

Metals and Non-metals

TOPICS COVERED

Physical and Chemical Properties of Metals and Non-metals, Formation and Properties of Ionic Compounds



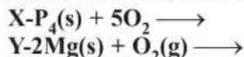
Multiple Choice
Questions

1 Mark

1. Metal oxides react generally with acids but few oxides of metal also react with bases. Such metallic oxides are
I. MgO II. ZnO III. Al₂O₃ IV. CaO [CBSE 2023]
(a) I and II (b) II and III (c) III and IV (d) I and IV
2. The number of valence electrons in outermost shell of the atom of a non-metal [CBSE 2023]
(a) 1, 2 or 3 (b) 3, 4 or 5 (c) 5, 6 or 7 (d) 5, 6 or 8
3. The image shows an incomplete chemical equation of the reaction between iron and oxygen.
 $4\text{Fe}(s) + 3\text{O}_2(g) \longrightarrow$
Which option shows the products formed during the reaction? [CBSE T.E.R.M.*]
(a) 4FeO(s) (b) 12FeO(s) (c) 3Fe₄O₂(s) (d) 2Fe₂O₃(s)
4. Which option classifies the substance based on their physical properties? [CBSE T.E.R.M.*]

Lustrous	Good conductor of electricity	Malleable	Bad conductor of electricity
(a) Graphite and silver	Copper	Iron	Rubber
(b) Copper	Rubber	Iron	Graphite and silver
(c) Copper	Graphite and silver	Iron	Rubber
(d) Copper	Graphite and silver	Rubber	Iron

5. A student writes two incomplete chemical reactions.



Which option completes the reaction to form a balanced chemical equation? [CBSE T.E.R.M.*]

- (a) $X-P_5O_4(s)$, $Y-MgO(s)$
 (b) $X-4PO_{10}(s)$, $Y-4MgO(s)$
 (c) $X-P_4O_{10}(s)$, $Y-2MgO(s)$
 (d) $X-5P_4O_2(s)$, $Y-Mg_2O_2(s)$
6. A student studying the chemical properties of metals finds an incomplete chemical reaction as shown below. [CBSE T.E.R.M.*]



Which option completes the reaction?

- (a) $MgO + HNO_3 \longrightarrow Mg_3N_2 + 4H_2O$
 (b) $MgO + HNO_3 \longrightarrow Mg(OH)_2 + 2NO_2$
 (c) $MgO + HNO_3 \longrightarrow Mg + NO_2 + O_2$
 (d) $MgO + 2HNO_3 \longrightarrow Mg(NO_3)_2 + H_2O$
7. The chemical reaction between a piece of copper and nitric acid is given by the chemical equations,



conc.

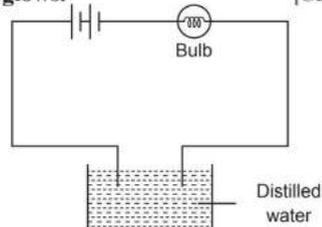


What can be inferred from the chemical equation? [CBSE T.E.R.M.*]

- (a) Copper causes the oxidation of HNO_3 to form NO_2
 (b) Hydrogen gets oxidised by HNO_3 to form water.
 (c) Hydrogen gas reacts with oxygen in air to form water.
 (d) Nitrate reacts with hydrogen to form NO_2 and H_2O .
8. A student adds an equal amount of $CuSO_4$ in two beakers. He adds zinc in the beaker P and silver in beaker Q. The student observes that the colour of the solution in beaker P changes while no change is observed in beaker Q. Which option arranges metals in correct increasing order of reactivity? [CBSE T.E.R.M.*]

- (a) $Ag < Zn < Cu$ (b) $Zn < Cu < Ag$
 (c) $Ag < Cu < Zn$ (d) $Cu < Ag < Zn$
9. A student learns that Na and Mg react with Cl_2 to form NaCl and $MgCl_2$.
 $2Na + Cl_2 \longrightarrow 2NaCl$; $Mg + Cl_2 \longrightarrow MgCl_2$
 The melting point of NaCl is 1074 K while melting point of $MgCl_2$ is 981 K. Why does NaCl and $MgCl_2$ have different melting points? [CBSE T.E.R.M.*]
- (a) $MgCl_2$ is soluble in kerosene and petrol.
 (b) Sodium chloride is formed by combining Na and 1 molecule of Cl_2
 (c) NaCl has strong inter-ionic bonding than $MgCl_2$.
 (d) $MgCl_2$ is formed by combining one molecule of Mg.
10. A student makes an electric circuit using an LED, a battery and connecting wires as shown in diagram.

He notices that LED does not glow. He replaces distilled water by salt solution and observes that LED glows. [CBSE T.E.R.M.*]

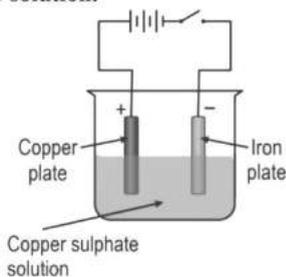


How does the salt solution help the LED to glow?

- (a) Salt solution is covalent in nature and conducts electricity.
 (b) Salt solution has low melting point which allows current to flow through it.
 (c) Salt solution has high boiling point which allows the flow of current in the circuit without getting hot.
 (d) Salt solution contains ions which make it conductive and allows electricity to flow through it.

Questions 11, 12, 13, 14, 15 are based on the information given below:

Krunal connected a copper plate and an iron plate to the positive and negative terminals of a battery respectively along with a switch. He immersed the plates into a beaker containing acidified copper sulphate solution. [CFPQ, CBSE]



11. After a few minutes, even before he turned the switch on he noticed that copper was deposited on the iron plate. This could have been due to ____.
- (a) electrolysis
 (b) electroplating
 (c) a combination reaction
 (d) a displacement reaction
12. Which of the following is likely to happen when the current is started?
- (a) Iron will be deposited on the copper plate.
 (b) Copper will continue to be deposited on the iron plate.
 (c) No reaction will occur at the iron plate or at the copper plate.
 (d) The copper already deposited on the iron plate will go back into the solution.

13. Krunal now replaces the iron plate with a silver plate. He sees that there is no deposition of copper on the silver plate before starting the current.

Which of the following could be the reason?

- (a) Silver is more reactive than iron.
 (b) Silver is less reactive than copper.
 (c) Silver is a poorer conductor of electricity than iron.
 (d) Silver is a better conductor of electricity than copper.

14. What is likely to happen to the concentration of copper sulphate in the solution on passing electric current through the solution in the set-up with the silver plate?

- (a) It will increase.
 (b) It will decrease.
 (c) It will remain the same.
 (d) Cannot say without knowing the amount of current passed.

15. Which of the following will happen to the weights of the silver and copper plates after passing the current for some time?

- (a) The weight of the silver plate will increase and that of the copper plate will decrease.
 (b) The weight of the copper plate will increase and that of the silver plate will decrease.
 (c) Both the plates will decrease in weight.
 (d) Both the plates will increase in weight.

16. Which of the following non-metal is lustrous?

[DoE Pre-Board 2023]

- (a) Oxygen (b) Chlorine
 (c) Hydrogen (d) Iodine

17. Generally when metals react with nitric acid the gas is produced is

[DoE Pre-Board 2023]

- (a) CO₂ (b) SO₂ (c) NO₂ (d) CO

18. A student performs some activities on two substances and records the observations in a table shown below.

Activity	M	N
Cut with Knife	Forms small pieces	Forms small pieces
Beaten with hammer	Shape changes	Changes into powder

Which option classify substances into metal and non-metals?

