide (Ag_2S).

Q. 11. Which oxide of iron could be obtained on prolonged reaction of iron with steam?

Ans. Fe_3O_4

$3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$

Q. 12. Why are ionic compounds usually hard?

Ans. In all ionic compounds, their positive and negative ions are attached to each other by a strong ionic bond. So, they are rigid and hard solids.

Q. 13. Why does aluminium not react with water under ordinary conditions?

Ans. Aluminium does not react with water under ordinary conditions because of the presence of a thin layer of aluminium oxide on its surface.

Q. 14. In nature, metal A is found in a free state while metal B is found in the form of its compounds. Which of these two will be nearer to the top of the activity series of metals?

Ans. Metal B will be nearer to the top of the activity series of metals as it is so reactive that it is found in combined state.

Q. 15. Arrange the following metals in decreasing order of their reactivity: Fe, Zn, Na, Cu, Ag

Ans. Na > Zn > Fe> Cu >Ag.

Q. 16. Why cannot aluminium be obtained by reduction of its oxide with carbon?

Ans. Aluminium has more affinity for oxygen than carbon.

Q. 17. Why does a little addition of carbon in iron make it more useful

Ans. Pure iron is very soft and stretches easily when hot. When it is mixed with a small quantity of carbon (0.05%), it becomes hard and strong and hence becomes more useful.

Q. 18. Give an example of a sulphide ore which is reduced to metal by heating alone, i.e., by roasting.

Ans. Cinnabar (HgS) on roasting is first changed to mercuric oxide which on further

$$2HgS(s) + 3O_2(g) \overset{Heat}{\rightarrow} 2HgO(s) + 2SO_2(g)$$

$$2HgO(s) \overset{Heat}{\rightarrow} 2Hg(l) + O_2(g)$$

Q. 19. Metals are refined by using different methods. Name two metals refined by electrolytic refining.

Ans. Copper and gold.

Q. 20. What is rust?

Ans. The coating of brown, flaky substance on the surface of iron when it is kept exposed in moist air is called rust.

Q. 21. What is corrosion?

Ans. When the surface of a metal is attacked by air, water and some other substances, it is said to be corroded. This phenomenon is known as corrosion.

Q. 22. What is aqua regia?

Ans. It is a freshly prepared mixture of concentrated hydrochloric acid and concentrated nitric acid in the ratio of 3 : 1. It can dissolve gold. It is a highly corrosive liquid.

Q. 23. Which metals are mixed with iron to get stainless steel?

Ans. Nickel and chromium.

Q. 24. Why is stainless steel preferred for making household utensils?

Ans. Stainless steel is preferred as it is non-reactive and so the milk or food is not spoiled in it.

Q. 25. What is galvanisation?

Ans. Galvanisation is a method of protecting steel and iron from rusting by coating them with a thin layer of zinc.

Q. 26. Name an alloy of

(i) aluminium used in the construction of aircraft.
(ii) lead used in joining metals for electrical work.

Ans. (i) Duralium (ii) Solder.

Short Answer Type Questions – I

[2 marks]

Q. 1. Explain why the surface of some metals acquires a dull appearance when exposed to air for a long time.

Ans. The surface of some metals acquires a dull appearance when exposed to air for a long time due tothe formation of a thin layer of oxide, carbonate or sulphide on their surface by the slow action ofthe various gases present in air.

Q. 2 Give two each of the metals that are good conductors and poor conductors of heat respectively.

Ans. (a) Good conductors: Ag and Cu
(b) Poor conductors: Pb and Hg

Q. 3. Name one metal and one non-metal that exist in liquid state at room temperature. Also name two metals having melting point less than 310 K (37^0 C).

Ans.Metal: Mercury (Hg); **Non-metal:** Bromine (Br)

Two metals with melting points less than 310K are Cesium (Cs) and Gallium (Ga).

Q. 4. A zinc plate was kept in a glass container having copper sulphate solution. On examining it was found that the blue colour of the soluton is getting fader and fader. After a few days when the zinc plate was taken out of the solution, a number of small holes were noticed in it. State the reason and give chemical equation of the reaction involved.

Ans. Zinc is more reactive than copper. Hence, when a zinc plate is kept in a solution of copper sulphate, it slowly displaces copper from the solution and blue colour of the solution keeps fading away. Because of zinc going into solution as zinc sulphate a number of holes are seen in the zinc plate. The reaction is

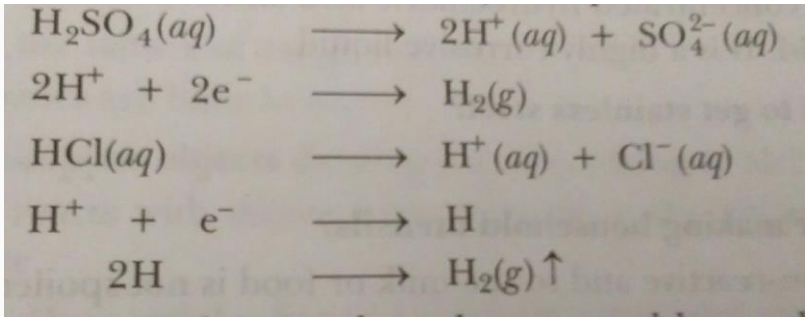
$$\underset{Blue}{CuSO_4(aq)} + Zn(s) \rightarrow \underset{Colourless}{ZnSO_4(aq)} + Cu(s)$$

Q.5. Generally, when metals are treated with mineral acids, hydrogen gas is liberated but when metals (except Mn and Mg) are treated with HNO_3, hydrogen is not liberated, why?

