Metal and Non – Matals

Previous Years' CBSE Board Questions

3.2 Chemical Properties of Metals

MCQ

1. Which of the following statements is true for an amphoteric oxide? 2.
(a) It reacts only with acid and does not form water.
(b) It reacts with acid as well as base to form salt and hydrogen gas.
(c) It reacts with both acid as well as base to form salt and water.
(d) It reacts only with base and does not form water. (2023)

2. A student while burning a magnesium ribbon in air, collected the products in a wet watch glass. The new product obtained was
(a) magnesium oxide
(b) magnesium carbonate
(c) magnesium hydroxide
(d) magnesium chloride. (Term I, 2021-22)

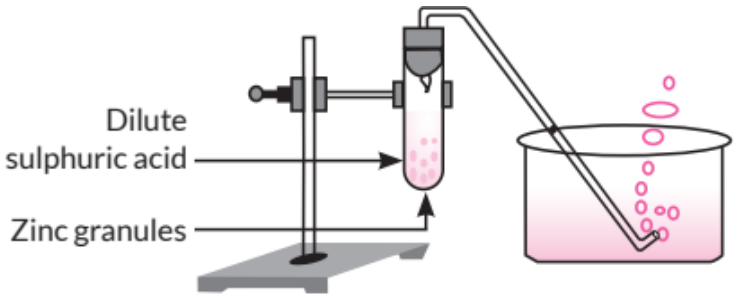
3. Select the correct matching in the following table in connection with the given chemical reaction.

$CuSO_4 + Fe \rightarrow FeSO_4 + Cu$

	Initial colour of solution	Final colour of solution	Final colour of iron nail	Type of reaction
(a)	Pale green	Blue	Grey	Displacement
(b)	Blue	Pale green	Brownish	Double displacement
(c)	Blue	Light blue	Grey	Double displacement
(d)	Blue	Pale green	Brownish	Displacement

(Term I, 2021-22) An

4. Study the diagram given below and identify the gas formed in the reaction.



(a) Carbon dioxide which extinguishes the burning candle.
(b) Oxygen due to which the candle burns more brightly.
(c) Sulphur dioxide which produces a suffocating smell.
(d) Hydrogen which while burning produces a popping sound. (Term I, 2021-22)

5. The pair(s) which will show displacement reaction is/ are
(i) NaCl solution and copper metal
(ii) $AgNO_3$ solution and copper metal
(iii) $Al2(SO_4)_3$ solution and magnesium metal
(iv) $ZnSO_4$ solution and iron metal.
(a) (ii) only
(b) (ii) and (iii)
(c) (iii) and (iv)
(d) (i) and (ii) (Term I, 2021-22)

Read the passage given below and answer the following
questions 6 to 9:
A student, took four metals P, Q, R and S and carried out different experiments to study the properties of metals. Some of the observations were:
- All metals could not be cut with knife except metal R.
- Metal P combined with oxygen to form an oxide
- M_2O_3 which reacted with both acids and bases.
- Reaction with water:

P- Did not react either with cold or hot water but reacted with steam.
Q-Reacted with hot water and the metal started floating
R- Reacted violently with cold water.
S - Did not react with water at all
Based on the above observations answer the following.
6. Out of the given metals, the one which needs to be stored in kerosene is

(a) P
(b) R
(c) S
(d) Q

7. Out of the given metals, the metal Q is
(a) iron
(b) zinc
(c) potassium
(d) magnesium.

8. Metal which forms amphoteric oxides is
(a) P
(b) Q
(c) R
(d) S.

9. The increasing order of the reactivity of the four metals is
(a) P<Q<R <S
(b) S<R<Q<P
(c) S<P<Q<R
(d) P<R<Q<S. (Term I, 2021-22)

10. Which one of the following statements is true about the position of metals in the activity series of metals?
(a) Copper is below hydrogen but above lead.
(b) Iron is below lead and zinc.
(c) Zinc is below magnesium but above aluminium.
(d) Magnesium is below calcium but above aluminium. (2020 C)

11. Why is potassium kept immersed in kerosene ? (2021 C)

12. Give reason why:
(a) gold and silver are used for making jewellery.
(b) a few metals are used for making cooking utensils. (2021 C)

13. What would a student report nearly after 30 minutes of placing duly cleaned strips of aluminium, copper, iron and zinc in freshly prepared iron sulphate solution taken in four beakers? (2019)
14. A pale green solution of ferrous sulphate was taken in four separate test

tubes marked I, II, III and IV. Pieces of Cu, Zn and Al were dropped in test tubes II, III and IV respectively. In which case(s)
(a) the colour of ferrous sulphate solution will match with the colour in test tube (I) ? Give reason.
(b) the colour of ferrous sulphate solution will fade and black mass will be deposited on the surface of the metal ? (2019 C)

15. 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. (Board Term 1, 2016)

16. Name a metal which :
(a) is the best conductor of heat.
(b) has a very low melting point.
(c) does not react with oxygen even at high temperature.
(d) is most ductile. (Board Term 1, 2015)

17. What is meant by amphoteric oxides? Choose the amphoteric oxides from the following:

Na_2O, ZnO, CO_2, Al_2O_3, H_2O (Board Term I, 2014)

SA II (3 marks)

18. Compare in tabular form the reactivities of the following metals with cold and hot water :
(a) Sodium
(b) Calcium
(c) Magnesium (2020)

19. Give reason for the following:
(i) Hydrogen gas is not evolved when most of the metals react with nitric acid.
(ii) Zinc oxide is considered as an amphoteric oxide.
(iii) Metals conduct electricity. (Board Term 1, 2016)

20. (a) Why does calcium start floating when it reacts with water? Write the balanced chemical equation of the reaction.

(b) Name two metals which do not react with water. (Board Term 1, 2015)

21. State what would happen if :
(i) some zinc pieces are placed in blue copper sulphate solution.
(ii) some copper pieces are placed in green ferrous sulphate solution.
(iii) an iron nail is dipped in a solution of copper sulphate for some time.
(Board Term I, 2014)

22. Give reason:
(a) Aluminium is a reactive metal but is still used for packing food articles. (NCERT)
(b) Calcium starts floating when water is added to it. (Board Term 1, 2014)

LA (5 marks)

23. (a) Complete and balance the following chemical equations:
(i) $Al_2O_3 + HCl \longrightarrow$ (ii) $K_2O + H_2O \longrightarrow$
(iii) $Fe + H_2O \longrightarrow$

(b) An element 'X' displaces iron from the aqueous solution of iron sulphate. List your observations if the element 'X' is treated with the aqueous solutions of copper sulphate, zinc sulphate and silver nitrate. Based on the observations arrange X, Zn, Cu and Ag in increasing order of their reactivities. (2020)

3.3 How do Metals and Non-metals React?

MCQ

24. Assertion (A): The solution of ionic compounds are good conductors of electricity.
Reason (R): Movement of atoms of elements take place in solution.
(a) Both (A) and (R) are true and (R) is the correct explanation of (A).
(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
(c) (A) is true, but (R) is false.
(d) (A) is false, but (R) is true. (Term I, 2021-22)

SA II (3 marks)

25. (a) Write electron dot structure 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. (2020)

26. A metal 'X' combines with a non-metal 'Y' by the transfer of electrons to form a compound Z.
(i) State the type of bond in compound Z.
(ii) What can you say about the melting point and boiling point of compound Z?
(iii) Will this compound dissolve in kerosene or petrol?
(iv) Will this compound be a good conductor of electricity? (Board Term 1, 2017)

LA (4/5 marks)

27. The following questions are source based/case based questions. Read the case carefully and answer the questions that follow. The melting points and boiling points of some ionic compounds are given below:

Compound	Melting Point (K)	Boiling Point (K)
NaCl	1074	1686
LiCl	887	1600
$CaCl_2$	1045	1900
CaO	2850	3120
$MgCl_2$	981	1685

These compounds are termed ionic because they are formed by the transfer of electrons from a metal to a non-metal. The electron transfer in such compounds is controlled by the electronic configuration of the elements involved. Every element tends to attain a completely filled valence shell of its nearest noble gas or a stable octet.
(i) Show the electron transfer in the formation of magnesium chloride.
(ii) List two properties of ionic compounds other than their high melting and boiling points.
(iii) (A) While forming an ionic compound say sodium chloride how does sodium atom attain its stable configuration?
(B) Give reasons:

OR

(i) Why do ionic compounds in the solid state not conduct electricity?
(ii) What happens at the cathode when electricity is passed through an aqueous solution of sodium chloride? (2023)

28. (i) By the transfer of electrons, illustrate the formation of bond in magnesium chloride and identify the ions present in this compound.
(ii) lonic 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. (2020)

29. (a) (i) Write two properties of gold which make it the most suitable metal for ornaments.
(ii) Name two metals which are the best conductors of heat.
(iii) Name two metals which melt when you keep them on your palm.
(b) Explain the formation of ionic compound CaO with electron-dot structure. Atomic numbers of calcium and oxygen are 20 and 8 respectively.
(2020)

30. (i) Write down the electronic configuration of magnesium and oxygen.
(ii) Give two general properties of the compound formed by combination of magnesium and oxygen.
(iii) Show the formation of this compound by the transfer of electrons. (Board Term 1, 2014)

3.4 Occurrence of Metals

SA II (3 marks)

31. An ore on treatment with dilute hydrochloric acid produces brisk effervescence. Name the type of ore with one example. What steps will be required to obtain metal from the enriched ore? Also write the chemical equations for the reactions involved in the process. (AI 2019)

32. (i) Carbonate of metal 'X' is abundant in earth crust
and its hydroxide is used in 'white washing.
Identify metal 'X'.
(ii) How will you convert this carbonate into its oxide? Name the process and write its equation. (Board Term 1, 2014) (Ap

LA (4/5 marks)

33. The following questions are source based/case based questions. Read the case carefully and answer the questions that follow. Metals are required for a variety of purposes. For this we need their extraction from their ores. Ores mined from the earth are usually contaminated with many impurities which must be removed prior to the extraction of metals. The extraction of pure metal involves the following steps:
(1) Concentration of ore
(2) Extraction of metal from the concentrated ore
(3) Refining of metal
(a) Name an ore of mercury and state the form in which mercury is present in it.
(b) What happens to zinc carbonate when it is heated strongly in a limited supply of air?
(c) The reaction of a metal A with Fe_2O_3 is highly exothermic and is used to join railway tracks.
(I) Identify the metal A and name the reaction taking place.
(II) Write the chemical equation or the reaction of metal A with Fe2O3.