- (a) Both are metals
 (b) Both are non-metals
 (c) M is metal, N is non-metal
 (d) M is non-metal, N is metal

19. Sodium reacts with water to form sodium hydroxide and hydrogen gas. The balanced equation which represents the above reaction is,

[CBSE 2021]

- (a) Na(s) + 2H₂O(l) → 2NaOH(aq) + 2H₂(g)
 (b) 2Na(s) + 2H₂O(l) → 2NaOH(aq) + H₂(g)



20. Which one of the following structures correctly depicts the compound CaCl₂?

[CBSE 2021]

- (a) Ca²⁺ [:Cl:]²⁺ (b) [:Ca:]²⁺ [:Cl:]₂⁻
 (c) Ca²⁺ [:Cl:]₂ (d) [:Ca:]⁺ [:Cl:]₂⁻

21. The pair(s) which will show displacement reaction is/are

[CBSE 2021]

- (i) NaCl solution and copper metal
 (ii) AgNO₃ solution and copper metal
 (iii) Al₂(SO₄)₃ solution and magnesium metal
 (iv) ZnSO₄ solution and iron metal
 (a) (ii) only (b) (ii) and (iii)
 (c) (iii) and (iv) (d) (i) and (ii)

22. The metal with lowest density among these

- (a) Hg (b) Ga (c) Cs (d) Fr

23. Aqua regia is called as royal water because it dissolves gold its composition is 1:3 concentrated.

- (a) H₂SO₄ : HNO₃
 (b) HNO₃ : H₂SO₄
 (c) HNO₃ : HCl
 (d) HCl : HNO₃

[KVS]

24. Which of the following is purest form of carbon?

- (a) Diamond (b) Graphite
 (c) Fullerene (d) Charcoal

25. An element 'X' is yellow coloured solid, insoluble in water but soluble in carbon disulphide. It has low melting point 114.5°C. It boils at 445°C and it burns with pale blue flame forming pungent smelling gas 'Y' which turns moist blue litmus red and finally colourless. 'X' and 'Y' are

- (a) C, CO₂ (b) N, NO₂
 (c) S, SO₂ (d) I₂, I₂O₅

26. Which of the following metals liberate hydrogen gas with 5% HNO₃?

- (i) Cu (ii) Zn
 (iii) Mn (iv) Mg
 (a) (i) and (ii) (b) (ii) and (iii)
 (c) (iii) and (iv) (d) (i) and (iv)

27. An element 'X' reacts with O₂ to give a compound with a high melting point. This compound is also soluble in water. The element 'X' is likely to be:

- (a) iron (b) calcium
 (c) carbon (d) silicon [CBSE 2020]

28. Reaction between X and Y, forms compound Z. X loses electron and Y gains electron. Which of the following properties is not shown by Z?

- (a) Has high melting point
 (b) Insoluble in water
 (c) Conducts electricity in molten state
 (d) Occurs as solid

29. A student adds some metallic ash in water taken in a test tube. The ash gets completely dissolved in water and solution changes colour.

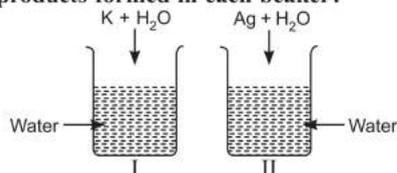
What should be done to test the product of solution?

- Evaporate solution to get crystals.
- Test the basicity using red litmus paper.
- Test the acidity of solution by blue litmus.
- Measure the temperature using a thermometer.

30. What happens when sodium is dropped in water?

- It catches fire and forms oxide.
- It absorbs heat and forms oxide.
- It catches fire and forms hydroxide.
- It absorbs heat and forms hydroxide.

31. A student drops pieces of potassium and silver in beakers I and II containing water. What are products formed in each beaker?



- K_2O and H_2O in I, Ag_2O and H_2O in II
- $KOH + H_2O$ in I, $AgO + H_2O$ in II
- $K_2O + H_2O$ in I, II no reaction takes place
- $KOH + H_2$ in I, II no reaction takes place

32. Mg reacts with 5% of HNO_3 and gives

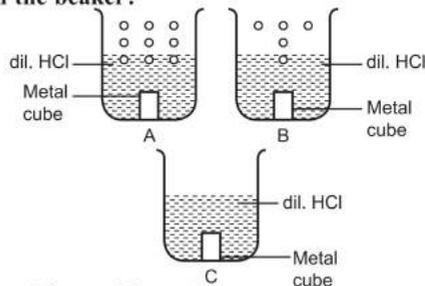
- $MgNO_3 + 2H_2$
- $Mg(NO_3)_2 + H_2O$
- $Mg(NO_3)_2 + H_2$
- $MgNO_3 + H_2O$

33. Which of the following statement is true about the position of metals in the activity series of metals?

- Copper is below hydrogen but above leads.
- Iron is below lead and zinc.
- Zinc is below Mg and above Al.
- Mg is below Ca but above Al. [CBSE 2020(C)]

34. Metal cubes of same size were each dropped in a beaker containing dil. HCl.

What are the possible identities of the metal cubes in the beaker?



- | | | |
|--------|-----|-----|
| 'A' | 'B' | 'C' |
| (a) Mg | Fe | Cu |
| (b) Na | K | Cu |
| (c) Pb | Mg | Ag |
| (d) Zn | Mg | Au |

Answers

- (b) These oxides are amphoteric (acidic as well as basic)
- (c)
- (d)
- (c)
- (c)
- (d)
- (b)
- (c)
- (c)
- (d)
- (d) $Fe(s) + CuSO_4(aq) \longrightarrow FeSO_4(aq) + Cu(s)$
- (b) $Cu^{2+} + 2e^- \longrightarrow Cu$ [At cathode]
- (b) $Ag(s) + CuSO_4(aq) \longrightarrow$ No reaction
- (c) It will remain same because no reaction is taking place
- (a) Copper metal will change into $Cu^{2+}(aq)$ and its weight will decrease. Cu^{2+} will get deposited on Ag metal. Therefore, its weight will increase.
- (d) Iodine is crystalline, lustrous solid.
- (c) Brown coloured (NO_2) gas is evolved.
- (c)
- (b) Sodium reacts vigorously with water.
- (c) Ca loses two electrons, 2Cl gain two electrons.
- (b) $Cu + 2AgNO_3 \longrightarrow Cu(NO_3)_2 + 2Ag$
 $3Mg + Al_2(SO_4)_3 \longrightarrow 3MgSO_4 + 2Al$
- (c) Cs has lowest density among these.
- (c)
- (c) It does not have edges, impurities can't enter into it.
- (c) $S + O_2 \longrightarrow SO_2$ (acidic oxide)
- (c)
- (b) Calcium oxide has high melting point and soluble in water.
 \therefore 'X' is calcium.
- (b) Ionic compounds are soluble in water.
- (b) Metallic oxides are mostly basic in nature.
- (c) $2Na + 2H_2O \longrightarrow 2NaOH + H_2$, H_2 catches fire.
- (d) $2K + 2H_2O \longrightarrow 2KOH + H_2$
- (c) $Mg + 2HNO_3(5\%) \longrightarrow Mg(NO_3)_2 + H_2$
- (d) Mg is less reactive than Ca but more reactive than Al.
- (a)



Very Short Answer Type Questions 2 Marks



35. Read the following statements.

(P) Stainless steel does not rust.

(Q) Iron, nickel and chromium form an alloy.

Does statement (Q) present a valid explanation for statement (P)? Justify your answer. [CFPQ, CBSE]

Ans. Yes, it does. Alloying can change the properties of a metal.

36. A metallic element, M, has the following properties:

- floats on water
- can be cut with a knife
- occurs naturally as its chloride, of formula MCl
- its oxide dissolves in water to form the hydroxide

(a) State the method of manufacture of the metal M.

(b) Name the major byproduct obtained in the process. [CFPO, CBSE]

Ans. (a) Electrolysis of the molten chloride
(b) Chlorine is obtained as byproduct in electrolysis of NaCl.

37. Give reason for the following:

- (a) School bells are made up of metals.
(b) Electric wire are made up of copper.

