Metals and Non-metals

Objective Section (1 marks each)

Note: Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

(a) Both (A) and (R) are true and (R) is correct explanation of the assertion.

(b) Both (A) and (R) are true but (R) is not the correct explanation of the assertion.

(c) (A) is true but (R) is false.

(d) (A) is false but (R) is true.

Q. 1. Assertion (A): Alloys are commonly used in electrical heating devices like electric iron and heater.

Reason (R): Resistivity of an alloy is generallly higher than that of its constituent metals but the alloys have low melting points than their constituent metals. [CBSE OD, Set 1, 2020]

Ans. (b) Both (A) and (R) are true but (R) is not the correct explanation of the assertion.

Q. 2. The compound obtained on reaction of iron with steam is/are:

[CBSE Delhi, Set 1, 2020]

(a) Fe_2O_3 (b) Fe_3O_4

(c) FeO (d) Fe_2O_3 and Fe_3O_4

Ans. (b) Fe_3O_4

Q. 3. An element 'X' reacts with O_2 to give a compound with a high melting point. This compound is also soluble in water. The element 'X' is likely to be:

[CBSE Delhi, Set 1, 2020]

(a) iron (b) calcium

(c) carbon (d) silicon

Ans. (b) calcium

Very Short Answer Type Questions (1 marks each)

Q. 1. How are covalent bonds formed?

[CBSE OD, Set 1, 2020]

Ans. Covalent bonds are formed by the sharing of electrons between atoms. By sharing their outermost valence electrons, atoms can fill up their outer electron shell and gain stability.

Q. 2. Four metal rods labelled as P, Q, R and S along with their corresponding colours are shown below. Which of these rods could be made up of aluminium?

Reddish brown (P)	Blackish grey (Q)	Dark grey (R)	Silvery white (S)

[CBSE, Term 1, Set 1, 2016]

(a) P (b) Q

(c) R (d) S

Ans. (d) S.

Q. 3. In which form zinc metal is used from laboratory to prepare hydrogen?

(a) Rod (b) Powder

(c) Filing (d) Granules

[CBSE, Term 1, Set 1, 2015]

Ans. (d) Granules.

Q. 4. Four test tubes marked I, II, III and IV were taken. 20 ml of $Al_2(SO_4)_3$ solution in water was poured in each of the test tubes. A piece of zinc metal was placed in test tube I, an iron nail was put in test tube II, copper turnings were put in test tube III and a clean aluminium strip was placed in test tube IV. No change was observed in any of the test tubes. The correct inference drawn is:

(a) Copper is more reactive than Aluminium.

(b) Zinc is more reactive than Aluminium.

(c) Zinc is more reactive than Copper.
(d) Zinc, Iron and Copper are less reactive than Aluminium.

[CBSE, Term 1, Set 2, 2015]

Ans. **(d)** Zinc, Iron and Copper are less reactive than Aluminium.

Q. 5. A student placed Zn rod in $FeSO_4$ solution. After 10 hours when rod was taken out and it was observed that:

(a) Zn rod became thinner.
(b) Zn rod became thicker due to Iron deposition.
(c) Zn rod remains as it was.
(d) Zn rod has holes.

[CBSE, Term 1, Set 2, 2015]

Ans. **(d)** Zn rod has holes.

Short Answer Type Questions-I (2 marks each)

Q. 1. Given reasons:
(a) Platinum, gold and silver are used to make jewellery.
(b) Metals like sodium and potassium are stored under oil.

[CBSE OD, Set 1, 2019]

Ans. **(a)** Platinum, gold and silver are used to make jewellery because of its bright, shiny surface, malleable and ductile nature. These properties are causes of jewellery being very lustrous, drawn into wires and sheets to make jewellery designs more efficient.
(b) Metals like sodium and potassium are stored under oil because they are very reactive in nature, they react with oxygen present in air. Thus to prevent their oxidation they are kept in the oil.

Q. 2. Silver articles become black when kept in open for some time, whereas copper vessels lose their shiny brown surfaces and gain a green coat when kept in open. Name the substances present in air with which these metals react and write the name of the products formed.

[CBSE OD, Set 1, 2019]

Ans. Silver articles become black when kept in open for some time, whereas copper vessel lose their shiny brown surfaces and gain a green coat when kept in open because silver articles reacts with sulphur compounds such as hydrogen suphide present in the air to form silver sulphide (Ag_2S) whereas copper reacts slowly with CO_2 and water present in the air to form green coating of mixture of copper carbonate and copper hydroxide.

Q. 3. Give reasons:
(a) Carbonate and sulphide ores are usually converted into oxides during the process of extraction.
(b) Aluminium is a highly reactive metal; still it is widely used in making cooking utensils.