OR

(c) We cannot use carbon to obtain sodium from sodium oxide. Why? State the reactions taking place at cathode and anode during electrolytic reduction of sodium chloride. (2023)

34. (a) How is the method of extraction of metals high up in the reactivity series different from that for metals in the middle? Why cannot the same process be applied for them? Name and explain the process of extraction of sodium.
(b) Draw a labelled diagram of electrolytic refining of copper. (2020)

35. Two ores X and Y were taken. On heating these ores it was observed that
(a) ore X gives CO2 gas, and
(b) ore Y gives SO2 gas.
Write steps to convert these ores into metals, giving chemical equations of the reactions that take place. (2020)

36. 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. (2020)

37. Write balanced chemical equations to explain what happens, when
(i) Mercuric oxide is heated.
(ii) Mixture of cuprous oxide and cuprous sulphide is heated.
(iii) Aluminium is reacted with manganese dioxide.
(iv) Ferric oxide is reduced with aluminium.
(v) Zinc carbonate undergoes calcination. (2020)

38. (a) List in tabular form three chemical properties on the basis of which we can differentiate between a metal and a non-metal. (NCERT)
(b) Give reasons for the following:
(i) Most metals conduct electricity well.
(ii) The reaction of iron(III) oxide [Fe_2O_3] with heated aluminium is used to join cracked machine parts. (Delhi 2019)

39. (a) Name two metals which are obtained from their ores by simple heating.
(b) Differentiate between calcination and roasting, taking examples of zinc ores.
(c) What is thermite reaction? State its significance. (2019 C)

40. (a) Write the steps involved in the extraction of pure metals in the middle of the activity series from their carbonate ores.
(b) How is copper extracted from its sulphide ore? Explain the various steps supported by chemical equations. Draw labelled diagram for the electrolytic refining of copper. (2018)

41. Draw a schematic diagram of the various steps involved in the extraction of metals from ores for metals of medium reactivity and for metals of low reactivity.(Board Term 1, 2018)

42. (a) Describe an activity to show that metals are good conductors of electricity.
(b) Account for the following:
(i) Hydrogen gas is not evolved when a metal reacts with nitric acid.
(ii) For storing sodium metal, it is kept immersed in kerosene.

(iii) The reaction of iron(III) oxide with aluminium is used to join cracked iron parts of machines. (Board Term 1, 2016)

43. How is copper obtained from its ore (Cu_2S)? Write only the chemical equations. How is copper thus obtained refined? Name and explain the process along with a labelled diagram. (Board Term 1, 2015)

44. (a) Copper produced by heating the ore in air is not very pure. Describe the method used for refining impure copper. Draw labelled diagram of the process.
(b) Write chemical equations for the reactions taking place when :
(i) zinc sulphide is heated in air.
(ii) zinc carbonate is calcined. (Board Term 1, 2014)

3.5 Corrosion

MCQ

45. Assertion (A): The metals and alloys are good conductors of electricity.
Reason (R): Bronze is an alloy of copper and tin and it is not a good conductor of electricity.
(a) Both (A) and (R) are true and (R) is the correct explanation of the assertion (A).
(b) Both (A) and (R) are true, but (R) is not the correct explanation of the assertion (A).
(c) (A) is true, but (R) is false.
(d) (A) is false, but (R) is true. (2020)

SAI (2 marks)

46. 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. (2019)

47. Name first discovered alloy. Give its composition also. (Board Term 1, 2014)

SA II (3 marks)

48. List three differentiating features between the processes of galvanisation and alloying. (2020)

49. Describe an activity to find out the conditions under which iron rusts. (Board Term 1, 2017)

50. Why some metal surfaces acquire a dull appearance when they are exposed to moist air? Write colour acquired by the surfaces of copper and silver in such situation and also write the chemical names of the substances due to which it happens. (Board Term 1, 2016)

LA (5 marks)

51. (a) Name the following:
(i) Metal that can be cut by knife
(ii) Lustrous non-metal
(iii) Metal that exists in liquid state at room temperature

(iv) Most malleable and ductile metal
(v) Metal that is best conductor of electricity
(vi) Non-metal that can exist in different forms
(b) How are alloys better than metals? Give composition of solder and amalgam. (2020)

52. (a) Define corrosion.
(b) What is corrosion of iron called?
(c) How will you recognise the corrosion of silver?
(d) Why corrosion of iron is a serious problem?
(e) How can we prevent corrosion of iron? (Board Term 1, 2017)

53. Give reason for the following:
(a) lonic compounds have higher melting point and higher boiling point.
(b) Sodium is kept immersed in kerosene. (NCERT Intext)
(c) Reaction of calcium with water is less violent.
(d) Silver articles become black after some time when exposed to air.
(e) Prior to reduction the metal sulphides and carbonates must be converted into metal oxides for extracting metals. (Board Term 1, 2015)

CBSE Sample Questions

3.1 Physical Properties

MCQ

1. A cable manufacturing unit tested few elements on the basis of their physical properties.

Properties	*W*	*X*	*Y*	*Z*
Malleable	Yes	No	No	Yes
Ductile	Yes	No	No	Yes
Electrical conductivity	Yes	Yes	Yes	No
Melting Point	High	Low	Low	High

Which of the above elements were discarded for usage by the company?
(a) W,X,Y (b) X, Y, Z (c) W, X,Z (d) W, Y, Z (Term I, 2021-22)

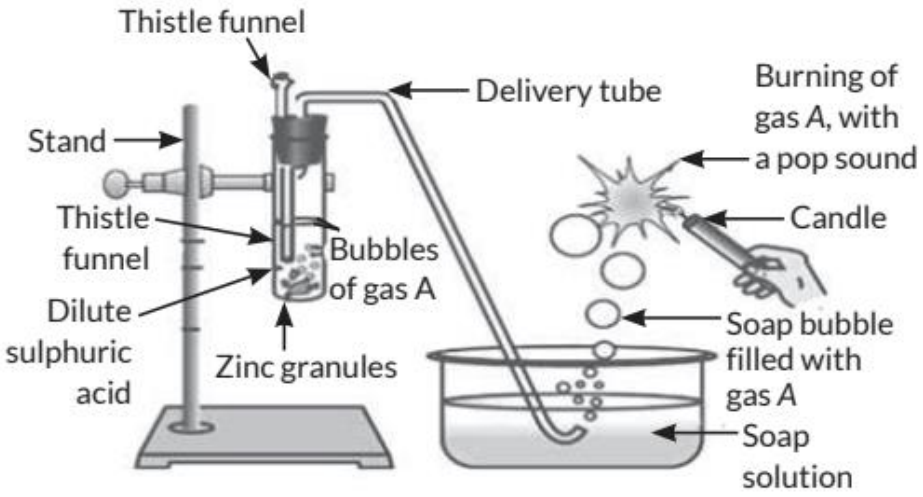
3.2 Chemical Properties of Metals

MCQ

2. On placing a copper coin in a test tube containing green ferrous sulphate solution, it will be observed that the ferrous sulphate solution

(a) turns blue, and a grey substance is deposited on the copper coin.
(b) turns colourless and a grey substance is deposited on the copper coin.
(c) turns colourless and a reddish-brown substance is deposited on the copper coin.
(d) remains green with no change in the copper coin.

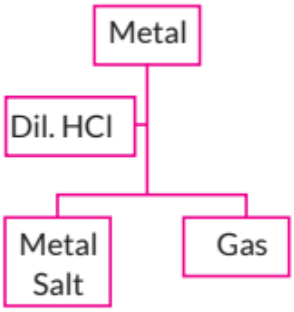
3. Identify gas A in the following experiment. (2022-23)



(a) Nitrogen
(b) Hydrogen
(c) Oxygen
(d) Carbon dioxide

(Term I, 2021-22)

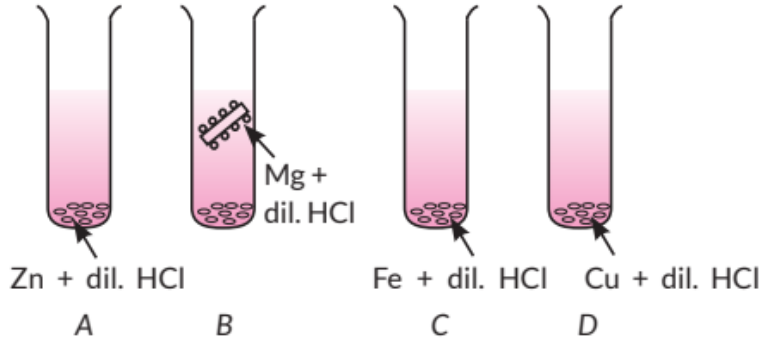
4.