Ans. It is because HNO_3 is a strong oxidisings agent. It oxidises the H_2 produced to H_2O and itself getreduced to any of the oxides of the nitrogen, like NO_2, NO, etc.

Q. 6. Metals replace hydrogen from dilute acids, whereas non-metals do not. Why?

Ans. Hydrogen from dilute acids can only be replaced if electrons are supplied to H^+ ions of the acid,



Q. 7. What happens when

(i) Iron nail is placed in silver nitrate solution?
(ii) Iron strip is dipped in zinc sulphate solution?

Ans. (i) Iron is more reactive than silver.
$Fe(s) + 2AgNO_3(aq) \rightarrow Fe(NO_3)_2(aq) + 2Ag(s)$

(ii) Iron is below zinc in the reactivity series; therefore, iron cannot displace zinc from zincsulphate solution. No reaction takes place.

Q. 8. Why do metals not evolve hydrogen gas with nitric acid?

Ans. When metal reacts with nitric acid (HNO_3), hydrogen gas is not evolved. This is because HNO_3 is a strong oxidising agent. It oxidises H_2 produced to water and is itself reduced to any of the oxides of nitrogen (N_2O, NO or NO_2). For example,
$3Cu(s) + 8HNO_3(aq) \rightarrow 3Cu(NO_3)_2(aq) + 2NO(g) + 4H_2O(l)$

Q. 9. (i) Name a metal for each case:
(a) It does not react with cold as well as hot water but reacts with steam.
(b) It does not react with any physical state of water.
(ii) When calcium metal is added to water the gas evolved does not catch fire but the same gasevolved on adding sodium metal to water catches fire. Why is it so?

Ans. (i) (a) Aluminium, (b) Copper
(ii) In both cases, the gas evolved is H_2. When calcium reacts with water the heat evolved is not sufficient for hydrogen to catch fire. On the other hand, sodium metal reacts with water violently and in this case a lot of heat is evolved which is sufficient for hydrogen to catch fire.

Q. 10. Which of the following reactions will not occur? Give reasons.

(i) $MgSO_4(aq) + Fe(s) \rightarrow FeSO_4(aq) + Mg(s)$
(ii) $MgSO_4(aq) + Cu(s) \rightarrow CuSO_4(aq) + Mg(s)$
(iii) $CuSO_4(aq) + Fe(s) \rightarrow FeSO_4(aq) + Cu(s)$

Ans. Reaction (i) will not occur because Fe is less reactive than Mg. Reaction (i) will not occur because Cuis less reactive than Mg.

Q. 11. List any two observations when a highly reactive metal is dropped in water.

Ans. (i) Large amount of heat is evolved.
(ii) Metal starts floating.

Q. 12. State the reason for the following behaviour of zinc metal:
On placing a piece of zinc metal in a solution of mercuric chloride, it acquires a shining silvery surface but when it is placed in a solution of magnesium sulphate no change is observed.

Ans. When a piece of zinc metal is placed in a solution of mercuric chloride ($HgCl_2$).a white layer of mercury is deposited on zinc metal to give it silvery shining look. This is because mercury is lower to zinc in reactivity series and hence, zinc can displace mercury from $HgCl_2$.
But when zinc is placed in a solution of magnesium sulphate, there is no change. This is becausemagnesium is above zinc in the reactivity series and hence, zinc cannot displace magnesium from its salt solution.

Q. 13. An ore gives carbon dioxide on treatment with a dilute acid. What steps will you take to convert such a concentrated ore into free metal?

Ans. A metal carbonate reacts with a dilute acid to form carbon dioxide. Therefore, this ore is a carbonate ore. Carbonate ore is converted into free metal in the following two steps:

(1) Calcination: The carbonate ore is strongly heated in the absence of air to get the metal oxide.

$$Metal\ carbonate \xrightarrow{Calcination} Metal\ oxide + Carbon\ dioxide$$

(ii) Reduction: The metal oxide is reduced with carbon to get free metal.

$$Metal\ oxide + \underset{(Coke)}{Carbon} \xrightarrow{Reduction} Metal + Carbon\ monoxide$$

Q. 14. The following reaction takes place when aluminium powder is heated with MnO_2.

$3MnO_2(s) + 4Al(s) \rightarrow 3Mn\ (l) + 2Al_2O_3\ (l) + Heat$

(a) Is aluminium getting reduced?
(b) Is MnO_2 getting oxidised?

Ans. (a) No, because oxygen is added to aluminium therefore, it is getting oxidised.
(b) No, since manganese has lost oxygen therefore, it is getting reduced.

Q. 15. What is a thermit reaction? State one use of this reaction.

Ans. The reaction between iron (III) oxide (Fe_2O_3) and aluminium gives out lots of heat.
It is called the thermit reaction.

$$\underset{Iron(III)\ oxide}{Fe2O3(s)} + \underset{Aluminium}{2Al(s)} \rightarrow \underset{Iron}{2Fe(l)} + \underset{Aluminium\ oxide}{Al2O3(s)} + Heat$$

This displacement reaction is used to join railway tracks on cracked machine parts. This heat gives out in the reaction melts the iron formed. The molten iron runs down between the tracks and welds them together.

Q. 16. Why should the metal sulphides and carbonates be converted to metal oxides in the process of extraction of metal from them?

Ans. It is easier to obtain metal from its oxide, as compared from its sulphides and carbonates. So prior to reduction, sulphide ores are converted into oxides by roasting and carbonate ores by calcination.

Q. 17. What is 24-carat gold? How will you convert it into 18-carat gold?

Ans. 24-carat gold is pure gold. Pure gold is very soft and not suitable for making jewllery. Therefore, to increase its hardness, it is alloyed either with copper or sılver. 18-carat gold is prepared by alloying 18 parts pure gold with 6 parts of either copper or silver.