[CBSE OD, Set 2, 2019]

Ans. **(a)** Carbonate and sulphide ores are usually converted into oxides during the process of extraction because obtaining a metal from its metal oxide is much easier than from metal carbonates and sulphides.
(b) Aluminium is highly reactive metal still it is widely used in making cooking utensils because it reacts with O_2 present in air to form aluminium oxide that forms a protective layer and protects the metal from corrosion.

Q. 4. Name a metal of medium reactivity and write three main steps in the extraction of this metal from its sulphide ore.

[CBSE OD, Set 3, 2019]

Ans. Zinc is the metal with medium reactivity.

The steps involved in extraction of zinc from zinc sulphide are:

(i) Roasting of sulphide ore in the presence of air to convert it into metal oxide.

$$\underset{\text{Zinc sulphide}}{2\,ZnS\,(s)} + \underset{\text{Oxygen}}{3O_2\,(g)} \xrightarrow{\text{Roasting}} \underset{\text{Zinc oxide}}{2\,ZnO\,(s)} + \underset{\text{Sulphur dioxide}}{2\,SO_2\,(g)}$$

(ii) Reduction of metal oxide with carbon to get the free metal.

$$\underset{\text{Zinc oxide}}{ZnO\,(s)} + \underset{\text{Carbon}}{C(s)} \rightarrow \underset{\text{Zinc}}{Zn\,(s)} + \underset{\text{Carbon-monoxide}}{CO\,(g)}$$

(iii) Refining of impure metal to get pure metal.

Q. 5. List four important properties of aluminium which are responsible for its great demand in industry.

[CBSE, Term 1, Set 1, 2015]

Ans. Important properties of aluminium are:

(i) It is a light metal.

(ii) It does not corrode as it forms a protective layer of oxide which prevents it from further oxidation.

(iii) It is a good conductor of heat and electricity.

(iv) It is used as a reducing agent in the extraction of metals from the oxide.

Q. 6. Reverse of the following chemical reaction is not possible:

$Zn\,(s) + CuSO_4\,(aq) \rightarrow ZnSO_4\,(aq) + Cu\,(s)$

Justify this statement with reason.

[CBSE, Term 1, Set 1, 2015]

Ans. Most reactive metal displaces less reactive metals since Cu is less reactive than Zn so it will not displace Zn from $ZnSO_4$.

$$ZnSO_{4\,(aq)} + Cu_{(s)} \rightarrow \text{No reaction}$$

Q. 7. Name the gas which is usually produced when dil. sulphuric acid reacts with a metal. Illustrate it with an example. How will you test the evolution of this gas?

[CBSE, Term 1, Set 2, 2015]

Ans. Metals react with dilute sulphuric acid to give metal sulphates and hydrogen gas.

For example,

$$Zn\,(s) + H_2SO_4\,(aq) \rightarrow ZnSO_4\,(aq) + \underset{\text{(Hydrogen gas)}}{H_2\uparrow}$$

Test for hydrogen gas: Take about 5ml of dilute sulphuric acid in a test tube and add a few pieces of zinc granules to it. Hydrogen gas is evolved which forms bubbles in the soap solution.

Bring a burning candle near hydrogen gas-filled bubble. It burns with a pop sound.

Q. 8. A metal 'M' is found in nature as its carbonate. It is used in the galvanization of iron. Identify 'M' and name its ore. How will you convert this ore into free metal?

[CBSE, Term 1, Set 2, 2015]

Ans. 'M' = Zinc metal

Zinc occurs as zinc carbonate in calamine ore, $ZnCO_3$ that is used in galvanization of iron.

Zinc can be extracted from the ore by:

(i) Zinc carbonate is first converted into zinc oxide by calcination. When calamine ore (zinc carbonate) is heated strongly in the absence of air, it decomposes to form zinc oxide and carbon dioxide.

$$\underset{\text{(Calamine ore)}}{ZnCO_3} \xrightarrow[\Delta]{\text{Calcination}} ZnO(s) + CO_2\uparrow$$

(ii) Zinc metal is then extracted from zinc oxide by reduction with carbon (coke).

$$\underset{\text{Zinc oxide}}{ZnO(s)} + \underset{\text{(Coke)}}{C(s)} \xrightarrow{673\,K} \underset{\text{Zinc metal}}{Zn(s)} + \underset{\text{Carbon monoxide}}{CO\uparrow}$$

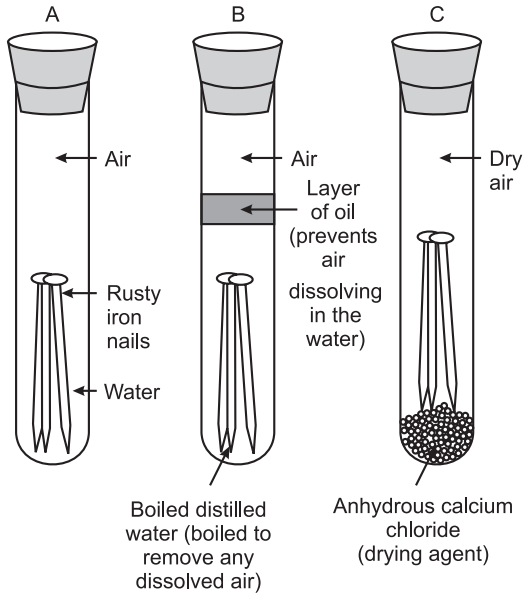
Short Answer Type Questions-II (3 marks each)

Q. 1. What is 'rusting' ? Describe with a labelled diagram an activity to investigate the condition under which iron rusts.