	Metal	Gas Evolved
(i)	Copper	Yes
(ii)	Iron	Yes
(iii)	Magnesium	No
(iv)	Zinc	Yes

Which of the following two combinations are correct?
(a) (i) and (iii)
(b) (i) and (iv)
(c) (ii) and (iii)
(d) (ii) and (iv) (Term I, 2021-22)

5. The diagram shows the reaction between metal and dil. acid.



What is the reason for different behaviour of Mg in test tube B?
(a) Mg is lighter element than dil. HCI.
(b) Mg reacts with dil. HCl to produce H2 gas which helps in floating.
(c) Mg reacts with dil. HCI to produce N2 gas which helps in floating.
(d) Mg reacts with dil. HCI to produce CO_2 gas which helps in floating.
(Term I, 2021-22)

6. The table given below shows the reaction of a few elements with acids and bases to evolve hydrogen gas.

Element	Acid	Base
A	×	×
B	✓	✓
C	✓	×
D	✓	✓

Which of these elements form amphoteric oxides?
(a) A and D
(b) B and D
(c) A and C
(d) B and A (Term I, 2021-22)

SAI (2 marks)

7. A clear solution of slaked lime is made by dissolving Ca(OH)2 in an excess of water. This solution is left exposed to air. The solution slowly goes milky as a

faint white precipitate forms. Explain why a faint white precipitate forms, support your response with the help of a chemical equation.

OR

Keerti added dilute Hydrochloric acid to four metals and recorded her observations as shown in the table given below:

Metal	Gas Evolved
Copper	Yes
Iron	Yes
Magnesium	No
Zinc	Yes

Select the correct observation(s) and give chemical equation(s) of the reaction involved. (2022-23)

3.3 How do Metals and Non-metals React?

MCQ

8. The table shown below gives information about four substances: A, B, C and D.

Substance	Melting point (K)	Electrical conductivity	
		Solid	Liquid/ aqueous
A	295	Good	Good
B	1210	Poor	Good
C	1890	Poor	Good
D	1160	Poor	Poor

Identify ionic compounds from the above given substances.
(a) A, B (b) B, C (c) A, B, D (d) A, C, D (Term I, 2021-22)

SA II (3 marks)

9. (a) Explain the formation of calcium chloride with the help of electron dot structure. (At. numbers: Ca= 20; CI = 17)

(b) Why do ionic compounds not conduct electricity in solid state but conduct electricity in molten and aqueous state? (2020-21)

3.5 Corrosion

Case Based (4 marks)

10. Two students decided to investigate the effect of water and air on iron object under identical experimental conditions. They measured the mass of each object before placing it partially immersed in 10 mL of water. After a few days, the objects were removed, dried and their masses were measured. The table shows their results.

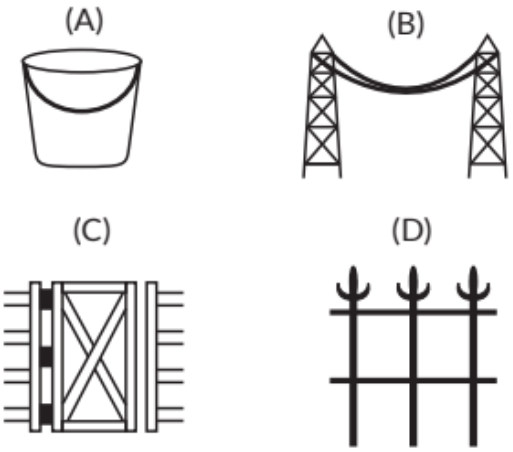
Student	Object	Mass of Object before Rusting in g	Mass of the coated object in g
A	Nail	3.0	3.15
B	Thin plate	6.0	6.33

(a) What might be the reason for the varied observations of the two students?
(b) In another set up the students coated iron nails with zinc metal and noted that, iron nails coated with zinc prevents rusting. They also observed that zinc initially acts as a physical barrier, but an extra advantage of using zinc is that it continues to prevent rusting even if the layer

of zinc is damaged. Name this process of rust prevention and give any two other methods to prevent rusting.

OR

(b) In which of the following applications of Iron, rusting will occur most? Support your answer with valid reason.



A - Iron Bucket electroplated with Zinc
B - Electricity cables having iron wires covered with aluminium
C - Iron hinges on a gate
D - Painted iron fence (2022-23)

SOLUTIONS

Previous Years' CBSE Board Questions

1. (c): Some metal oxides such as aluminium oxide and zinc oxide show amphoteric nature (acidic and basic both) and react with both acids as well as with alkalies to form salt and water. These are called amphoteric oxides.

$$Al_2O_{3(s)} + 2NaOH_{(aq)} \longrightarrow \underset{\text{Sodium meta-aluminate}}{2NaAlO_{2(aq)}} + H_2O_{(l)}$$

$$Al_2O_{3(s)} + 6HCl_{(aq)} \longrightarrow \underset{\text{Aluminium cloride}}{2AlCl_{3(aq)}} + 3H_2O_{(l)}$$

2. (c) As the watch glass used by student was wet, the MgO and Mg3N2 produced by burning of magnesium ribbon are hydrolysed to magnesium hydroxide.

$$Mg + \underset{(air)}{N_2 + O_2} \xrightarrow{\Delta} MgO + Mg_3N_2$$

$$MgO + H_2O \longrightarrow Mg(OH)_2$$
$$Mg_3N_2 + 6H_2O \longrightarrow 3Mg(OH)_2 + 2NH_3$$

3.

$$\text{(d) : } \underset{\text{(Blue)}}{CuSO_4} + Fe \longrightarrow \underset{\text{(Pale green)}}{FeSO_4} + Cu$$

The above reaction is a displacement reaction in which iron being more reactive, displaces copper from CuSO4 solution, resulting into pale green solution of FeSO4.

4. (d): The gas evolved is hydrogen that burns with a popping sound.

$$Zn_{(s)} + H_2SO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + H_{2(g)}\uparrow$$

5. (b): As copper metal is less reactive than sodium, no displacement reaction will occur between NaCl solution and copper metal. Similarly, zinc is more reactive than iron and hence cannot be displaced by iron. Copper can displace silver and magnesium can displace aluminium.

6. (b) Metal R is highly reactive. It can be cut with knife, it should be either lithium, potassium or sodium and must be stored in kerosene oil.

7. (d): Magnesium does not react with cold water but reacts with hot water to form magnesium hydroxide and hydrogen gas.

$$Mg_{(s)} + \underset{\text{(Hot)}}{2H_2O_{(l)}} \longrightarrow Mg(OH)_{2(aq)} + H_{2(g)}$$

Magnesium starts floating on water as bubbles of hydrogen stick to it and as bubbles move up, they pull magnesium with them.

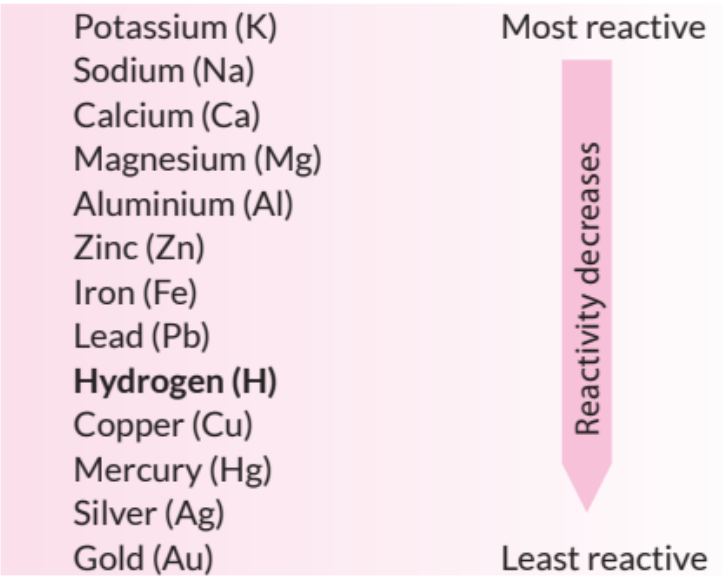
8. (a): It is given that metal P combines with oxygen to form its oxide which reacts both with acids and bases, so oxide of P is amphoteric in nature.

9. (c): Reactivity of given metals can be analysed on the basis of their reaction with water. Since S does not react with water, it is least reactive while R is most reactive because it reacts vigorously even with cold water. Q reacts with

hot water while P reacts with steam only. So, the reactivity order of metals is S<P<Q<R.

10.

(d):



11. Potassium being a very reactive metal reacts violently even with cold water thus, release enormous amount of heat. Hence, it is kept immersed in kerosene.

12. (a) Gold and silver are highly malleable metals so, they are used for making jewellery.
(b) Metals are generally good conductor of heat so, they are used for making cooking utensils.

13. When strips of Al, Cu, Fe and Zn are dipped in freshly prepared $FeSO_4$ solution taken in four beakers, Al and Zn being more reactive than Fe displaces Fe from $FeSO_4$ solution. Cu being less reactive than Fe could not displace Fe from $FeSO_4$ solution. No reaction takes place in a beaker containing Fe and $FeSO_4$ solution.

$$2Al_{(s)} + 3FeSO_{4(aq)} \longrightarrow Al_2(SO_4)_{3(aq)} + 3Fe_{(s)}$$

Aluminium | Ferrous sulphate (Pale green solution) | Aluminium sulphate (colourless solution) | Iron

$$Zn_{(s)} + FeSO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + Fe_{(s)}$$

Zinc | Ferrous sulphate (Pale green solution) | Zinc sulphate (colourless solution) | Iron

14. (a) In test tube (II), the colour of ferrous sulphate solution will match the colour in test tube (1) because Cu being less reactive than Fe, does not displace Fe from FeSO4 solution.
(b) In test tubes (III) and (IV), the colour of ferroes sulphate solution will fade and black mass of Fe will be deposited on the surface of metal. Zn and Al being more reactive than Fe will displace Fe from FeSO4 solution.

$$Zn_{(s)} + FeSO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + Fe_{(s)}$$

Zinc | Ferrous sulphate (Pale green) | Zinc sulphate (colourless) | Iron

$$2Al_{(s)} + 3FeSO_{4(aq)} \longrightarrow Al_2(SO_4)_3 + 3Fe$$

Aluminium | Ferrous sulphate (Pale green) | Aluminium sulphate (colourless) | Iron

15. If a strip of zinc metal is put in copper sulphate solution, then the blue colour of copper sulphate fades gradually due to the formation of colourless zinc sulphate solution and reddish-brown copper metal is deposited on zinc strip.

$$CuSO_{4(aq)} + Zn_{(s)} \longrightarrow ZnSO_{4(aq)} + Cu_{(s)}$$

Copper sulphate (Blue solution) | Zinc | Zinc sulphate (Colourless solution) | Copper (Reddish brown)

In this reaction, zinc metal being more reactive than copper displaces copper from copper sulphate solution. If however, a strip of copper metal is placed in zinc sulphate solution, then no reaction occurs. This is because copper metal is

less reactive than zinc metal and hence, cannot displace zinc from its salt solution.

$$\underset{\text{Copper}}{Cu_{(s)}} + \underset{\text{Zinc sulphate}}{ZnSO_{4(aq)}} \longrightarrow \text{No reaction}$$

16. (a) Metal which is the best conductor of heat is silver.
(b) Gallium has a very low melting point.
(c) Silver and gold do not react with oxygen even at high temperature.
(d) Gold is the most ductile metal.