Q. 18. What would happen to iron railings on the road side if they are not painted? Why does it happen so?

Ans. If the iron railing on the road side is not painted, a brown rust would form on its surface because the moist air of the atmosphere reacts with iron to form brown flaky substance on its surface. The rust is hydrated iron (III) oxide, $Fe_2O_3.xH_2O$.

Q. 19. Explain why, the galvanised iron article is protected against rusting even if the zinc layer is broken.

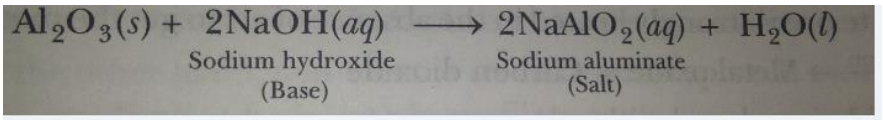
Ans. The galvanised iron article is protected against rusting even if the zinc layer is broken because zinc is more easily oxidised than iron. So when zinc layer on the surface of galvanised iron article is broken, then zinc continues to corrode but iron article does not corrode or rust.

Q. 20. Why is aluminium oxide considered an amphoteric oxide?

Ans. Aluminium oxide (Al2O3) shows basic as well as acidic behaviour because it reacts with both acids and bases. Thus, it is considered an amphoteric oxide. The two types of reactions given by Al2O3 are as follows:

(i) $\underset{Aluminium\ oxide}{Al_2O_3(s)} + \underset{Hydrochloric\ acid\ (Acid)}{6HCl(aq)} \rightarrow \underset{Aluminium\ chloride\ (Salt)}{2AlCl_3(aq)} + 3H_2O(l)$

(ii)



Q. 21. Why are food cans tin- Plated instead of zinc plated though zinc is cheaper than tin?

Ans. Tin is less reactive zinc. It is less likely to dissolve in the liquid strored in the food cans. Tin reacts only with powerful acids whereas zinc can easily react even with tomatoes, so it is ot safe to store food in zinc- plated cans.

Short Answer Type Questions – II

[3 Marks]

Q. 1. Name two metals which react violently with cold water. Write any observation you would make when such a metal is dropped into water. How would you identify the gas evolved, if any, during the reactions?

Ans. Metals which react violently with cold water are potassium (K) and sodium (Na).

$2K + 2H_2O \rightarrow 2KOH + H_2 + \text{Heat energy}$

$2Na + 2H_2O \rightarrow 2NaOH + H_2 + \text{Heat energy}$

The hydrogen gas produced during the reaction of these tow metals with water immediately catches fire. Thus, these reactions are violent and exothermic.
The gas evolved during these reaction burns with popping sound which confirms that the gas is hydrogen (H_2).

Q. 2. Give reasons:

(i) Reactivity of Al decreases if it is dipped in HNO_3.
(ii) Carbon cannot reduce the oxides of Na or Mg.
(iii) NaCl is not a conductor of electricity in solid state whereas it does conduct electricity in aqueous solution as well as in molten state.
(iv) Metals like Na, K, Ca and Mg are never found in their free in nature.

Ans. (i) Due to the formation of a layer of oxide, i.e., Al_2O_3 it becomes less reactive.

(ii) Na or Mg are more reactive metals as compared to carbon. So, their oxides are more stable.

(iii) In solid NaCl, the movement of ions is not possible due to its rigid structure but in aqueous solution or molten state, the ions can move freely. These free ions are responsible for conduction of electricity.

(iv) Na, K, Ca and Mg are highly reactive metals and thus never found in their free state in nature.

Q. 3. Explain the following statement:

(i) Most metal oxides are insoluble in water but some of these dissolve in water. What are these oxides and their solutions in water called?

(ii) At ordinary temperature, the surface of metal such as magnesium, aluminium and zinc, etc. is covered with a thin layer. What is the composition of this layer? State its importance.

(iii) Some alkali metals can be cut with a knife.

Ans. (i) These oxides are called basic oxides and their solutions in water are called alkalis.

(ii) This layer formed is protective oxides layer which prevents the metal from further oxidation.

(iii) Some alkali can be cut with a knife because they are very soft and have low densities.

Q. 4. When a metal X is treated with cold water, it gives a basic salt Y with molecular formula XOH (molecular mass = 40) liberates a gas Z which easily catches fire. Identify X,Y and Z and also write the reaction involved.

Ans. Sodium (Na) and potassium (K) react with cold water to form basic salt NaOH and KOH respectively. The molecular mass of NaOH is 40. So, X is Na and Y is NaOH. The gas liberated during the reaction is hydrogen (H_2). So. Z is H_2.
$2Na + 2H_2O \rightarrow 2NaOH + H_2 + Heat\ energy$

Q. 5. Of the three metals X,Y and Z,X reacts with cold water,Y with hot water and Z with steam only. Identify X,Y and Z and also arrange them in order of increasing reactivity.

Ans. X is an alkali metal, Na or K.
Y is an alkaline earth, Mg or Ca.
Z is Fe.
Increasing reactivity series: Na > Mg > Fe

Q. 6. An element A burns with golden flame in air. It reacts with another element B, atomic number 17 to give a product C. An aqueous solution of product C on electrolysis gives a compound D and liberates hydrogen. Identify A , B, C and D. Also write down the equations for the reactions involved.

Ans. A – Na; B – Cl_2; C – NaCl; D - NaOH
$2Na + Cl_2 \rightarrow 2NaCl$
$2NaCl(aq) + 2H_2O(l) \rightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$

Q. 7. Iqbal treated a lustrous, divalent element M with sodium hydroxide. He observed he formation of bubbles in reaction mixture. He made the same observation when this element was treated with hydrochloric acid. Suggest how can he identify the produced gas. Write chemical equations for both the reactions.