[CBSE 2013]
Ans. (a) It is because metals are sonorous, i.e. produce sound when struck with a hard substance.
(b) It is because copper is good conductor of substance.

38. Write one example of each of

- (a) A metal which is so soft that, it can be cut with knife and a non-metal which is the hardest substance.
(b) A metal and a non-metal which exist as liquid at room temperature. [CBSE 2015]

Ans. (a) Sodium, carbon (diamond)
(b) Mercury is liquid metal, bromine is liquid non-metal.

39. Name the following:

- (a) A metal, which is preserved in kerosene.
(b) A lustrous coloured non-metal.
(c) A metal, which can melt while kept on palm.
(d) A metal, which is a poor conductor of heat.

[CBSE 2012]
Ans. (a) Sodium is preserved in kerosene.
(b) Iodine is lustrous coloured non-metal.
(c) Gallium
(d) Lead

40. Give two examples each of the metals that are good conductors and poor conductors of heat respectively.

Ans. Good conductors of heat are copper and silver.
Poor conductors of heat are lead and mercury.

41. Explain why calcium metal after reacting with water starts floating on its surface. Write the chemical equation for the reaction. Name one more metal that starts floating after some time when immersed in water. [KVS] [CBSE 2012]

Ans. Calcium starts floating because the bubbles of hydrogen gas formed stick to the surface of metal.
 $\text{Ca(s)} + 2\text{H}_2\text{O(l)} \longrightarrow \text{Ca(OH)}_2\text{(aq)} + \text{H}_2\text{(g)}$
Magnesium reacts with hot water and starts floating due to the bubbles of hydrogen gas sticking to its surface.

42. The way, metals like sodium, magnesium and iron react with air and water is an indication of their relative positions in the 'reactivity series'. Is this statement true? Justify your answer with examples.

Ans. Yes, sodium reacts explosively even with cold water, it is most reactive. Magnesium reacts with hot water, it is less reactive than Na. Iron reacts only with steam which shows it is least reactive.

43. Which of the following listed metals can displace zinc from its salt solution? Give reason of your answer along with chemical equation. [CBSE 2016]
Copper, Lead, Magnesium, Silver

Ans. Metals which are more reactive than zinc can displace Zn from its salt solution. Therefore, Magnesium can displace zinc from its salt solution.



Short Answer Type Questions 3 Marks

44. A teacher asks her students to identify a metal, M. She gives them the following clues to help them.

(P) Its oxide reacts with both HCl and NaOH.

(Q) It does not react with hot or cold water but reacts with steam.

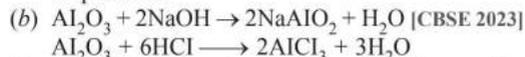
(R) It can be extracted by electrolysis of its ore.

(a) Identify the metal.

(b) Write the chemical equations for the reaction of the metal with HCl and NaOH respectively.

(c) What would happen if the metal is reacted with iron oxide?

Ans. (a) Aluminium because it forms Al_2O_3 which is amphoteric.



(c) It would displace iron to form aluminium oxide.
 $2\text{Al} + \text{Fe}_2\text{O}_3 \longrightarrow \text{Al}_2\text{O}_3 + \text{Fe}$

45. The atomic number of an element is 20. Write its electronic configuration. State whether this element is a metal or a non-metal. What is its valency? Write the name and formula of the compound which this element forms with chlorine. [CBSE 2021 (C)]

Ans. The electronic configuration of calcium ($Z = 20$) is 2, 8, 8, 2. Since it has two valence electrons its valency is 2 and due to presence in group 2, it is a metal. The name of compound calcium forms with chlorine is calcium chloride and its formal is CaCl_2 .

46. (a) Draw the electron-dot structures of the following compound:

(i) KCl (ii) CaO

(b) The electronic configuration of two elements X and Y are given below:

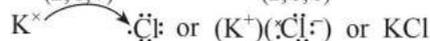
X: 2, 7 Y: 2, 8, 1

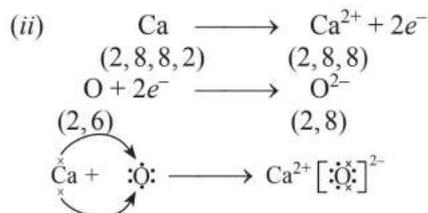
What type of bond will be formed between the atoms of X and Y?

Ans. (a) (i) $\text{K} \longrightarrow \text{K}^+ + e^-$
(2, 8, 8, 1) (2, 8, 8)



(2, 8, 7) (2, 8, 8)





(b) The bond formed will be ionic. Y (2, 8, 1) will donate its extra one electron to X (2, 7), so that both of them will acquire stable electronic configuration. $(Y^{+}) (\overset{\times}{\underset{\times}{\text{X}}})^{-}$

47. State three reasons for the following facts:

(a) Sulphur is a non-metal

(b) Magnesium is a metal

One of the reasons must be supported with a chemical equation. [CBSE 2015]

Ans.

(a) Sulphur is a non-metal	(b) Magnesium is a metal
(i) Poor conductor of heat and electricity.	(i) Good conductor of heat and electricity.
(ii) Neither malleable nor ductile.	(ii) Malleable and ductile
(iii) $\text{S} + \text{O}_2 \longrightarrow \text{SO}_2$ Sulphur dioxide is acidic oxide. $\text{SO}_2 + \text{H}_2\text{O} \longrightarrow \text{H}_2\text{SO}_3$ (Sulphurous acid)	(iii) $2\text{Mg} + \text{O}_2 \xrightarrow{2\text{MgO}}$ Magnesium oxide is basic in nature. $\text{MgO} + \text{H}_2\text{O} \longrightarrow \text{Mg}(\text{OH})_2$ (Magnesium hydroxide)

48. Explain the following:

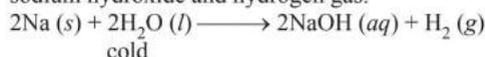
- (a) Sodium chloride is an ionic compound which does not conduct electricity in solid state where as it does conduct electricity in molten state as well as in aqueous solution.
- (b) Reactivity of aluminium decreases if it is dipped in nitric acid.
- (c) Metals like calcium and magnesium are never found in their free state in nature. [Delhi 2019]

- Ans. (a) • Sodium chloride is an ionic compound because it is made up of Na^{+} and Cl^{-} ions.
• It does not conduct electricity in solid state because ions are not free to move.
• It conducts electricity in molten state because ions are free to move.
- (b) It is due to formation of oxide layer on its surface which makes it passive (less reactive) HNO_3 is good oxidising agent.
- (c) It is because Mg and Ca are highly reactive, react with other elements to form compounds, therefore, are not found in free state.

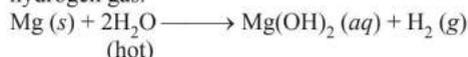
52. Distinguish between metals and non-metals on the basis of (a) two physical and (b) three chemical properties. [CBSE 2018 for Blind, KVS]

49. You are given samples of three metals: Sodium, magnesium and copper. Suggest any two activities to arrange them in order of decreasing activity. [CBSE 2014]

Ans. **Activity 1:** Sodium reacts with cold water to form sodium hydroxide and hydrogen gas.

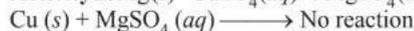


Magnesium does not react with cold water but with hot water to form magnesium hydroxide and hydrogen gas.



Hence sodium is more reactive than magnesium.

Activity 2: $\text{Mg}(s) + \text{CuSO}_4(aq) \rightarrow \text{MgSO}_4(aq) + \text{Cu}(s)$

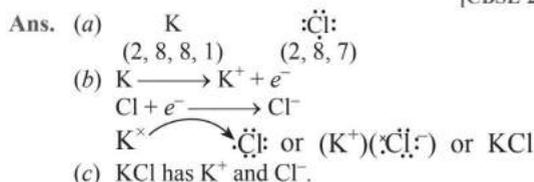


So magnesium is more reactive than copper. Concluding from activity 1 and 2 $\text{Na} > \text{Mg} > \text{Cu}$.