[CBSE Delhi, Set 2, 2020]

Ans. When iron or iron objects are exposed to the moist air for a long time acquires a coating of a brown flaky substance called rust. This process is called rusting.

An activity to investigate the conditions under which the iron rusts is as follows:



(i) Take three test tubes A, B and C.

(ii) Pour some water in A and cork it.

(iii) Pour distilled water in test tube B, add about 1 ml of oil and cork it.

(iv) The oil will float on water and prevent the air from dissolving.

(v) Put some anhydrous calcium chloride in test tube C and cork it.

(vi) Iron nail will rust in test tube A, but they do not rust in test tube B and C.

Conclusion: This can be concluded from the experiment that water is essential for the rusting of iron and iron objects.

Q. 2. What are amphoteric oxides? Give an example. Write balanced chemical equations to justify your answer.

[CBSE OD, Set 1, 2019]

Ans. Those oxides which behave both as acidic and basic oxides are called amphoteric oxides.

Example: Al_2O_3 (Alumina)

(i) $\underset{\text{Alumina}}{Al_2O_3} + \underset{\text{Acid}}{6HCl} \rightarrow \underset{\text{Salt}}{2AlCl_3} + 3H_2O$

(ii) $\underset{\text{Alumina}}{Al_2O_3} + \underset{\text{Base}}{2NaOH} \rightarrow \underset{\text{Salt}}{2NaAlO_2} + H_2O$

Q. 3. During the reaction of some metals with dilute hydrochloric acid, the following observations were made by a student:

(a) Silver does not show any change.

(b) Some bubbles of a gas are seen when lead is reacted with the acid.

(c) The reaction of sodium is found to be highly explosive.

(d) The temperature of the reaction mixture rises when aluminium is added to the acid.

Explain these observations giving appropriate reason.

[CBSE OD, Set 3, 2019]

Ans. **(a)** Silver is covered with a thin layer of silver chloride, so it does not react with dilute hydrochloric acid.

$$\underset{\text{Silver}}{Ag} + \underset{\substack{\text{(dil.)}\\ \text{Hydrochloric acid}}}{HCl} \rightarrow \text{No Reaction}$$

(b) Bubbles of hydrogen gas are evolved when lead is reacted with the acid.

$$\underset{\text{Lead}}{Pb} + \underset{\substack{\text{(dil.)}\\ \text{Hydrochloric acid}}}{2HCl} \rightarrow \underset{\substack{\text{Lead}\\ \text{chloride}}}{PbCl_2} + \underset{\text{Hydrogen}}{H_2}$$

(c) The reaction of sodium is found to be highly explosive because sodium is very reactive in nature.

$$\underset{\text{Sodium}}{2Na(s)} + \underset{\substack{\text{Hydrochloric}\\ \text{acid}}}{2HCl(aq)} \rightarrow \underset{\substack{\text{Sodium}\\ \text{chloride}}}{2NaCl(aq)} + \underset{\text{Hydrogen}}{H_2(g)}$$

(d) The temperature of the reaction mixture rises when aluminium is added to the acid because the reaction is highly exothermic in nature.

$$\underset{\text{Aluminium}}{2Al(S)} + \underset{\substack{\text{Hydrogen}\\ \text{chloride}}}{6HCl(aq)} \rightarrow \underset{\substack{\text{Aluminium}\\ \text{chloride}}}{2AlCl_3(aq)} + \underset{\text{Hydrogen}}{3H_2(g)}$$

Q. 4. Given below are the steps for the extraction of copper from its ore. Write the chemical equation of the reactions involved in each case.

(i) Roasting of copper(I) sulphide.

(ii) Reduction of copper(I) oxide from copper(I) sulphide

(iii) Electrolytic refining.