Ans. The element is a metal.

$M + 2NaOH \rightarrow Na_2MO_2 + H_2$

$M + 2HCl \rightarrow MCl_2 + H_2$

Q. 8. Give reason:

(a) Platinum, gold and silver are used to make jewellery.
(b) Sodium, Potassium and lithium are stored under oil.
(c) Aluminium is a highly reactive metal, yetit is used to make utensils for cooking.

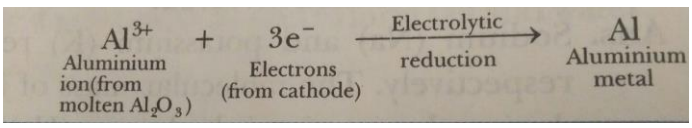
Ans. (a) Platinum, gold and silver are used to make jewellery because of their bright shiny surface and high resistance to corrosion. Also they have high malleability and ductility.

(b) Sodium, potassium and lithium are stored under oil to prevent their reaction with oxygen, moisture and carbon dioxide of air so as protect them as they are highly reactive metals.

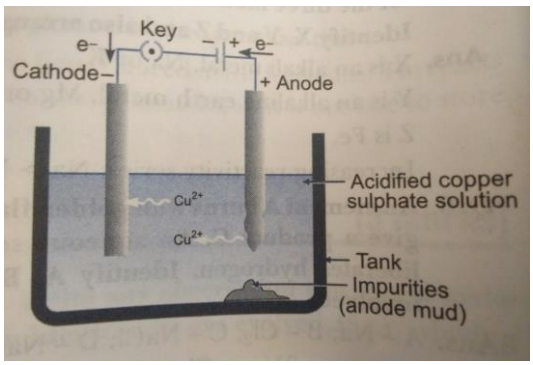
(c) Aluminium metal forms a thin layer of aluminium oxide all over its surface under the action of moist air. This layer prevents the metal underneath from further corrosion. It is cheap, easily available, malleable and ductile. Therefore, it is used to make utensils for cooking.

Q. 9. Give the differences between electrolytic reduction and reduction with carbon.

Ans.

Reduction with carbon	Electrolytic reduction
1. Carbon is used as a reducing agent.	1. Electrolysis process is used for reduction.
2. Oxides of moderately reactive metals (e.g., Zn, Fe, Cu, Ni) are reduced by carbon.	2. Oxides (and chlorides) of highly reactive metals (e.g., Al, Na, K, Mg, Ca) are reduced by this process.
3. In this process, the metal oxide is missed with carbon (Coke) and heated in a furnace. $\underset{Zinc\ oxide}{Zn} + \underset{Carbon}{C} \rightarrow \underset{Zinc}{Zn} + \underset{Carbon\ monoxide}{CO}$	3. In this process, molten metal oxide is electrolysed in an electrolytic cell where the cathode acts as a powerful reducing agent by supplying electrons to reduce metal ions into metal. 

Q. 10. What is meant by refining of metals? Describe the electrolytic refining of copper with a neat labelled diagram.



Ans. In electrolytic refining process, the impure metal is made as anode and a thin strip of pure metal is made as cathode. A solution of the metal salt is made as an electrolyte. On passing the current through the electrolyte, the pure metal from the anode dissolves into the electrolyte. An equivalent amount or pure metal from the electrolyte is deposited on the cathode. The soluble impurities go into the solution, whereas, the insoluble impurities settle down at the bottom of the anode and are known as anode mud.

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

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

Q. 11. An ore on heating in air produces sulphur dioxide. Which process would you suggest for its concentration? Describe briefly any two steps involved in the conversion of this concentrated ore into related metal.

Ans. The ore on heating produces sulphur dioxide gas so it is a sulphide ore. The method used for its concentration is “froth floatation process”. After concentration of the ore following two steps would be followed.to convert it into metal.

(i) Roasting: The sulphide ore is converted into its oxide by heating it in the presence of air.

$MS + O2 \rightarrow MO + SO_2 \uparrow$

(ii) Reduction of metal oxide to metal: The oxide formed by roasting is then reduced to metal by using a suitable reducing agent like carbon (Coke).

$$MO + \underset{(Coke)}{C} \rightarrow M + CO$$

Q. 12. During extraction of metal, electrolytic refining is used to obtain pure metals.

(i) Which material will be used as anode and cathode for refining of silver metal by this process?
(ii) Suggest a suitable electrolyte also.
(iii) In this electrolytic cell, where do we get pure silver after passing electric current?

Ans. (i) Anode: Impure silver

Cathode: Pure silver

(ii) Electrolyte: Silver salt, such as $AgNO_3$, AgCl, etc.

(iii) We get pure silver at cathode.

Q. 13. A metal that exists as a liquid at room temperature is obtained by heating its sulphide in the presence of air. Identify the metal and its ore and give the reaction involved.

Ans. Metal low in activity series can be obtained by reducing their sulphides or oxides by heating. Mercury is the only metal that exists as liquid at room temperature. It can be obtained by heating cinnabar (HgS), the sulphide ore of mercury.

The reaction are as follows:

$$2HgS(s) + 3O_2(g) \overset{Heat}{\rightarrow} 2HgO(s) + 2SO_2(g)$$

$$2HgO(s) \overset{Heat}{\rightarrow} 2Hg(l) + O_2(g)$$

Q. 14. How can a layer of aluminium oxide on an aluminium object be made thicker? What is this process called?

Ans. Aluminium develops a thin oxide layer when exposed to air. This aluminium oxide coat makes it resistant to further corrosion. The resistance can be improved further by making the oxide layer thicker. This process is called anodising. During anodising, a clean aluminium article is made the anode and is electrolysed with dilute sulphuric acid. The oxygen gas evolved at the anode reacts with aluminium articles an attractive finish.