50. (a) Write the electron dot structures for potassium and chlorine.

(b) Show the formation of KCl by the transfer of electrons.

(c) Name the ions present in this compound, KCl. [CBSE 2015]



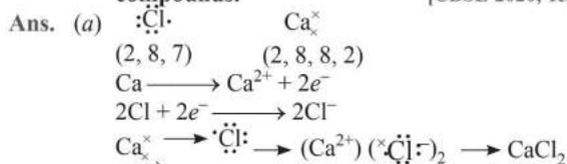
Long Answer

Type Questions

5 Marks

51. (a) Write electron dot structure for chlorine (At No. 17) and calcium (At No. 20). Show the formation of calcium chloride by the transfer of electrons.

(b) Identify the nature of the above compound and explain three physical properties of such compounds. [CBSE 2020, 15]



(b) It is ionic compound.

Physical properties

- (i) It is hard and solid.
(ii) It has high melting and boiling point.
(iii) It is soluble in water.

Ans.	Metals	Non-metals
	Physical: (i) Metals are malleable and ductile. (ii) Metals are good conductor of heat and electricity. Chemical: (i) Reactive metals displace hydrogen from dilute acids. (ii) Metallic oxides are basic in nature. (iii) Metal can lose electron to form positive ions.	(i) Non-metals are brittle. (ii) Non-metals do not conduct heat and electricity. (i) Non-metals do not displace H ₂ from dilute acids. (ii) Non-metallic oxides are acidic in nature. (iii) Non-metals can gain electrons to form negative ions.

PRACTICE QUESTIONS

- Among the following the metal with lowest density is [CBSE 2023]
 (a) Lithium (b) Lead
 (c) Magnesium (d) Aluminium
- The compound obtained on reaction of iron with steam is/are: [CBSE 2020]
 (a) Fe₂O₃ (b) Fe₃O₄
 (c) FeO (d) Fe₂O₃ and Fe₃O₄
- Which one of the following metals would be displaced from the solution of its salts by other three metals? [KVS]
 (a) Mg (b) Ag (c) Zn (d) Cu
- The chemical reaction between Cu and nitric acid is given by chemical equation

$$\text{Cu} + 4\text{HNO}_3(\text{conc.}) \longrightarrow \text{Cu}(\text{NO}_3)_2 + 2\text{NO}_2 + 2\text{H}_2\text{O}$$
 Which of the following is correct?
 (a) Copper oxidises HNO₃ to NO₂
 (b) HNO₃ gets oxidised to H₂O
 (c) HNO₃ gets reduced to NO₂
 (d) None of these
- Pb(s) + CuCl₂(aq) → PbCl₂(aq) + Cu(s)
 Which option explains reason for formation of PbCl₂?
 (a) Copper is more reactive than lead
 (b) Lead is less reactive than Cu
 (c) Pb and Cu are equally reactive
 (d) Lead is more reactive than Cu
- Aluminium strip is dipped in FeSO₄(aq) and change that is observed, is
 (a) Green colour changes to brown
 (b) Lower end of test tube becomes warm
 (c) Coloured gas with smell of burning sulphur
 (d) None of these
- Copper is used for making utensils. Which of the following physical properties of copper is not responsible for the same?
 (a) Malleability (b) High melting point
 (c) Thermal conductivity
 (d) High reactivity
- The most abundant element in the universe is
 (a) Hydrogen (b) Helium
 (c) Carbon (d) Oxygen
- Which of the following is not an ionic compound?
 (a) KCl (b) MgCl₂
 (c) HCl (d) NaCl
- A gas is evolved when dil. sulphuric acid reacts with zinc granules. It gives a pop sound when lit match stick is introduced near it. Identify the gas.
 (a) Nitrogen (b) Hydrogen
 (c) Oxygen (d) Carbon dioxide
- Metal X reacts with dil. HCl to form metal salt and gas. Identify X. [CBSE Sample Paper 2022]
 (a) Copper (b) Mercury
 (c) Silver (d) Zinc
- When zinc reacts with sodium hydroxide, the product formed is [CBSE 2023]
 (a) Sodium oxide (b) Sodium zincate
 (c) Zinc hydroxide (d) Zinc oxide
- The reason for different behaviour (floating) of Mg in dil HCl is due to:
 (a) Mg is lighter element than dil. HCl.
 (b) Mg reacts with dil. HCl to produce H₂ gas which helps in floating.
 (c) Mg reacts with dil. HCl to produce N₂ gas which helps in floating.
 (d) Mg reacts with dil. HCl to produce CO₂ gas which helps in floating. [CBSE Sample Paper 2022]
- Which of the following solutions are electrolytes?
 I. Dil. HCl II. Sugar Solution
 III. Alcohol in water IV. Lime water
 (a) I and II (b) I and IV
 (c) II, III and IV (d) I, II and IV
 [CBSE Sample Paper 2022]
- (a) Why is potassium kept immersed in kerosene? [CBSE 2021 (C)]
 (b) Write the name of an allotrope of carbon. [CBSE 2021 (C)]
- (a) Name any one metal which reacts neither with cold water nor with hot water, but reacts with heated steam to produce hydrogen gas.
 (b) Arrange the following metals in the decreasing order of reactivity:
 Na, K, Cu, Ag

17. (a) A non-metal X exists in two different forms Y and Z. Y is the hardest natural substance, whereas Z is a good conductor of electricity. Identify X, Y and Z. [CBSE 2020, HOTS]
 (b) Which metal does not react with water at all? [DoE]
18. When metal reacts with nitric acid, H_2 is not evolved why?
19. From amongst the metals sodium, calcium, aluminium, copper and magnesium, name the metal
 (a) which reacts with water only on boiling, and
 (b) another which does not react even with steam.
20. Name one metal and one non-metal that exist in liquid state at room temperature. Also name two metals having melting point less than 310 K ($37^\circ C$).
21. Give reason why:
 (a) gold and silver are used for making jewellery.
 (b) a few metals are used for making cooking utensils. [CBSE 2021 (C)]
22. (a) Give reason for the following :
 (i) Aluminium oxide is considered as an amphoteric oxide.
 (ii) Ionic compounds conduct electricity in molten state.
 (b) Name the metal:
 (i) Which has low melting point.
 (ii) Which exist in liquid state at room temperature.
 (iii) Which is most abundant in earth's crust.
 (iv) Which is placed at the top of the reactivity series.
23. How do metals reacts with dilute acids? Explain with the help of an example.
24. Give the names and formulae of
 (a) two acidic oxides (b) two basic oxides
25. (a) Why are ionic compounds generally hard?
 (b) Name the solvent in which ionic compounds are generally soluble.
 (c) Why are aqueous solutions of ionic compounds able to conduct electricity?
26. A metal 'X' loses two electrons and a non-metal 'Y' gains one electron. Show the electron dot structure of compound formed between them. Is it ionic or covalent? Does it have high melting point or low? Will it conduct electricity in solid state or in aqueous solution and why? Will it be soluble in water?
27. Show the formation of magnesium chloride with the help of electron dot structure. [CBSE 2023, 20] [HOTS]
28. What happens when
 (a) Zinc reacts with copper sulphate solution
 (b) Aluminum reacts with steam
 (c) Sodium reacts with water
 Give balanced equations for each. [KVS]
29. (a) Show the formation of Na_2O by the transfer of electrons between the combining atoms.
 (b) Why are ionic compounds usually hard?
 (c) How is it that ionic compounds in the solid state do not conduct electricity but they do so when in molten state? [CBSE 2023]
30. A student was given Mn, Zn, Fe and Cu metals. Identify which of them
 (a) will not displace H_2 from dil. HCl.
 (b) will react only with steam to give $H_2(g)$.
 (c) will give H_2 with 5% HNO_3 .
 Write the chemical reactions involved. [HOTS]
31. With the help of a suitable example, explain how ionic compounds are formed. State any three general properties of ionic compounds.
32. Four metals A, B, C and D are added to the following aqueous solutions one by one. The observations made are tabulated below:

Metal	Iron (II) sulphate	Copper (II) sulphate	Zinc sulphate	Silver nitrate
A	No reaction	Reddish brown deposit
B	Grey deposit	No reaction
C	No reaction	No reaction	No reaction	White shining deposit
D	No reaction	No reaction	No reaction	No reaction

Answer the following questions based on the above observations:

- (a) Which is the most active metal and why?
 (b) What would be observed if B is added to a solution of copper (II) sulphate and why?
 (c) Arrange the metals A, B, C and D in order of increasing reactivity.
 (d) Container of which metal can be used to store both zinc sulphate solution and silver nitrate solution?
 (e) Which of the above solutions can be easily stored in a container made up of any of these metals?