17. Amphoteric oxides are those which show acidic as well as basic character, i.e., they react with bases as well as acids. ZnO and Al_2O_3 are amphoteric oxides.

18.

	Metal	Reaction with water
(a)	Sodium	Reacts violently with cold water $2Na_{(s)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + H_{2(g)}$
(b)	Calcium	Reacts less violently with cold water $Ca_{(s)} + 2H_2O_{(l)} \rightarrow Ca(OH)_{2(aq)} + H_{2(g)}$
(c)	Magnesium	Does not react with cold water, it reacts with hot water $Mg_{(s)} + 2H_2O_{(l)} \xrightarrow{\text{Heat}} Mg(OH)_{2(aq)} + H_{2(g)}$

19. (i) Hydrogen gas is not evolved when most metals react with nitric acid. It is because HNO_3 is a strong oxidising agent. It oxidises the produced H_2 to water and itself gets reduced to any of the nitrogen oxides (N_2O, NO, NO2).
(ii) ZnO reacts both with acids as well as bases to form salt and water. Thus, ZnO is an amphoteric oxide.

$$\underset{\text{Zinc oxide}}{ZnO} + \underset{\text{Dil. hydrochloric acid}}{2HCl} \longrightarrow \underset{\text{Zinc chloride}}{ZnCl_2} + \underset{\text{Water}}{H_2O}$$

$$\underset{\text{Zinc oxide}}{ZnO} + \underset{\text{Sodium hydroxide}}{2NaOH} \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2} + \underset{\text{Water}}{H_2O}$$

(iii) Metals conduct electricity due to the flow of free electrons present in them.

20. (a) Calcium reacts with cold water to form calcium hydroxide and hydrogen gas.

$$Ca_{(s)} + 2H_2O_{(l)} \xrightarrow[\text{temperature}]{\text{Room}} Ca(OH)_{2(aq)} + H_{2(g)}$$

The bubbles of hydrogen gas produced stick to the surface of calcium and hence, it starts floating on the surface of water.
(b) Gold and silver do not react with water.

21. (i) Since Zn is more reactive than Cu, it would displace Cu^{2+} from its solution and form colourless $ZnSO_4$ solution.
(ii) $Cu + FeSO_4 \rightarrow$ No reaction Cu is less reactive than Fe, thus, it cannot displace Fe from $FeSO_4$ solution.
(iii) When an iron nail is dipped in copper sulphate solution, then the blue colour of copper sulphate fades gradually and a reddish brown coating is formed on the iron nail because iron is more reactive than copper,

$$\underset{\substack{\text{Copper (II)}\\\text{sulphate}\\\text{(Blue solution)}}}{CuSO_{4(aq)}} + \underset{\substack{\text{Iron}\\\text{(Grey)}}}{Fe_{(s)}} \longrightarrow \underset{\substack{\text{Iron (II)}\\\text{sulphate}\\\text{(Greenish}\\\text{solution)}}}{FeSO_{4(aq)}} + \underset{\substack{\text{Copper}\\\text{(Reddish}\\\text{brown)}}}{Cu_{(s)}}$$

22. (a) Aluminium is a strong and cheap metal. It is also a good conductor of heat. But it is highly reactive. When it is exposed to moist air, its surface is covered with a thin impervious layer of aluminium oxide (Al_2O_3). This layer does not allow moist air to come in contact with the fresh metal and hence, protects the metal underneath from further damage or corrosion. Thus, after the formation of this protective layer of Al_2O_3, aluminium becomes resistant to corrosion. It is because of this reason that although aluminium is a highly reactive metal, it is still used in food packaging.
(b) Calcium reacts with cold water to form calcium hydroxide and hydrogen gas.

$$Ca_{(s)} + 2H_2O_{(l)} \xrightarrow[\text{temperature}]{\text{Room}} Ca(OH)_{2(aq)} + H_{2(g)}$$

The bubbles of hydrogen gas produced stick to the surface of calcium and hence, it starts floating on the surface of water.

23.

(a) (i) $Al_2O_3 + 6HCl \longrightarrow 2AlCl_3 + 3H_2O$

(ii) $K_2O + H_2O \longrightarrow 2KOH$

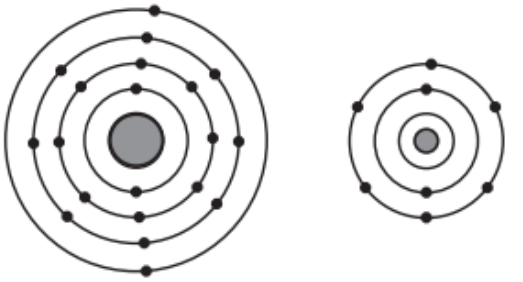
(iii) $3Fe + 4H_2O \longrightarrow Fe_3O_4 + 4H_2$

(b) As X displaces iron from its salt solution hence X is more reactive than iron. It will also displace copper from copper sulphate and silver from silver nitrate as both are less reactive than iron. As zinc is more reactive than iron hence, X can be more or less reactive than zinc. Then the order of their reactivities can be
Ag < Cu < Fe < Zn < X or Ag < Cu < Fe < X < Zn.

24. (c) The solutions of ionic compounds are good conductors of electricity as the ions of compound becomes free to move and conduct electricity.

25.

(a)



Calcium atom (Ca) (2, 8, 8, 2)

Oxygen atom (O) (2, 6)

(b) $Ca \longrightarrow Ca^{2+} + 2e^-$

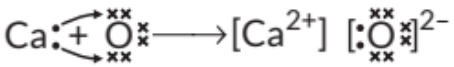
(2, 8, 8, 2) (2, 8, 8)

Calcium cation

$O + 2e^- \longrightarrow O^{2-}$

(2, 6) (2, 8)

Oxide

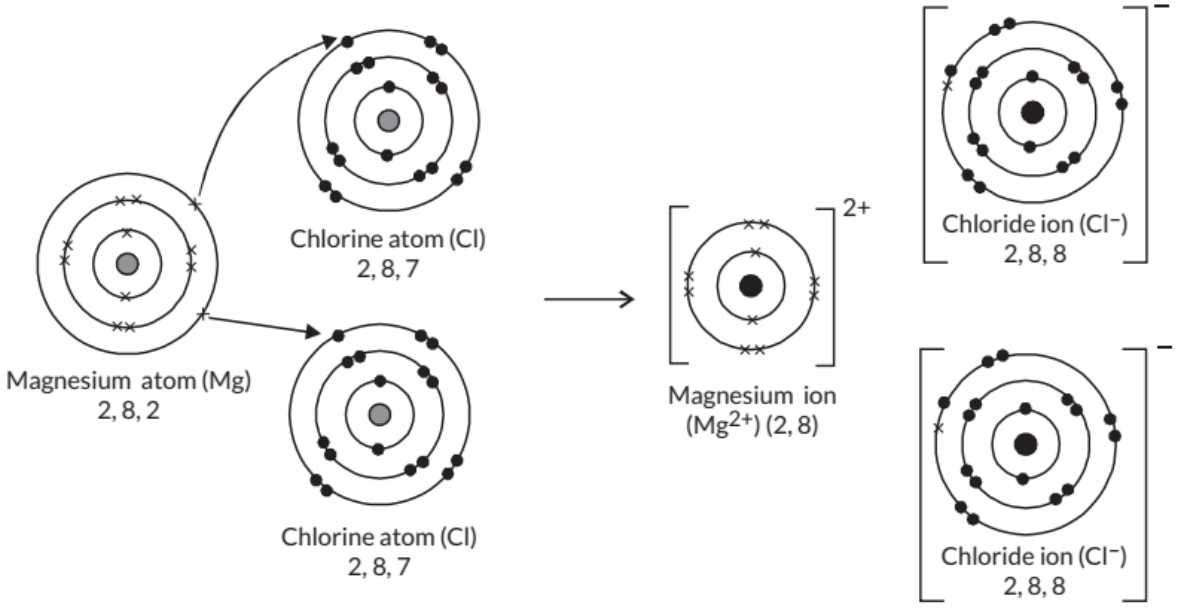


(c) The ions present in this compound are calcium and oxide ions.
(d) CaO is an ionic compound. Its important characteristics are as follows:

(i) It is hard.
(ii) It has high melting and boiling points.
(iii) It is soluble in water and insoluble in non-polar solvents.
(iv) Its aqueous solution conducts electricity.

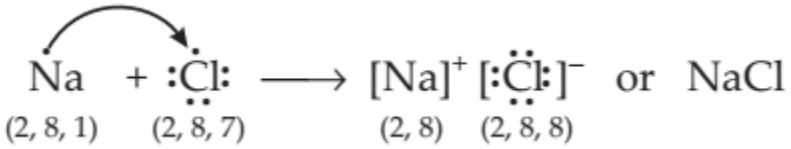
26. X being a metal loses electrons and Y being a non-metal gains electrons to form Z.
(i) The chemical bond formed by the transfer of electrons from one atom to another is known as an ionic bond. Hence, Z is an ionic compound.
(ii) Compound Z is an ionic compound thus, it has high melting and boiling points.
(iii) lonic compounds are insoluble in non-polar solvents such as kerosene or petrol.
(iv) As Z is an ionic compound, it does not conduct electricity in the solid state because movement of ions in the solid is not possible due to their rigid structure. But it conducts electricity in the molten state or in aqueous solution due to the movement of ions freely.