Q. 15. (i) A metal M is found in nature as MCO_3. It is used in galvanising iron articles. Name the metal.

(ii) How can the metal be obtained from its carbonate ore?

Ans. (i) The metal is zinc (Zn).

(ii) The carbonate ore is first heated strongly in limited supply of oxygen and changed into its oxide. This process is called calcination.

$$ZnCO_3(s) \overset{Heat}{\rightarrow} ZnO(s) + CO_2(g)$$

Zinc oxide is then reduced to zinc metal by heating it with carbon. This process is called reduction.

$$ZnO(s) + C(s) \overset{Heat}{\rightarrow} Zn(s) + CO(g)$$

Q. 16. Which two metals do not corrode easily? Give example in each case to support that

(i) Corrosion of some metals is an advantage.
(ii) Corrosion of some metals is a serious problem.

Ans. Gold and platinum.

(i) A thin impervious layer aluminium oxide forms a protective layer which protects the aluminium metals underneath from further damage.

(ii) Corrosion of iron is a serious problem. Every year enormous amount of money is spent to replace damaged iron and steel structures.

Q. 17. In the formation of the compound XY, atoms of X lost one electron each while atoms of Y gained one electron each. What is the nature of bond in XY? Predict the two properties of XY.

Ans. The atoms of X electrons whereas the atoms of Y gain electrons. Thus, there is transfer of electrons from atoms of X to atoms of Y. The bond formed by the transfer of electrons is called ionic bond. Therefore, the nature of bond in the compound XY is ionic.

Properties of ionic compound XY:

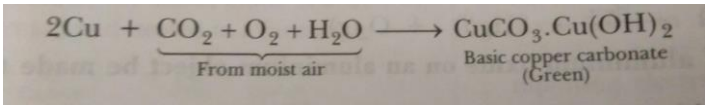
(i) The compound will be soluble in water.
(ii) The compound will conduct electricity when dissolved in water or in molten state

Q. 18. Explain how the properties of an alloy are different from those of constituent metals.

Ans. (i) Alloys are stronger and harder than the constituent metals.
(ii) Alloys are more resistant to corrosion.
(iii) Alloys are more resistant to corrosion.
(iv) Alloys have lower electrical conductivity than pure metals.

Q. 19. State reason for the following:
(i) Lemon is used for restoring the shine of tarnished copper vessels.
(ii) A metal sulphide is converted into its oxide to extract the metal from the sulphide ore.
(iii) Copper wires are used in electrical connections.

Ans. (i) When copper vessels are exposed to moist air, they form a green coating of basic copper carbonate [$CuCO_3.Cu(OH)_2$].



The sour substance such as lemon or tamarind juice contain acids. Lemon juice contains citric acid and tamarind contain tartaric acid. These acids dissolve the coating of copper oxides or basic copper carbonate present on the surface of tarnished copper vessels and make them shining red-brown again.

(ii) It is easier to obtain a metal from its oxides as compared to its sulphides and carbonates. So, prior to reduction, metal carbonate and sulphides must be converted

into metal oxides**.** A carbonate ore is converted into oxide by **calcination** whereas a sulphide ore is converted into oxide by **roasting.'**

(iii) Copper wires are good conductor of electricity, so they are used in electrical connections.

Long Answer Type Questions

[5 Marks]

Q. 1. What are ionic or electrovalent compounds? Give an example of ionic compound. Explain with reason four properties of these compounds.

Ans. Ionic compounds are those compounds which are formed by the transfer of electrons from a metal to a non-metal. For example, NaCl.

Properties:

(i) Physical nature: Ionic compounds are hard and solid due to strong force of attraction between oppositely charged ions.

(ii) Melting point and boiling point: As more amount of energy is required to break strong bonds. So, they have high melting points and boiling point.

(iii) Solubility: These are soluble in water (polar solvent) but insoluble in organic solvent.

(iv) Conduction of electricity: They conduct electricity in solution or molten state as ions move towards opposite electrodes.

Q. 2. Two ores A and B were taken. On heating ore A gives CO_2 whereas, ore B gives SO_2. What steps will you take to convert them into metals?

Ans. Since ore A gives CO_2 and gives SO_2. Therefore, ores are MCO_3 and MS.
As A is a carbonate ore, it is first subjected to calcination followed by reduction.

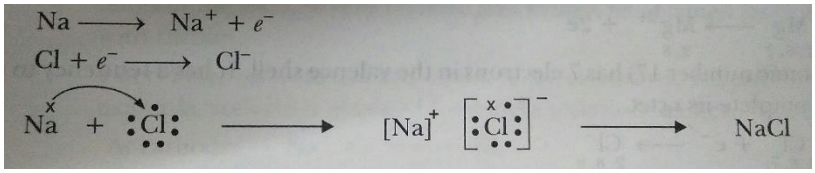
$$MCO_3 \overset{Calcination}{\rightarrow} MO + CO_2$$
$$MO + C \overset{Reduction}{\rightarrow} M + CO$$

As B is a sulphide ore, it is first subjected to roasting followed by reduction.

$$2MS + 3O_2 \overset{Roasting}{\rightarrow} 2MO + 2SO_2$$
$$MO + C \overset{Reduction}{\rightarrow} M + CO$$

Q. 3. Write the names and symbols of two most reactive metals. Explain by drawing electronics structure how any one of them reacts with a halogen. Explain any two physical properties of the compound formed.

Ans. Most reactive metals are Na (sodium) and K (potassium)



Physical Properties:

(i) Physical nature: Hard and solid due to strong attractive forces between oppositely charged ions.