[CBSE OD, Set 3, 2019]

Ans. **(i)** $\underset{\substack{\text{Copper(I)}\\ \text{sulphide}\\ \text{(Copper}\\ \text{glance ore)}}}{2Cu_2S(s)} + \underset{\substack{\text{Oxygen}\\ \text{(From air)}}}{3O_2(g)} \xrightarrow{\text{Roasting}} \underset{\substack{\text{Copper (I)}\\ \text{oxide}}}{2Cu_2O(s)} + \underset{\substack{\text{Sulphur}\\ \text{dioxide}}}{2SO_2(g)}$

(ii) $\underset{\substack{\text{Copper(I)}\\ \text{oxide}}}{2Cu_2O(s)} + \underset{\substack{\text{Copper(I)}\\ \text{sulphide}}}{Cu_2S(s)} \xrightarrow{\text{Heat}} \underset{\substack{\text{Copper}\\ \text{metal}}}{6Cu(s)} + \underset{\substack{\text{Sulphur}\\ \text{dioxide}}}{SO_2(g)}$

(iii) (a) At cathode:

Cu^{2+}	+	$2e^-$	→	Cu
Copper ion (From electrolyte)		Electrons (From cathode)		Copper (Deposits on cathode)

(b) At anode:

Cu	–	$2e^-$	→	Cu^{2+}
Copper atom (From impure anode)		Electrons (Given to anode)		Copper ion (Goes into electrolyte)

Q. 5. Explain the following:

(a) Sodium chloride is an ionic compound which does not conduct electricity in solid state whereas it does conduct electricity in molten state as well as in aqueous solution.

(b) Reactivity of aluminium decrease if it is dipped in nitric acid.

(c) Metals like calcium and magnesium are never found in their free state in nature. [CBSE Delhi, Set 3, 2019]

Ans. (a) Sodium chloride is an ionic compound but it conducts electricity only in molten and aqueous state because in molten and aqueous form the compound liberate to give ions. These ions move freely and hence conduct electricity.

(b) Reactivity of aluminium decreases if it is dipped in nitric acid because it is a strong oxidising reagent. The layer of aluminium oxide (Al_2O_3) prevents further reaction of aluminium due to which its reactivity decreases.

(c) Metals like calcium and magnesium are never found in their free states in nature; they occur in the form of ores because these metals are present on the top of the reactivity series. They are so reactive that they react with gases and surrounding elements, form compounds and thus are not found in free state.

Q. 6. (a) Name any one metal each which can be extracted by:

(i) reduction with carbon

(ii) electrolytic reduction

(iii) reduction with aluminium

(iv) reduction with heat alone

(b) Write a chemical equation for any of the above four parts.

[CBSE, Term 1, Set 1, 2016]

Ans. (a) (i) Zinc **(ii)** Aluminium **(iii)** Magnesium **(iv)** Mercury

(b) (i) $ZnO + C \rightarrow Zn + CO$

(ii) $3MgO + 2Al \rightarrow 3Mg + Al_2O_3$

Q. 7. Give reason for the following:

(i) Why are copper and aluminium wires used as connecting wires?

(ii) Why is tungsten used for filaments of electric lamps?

(iii) Why is lead-tin alloy used for fuse wires? [CBSE, Term 1, Set 1, 2016]

Ans. (i) Copper and aluminium wires are used as connecting wires because they have low resistivity and are good conductors of electricity.

(ii) Tungsten has highest melting point and greatest tensile strength and lowest vapour pressure. So it is used as light bulb filament in electric lamps.

(iii) Lead-tin alloy is used for fuse wires because they have low melting point.

Q. 8. What are covalent compounds? Why are they different from ionic compounds? List their three characteristic properties. [CBSE Delhi, Term 2, Set 1, 2016]

Ans. Covalent compounds are formed by sharing of unpaired electrons. They are different from ionic compounds as ionic compounds are formed by transfer of electrons.

Characteristics of covalent compounds are:

(i) They generally have low melting and boiling points.

(ii) They are generally insoluble or sparingly soluble in water but soluble in organic solvents.

(iii) They do not conduct electricity.

Q. 9. Name the substance oxidised and the substance reduced, and also identify the oxidising agent and reducing agents in the following reaction:

(a) $3MnO_2 + 4Al \rightarrow 3Mn + 2Al_2O_3$

(b) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

(c) $SO_2 + 2H_2S \rightarrow 3S + 2H_2O$

[CBSE, Term 1, Set 1, 2015]

Ans.

(a) $3MnO_2 + 4Al \longrightarrow 3Mn + 2Al_2O_3$

Reduction: $MnO_2 \rightarrow Mn$

Oxidation: $Al \rightarrow Al_2O_3$

Substance oxidised = Al

Substance reduced = MnO_2

Oxidising agent = MnO_2

Reducing agent = Al

(b) $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$

Reduction: $Fe_2O_3 \rightarrow Fe$

Oxidation: $CO \rightarrow CO_2$

Substance oxidised= CO

Substance reduced = Fe_2O_3

Oxidising agent = Fe_2O_3

Reducing agent = CO

(c) $SO_2 + 2H_2S \longrightarrow 3S + 2H_2O$

Reduction: $SO_2 \rightarrow S$

Oxidation: $H_2S \rightarrow S$

Substance oxidised = H_2S

Substance reduced = SO_2

Oxidising agent = SO_2

Reducing agent = H_2S

Q. 10. Differentiate between the following with suitable examples:

(i) Mineral and ore

(ii) Corrosion and rancidity

(iii) Malleability and ductility

[CBSE, Term 1, Set 1, 2015]

Ans. (i) Difference between Mineral and Ore:

S. No.	Mineral	Ore
1.	Naturally occuring substances of metals present in the earth's crust are called minerals.	Minerals which can be used to obtain the metal profitably are called ores.
2.	All minerals are not ores.	All ores are essentially minerals.