27.
(i)



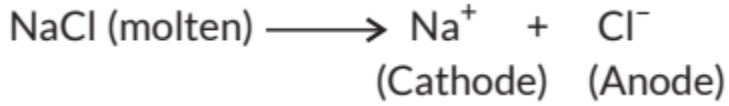
(ii) lonic compounds are generally soluble in water and insoluble in solvents like kerosene, petrol, etc. Ionic compounds conduct electricity in solutions or in molten state.
(iii) (A) Sodium (Na) atom has single electron in the valence shell which it donates to chlorine (CI) atom with seven valence electrons. By losing one

electron, Na atom changes to Na^+ cation with electronic configuration 2, 8, which resembles the configuration of previous noble gas neon (Ne). By accepting one electron, Cl atom changes to Cl^- anion with electronic configuration 2, 8, 8, which resembles the configuration of next noble gas, argon (Ar).

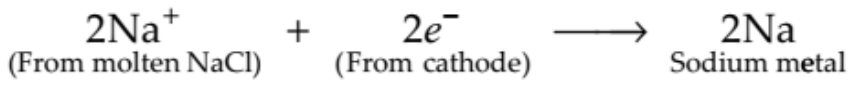


OR

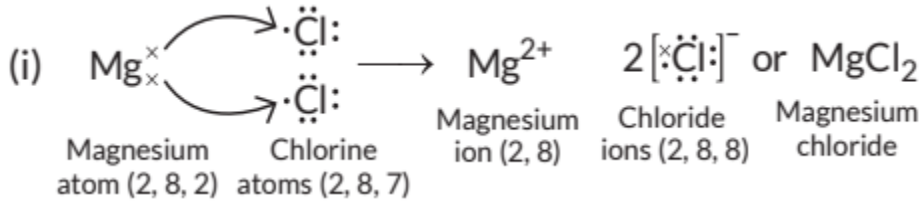
(B) (i) lonic compounds conduct electricity in solutions or in molten state, but not as solids. This is because in solid state ions are very closely packed and are not free to move.
(ii) In aqueous solution of sodium chloride (NaCl), sodium ions (Na) and chloride ions (CI) are present.



During the electrolysis of aqueous solution of sodium chloride:
Sodium ions (Na^1) move towards negative electrode i.e., cathode. They accept electrons from the cathode and get reduced to sodium metal. During electrolysis, anhydrous halide ore is used because sodium metal formed can react with water forming sodium hydroxide. Sodium metal thus produced get deposited at cathode. At cathode :

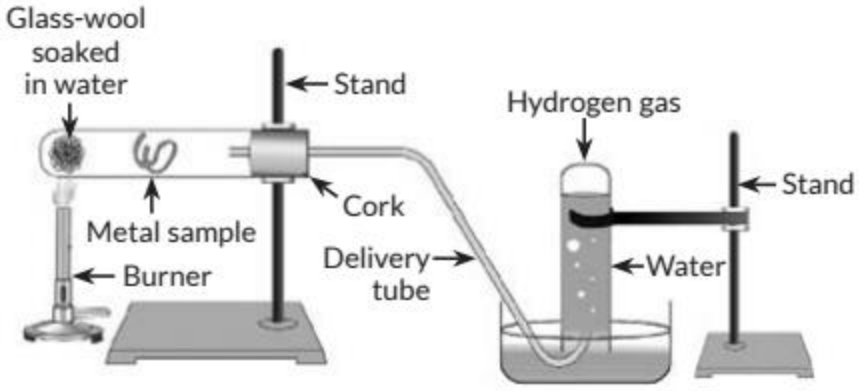


28.



(ii) lonic compounds are solids because the particles which make up ionic compounds are held together by strong electrostatic bonds.

(iii)



Action of steam on metal

29. (a) (i) Malleability and ductility.
(ii) Silver and gold.
(iii) Gallium and caesium have so low melting points that they melt when kept on palm.

(b) $Ca \longrightarrow Ca^{2+} + 2e^-$

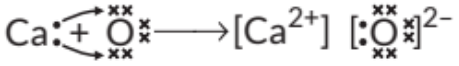
(2, 8, 8, 2) (2, 8, 8)

Calcium ion (cation)

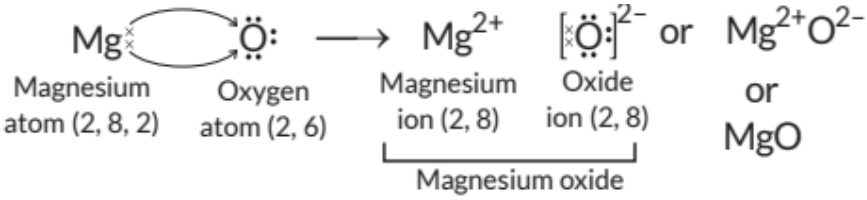
$O + 2e^- \longrightarrow O^{2-}$

(2, 6) (2, 8)

Oxide ion (anion)



30. (i) Atomic number of magnesium (Mg) = 12 Its electronic configuration=2, 8, 2 Atomic number of oxygen = 8 Electronic configuration of oxygen = 2, 6



(ii) Magnesium (Mg) reacts with oxygen (O2) to form magnesium oxide (MgO). 2Mg + O2→ 2MgO Properties of MgO are:
(a) It is soluble in water.
(b) It has high melting point due to strong electrostatic forces of attraction between Mg^{2+} and O^{2}- ions.

(iii) In the formation of magnesium oxide, two electrons are transferred from magnesium atom to oxygen atom as represented:

31. The ore on treatment with dilute hydrochloric acid produces brisk effervescence hence, it must be a carbonate ore. Calamine (ZnCO3) is an important carbonate ore of zinc. Steps required to obtain metal from the enriched carbonate ore :
(a) Conversion of the carbonate ore into metal oxide: This is done by calcination (for carbonate ores). Calcination is the process of heating the ore strongly in the absence or limited supply of air. The zinc carbonate on heating decomposes to form zinc oxide as shown:

$$\underset{\text{Zinc carbonate (Calamine-ore of Zn)}}{ZnCO_{3(s)}} \xrightarrow[\text{(Absence of air)}]{\text{Heat}} ZnO_{(s)} + CO_{2(g)}$$

(b) Reduction of the metal oxide to metal : As zinc is moderately reactive, zinc oxide cannot be reduced by heating alone. Hence, it is reduced to zinc by using a reducing agent such as carbon.

$$\underset{\text{Zinc oxide}}{ZnO_{(s)}} + \underset{\text{Coke}}{C_{(s)}} \xrightarrow{\text{Heat}} \underset{\text{Zinc}}{Zn_{(s)}} + \underset{\text{Carbon monoxide}}{CO_{(g)}}$$

32. (i) Calcium carbonate is abundant in earth's crust and calcium hydroxide is used in white washing. Hence, metal X is calcium (Ca).
(ii) $CaCO_3$ is strongly heated in the absence of air to get the metal oxide. This process is called calcination.

33.
(a) Cinnabar, HgS is an ore of mercury.

$$2HgS_{(s)} + 3O_{2(g)} \xrightarrow{\text{Heat}} 2HgO_{(s)} + 2SO_{2(g)}$$

$$2HgO_{(s)} \xrightarrow{\text{Heat}} 2Hg_{(l)} + O_{2(g)}$$

(b) When zinc carbonate is strongly heated in a limited supply of air, zinc oxide is formed. This process is known as calcination.

$$ZnCO_{3(s)} \xrightarrow{\text{Heat}} ZnO_{(s)} + CO_{2(g)}$$

(c) (1) The metal is aluminium. The reaction of iron(III) oxide, (Fe_2O_3) with aluminium is highly exothermic and the iron produced melts. This molten iron is used to join cracked iron parts of machines and railway tracks. This reaction is known as thermite reaction.

OR

(c) Oxides of highly reactive metals like, Na, Ca, Mg, etc., cannot be reduced with the help of carbon (coke) because they are highly reactive metal and have higher affinity for oxygen than carbon. They can be obtained by electrolysis of molten salts generally chlorides or oxides i.e., by electrolytic reduction method. In molten sodium chloride (NaCl), sodium ions (Na+) and chloride ions (CI) are present.

$$NaCl(molten) \longrightarrow \underset{(Cathode)}{Na^+} + \underset{(Anode)}{Cl^-}$$

During the electrolysis of molten sodium chloride, sodium ions (Na^+) move towards negative electrode i.e., cathode. They accept electrons from the cathode and get reduced to sodium metal. During electrolysis, anhydrous halide ore is used because sodium metal formed can react with water forming sodium hydroxide. Sodium metal then gets deposited at cathode.

$$\text{At cathode : } \underset{\text{(From molten NaCl)}}{2Na^+} + \underset{\text{(From cathode)}}{2e^-} \longrightarrow \underset{\text{Sodium metal}}{2Na}$$

Chloride ions (CI) move towards positive electrode i.e., anode. Chloride ions donate electrons to the anode and get oxidised to chlorine gas and get liberated.

$$\text{At anode : } \underset{\text{(From molten NaCl)}}{2Cl^-} \longrightarrow \underset{\text{Chlorine gas}}{Cl_2} + 2e^-$$

The overall reaction is

$$\underset{\text{Sodium chloride}}{2NaCl} \xrightarrow{\text{electrolysis}} \underset{\text{(at cathode)}}{2Na} + \underset{\text{(at anode)}}{Cl_2}$$