(ii) High melting points and boiling points because more amount of energy is required to break strong force or attraction.

Q. 4. (i) Hydrogen is not a metal but it has been assigned a place in the reactivity series of metals. Explain.

(ii) How would you show that silver is chemically less reactive than copper?

Ans. (i) Though hydrogen is not a metal but even then it has been assigned a place in the activity series. The reason is that like metals, hydrogen also has a tendency to lose electron and forms a positive ion H^+.
The metals which lose electrons less readily than hydrogen are placed below it and the metals which lose electrons more readily than hydrogen are placed above it in the reactivity series of metals.

(ii) By displacement reaction silver can be shown to be chemically less reactive than copper or copper is more reactive than silver. If a piece of silver is immersed in a solution of copper sulphate, no reaction will take place because silver is less reactive than copper and will not displace copper from the copper from the copper sulphate solution.

$$CuSO_4(aq) + Ag(s) \rightarrow No\ reaction$$

On the other hand, if a copper plate is placed in a solution of silver nitrate, copper will slowly displace silver from the solution and blue solution of copper nitrate is formed.

$$\underset{Colourless}{2AgNO_3(aq)} + Cu(s) \rightarrow \underset{Blue}{Cu(NO_3)\,(aq)} + 2Ag(s)$$

This shows that copper is more reactive than silver.

Q. 5. (i) What is an ionic bond?

(ii) How is an ionic bond formed?

(iii) Write the formation of magnesium chloride.

Ans. (i) The chemical bond formed by the transfer of electrons from one atom to another is known as an ionic bond.

(ii) An ionic bond is formed when one of the atoms can donate electrons to achieve the inert gas electronic configuration and other atom needs electrons to achieve the inert gas electronic configuration.

When a metal (usually 1, 2 or 3 electrons in outermost shell) reacts with a non-metal (usually 5, 6 or 7electrons in outermost shell), transfer of electrons takes place from metal atoms to the non-metal atoms and an ionic bond is formed. There is a strong force of electrostatic attraction between metallic cation and non-metallic anion which is responsible for the formation of ionic bond.

(iii) Formation of magnesium chloride ($MgCl_2$): The atomic number of magnesium is 12. It has two electrons in its valence shell as shown below:

$$^{12}Mg\ -2,8,2$$

Magnesium, therefore, has a tendency to lose the 2 valence electrons andin the process arraigns the electronic configuration of neon.

$$\underset{2,8,2}{Mg} \rightarrow \underset{2,8}{Mg^{2+}} + 2^{e-}$$

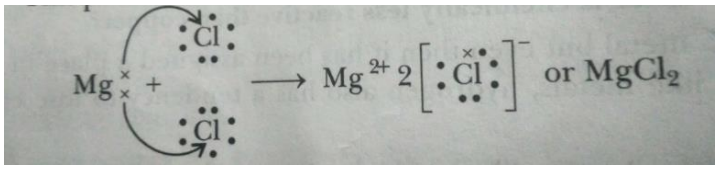
Chlorine (atomic number 17) has 7 electrons in the valence shell. It has a tendency to gain one electron to complete its octet.

$$\underset{2,8,7}{Cl} + \ ^{e-} \rightarrow \underset{2,8,8}{Cl^{-}}$$

Thus, when magnesium and chlorine are brought together, the magnesium atom transfers its two valence electrons to two chlorine atoms. In the process, both the atoms acquire the stable electronic configuration of nearest inert gases. The positively charged magnesiun ion Mg^{2+} and negatively charged chloride ions (Cl^-) are now held together by the electrostatic force of attraction and form ionic bond.

$$Mg^{2+} + 2Cl^- \rightarrow Mg^{2+}\ 2Cl^- \text{ or } MgCl_2$$

This process can also be shown as below:



Q.6. (i) Distinguish between ionic and covalent compounds under the following properties:
(a) Strength of forces between constituent elements
(b) Solubility of compounds in water
(c) Electrical conduction in substances
(ii) Explain how the following metals are obtained from their compounds by the reduction process:
(a) Metal M which is in the middle of the reactivity series
(b) Metal N which is high up in the reactivity series
Give one example of each type.

Ans. (i) (a) Ionic compounds have strong force of attraction between the oppositely charged ions (e.g., Na^+ and Cl^-), so they are solids. Covalent compounds have weak force of attraction between their molecules, so they are usually liquids or gases.

(b) Ionic compounds are soluble in water but covalent compounds are insoluble in water

(c) Ionic compounds conduct electricity when dissolved in water or when melted because they contain ions (charged particles). But, covalent compounds like glucose do not conduct electricity because they do not contain ions.

(ii) (a) The metal M which is in the middle of the reactivity series (such as iron, zinc, lead, copper, etc.) is moderately reactive. So, for obtaining such metals from their compounds, their sulphides and carbonates (in which they are present in nature) are first converted into their oxides by the process of roasting and calcination respectively.
For example,

$$\underset{Zinc\ sulphite\ (sulphide\ ore)}{2ZnS(s)} + 3O_2(g) \overset{Heat}{\rightarrow} 2ZnO(s) + 2SO_2(g)$$

$$\underset{Zinc\ carbnonate(Carbonate\ ore)}{ZnCO_3(s)} \overset{Heat}{\rightarrow} ZnO(s) + CO_2(g)$$

The metal oxides (MO) are then reduced to the corresponding metals by using suitable reducing agents such as carbon. For example, zinc metal from its oxide is obtained as follow:

$$\underset{Zinc}{ZnO(s)} + C(s) \rightarrow \underset{Zinc}{Zn(s)} + CO(g)$$

(b) The metal N which is high up in the reactivity series (such as sodium, magnesium, calcium, aluminium, etc.), is very reactive and cannot be obtained from its compound by heating with carbon.
Therefore, such metals are obtained by electrolytic reduction of their molten salt. For example, sodium is obtained by the electrolysis of molten sodium chloride (NaCl).
At cathode: $Na^+ + e^- \rightarrow Na$
At anode: $2Cl^- \rightarrow Cl_2 + 2e^-$

Q. 7. (i) Distinguish between 'roasting' and 'calcination'. Which of these two is used for sulphide ores and why?
(ii) Write a chemical equation to illustrate the use of aluminium for joining cracked railway lines.
(iii)Name the anode, the cathode and the electrolyte used in the electrolytic refining of impure copper.