TOPICS COVERED

Occurrence and Extraction of Metals, Corrosion, Alloys



Multiple Choice Questions

1 Mark

- Copper becomes green when exposed to air for a long time due to**
 - formation of CuO on the surface
 - formation of basic copper carbonate on surface
 - formation of copper hydroxide on the surface
 - none of the above
- In stainless steel, iron metal is alloyed with**
 - Cu and Cr
 - Cr and Ni
 - Cr and Sn
 - Cu and Ni [KVS]
- The process of heating sulphide ore in presence of air is called**
 - roasting
 - calcination
 - smelting
 - electrolytic refining
- The process in which carbonate ore is heated strongly in absence of air is called**
 - roasting
 - calcination
 - smelting
 - reduction
- Which of the statements about the reaction, $\text{ZnO} + \text{CO} \longrightarrow \text{Zn} + \text{CO}_2$ is correct?**
 - ZnO is being oxidised
 - CO is being reduced
 - CO₂ is being oxidised
 - ZnO is being reduced
- Bauxite is mixed with cryolite so as to**
 - reduce its melting point
 - increase its electrical conductivity
 - molten cryolite acts as solvent
 - increase its melting point
 - (i), (ii) and (iii)
 - (ii), (iii) and (iv)
 - (iii) and (iv)
 - (i) and (ii)
- In electrolytic refining of copper, the electrolyte used is**
 - CuO
 - Cu(OH)₂
 - Acidified CuSO₄(aq)
 - CuSO₄(s)
- Which of the following ore is concentrated by Froth floatation process?**
 - ZnCO₃
 - ZnO
 - ZnS
 - Na₂S
- In extraction of copper, the flux used is**
 - CaO
 - SiO₂
 - FeO
 - FeSiO₃
- $\text{Cu}_2\text{S} + 3 \text{Cu}_2\text{O} \longrightarrow 6 \text{Cu} + \text{SO}_2$
The above process is**
 - auto-reduction
 - Roasting
 - electrolytic reduction
 - None of these
- Which of the following is not an ionic compound?**
 - KCl
 - MgCl₂
 - CCl₄
 - NaCl [KVS]
- Which option gives the process of extraction of mercury from its ore cinnabar? [CBSE T.E.R.M.*]**
 - Cooling cinnabar in the presence of excess air.
 - Cooling cinnabar to convert into HgO and then heating it.
 - Heating cinnabar in air to convert into HgO and then heating it again.
 - Heating cinnabar in limited air and then adding to small amount of water.
- A researcher conducts an experiment to obtain Zn from its ore. Which option gives the process that the researcher must perform? [CBSE T.E.R.M.*]**
 - Converting metal sulphide into metal oxides then using carbon to reduce it to obtain pure metal.
 - Metal oxide into metal sulphide and reducing with C to get pure metal.
 - Converting metal oxide into metal carbonate then reducing with C to get pure metal.
 - Metal sulphide into metal carbonate and then heating to get pure metal.
- In extraction of iron, the flux used is**
 - CaO
 - SiO₂
 - FeO
 - FeSiO₃

Answers

- (b) CuCO₃.Cu(OH)₂ is green.
- (b)
- (a) $2\text{ZnS} + 3\text{O}_2 \longrightarrow 2\text{ZnO} + 2\text{SO}_2$
- (b) $\text{ZnCO}_3 \xrightarrow{\text{heat}} \text{ZnO} + \text{CO}_2$
- (d) CO is reducing agent.

6. (a)
 7. (c) $\text{CuSO}_4 + \text{dil H}_2\text{SO}_4$
 8. (c) Sulphide ores are concentrated by this process.
 9. (b) $\text{SiO}_2 + \text{FeO}(\text{gangue}) \longrightarrow \text{FeSiO}_3$
 10. (a) Cu_2S is reducing agent.
 11. (c) It is covalent compound.
 12. (c) $2\text{HgS} + 3\text{O}_2 \longrightarrow 2\text{HgO} + 2\text{SO}_2$,
 $2\text{HgO} \xrightarrow{\Delta} 2\text{Hg} + \text{O}_2$
 13. (a)
 14. (a) $\text{CaO} + \text{SiO}_2(\text{gangue}) \longrightarrow \text{CaSiO}_3$

VSA **Very Short Answer**
Type Questions 2 Marks

15. Name a metal/non-metal: [CBSE 2016]
 (i) Which makes iron hard and strong?
 (ii) Which is alloyed with any other metal to make an amalgam?
 (iii) Which is used to galvanise iron articles?
 (iv) Whose articles when exposed to air form a black coating?

- Ans. (i) Carbon makes iron hard and strong. Tungsten can also make iron hard and strong.
 (ii) Mercury
 (iii) Zinc
 (iv) Silver

16. Which one of the methods given in Column I are used for extraction of each of the metals given in Column II.

Column I	Column II
(i) Electrolytic reduction	Al Zn
(ii) Reduction with carbon	Na Fe
(iii) Reduction with Al	Mn Sn

- Ans. (i) Electrolytic reduction is used in case of Al, Na.
 (ii) Reduction with carbon is done in case of Zn, Fe, Sn.
 (iii) Reduction with Al is carried out in case of Mn.

17. What is an alloy? State the constituents of solder. Which property of solder makes it suitable for welding electrical wires?

- Ans. Alloy is a homogeneous mixture of two or more metals. One of them can be a non-metal also. Solder consists of lead and tin, it has low melting point which makes it suitable for soldering electric wires.

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

- Ans. 24 carat gold is pure gold. It is converted into 18 carat gold by adding 6 parts of copper to 1 part of gold, i.e., 75% Au and 25% Cu.

SA **Short Answer**
Type Questions 3 Marks

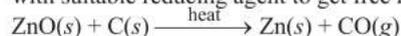
19. An ore on heating in air produces sulphur dioxide. Which process would you suggest for its concentration? Describe briefly any two steps involved in the conversion of this concentrated ore into related metal. [CBSE 2020]

Ans. It is concentrated by froth-floatation process.

(i) **Roasting** : The concentrated sulphide ore is heated strongly in the presence of oxygen to convert it into its oxide.



(ii) **Reduction** : This oxide of metal is reduced with suitable reducing agent to get free metal.



20. (a) What is reactivity series? How does the reactivity series help in predicting the relative activity of various metal?
 (b) Suggest different chemical processes used for obtaining a metal from its oxides of metals in the middle and top of reactivity series. Support your answer with one example.

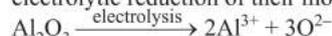
[CBSE Sample Paper 2018]

- Ans. (a) The series of metals in decreasing order of reactivity is called reactivity series of metals. The metals at the top are most reactive and metals at the bottom are least reactive.

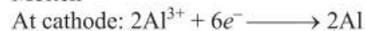
(b) The metals in the middle of reactivity series are obtained from their ores by chemical reduction with suitable reducing agent, e.g.