34. (a) Metals of high reactivity are extracted by electrolysis of molten ores while the metals of moderate reactivity are extracted by reduction of oxides

with carbon. This is because highly reactive metals have greater affinity for oxygen than for carbon. Thus, their oxides are very stable and if heated at high temperatures, they form carbides with carbon. Sodium is extracted by the electrolysis of molten sodium chloride. When sodium chloride melt, it splits into sodium ion (Na^+) and chloride ions (CI)

$$NaCl_{(s)} \xrightarrow{\text{Heat to melt}} Na^+_{(l)} + Cl^-_{(l)}$$

At Cathode :

$$\underset{\text{Sodium ions}}{Na^+_{(l)}} + \underset{\text{Electron}}{e^-} \xrightarrow{\text{Reduction}} \underset{\text{Sodium metal}}{Na_{(s)}}$$

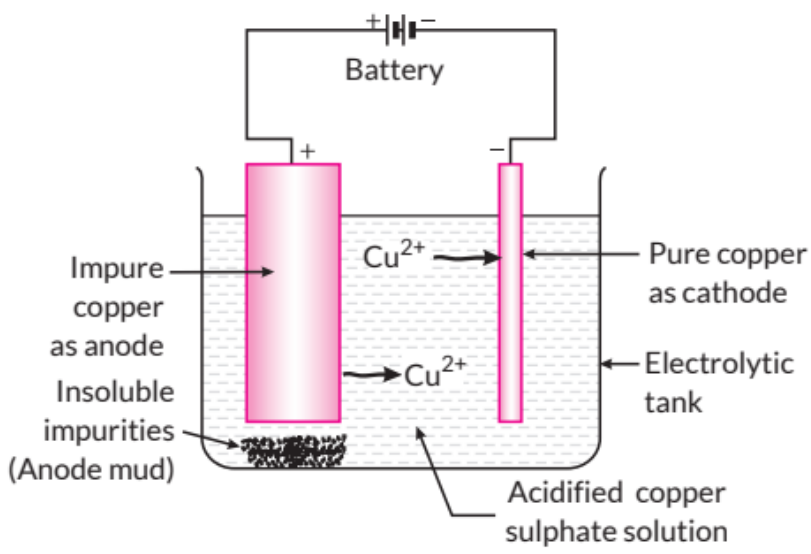
At Anode :

$$\underset{\text{Chloride ion}}{Cl^-_{(l)} - e^-} \xrightarrow{\text{Oxidation}} \underset{\text{Chlorine atom}}{Cl_{(g)}}$$

$$\underset{\text{Chlorine atoms}}{Cl_{(g)} + Cl_{(g)}} \xrightarrow{\text{Oxidation}} \underset{\text{Chlorine gas}}{Cl_{2(g)}}$$

Thus, sodium metal is obtained at the cathode whereas chlorine gas is liberated at the anode.

(b)



Experimental set-up for the electrolytic refining of copper

35. (a) Ore 'X' is a carbonate ore as on heating, it gives CO2 gas.
(b) Ore 'Y' is a sulphide ore as on heating, it gives SO2 gas.

Conversion of carbonate ore to metal :

1. Calcination:

$$\underset{\text{Zinc carbonate}}{ZnCO_{3(s)}} \xrightarrow[\text{(in absence of air)}]{\text{heat}} \underset{\text{Zinc oxide}}{ZnO_{(s)}} + \underset{\text{Carbon dioxide}}{CO_{2(g)}}$$

2. Reduction by heating with carbon:

$$\underset{\text{Zinc oxide}}{ZnO_{(s)}} + \underset{\text{Coke}}{C_{(s)}} \xrightarrow{\text{heat}} \underset{\text{Zinc}}{Zn_{(s)}} + \underset{\text{Carbon monoxide}}{CO_{(g)}}$$

Conversion of sulphide ore to metal:

1. Roasting:

$$\underset{\text{Copper glance}}{2Cu_2S_{(s)}} + \underset{\text{Oxygen (air)}}{3O_{2(g)}} \xrightarrow{\text{heat}} \underset{\text{Copper (I) oxide}}{2Cu_2O_{(s)}} + \underset{\text{Sulphur dioxide}}{2SO_{2(g)}}$$

2. Auto-reduction :

$$\underset{\text{Copper oxide}}{2Cu_2O_{(s)}} + \underset{\text{Copper glance}}{Cu_2S_{(s)}} \xrightarrow{\text{heat}} \underset{\text{Copper}}{6Cu_{(s)}} + \underset{\text{Sulphur dioxide}}{SO_{2(g)}}$$

36. Sodium, magnesium and aluminium have higher affinity towards oxygen than that of carbon because these are highly reactive metals. Hence, carbon cannot reduce the oxides of sodium, magnesium and aluminium to their respective metals. These metals are placed at the top of the reactivity series. The highly reactive metals like Na, Mg, Al, etc. are extracted by electrolytic reduction of their molten chlorides or oxides. Electrolytic reduction is brought about by passing electric current through the molten state. Metal gets deposited at the cathode.

$$NaCl \longrightarrow Na^+ + Cl^-$$

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

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

37. (i) On heating, mercuric oxide decomposes to give mercury and oxygen.

$$2HgO_{(s)} \xrightarrow{\text{Heat}} 2Hg_{(l)} + O_{2(g)}$$

(ii) On heating mixture of cuprous oxide and cuprous sulphide, copper and sulphur dioxide are produced.

$$2Cu_2O_{(s)} + Cu_2S_{(s)} \xrightarrow{Heat} 6Cu_{(s)} + SO_{2(g)}$$

(iii) When aluminium is heated with manganese dioxide, manganese and aluminium oxide are formed.

$$3MnO_{2(s)} + 4Al_{(s)} \xrightarrow{Heat} 3Mn_{(l)} + 2Al_2O_{3(s)}$$

(iv) Ferric oxide reacts with aluminium to produce aluminium oxide and iron.

$$Fe_2O_{3(s)} + 2Al_{(s)} \xrightarrow{Heat} 2Fe_{(l)} + Al_2O_{3(s)}$$

(v) On calcination, zinc carbonate produces zinc oxide and carbon dioxide.

$$ZnCO_{3(s)} \xrightarrow{Calcination} ZnO_{(s)} + CO_{2(g)}$$

38. (a)

S. No.	Chemical property	Metals	Non-metals
1.	Nature of oxides	Metals generally form basic oxides.	Non-metals generally form acidic oxides.
2.	Reaction with water	Metals which lie above hydrogen in the reactivity series displace hydrogen from water.	Non-metals (except F) do not react with water.
3.	Oxidising or reducing character	Metals generally behave as reducing agents.	Non-metals generally behave as oxidising agents.

(b) (i) Metals conduct electricity due to the flow of free electrons present in them.

(ii) The reaction of iron(III) oxide, (Fe2O3) with aluminium is highly exothermic and the iron produced melts. This molten iron is used to join cracked iron parts of machines and railway tracks.

$$\underset{\text{Iron (III) oxide}}{Fe_2O_{3(s)}} + \underset{\text{Aluminium}}{2Al_{(s)}} \xrightarrow{\text{Ignited}} \underset{\text{Iron (molten)}}{2Fe_{(l)}} + \underset{\text{Aluminium oxide}}{Al_2O_{3(s)}} + \text{Heat}$$

39. (a) Metals of low reactivity can be obtained from their oxides by heating alone, For example, copper and mercury.
(b) Calcination : The carbonate ores are changed into oxides by heating strongly in absence or limited air.

$$ZnCO_{3(s)} \xrightarrow{\text{heat}} ZnO_{(s)} + CO_{2(g)}$$

Roasting: The sulphide ores are converted into oxides by heating strongly in the presence of excess air.

$$2ZnS_{(s)} + 3O_{2(g)} \xrightarrow{\text{heat}} 2ZnO_{(s)} + 2SO_{2(g)}$$

(c) The reduction of metal oxides to metal using aluminium as the reducing agent is called aluminothermy. The reaction is highly e[othermic. The heat evolved is so high that the metal is obtained in the molten state.

$$Fe_2O_{3(s)} + 2Al_{(s)} \xrightarrow{\text{Ignited}} 2Fe_{(l)} + Al_2O_{3(s)}$$

This reaction is known as thermite reaction and used for welding the broken parts of iron machinery, railway tracks, girders, etc.

40. (a) Extraction of metals of medium reactivity :
The metals in the middle of the reactivity series are zinc, iron, lead, etc. The carbonate ores first need to get converted to oxides as it is easier to get metal from their oxides. Calamine ($ZnCO_3$) is an important carbonate ore of zinc.
Steps required to obtain metal from the enriched carbonate ore:
(i) Conversion of the carbonate ore into metal oxide: This is done by calcination (for carbonate ores). Calcination is the process of heating the ore strongly in the absence or limited supply of air. The zinc carbonate on heating decomposes to form zinc oxide as shown:

$$\underset{\substack{\text{Zinc carbonate}\\\text{(Calamine-ore of Zn)}}}{ZnCO_{3(s)}} \xrightarrow[\text{(Absence of air)}]{\text{Heat}} ZnO_{(s)} + CO_{2(g)}$$

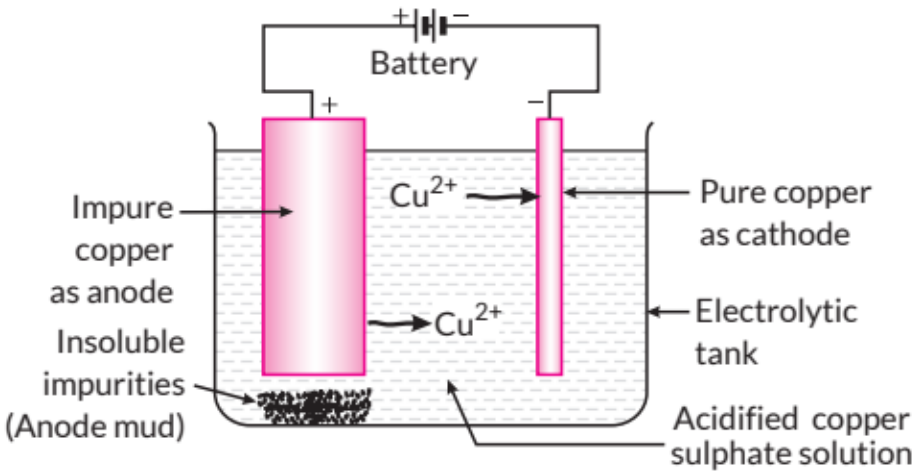
(ii) Reduction of the metal oxide to metal : As zinc is moderately reactive, zinc oxide cannot be reduced by heating alone. Hence, it is reduced to zinc by using a reducing agent such as carbon.

$$\underset{\text{Zinc oxide}}{ZnO_{(s)}} + \underset{\text{Coke}}{C_{(s)}} \xrightarrow{\text{Heat}} \underset{\text{Zinc}}{Zn_{(s)}} + \underset{\substack{\text{Carbon}\\\text{monoxide}}}{CO_{(g)}}$$

The reduction of metal oxides by heating with coke is called smelting.
(b) Copper glance (Cu_2S) when heated in air gets partially oxidised to copper oxide which further reacts with the remaining copper glance to give copper metal.