(ii) Difference between Corrosion and Rancidity:

S. No.	Corrosion	Rancidity
1.	The tarnishing of the metals by the attack of moisture and acids in the air is called corrosion.	When fats and oils present in the food gets oxidised, the smell and taste of the food changes. This is called Rancidity.

(iii) Difference between Malleability and Ductility:

S. No.	Malleability	Ductility
1.	The property which allows the metals to be hammered into thin sheets is called malleability.	The property which allows the metals to be drawn into thin wires is called ductility.

Q. 11. You are given samples of three metals—sodium, magnesium and copper. Suggest any two activities to arrange them in order of their decreasing reactivity.

[CBSE, Term 1, Set 2, 2015]

Ans. Given three metals–sodium (Na), magnesium (Mg), copper (Cu)

Activity I: When the three given metals Na, Mg and Cu are added to magnesium chloride solution separately taken in three different test tubes, we will find that displacement reactions will take place in the following manner:

$MgCl_2$ solution	Metals
Displacement reaction	Na
No reaction	Mg
No reaction	Cu

This shows that Na is the most reactive metal as it displaces Mg from $MgCl_2$ solution.

Activity II: When Na, Mg and Cu metals are taken in three different test tubes and $CuSO_4$ solution is added in each test tube, we will find that displacement reactions will take place in the following manner:

$CuSO_4$ solution	Metals
Displacement reaction	Na
Displacement reaction	Mg
No reaction	Cu

This shows that Cu is the least reactive metal.

Order of decreasing reactivity: Na > Mg > Cu.

Q. 12. Which three chemical substances are obtained when electricity is passed through an aqueous solution of brine? Write one industrial use of each.

[CBSE, Term 1, Set 1, 2015]

Ans. When electricity is passed through a concentrated solution of sodium chloride (called brine), it decomposes to form sodium hydroxide, chlorine and hydrogen gas.

$$2NaCl\,(aq.) + 2H_2O \xrightarrow{\text{Electricity}} 2NaOH\,(aq.) + Cl_2\uparrow + H_2\uparrow$$

(i) Use of sodium hydroxide (NaOH): It is used for making soaps and detergents.

(ii) Use of chlorine (Cl_2): It is used in the production of bleaching powder.

(iii) Use of hydrogen gas (H_2): It is used to make ammonia for fertilisers; used as a fuel or margarine.

Long Answer Type Questions (5 marks each)

Q. 1. (i) By the transfer of electrons, illustrate the formation of bond in magnesium chloride and identify the ions present in this compound.

(ii) Ionic compounds are solids. Give reasons.

(iii) With the help of a labelled diagram show the experimental set up of action of steam on a metal.

[CBSE OD, Set 1, 2020]

Ans. (i) $Mg \rightarrow Mg^{2+} + 2e^-$

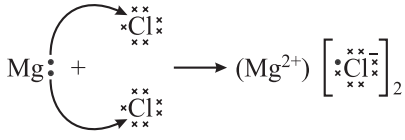
2, 8, 2 — 2, 8

(Magnesium cation)

$Cl + e^- \rightarrow Cl^-$

2, 8, 7 — 2, 8, 8

(Chloride anion)



Ions present in this compound are Mg^{2+} and Cl^-.

(ii) Ionic compounds are solids and are somewhat hard because of the strong force of attraction between the positive and negative ions. These compounds are generally brittle and break into pieces when pressure is applied.

(iii)

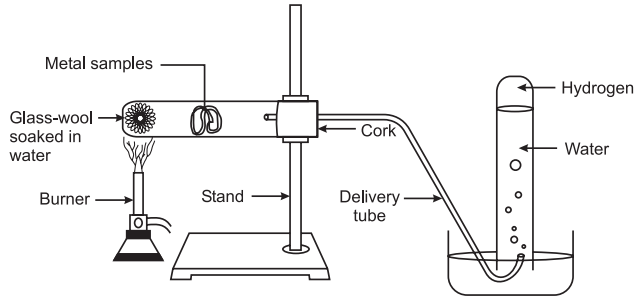


Fig: Action of steam on a metal

Q. 2. Carbon cannot reduce the oxides of sodium, magnesium and aluminium to their respective metals. Why? Where are these metals placed in the reactivity series? How are these metals obtained from their ores? Take an example to explain the process of extraction along with chemical equations.