The metals at the top of series are obtained by electrolytic reduction of their molten ore.



Molten

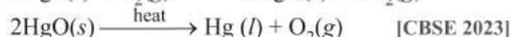


21. What is cinnabar? How is metal extracted from cinnabar? Explain briefly. [CBSE 2020, 15]

[DoE Pre-Board 2023]

Ans. Cinnabar is HgS .

Mercury is obtained by roasting cinnabar. HgO formed is thermally unstable and gives mercury.



Or



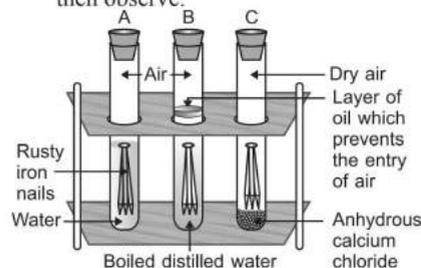
Mercury can be purified by distillation.

22. What is 'rusting'? Describe with a labelled diagram an activity to investigate the conditions under which iron rusts. [CBSE 2023]

Ans. Rusting is a process in which reddish brown coating of hydrated ferric oxide is formed at the surface of iron.

Activity:

- Take three boiling tubes A, B and C.
- Pour some water in test tube A. Put iron nails in it and cork it.
- Pour boiled distilled water in another test tube B and put iron nails in it. Add 1 ml of oil over it such that oil floats over it and prevents the air from entering.
- Take some iron nails in test tube C and put some anhydrous calcium chloride in it and cork it.
- Leave all the three test tubes for one day and then observe.



Observation: Iron nails get rusted in test tube A because both air and water are present in it. Iron nails do not get rusted in B because there is water but no air. In C, rusting will not take place because there is neither air nor water.

Conclusion: Iron gets rusted in the presence of air and water.

23. What is purpose of making alloys? [CBSE 2020]

Ans. Purpose of Making Alloy are as follows:

- Alloys do not get corroded or corroded to very less extent.
- They are harder and stronger than pure metal, e.g., gold mixed with copper is harder than pure gold.
- They have less conductance than pure metals, e.g., copper is good conductor of heat and electricity whereas brass and bronze are not good conductors.
- Some alloys have lower melting point than pure metals, e.g., solder is an alloy of lead and tin which has lower melting point than each of the metals. It is used for soldering of metals.



**Long Answer
Type Questions 5 Marks**



24. (a) Differentiate between roasting and calcination. Explain the two with the help of suitable chemical equations. How is zinc extracted from its ore?

(b) Name two metals that can be used to reduce metal oxides to metals. [CBSE 2012]

Calcination	Roasting
It is a process in which carbonate ore is heated in absence of air to form oxide. $\text{ZnCO}_3(\text{s}) \xrightarrow{\text{heat}} \text{ZnO}(\text{s}) + \text{CO}_2(\text{g})$	It is process in which sulphide ore is heated in presence of oxygen to convert into oxide. $2\text{ZnS} + 3\text{O}_2 \rightarrow 2\text{ZnO} + 2\text{SO}_2$
	[CBSE 2023]

By reduction process, Zn can be extracted from its ore.

Reduction.



(b) Aluminium, Magnesium.

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

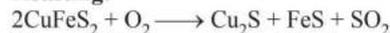
(b) How is copper extracted from its sulphide ore? Explain the various steps supported by chemical equations. Draw labelled diagram for the electrolytic refining of copper. [KVS]

[CBSE 2018]

Ans. (a) (i) Concentration of ore (ii) Calcination
(iii) Reduction (iv) Purification

(b) (i) Ore of copper is concentrated by froth floatation process.

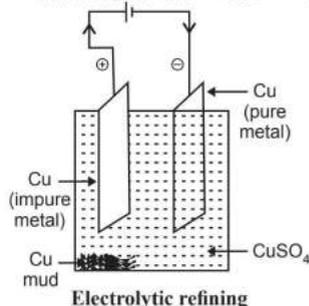
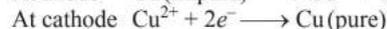
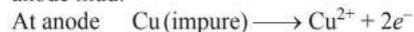
(ii) **Roasting:**



(iii) **Smelting:**



(iv) **Electrolytic refining:** Impure copper is taken as anode, pure copper is taken as cathode. Acidified CuSO_4 is taken as electrolyte. Impure copper changes into Cu^{2+} which gain electron at cathode forming pure Cu. Impurities are left behind as anode mud.



PRACTICE QUESTIONS

- Bronze is an alloy of
 - Copper and zinc
 - Aluminium and tin
 - Copper, tin, zinc
 - Copper and tin[CBSE 2023]
- Which of the following is incorrect description of the process:
 - The impure metal from anode dissolves in electrolyte.
 - The pure metal from the electrolyte deposits at cathode.
 - Insoluble impurities settle at the bottom of anode.
 - On passing electric current through the electrolyte, the pure metal from anode dissolves into electrolyte.[CBSE 2023]
- Mention the names of the metals for the following:
 - Two metals which are alloyed with iron to make stainless steel.
 - Two metals which are used to make jewellery.[CBSE 2015]
- A student has been collecting silver coins and copper coins. One day she observed a black coating on silver coins and green coating on copper coins. Give the chemical name of black and green coating. How are they formed?
- State the electron-dot structure for calcium and sulphur.
 - Show the formation of CaS by the transfer of electrons.
 - Name the ions present in this compound CaS. [Atomic number of Ca = 20, O = 16.] [CBSE 2015]
- Explain the formation of ionic compound CaO with electron dot structure. Atomic number of calcium and oxygen are 20 and 8 respectively.
 - Name the constituent metals of bronze. [CBSE 2020]
- Suggest a method of reduction for the following metals during their metallurgical processes:
 - metal 'A' which is one of the last second or third position in the reactivity.
 - metal 'B' which gives vigorous reaction even with water and air.
 - metal 'C' which is kept in the middle of activity series. [KVS] [CBSE 2013]
- Carbon cannot be used as reducing agent to obtain Mg from MgO. Why?
 - How is sodium obtained from molten sodium chloride? Give equation of the reactions.
 - How is copper obtained from its sulphide ore? Give equations of the reactions.
- Define corrosion. [CBSE 2016]
 - What is corrosion of iron called?
 - How will you recognise the corrosion of silver?
 - Why corrosion of iron is a serious problem?
 - How can we prevent corrosion of iron?



INTEGRATED (MIXED) QUESTIONS

- The way, metals like sodium, magnesium and iron react with air and water is an indication of their relative positions in the 'reactivity series'. Is this statement true? Justify your answer with examples. (2 Marks)
- Explain the following statements: (3 Marks)
 - Most metal oxides are insoluble in water but some of these dissolve in water. What are these oxides and their solutions in water called?
 - At ordinary temperature the surface of metals such as magnesium, aluminium, zinc, etc. is covered with a thin layer. What is the composition of this layer? State its importance.
 - Some alkali metals can be cut with a knife. [CBSE 2016]
- Give reason for the following: (3 Marks)
 - Metals can be given different shapes according to our needs.
 - Hydrogen is not evolved when a metal reacts with dilute nitric acid.
 - Write chemical equations that shows zinc oxide reacts with acid as well as base.
- Write one example of each of (3 Marks)
 - A metal which is so soft that, it can be cut with knife and a non-metal which is the hardest substance.
 - A metal and a non-metal which exist as liquid at room temperature.
 - Using the electronic configurations, explain how magnesium atom combines with oxygen atom to form magnesium oxide by transfer of electrons.
- Elements magnesium and oxygen respectively belong to group 2 and group 16 of the Modern Periodic Table. If the atomic numbers of magnesium and oxygen are 12 and 8 respectively,

draw their electronic configurations and show the process of formation of their compound by transfer of electrons.