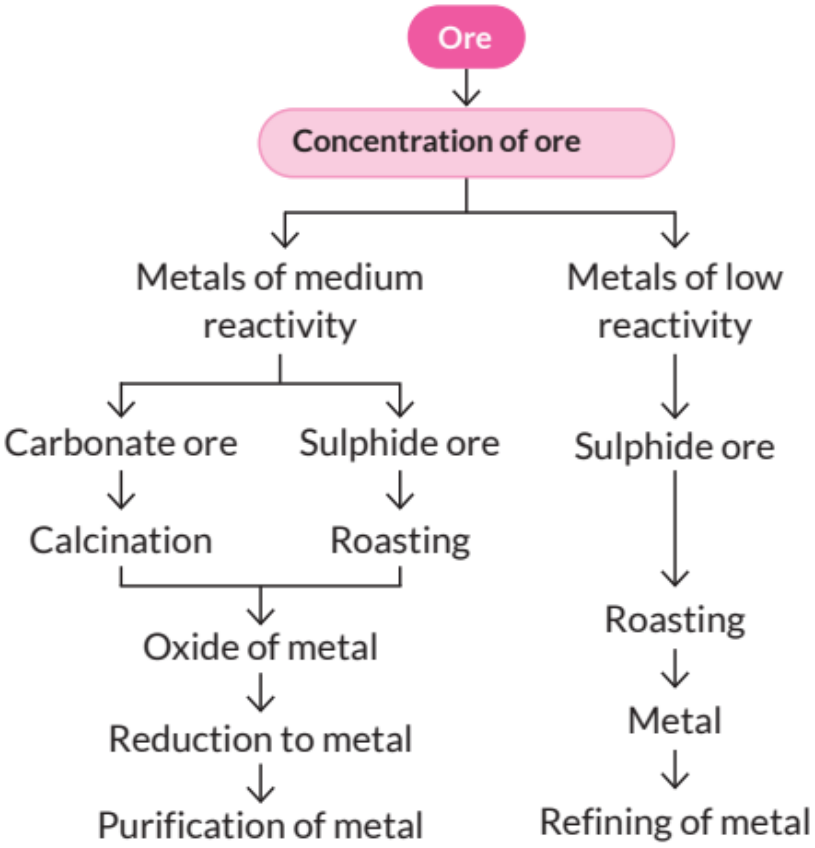
$$\underset{\text{Copper glance}}{2Cu_2S_{(s)}} + \underset{\text{(from air)}}{3O_{2(g)}} \xrightarrow{\Delta} \underset{\text{Copper oxide}}{2Cu_2O_{(s)}} + \underset{\text{Sulphur dioxide}}{2SO_{2(g)}}$$

$$2Cu_2O_{(s)} + Cu_2S_{(s)} \xrightarrow{\Delta} 6Cu_{(s)} + SO_{2(g)}$$

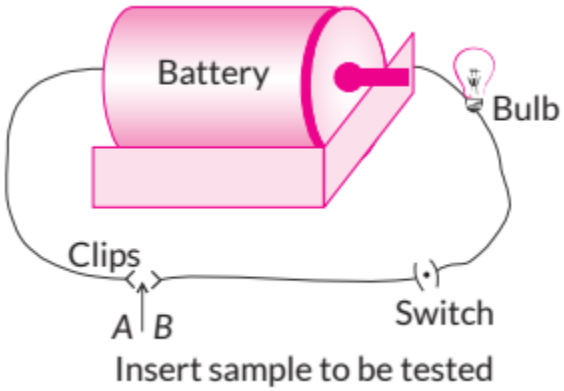


Experimental set-up for the electrolytic refining of copper

41. Various steps involved in the extraction of a metal from its ore followed by refining of the metal is called 'metallurgy'. The steps involved are summarised as follows



42. (a) Activity: (i) Set up an electric circuit as shown in the figure.
(ii) Place the metal to be tested (Cu, Al, Ag, Fe, etc.) as well as non-metals like wood or plastic in the circuit, between the terminal A and B.
(iii) Switch on the battery.



Observations: Bulb begins to glow in case of metals butbulb does not glow when materials like plastic or wood are placed between the clips. Conclusion: This indicates that the current is flowing through the metals. Hence, metals are good conductors of electricity.
(b) (i) Hydrogen gas is not evolved when most metals react with nitric acid. It is because HNO_3 is a strong oxidising agent. It oxidises the H_2 produced to water and itself gets reduced to any of the nitrogen oxides (N_2O, NO, NO_2).
(ii) Sodium reacts vigorously with air and catches fire. Also, sodium reacts with water and the hydrogen gas is evolved which catches fire. Therefore, sodium is kept under kerosene.
(iii) The reaction of iron(III) oxide, (Fe_2O_3) with aluminium is highly exothermic and the iron produced melts. This molten iron is used to join cracked iron parts of machines and railway tracks.

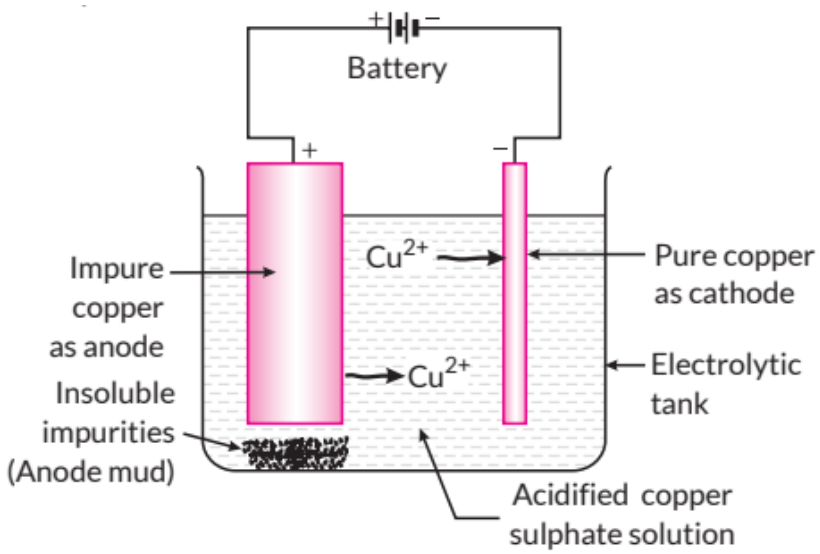
$$\underset{\text{Iron (III) oxide}}{Fe_2O_{3(s)}} + \underset{\text{Aluminium}}{2Al_{(s)}} \xrightarrow{\text{Ignited}} \underset{\text{Iron (molten)}}{2Fe_{(l)}} + \underset{\text{Aluminium oxide}}{Al_2O_{3(s)}} + \text{Heat}$$

43. Copper glance (Cu2S) when heated in air gets partially oxidised to copper oxide which further reacts with the remaining copper glance to give copper metal.

$$\underset{\text{Copper glance}}{2Cu_2S_{(s)}} + \underset{\text{(from air)}}{3O_{2(g)}} \xrightarrow{\Delta} \underset{\text{Copper oxide}}{2Cu_2O_{(s)}} + \underset{\text{Sulphur dioxide}}{2SO_{2(g)}}$$

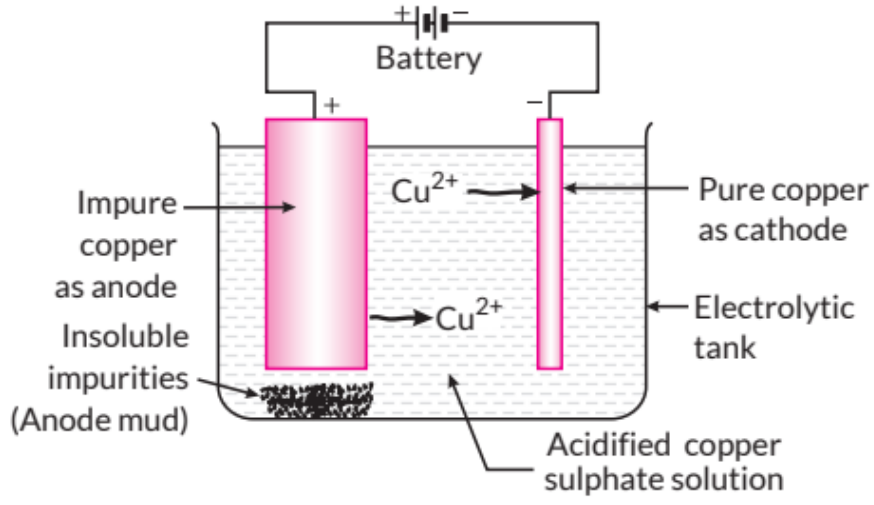
$$2Cu_2O_{(s)} + Cu_2S_{(s)} \xrightarrow{\Delta} \underset{\text{Copper metal}}{6Cu_{(s)}} + SO_{2(g)}$$

Copper obtained is refined by electrolytic refining. Electrolytic refining of crude copper: Thick block of impure metal acts as anode and a thin strip of pure copper metal acts as cathode. The electrolyte used is aqueous solution of copper sulphate containing a small amount of sulphuric acid. On passing electric current through the electrolyte, the metal from the anode dissolves into the electrolyte. An equivalent amount of copper metal from copper sulphate solution gets deposited on cathode.