Ans. (i) Roasting: It is the process in which sulphide ores of the metals are converted into oxides by heating them in the presence of excess air. For example, Zinc sulphide is converted into zinc oxide by roasting.

$$2ZnS(s) + 3O_2(g) \underset{Roasting}{\overset{Heat}{\rightarrow}} 2ZnO(s) + 2SO_2(g)$$

Calcination: It is the process in which carbonate ores of the metals are decomposed into oxides by heating them in the absence or limited air. For example zinc carbonate is decomposed into zinc and carbon dioxide by calcination.

$$ZnCO_3(s) \underset{Calcination}{\overset{Heat}{\rightarrow}} ZnO(s) + CO_2(g)$$

Out of roasting and calcination, only roasting is used for sulphide ores. This is because it is easier to obtain metal from its oxide as compared to its sulphide.

(ii) $\underset{Iron(III)\ Oxide}{Fe_2O_3(s)} + \underset{\substack{Aluminium\\ powder}}{2Al(s)} \overset{Heat}{\rightarrow} \underset{Iron\ metal}{2Fe(l)} + \underset{\substack{Aluminium\\ oxide}}{Al_2O_3(s)} + Heat$

(iii) Anode – Impure copper
Cathode – Strip of pure copper
Electrolyte – Acidified copper sulphate solution.

Q. 8. Write about different chemical processes used for obtaining a metal from its oxides, for metals low in the reactivity series, metals in the middle of reactivity series and metals towards the top of the reactivity series.

Ans. (i) For obtaining the metals that are low in the reactivity series, oxides of such metals can be reduced to metals by simply heating them in the air.
For example, HgS or cinnabar is the ore of mercury metal which on heating changes to HgO.
This metal oxide (HgO) gets reduced to mercury metal (Hg) on further heating.

$$2HgS + \underset{(air)}{3O_2} \underset{(Roasting)}{\overset{Heat}{\rightarrow}} 2HgO + 2SO_2 \uparrow$$

$$2HgO \overset{Heat}{\rightarrow} \underset{\substack{Mercury\\ metal}}{2Hg} + O_2 \uparrow$$

(ii) For obtaining metals that are in the middle of reactivity series, oxides of such metals can be reduced with coke (carbon) which acts as a reducing agent.
For example, iron (III) oxide can be reduced to iron, as follows:

$$2Fe_2O_3 + \underset{(Coke)}{3C} \overset{Heat}{\rightarrow} \underset{Metal}{4Fe} + 3CO_2 \uparrow$$

(iii) For obtaining metals that are high up in the reactivity series, their oxides are reduced to metals by electrolysis.

For example,

$$\underset{(Bauxite\ ore)}{2Al_2O_3} \overset{Current}{\rightarrow} 4Al^{3+} + 6(O)^{2-}$$

At cathode: $4Al^{3+} + 12^{e-} \rightarrow \underset{(Metal)}{4Al}$

At anode: $6(O)^{2-} \rightarrow 3O_2 + 12^{e-}$

Q. 9. (i) How do you classify elements into metals and non-metals on the basis of their electronic configuration? Choose metal and non-metal out of the following:

$^{23}_{11}A$, $^{19}_{9}B$, $^{24}_{12}C$, $^{31}_{15}D$, $^{35}_{17}E$

(ii) What type of bond will be formed if

(a) 'A 'combines with 'B '? **(b) 'A' combines with 'E'?**
(c) 'C' combines with 'E'? **(d) 'D' combines with 'E'?**

Ans. (i) Elements which contain1 to 3 electrons in their outermost shell are metals. Elements containing 4 to 7 electrons in their valence shell are non-metals.

Electronic configurations:

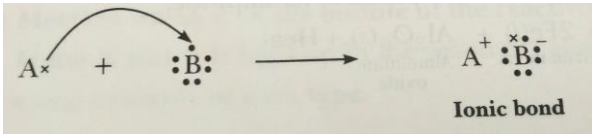
$^{23}_{11}A\ (Z = 11) = 2, 8, 1$
$^{19}_{9}B\ (Z = 9) = 2, 7$
$^{24}_{12}C\ (Z = 12) = 2, 8, 2$
$^{31}_{15}D\ (Z = 15) = 2, 8, 5$
$^{35}_{17}E\ (Z = 17) = 2, 8, 7$

Hence A and C are metals whereas, B, D and E are non-metals.

(ii) Type of bonds

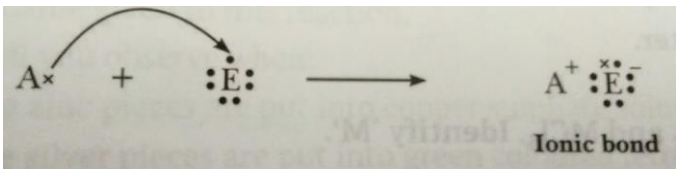
(a) 'A' is metal and 'B' is non-metal, so the bond formed will be ionic.