- (b) (i) Give one method to prevent the corrosion of copper.
(ii) Name the ores of the following metals:
• mercury, and • zinc (3 Marks)



ASSERTION AND REASON QUESTIONS

Direction: In the following Questions, the Assertion and Reason have been put forward. Read the statements carefully and choose the correct alternative from the following:

- (a) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion.
(b) The Assertion and the Reason are correct but the Reason is not the correct explanation of the Assertion.
(c) Assertion is true but the Reason is false.
(d) The statement of the Assertion is false but the Reason is true.

- Assertion:** Sodium oxide is an amphoteric oxide.
Reason: Those oxides which react with acid as well as base are amphoteric oxides. [CBSE 2023]
- Assertion:** Nitrogen is a non-metal.
Reason: Nitrogen has 5 valence electrons. [KVS]
- Assertion:** Copper does not react with dil. H_2SO_4 .
Reason: Copper is more reactive than hydrogen
- Assertion:** Highly reactive metals are obtained by electrolytic reduction of their molten ore.
Reason: Highly reactive metals can be extracted by chemical reduction.
- Assertion:** Silver becomes black in colour when exposed to atmosphere.
Reason: Silver reacts with H_2S gas to form Ag_2S which is black in colour.
- Assertion:** The metals and alloys are good conductors of electricity.
Reason: Bronze is an alloy of copper and tin and it is not good conductor of electricity. [CBSE 2020]
- Assertion:** If Na_2O reacts with HCl , it will form $NaCl$ and H_2O .

Reason: Sodium reacts with air to form sodium oxide (Na_2O).

- Assertion:** Metals are reducing agents.
Reason: Metals form positive ions by loss of electrons.
- Assertion:** Lead reacts with H_2SO_4 to form lead sulphate and further reaction stops.
Reason: Lead sulphate is insoluble in water and forms a coating over lead metal preventing further reaction.
- Assertion:** Sodium chloride has melting point above $1000^\circ C$.
Reason: Sodium chloride conducts electricity in solid state.
- Assertion:** The colour of an aqueous solution of copper sulphate turns colourless when a piece of lead is added to it.
Reason: Lead is more reactive than copper and hence displaces copper from its salt solution.
- Assertion:** K is more reactive than Na.
Reason: K is smaller in size than Na.
- Assertion:** Certain elements show properties of both metals and non-metals and are called metalloids.
Reason: Silicon and germanium are metalloids as they resemble with metals as well as non-metals.
- Assertion:** $MgCl_2$ is covalent compound.
Reason: Metals and non-metals react by mutual transfer of electrons.
- Assertion:** Sodium is less reactive than lead.
Reason: Sodium is kept in kerosene.
- Assertion:** Na, Ca, Mg are obtained by electrolysis of their molten oxides.
Reason: These metals have more affinity for oxygen than carbon. [CBSE 2023]



CASE-BASED QUESTIONS

- Read the following passage and answer the questions that follow based on passage and related studied concepts.

Elements are classified into metals, non-metals and metalloids. Metals are lustrous, malleable, ductile and good conductors of heat and electricity, mostly solids, form positive ions and basic oxides. Non-metals are

non-lustrous, brittle, exist as solids, liquids and gases, non-conductor of heat and electricity, form negative ions and acidic oxides mostly. Some metals form amphoteric oxides and some non-metals form neutral oxides. A more reactive metal can displace less reactive metal from its salt solution. Some less reactive metals occur in free state. Most of metals occur in combined

state in form of ores. Carbonates ores are converted into oxides by calcination and sulphide ores are roasted in presence of oxygen to form oxides. Oxides are reduced with suitable reducing agent to get free metal. Metals of middle reactivity series are obtained from their oxides by reduction with Al, Mg. Most reactive metals are obtained by electrolytic reduction of their molten ores. Impure metals are refined by suitable methods. Metals form ionic compounds with non-metals. Ionic compounds are soluble in water, high melting solids, conduct electricity in molten state and in aqueous solution.

- Out of elements from atomic number 1 to 20, name metalloids.
- X has atomic number (20) and Y has 17. What is formula of compound formed?
- What happens when zinc carbonate is heated in absence of air? Name the process.

Or

- What happens when Zn metal reacts with $\text{FeSO}_4(aq)$? Write chemical equation.

2. **Read the given passage and answer the questions based on the passage and related studied concepts.**

Pure metals are usually too soft and weak for most uses. In pure metals the atoms are arranged orderly in layers. When force is applied to the metal, the layers of metal atoms can slide over one another.

To improve the strength and hardness of metals, atoms of another element can be added usually in small amounts which prevents atoms of the metal from sliding over one another, making the metals stronger and harder and less likely to get its shape distorted. The final product is an alloy of metal, e.g. ornaments are made up of 22 carat gold in which copper is added to gold. Alloy is a homogeneous mixture of two or more metals. One of them can be non-metal also, e.g., steel is an alloy of Fe and carbon. Alloys are made so as to improve properties of metals. Amalgam is alloy of metal with mercury.

- What is composition of stainless steel?
- Which metal is present in solder, brass and bronze?
- What is amalgam? Give an example.

Or

- Calculate the percentage of gold present in 22 carat gold.

3. 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: [CBSE 2021]

- 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:

- Identify metal Q out of Fe, Zn, K, Mg? Give reason.
- Identify metal which forms amphoteric oxide.
- Arrange the metals in increasing order of reactivity. Give reason.

Or

- Which metal is kept in kerosene oil and why?
4. The activity series of metals is shown in the box. Study this table carefully and answer the questions based on this series and related studied concepts.

Reactivity Series
K
Na
Ca
Mg
Al
Zn
Fe
Pb
H
Cu
Ag
Au

- What happens when Ag metal is added to CuSO_4 solution?
- Why does Au exist in free state?
- Can we store $\text{MgSO}_4(aq)$ in copper container? Give reason.

Or

- Which metals do not occur in free state and react with cold water? How are these extracted?
5. The following table gives melting point of some metals. Study the table and answer the questions related to table and related studied concepts.

Metals	Melting Point
Na	98°C
Ag	961.8°C
Cu	1085°C
Al	660.3°C
Zn	419.5°C
Au	1064°C
Sn	231.9°C
Hg	-38.83°C

- (a) How are sodium and mercury refined? Why
 (b) Name two metals purified by electrolytic refining.
 (c) In electrolytic refining of copper, name the cathode, anode and electrolyte used.

Or

- (c) Why is bauxite mixed with cryolite before electrolytic reduction in extraction of aluminium?
 6. Almost all metals combine with oxygen to form metal oxides. Metal oxides are generally basic in nature. But some metals show both basic as well as acidic behaviour. Different metals show different reactivities towards oxygen. Some react vigorously while some do not react at all.

- (a) What happens when copper is heated in air? Give the equation of the reaction involved.
 (b) Why are some metal oxides categorised as amphoteric? Give one example.
 (c) Complete the following reaction [CBSE 2023]
 (i) $\text{Na}_2\text{O}(s) + \text{H}_2\text{O}(l) \longrightarrow$
 (ii) $\text{Al}_2\text{O}_3(s) + 2\text{NaOH} \longrightarrow$

Or

- (c) On burning sulphur in oxygen a colourless gas is produced.
 (i) Write chemical equation for the reaction.
 (ii) Name the gas formed.
 (iii) State the nature of the gas.
 (iv) What will be action of this on dry litmus paper?
 7. On the basis of reactivity metals are grouped into three categories:
 (i) Metals of low reactivity
 (ii) Metals of medium reactivity
 (iii) Metals of high reactivity.

Therefore metals are extracted in pure form from their ores on the basis of their chemical properties.

[CBSE 2023]

Metals of high reactivity are extracted from their ores by electrolysis of their molten ores. Metals of low reactivity are extracted from their sulphide ores which are converted into their oxides. The oxides of these metals are reduced to metals by simple heating.