Experimental set-up for the electrolytic refining of copper

44. Electrolytic refining of crude copper: Thick block of impure metal acts as anode and a thin strip of pure copper metal acts as cathode. The electrolyte used is aqueous solution of copper sulphate containing a small amount of sulphuric acid. On passing electric current through the electrolyte, the metal from the anode dissolves into the electrolyte. An equivalent amount of copper metal from copper sulphate solution gets deposited on cathode.



Experimental set-up for the electrolytic refining of copper

(b) (i) $2ZnS_{(s)} + 3O_{2(g)} \xrightarrow[\text{(in presence of excess air)}]{\text{Heat}} 2ZnO_{(s)} + 2SO_{2(g)}\uparrow$

Zinc sulphide (Zinc blende-ore of Zn); From air; Zinc oxide; Sulphur dioxide

(ii) $ZnCO_{3(s)} \xrightarrow{\text{Calcination}} ZnO_{(s)} + CO_{2(g)}$

Zinc carbonate; Zinc oxide

45. (d): Metals have free electrons in them which can move freely inside them, so they conduct electricity very easily. Bronze is an alloy of copper and tin and it is not a good conductor of electricity.

46. The surface of silver metal gets tranished on exposure to H_2S gas present in air.

$2Ag_{(s)} + H_2S \longrightarrow Ag_2S_{(s)} + H_{2(g)}$

Silver; Hydrogen sulphide (From air); Silver sulphide (Black); Hydrogen

Copper objects lose their lustre by forming a green coating of basic copper carbonate on reacting with CO2 and water vapour present in air.

$2Cu_{(s)} + \underbrace{CO_{2(g)} + O_{2(g)} + H_2O_{(l)}}_{\text{From moist air}} \longrightarrow CuCO_3.Cu(OH)_2$

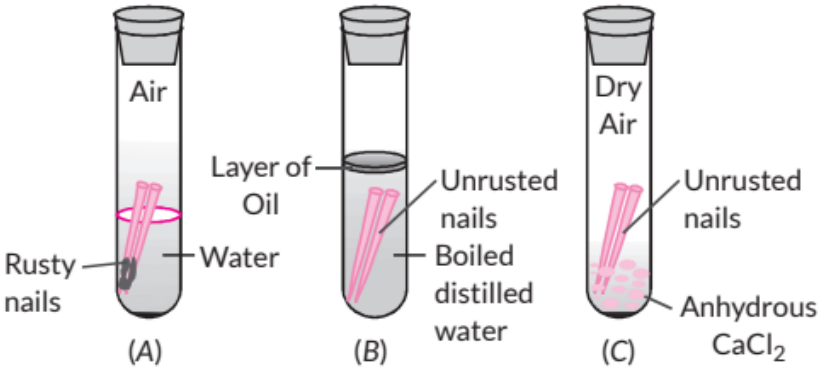
Copper; Basic copper carbonate (green)

47. Bronze is the first discovered alloy. Its composition is copper (90%) and tin (10%).

48.

	Galvanisation	Alloying
1.	It is the process of applying a protective zinc coating to steel or iron, to prevent rusting.	It is the process of combining two or more metals or a metal and a non-metal.
2.	It is done through electrolysis.	It is done by heating the primary metal and adding other elements in definite proportions and then cooling it down to room temperature.
3.	The properties of inner metal are not changed.	The properties like strength, conductivity etc. are changed.

49. Activity:
(i) Take three test tubes and put clean nails in each of the three tubes. Label them as A, B and C.
(ii) Pour some water in test tube A and cork it.
(iii) In test tube B, pour some boiled distilled water along with some turpentine oil and cork it.
(iv) In test tube C, add some anhydrous calcium chloride and cork it.
(v) Look these test tubes properly and keep them undisturbed for a few days.
Observation: Only in test tube A, iron nails get rusted since the nails in this test tube are exposed to both air and water. Conclusion: Both air and water are required for rusting of iron.



50. When a metal has been kept exposed to air for a long time, then it gets a dull appearance. The metals lose their shine or brightness due to the formation of a thin layer of oxide, carbonate or sulphide on their surface and thus, the metal surface gets corroded. The surface of copper gets coated with a green layer in moist air due to the formation of basic copper carbonate, silver articles acquire a blackish tinge due to the formation of silver sulphide.

51. (a) (i) Sodium (ii) lodine (iii) Mercury
(iv) Gold (v) Silver (vi) Carbon
(b) Alloys are stronger than the metals from which they are made, more resistant to corrosion, have lower melting point, have lower electrical conductivity. Solder is an alloy of lead and tin. An amalgam is an alloy of mercury with another metal.

52. (a) The process of slowly eating up of metals due to their conversion into oxides, carbonates, sulphides, etc., by the action of atmospheric gases and moisture is called corrosion.
(b) The corrosion of iron is called rusting.
(c) Silver articles become black after sometime when exposed to air. This is due to formation of a coating of black silver sulphide (Ag_2S) on its surface by the action of H_2S gas present in the air.
(d) Corrosion of iron is a serious problem. Every year large amount of money is spent to replace damaged iron articles. Corrosion causes damage to car bodies, bridges and iron railings, ships and to all objects made of metals specially those of iron.
(e) Corrosion of iron can be prevented by painting, greasing, galvanising, anodising, electroplating or making alloys.

53. (a) Due to strong forces of attraction, the ions are bound to each other very firmly. As a result, the electrovalent or ionic solids have high melting and boiling points.
(b) Sodium reacts vigorously with air and catches fire. Also, sodium reacts with water and the hydrogen gas is evolved which catches fire. Therefore, sodium is kept under kerosene.
(c) Calcium reacts with cold water but the reaction is less violent. The heat evolved is not sufficient for the hydrogen to catch fire.

$$\underset{\text{Calcium}}{Ca_{(s)}} + \underset{\text{Cold water}}{2H_2O_{(l)}} \longrightarrow \underset{\text{Calcium hydroxide}}{Ca(OH)_{2(aq)}} + \underset{\text{Hydrogen}}{H_{2(g)}\uparrow}$$

(d) Silver articles become black after sometime when exposed to air. This is due to formation of a coating of black silver sulphide (Ag_2S) on its surface by the action of H_2S gas present in the air.
(e) The reduction of metal oxides to metal is easier than the reduction of metal sulphides and metal carbonates. Hence, these are first reduced to their corresponding metal oxides.

CBSE Sample Questions

1. (b): The element should be malleable and ductile. It should have high electrical conductivity and high melting point. (0.80)

2. (d): Ferrous sulphate solution remains green with no change in the colour of copper coin as copper is less reactive than iron hence, will not displace Fe from $FeSO_4$ solution. (1)

3.
(b): $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2\uparrow$

H_2 is a colourless, odourless gas and burns with a pop sound. (0.80)

4. (d): Cu does not displace hydrogen from acids since it lies below hydrogen in the reactivity series. Magnesium, iron and zinc react with dilute HCI to give metal salt and hydrogen gas. (0.80)

5. (b): Mg reacts with dil. HCI to produce H_2 gas. Bubbles of H_2 gas stick to the surface of Mg and makes it float on the surface. (0.80)

6. (b): The elements which can dissolve both in acids and bases to evolve hydrogen gas will form amphoteric oxides. (0.80)

7. Calcium hydroxide reacts with carbon dioxide present in the atmosphere to form calcium carbonate which results in milkiness/white ppt. / formation of calcium carbonate

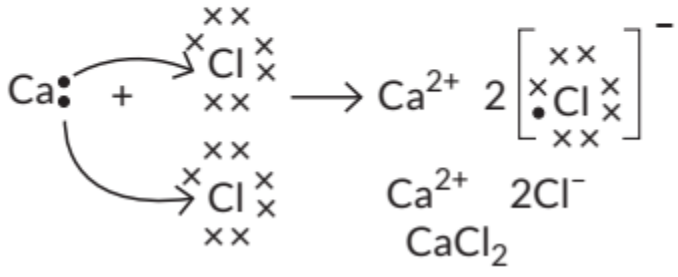
$$\underset{\text{Calcium hydroxide}}{Ca(OH)_2} + CO_2 \rightarrow \underset{\text{Calcium carbonate}}{CaCO_3} + H_2O$$

Only reactive metals like Fe, Mg, Zn liberates hydrogen gas on reaction with dilute HCI. Cu does not react with dilute HCI.
$Fe + HCI \rightarrow FeCl_2/ FeCl_3 + H_2$
$Zn + HCI \rightarrow ZnCl_2 + H_2$ (2)

8. (b): lonic compounds have high melting points. Ionic compounds in the solid state do not conduct electricity because movement of ions in the solid state is not possible due to their rigid structure. Ionic compounds conduct electricity in the molten state or in aqueous solution.(0.80)

9. (a)

Element	Atomic No.	Electronic configuration
Ca	20	2, 8, 8, 2
Cl	17	2, 8, 7



(2)

(b) lonic compounds do not conduct electricity in solid state due to absence of free ions but they conduct electricity in molten and aqueous state due to presence of free ions. (1)

10. (a) Rusting occurs in both cases A and B as there is an increase in mass. (1)
As the surface area in case B is more, extent of rusting is more in case B. (1)
(b) Galvanisation: It is a process of applying a protective zinc coating over steel or iron article to prevent rusting. Oiling/greasing/ painting/ alloying/ chromium plating method can be used to prevent rusting. (2)

OR

(b) C - Iron hinges on a gate. As in this case, iron is in contact with both atmospheric oxygen and moisture/ water vapour. So, it gets rusted most.