[CBSE Delhi, Set 1, 2020]

Ans. Carbon cannot reduce the oxides of sodium, magnesium and aluminium to their respective metals because sodium, magnesium and aluminium are more reactive than carbon. These metals are above carbon in the reactivity series and thus have a high affinity to oxygen than carbon and thus cannot be reduced by it.

Sodium, Magnesium and Aluminium are the metals placed at the top of the reactivity series. These metals are obtained by electrolytic reduction, obtained by electrolysis of their molten chlorides. For example, the metals are deposited at the cathode (the negatively charged electrode) whereas chlorine is liberated at the anode (the positively charged electrode).

The reactions involved in this process are:

At cathode: $Na^+ + e^- \rightarrow Na$

At anode: $2Cl^- \rightarrow Cl_2 + 2e^-$

Q. 3. (a) What is thermit process? Where is this process used? Write balanced chemical equation for the reaction involved.

(b) Where does the metal aluminium, used in the process, occurs in the reactivity series of metals?

(c) Name the substances that are getting oxidised and reduced in the process.

[CBSE Delhi, Set 2, 2020]

Ans. (a) A thermit reaction is the reaction in which the iron oxide (rust) reacts with aluminium to produce molten iron. The reaction of iron oxide (Fe_2O_3) with aluminium *i.e.,* this thermite process is used to join railway tracks or cracked machine parts. The balanced chemical reaction for the reaction involved is as follows:

$$Fe_2O_3(s) + 2Al(s) \rightarrow 2Fe\ (l) + Al_2O_3(s) + Heat$$

(b) Aluminium occurs high up in the reactivity series of the metals and that is why it displaces iron from its salt during the thermite reaction.

(c) Aluminium is being oxidised and iron is reduced in the process.

Q. 4. A metal 'M' is stored under kerosene. It vigorously catches fire, if a small piece of this metal is kept open in air. Dissolution of this metal in water releases great amount of energy and the metal catches fire. The solution so formed turns red litmus blue.

(a) Name the metal 'M'.

(b) Write the formula of the compound formed when this metal is exposed to air.

(c) Why is metal 'M' stored under kerosene?

(d) If oxide of this metal is treated with hydrochloric acid, what would be the products?

(e) Write balanced equation for:

(i) Reaction of 'M' with air.

(ii) Reaction of 'M' with water.

(iii) Reaction of metal oxide with hydrochloric acid.

[CBSE OD, Set 3, 2020]

Ans. (a) Metal M is Sodium

$$4Na + O_2 \rightarrow Na_2O$$

(b) Sodium oxide

(c) Metals such as potassium and sodium react so vigorously that they catch fire if kept in the open. Hence, to protect them and to prevent accidental fires, they are kept immersed in kerosene oil.

(d) As a strong base, sodium oxide reacts with acids. It would react with dilute hydrochloric acid to produce sodium chloride solution.

$$Na_2O + 2HCl \rightarrow 2NaCl + H_2O$$

(e) (i) Reaction of Metal "M" (Sodium) with air : Sodium reacts with air to form the sodium oxide.

$$4Na_2 + O_2 \rightarrow 2Na_2O$$

(ii) Reaction of Metal "M" (Sodium) with water: Sodium reacts with water to form sodium hydroxide along with the evolution of heat energy.

$$2Na(s) + 2H_2O(l) \rightarrow 2NaOH\ (aq) + H_2(g) + \text{Heat energy}$$

(iii) Reaction of metal oxide with hydrochloric acid: Sodium oxide reacts with hydrochloric acid to form sodium chloride and water.

$$Na_2O + 2HCl \rightarrow 2NaCl + H_2O$$

Q. 5. (a) Write electron dot structures of Ca (At. No. 20) and O (At. No. 8).

(b) Show the formation of calcium oxide by transfer of electrons.

(c) Name the ions present in this compound.

(d) List four important characteristics of this compound.

[CBSE OD, Set 3, 2020]

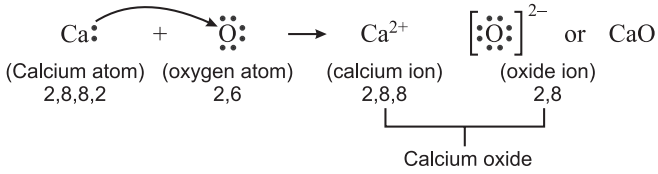
Ans. **(a)** Electron dot structure of Ca

Ca:

Electron dot structure of O

:Ö:

(b) Calcium reacts with oxygen to form an ionic compound calcium oxide (CaO). The atomic number of calcium is 20 and that of oxygen is 8. By losing two electrons, the calcium atom forms a calcium ion (Ca^{2+}) and by gaining two electrons, the oxygen atom forms an oxide ion (O^{2-}).



(c) Ions present in this compound are calcium ion (Ca^{2+}) and oxide ion (O^{2-}).