A = 2, 8, 1 B = 2, 7



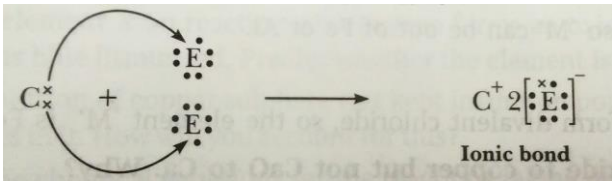
(b) 'A' is metal and 'E' is non-metal, so the bond formed is ionic.

A = 2, 8, 1 E = 2, 8, 7



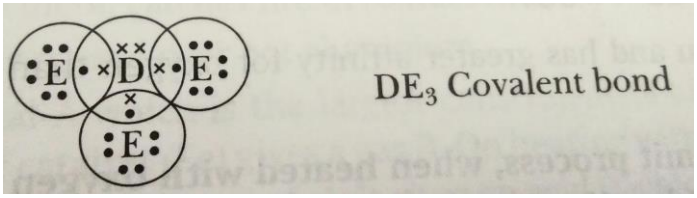
(c) ‘C’ is metal and ‘E’ is non-metal, so the bond formed is ionic.

C = 2, 8, 2 E = 2, 8, 7



(d) ‘D’ is a non-metal and E is also a non-metal, so the bond formed will be covalent.

D = 2, 8, 5 E = 2, 8, 7



HOTS (Higher Order Thinking Skills)

Q.1. There are 3 unknown metals-A, B and C. C displaces B from its oxide while with oxide of A, there is no reaction. Give the reactivity order of A, B and C.

Ans. C displaces B from its oxide, therefore, C is more reactive than B.
There is no reaction when C is treated with oxide of A or C does not displace A from its oxide. So, A is more reactive than C. Thus, the reactivity order is B < C < A.

Q.2. A copper coin is kept immersed in a solution of silver nitrate for some time. What will happen to the coin and the colour of solution?

Ans. Copper is placed above the silver in the reactivity series which indicated that copper is more reactive than silver. When a copper coin or strip is kept immersed in a solution of silver nitrate ($AgNO_3$), silver from its solution will deposit on copper coin.

$$\underset{Colourless}{2AgNO_3(aq)} + Cu(s) \rightarrow 2Ag(s) + \underset{Blue}{Cu(NO_3)_2}\,(aq)$$

Copper slowly displaces silver from the $AgNO_3$ solution and the colour of solution changes from colourless to blue due to formation of copper nitrate [$Cu(NO_3)_2$. The copper con will disappear and silver will precipitate out.

Q.3. An element A reacts with water to from a compound B which is used in white-washing. The compound B on heating forms an oxide C which on treatment with water gives back B. Identify A, B and C and give the reactions involved.

Ans. A is calcium, it reacts with water to form calcium hydroxide which is used in white washing. So, B is Ca $(OH)_2$

$$Ca(s) + 2H_2O(l) \rightarrow \underset{(B)}{Ca(OH)_2}(aq) + H_2(g)$$

On heating compound B, i.e., calcium hydroxide, it forms calcium oxide, i.e., C.

$$Ca(OH)_2 \overset{Heat}{\rightarrow} \underset{(C)}{Cao} + H_2O$$

Q.4. 'M' is an element which is out of Cu, Fe, Al, Na. It shows the following properties:

(i) One of its ore is rich in M_2O_3.
(ii) M_2O_3. Is not affected by water.
(iii) It corrodes easily.
(iv) It forms two chlorides MCl_2 and MCl_3. Identify 'M'.

Ans. As the metal 'M' forms oxide m_2O_3 it is trivalent. Out of the metals listed, only Fe and Al are trivalent.

M_2O_3 is not affected by water, so 'M' can be out of Fe or Al.
Fe and Al both corrode easily.
Out of Al and Fe, only Fe can form divalent chloride, so the element 'M' is Fe.

Q5. Carbon can reduce copper oxide to copper but not CaO to Ca. Why?

Ans. C is a strong reducing agent and can reduce CuO as follows:
$CuO + C \rightarrow Cu + CO\uparrow$

Ca is much more reactive than Cu and has greater affinity for oxygen than C has. So, carbon cannot reduce CaO to Ca.

Q.6. A metal A, which is used in thermit process, when heated with oxygen gives an oxide B, which is amphoteric in nature. Identify A and B. Write down the reactions of oxide B with HCl and NaOH.

Ans. A is aluminium (Al). It reacts with oxygen to form aluminium oxide, Al_2O_3**.**
$4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$

So, B is Al_2O_3.

$Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O$
$Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$

Value Based Questions

Q. 1. Mrs. Sharma has gone to the jewellers shop to buy gold jewellery. She asks the jeweller, if the Jewellery is made of pure gold. The jeweller assure her that it is 100% gold and nothing has been mixed in it. Mrs. Sharma is happy and buys the necklace.

Answer the following questions based on the above situation:

(i) was the jeweller right in saying that the necklace is made of 100% gold?
(ii) What values are promoted by the jeweller?
(iii) What precautions should you take, while purchasing gold jewellery?
(iv) Why does Government insist on purchasing Hallmarked jewellery?

Ans. (i) No, he was wrong. Pure gold is very soft and is, therefore, not suitable for making jewellery. It is alloyed with either silver or copper to make it hard. But, sometimes jewellers mix a large quantity of copper and silver in gold, to earn more profit.

(ii) Untrustworthiness, cheating, cunning.

(iii) We should always purchase the gold jewellery from a branded shop with proper receipt and Hallmark certificate.

(iv) Government insists on purchasing hallmarked jewellery as it contains the gold and its alloyed metal (i.e., copper or silver) in a fixed ratio.