(d) Important characteristic of calcium oxide are:

(i) Calcium oxide reacts vigorously with water to produce slaked lime (calcium hydroxide) releasing a large amount of heat.

(ii) Quick lime is an amorphous white solid with a high melting point of 2600°C.

(iii) It is a very stable compound and withstands high temperatures.

(iv) Calcium oxide is very useful in the production of building materials such as cement and concrete, similar to other calcium compounds such as calcium sulphate.

(v) They conduct electricity in molten state.

Q. 6. (a) List in tabular form three chemical properties on the basis of which we can differentiate between a metal and a non-metal.

(b) Give reasons for the following:

(i) Most metals conduct electricity well.

(ii) The reaction of iron (III) oxide [Fe_2O_3] with heated aluminimum is used to join cracked machine parts. **[CBSE Delhi, Set 1, 2019]**

Ans.

S. No.	Metals	Non Metals
1.	They react with oxygen to form basic oxides. $2\,Mg + O_2 \rightarrow 2\,MgO$ (Magnesium; Magnesium oxide)	They react with oxygen to produce acidic or neutral oxides. $4\,C(s) + O_2(g) \rightarrow CO_2(s)$ (Carbon; Carbondioxide)
2.	They react with water to produce metal hydroxide and hydrogen gas. $Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$	They do not react with water.
3.	Generally they do not combine with hydrogen except sodium, potassium, calcium which form ionic hydrides and they form positively ions.	They react with hydrogen to form covalent hydrides and they form negatively charged ions.

(b) (i) Metals for example Na has an electronic configuration of 2, 8, 1 *i.e.* it has one free electron. This electron moves through the metal and conducts electric current due to the presence of free electron.

(ii) $Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$ (l)
(s) (s) (s) + Heat

It is thermite reaction.

This reaction is an exothermic reaction as it produces large amount of heat due to which iron metal is produced in molten form that is why it is used to join the railway tracks.

Q. 7. (a) Write the steps involved in the extraction of pure metals in middle of the activity series from carbonate ores.

(b) How is copper extracted from its sulphide ore? Explain the various steps supported by chemical equations. Draw labelled diagram for electrolytic refining of copper.
[CBSE, 2018]

Topper's Answers

Answer : 16

(a) Extraction of pure metals from 'CO$_3$' ores :-

(i) Concentration of ore

Gangue or matrix must be removed from ore by processes taking in mind differences in physical & chemical properties of gangue & ore.

(ii) Calcination :- ½

The carbonate ores must be heated strongly in absence of air to convert them into metal ores.

$ZnCO_3(s) \xrightarrow{\Delta} ZnO(s) + CO_2(\uparrow)$

(iii) Reduction by a more reactive metal or carbon :- ½

$ZnO(s) + C \longrightarrow Zn + Co$

This will happen as Carbon has higher affinity for zinc oxygen than zinc.

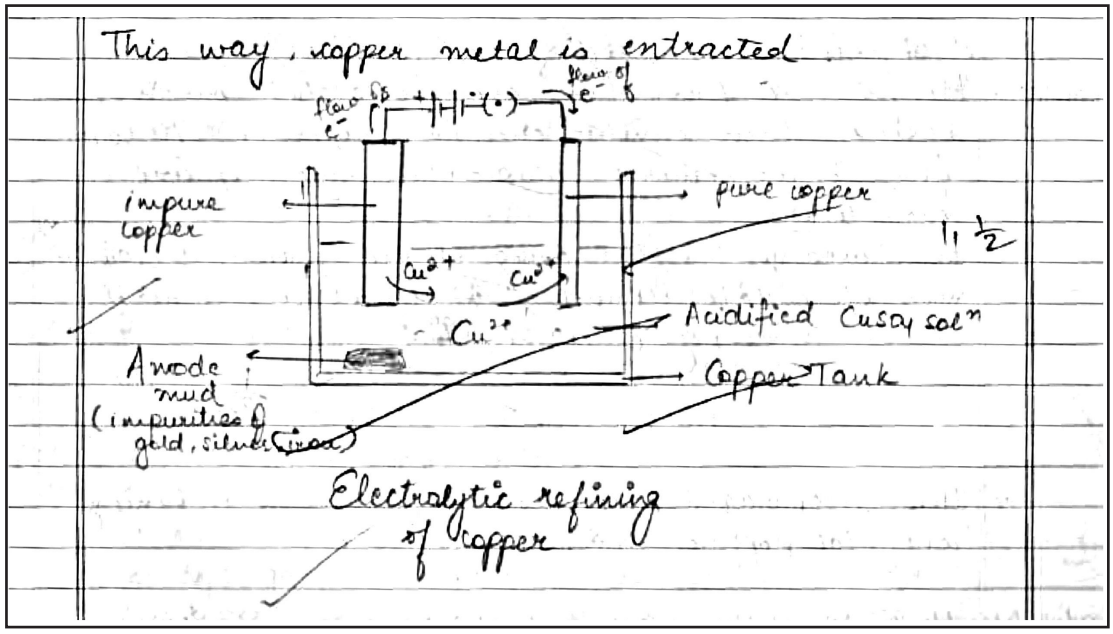
(iv) Finally, the obtained metal can be refined by electrolysis of their salt solution. ½

(b) Copper glance [Cu_2S] is copper's sulphide ore. It is first roasted & then reduced by the remaining Cu_2S in tank.

$2Cu_2S(s) + 3O_2(g) \xrightarrow{\Delta} 2Cu_2O(s) + 2SO_2(g)$

[Copper(I) sulphide] [Copper(I) oxide]

$2Cu_2O(s) + Cu_2S(s) \xrightarrow{\Delta} 6Cu(s) + SO_2(g)$ 2



Ans. **(a)** First the carbonate ore of a metal is heated in absence of air. This process is called calcination.

$$\underset{\text{Zinc carbonate}}{ZnCO_3} \xrightarrow[\text{absence of air}]{\text{Heat}} \underset{\text{Zinc oxide}}{ZnO} + \underset{\text{Carbon dioxide}}{CO_2}$$

Then, ZnO is heated with coke.

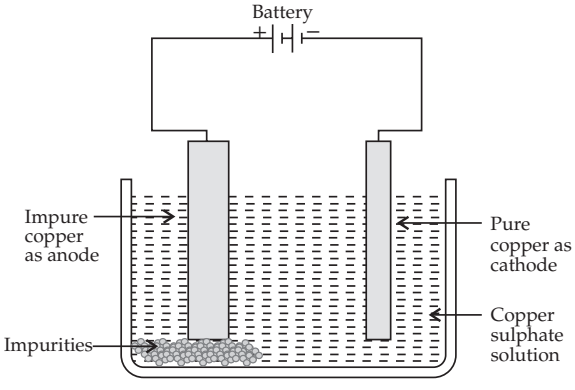
$$\underset{\text{Zine oxide}}{ZnO} + \underset{\text{Coke}}{C} \rightarrow \underset{\text{Pure metal}}{Zn} + \underset{\text{Carbon monoxide}}{CO}$$

(b) Copper is extracted from sulphide ore by the process of roasting. It is done in presence of air:

$$2Cu_2S + 3O_2 \xrightarrow{\text{Heat}} Cu_2O + 2SO_2$$

$$2Cu_2O + Cu_2S \xrightarrow{\text{Heat}} 6Cu + 2SO_2$$

Electrolytic refining of copper:



Q. 8. (a) In Column I different methods of extraction are given. Name the methods used for the extraction of metals given in Column II:

Column-I	Column-II
(i) Reduction with carbon	
(ii) Electrolytic reduction	Al, Zn, Na, Fe, Mn, Pb
(iii) Reduction with aluminium	

(b) Differentiate between roasting and calcination processes giving one example of each.

[CBSE, Term 1, Set 1, 2015]

Ans. **(a)**

Column-I	Column-II
(i) Reduction with carbon	Zn, Fe, Pb
(ii) Electrolytic reduction	Al, Na
(iii) Reduction with aluminium	Mn

(b) Difference between roasting and calcination.

S. No.	Roasting	Calcination
1.	Roasting is done in case of sulphide ores.	Calcination is done in case of carbonate ores.
2.	The sulphide ore is heated in the presence of excess air to convert it into its oxide.	The carbonate ore is heated in the absence of air (limited supply of air) to convert into its oxide.

3.	The gas given out is SO_2 (sulphur dioxide) gas. Example: $2ZnS + 3O_2 \xrightarrow{\text{Heat}}$ (Air) $2ZnO + 2SO_2\uparrow$	The gas given out is CO_2 (carbon dioxide) gas. Example: $ZnCO_3 \xrightarrow{\text{Heat}} ZnO + CO_2\uparrow$

Q. 9. (a) Explain any two physical properties of ionic compounds giving reason.

(b) List any two metals found in free state in earth's crust. Where are they located in activity series?

(c) Metals towards the top of the activity series can not be obtained from their compounds by reducing with carbon. Why?

[CBSE, Term I, Set 2, 2015]

Ans. (a) Physical properties of ionic compounds are:

(i) Ionic compounds are usually crystalline solids because their oppositely charged ions attract one another strongly and form a regular crystal structure.

(ii) Ionic compounds have high melting and high boiling points. The ionic compounds are made up of positive and negative ions. There is a strong force of attraction between the oppositely charged ions, so a lot of heat energy is required to break this force of attraction and melt or boil the ionic compounds.

(b) Gold and platinum metals are found in free state in the earth's crust. These metals are located at the bottom in the activity series.

(c) Metals towards the top of the activity series are highly reactive. The oxides of highly reactive metals are very stable and cannot be reduced by carbon to obtain free metals because these metals have more affinity for oxygen than carbon.