- (a) Name the process of reduction used for a metal that gives vigorous reaction with air and water both.
 (b) Carbon cannot be used as reducing agent to obtain aluminium from its oxide. Why?
 (c) Describe briefly the method to obtain mercury from cinnabar. Write the chemical equation for the reaction involved in the process.

Or

- (c) Differentiate between roasting and calcination giving chemical equation for each.

8. The melting points and boiling points of some ionic compounds are given below: [CBSE 2023]

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.

- (a) Show the electron transfer in the formation of magnesium chloride.
 (b) List two properties of ionic compounds other than their high melting and boiling points.
 (c) While forming an ionic compound say sodium chloride how does sodium atom attain its stable configuration?

Or

- (c) Give reasons:
 (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?



NCERT ZONE

NCERT INTTEXT QUESTIONS

Page 40

1. Give an example of a metal which
 (i) is a liquid at room temperature. [CBSE 2020]
 (ii) can be easily cut with a knife. [CBSE 2020]
 (iii) is the best conductor of heat.
 (iv) is a poor conductor of heat.

- Ans. (i) Metal that exists in liquid state at room temperature is mercury.
 (ii) Metal that can be easily cut with a knife is sodium.
 (iii) Metal that is the best conductor of heat is silver.
 (iv) Metal that is a poor conductor of heat is lead.

2. **Explain the meanings of malleable and ductile.**
Ans. Malleable: Substances that can be beaten into thin sheets are called malleable. Most of the metals are malleable. The most malleable metals are gold and silver.
Ductile: Substances that can be drawn into thin wires are called ductile. Most of the metals are ductile. Platinum, gold and silver are the most ductile metals.

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1. **Why is sodium kept immersed in kerosene oil?**
Ans. Sodium is a very reactive metal and combines explosively with air(oxygen) at room temperature.

3. **Samples of four metals A, B, C and D were taken and added to the following solutions one by one. The results obtained have been tabulated as follows.**

Metal	Iron(II) sulphate	Copper(II) sulphate	Zinc sulphate	Silver nitrate
A	No reaction	Displacement		
B	Displacement		No reaction	
C	No reaction	No reaction	No reaction	Displacement
D	No reaction	No reaction	No reaction	No reaction

Use the Table above to answer the following questions about metals A, B, C and D.

- (i) Which is the most reactive metal?
(ii) What would you observe if B is added to a solution of copper (II) sulphate?
(iii) Arrange the metals A, B, C and D in the order of decreasing reactivity.
- Ans.** A + FeSO₄ → No reaction, i.e. A is less reactive than iron.
A + CuSO₄ → Displacement, i.e. A is more reactive than copper.
B + FeSO₄ → Displacement, i.e. B is more reactive than iron.
B + ZnSO₄ → No reaction, i.e. B is less reactive than zinc.
C + FeSO₄ → No reaction, i.e. C is less reactive than iron.
C + CuSO₄ → No reaction, i.e. C is less reactive than copper.
C + ZnSO₄ → No reaction, i.e. C is less reactive than zinc.
C + AgNO₃ → Displacement, i.e. C is more reactive than silver.
D + FeSO₄/CuSO₄/ZnSO₄/AgNO₃ → No reaction, i.e. D is less reactive than iron, copper, zinc, and silver.

From the above equations, we obtain:

- (i) B is the most reactive metal.
(ii) If B is added to a solution of copper (II) sulphate, then it would displace copper.

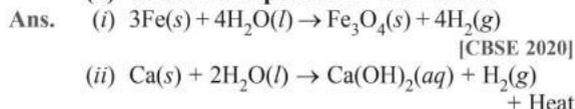
$$B + CuSO_4 \longrightarrow \text{Displacement}$$

(iii) The arrangement of the metals in the order of decreasing reactivity is:
B > A > C > D
4. **Which gas is produced when dilute hydrochloric acid is added to a reactive metal? Write the chemical reaction when iron reacts with dilute H₂SO₄.**
Ans. When dilute hydrochloric acid is added to a reactive metal, hydrogen gas is evolved. The reaction between iron and H₂SO₄ is:

$$\begin{array}{ccccccc} Fe(s) & + & H_2SO_4(dil.) & \longrightarrow & FeSO_4(aq) & + & H_2(g) \\ \text{Iron} & & \text{Sulphuric acid} & & \text{Iron(II) sulphate} & & \text{Hydrogen} \end{array}$$
5. **What would you observe when zinc is added to a solution of iron(II) sulphate? Write the chemical reaction that takes place.**
Ans. Zinc is more reactive than iron. Therefore, if zinc is added to a solution of iron (II) sulphate, then it would displace iron from the solution.

It also reacts violently with cold water. Hence, it catches fire if kept in open. Therefore, to prevent accidental fires and accidents, sodium is stored immersed in kerosene oil.

2. **Write equations for the reactions of**
(i) iron with steam.
(ii) calcium and potassium with water.



2. Name two metals which are found in nature in the free state.

Ans. The metals present at the bottom of the reactivity series are mostly found in free state. For example: gold, silver, and platinum. (any two)

3. What chemical process is used for obtaining a metal from its oxide?

Ans. The chemical process used for obtaining a metal from its oxide is reduction.

There are mainly three different methods of reduction:

(i) By heating

(ii) By using carbon

(iii) By using aluminium, calcium, sodium etc. as reducing agents.

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1. Metallic oxides of zinc, magnesium and copper were heated with the following metals.

Metal	Zinc	Magnesium	Copper
Zinc oxide	—	—	—
Magnesium oxide	—	—	—
Copper oxide	—	—	—

In which cases will you find displacement reactions taking place?

Metal	Zinc	Magnesium	Copper
Zinc oxide	No reaction	Displacement	No reaction
Magnesium oxide	No reaction	No reaction	No reaction
Copper oxide	Displacement	Displacement	No reaction

2. Which metals do not corrode easily?

Ans. Gold, platinum, rhodium.

3. What are alloys?

Ans. Alloy are a homogeneous mixture of two or more metals or a metal and a non-metal. For example, brass is an alloy of copper and zinc.

NCERT EXERCISES

1. Which of the following pairs will give displacement reactions?

- (a) NaCl solution and copper metal
- (b) $MgCl_2$ solution and aluminium metal
- (c) $FeSO_4$ solution and silver metal
- (d) $AgNO_3$ solution and copper metal.

Ans. (d) $Cu(s) + 2AgNO_3(aq) \longrightarrow Cu(NO_3)_2(aq) + 2Ag(s)$
because copper is more reactive than Ag.

2. Which of the following methods is suitable for preventing an iron frying pan from rusting?

- (a) Applying grease
- (b) Applying paint
- (c) Applying a coating of zinc
- (d) All of the above.

Ans. (c) Grease and paints are organic matter which can burn on heating. So, we do not apply grease or paint on a frying pan to prevent it from rusting. We can prevent it from rusting by applying coating of zinc. Zinc is more reactive than iron and hence it does not allow iron to rust.

3. An element reacts with oxygen to give a compound with a high melting point. This compound is also soluble in water. The element is likely to be

- (a) calcium.
- (b) carbon.
- (c) silicon.
- (d) iron.

Ans. (a) Calcium oxide has high melting point as it is ionic in nature and is soluble in water.

4. Food cans are coated with tin and not with zinc because

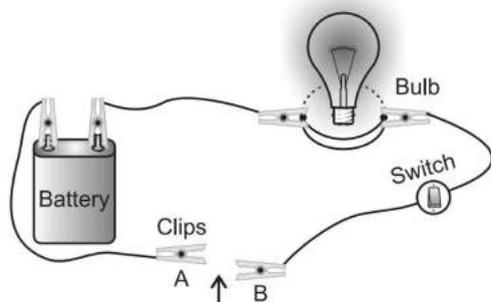
- (a) Zinc is costlier than tin.
- (b) Zinc has a higher melting point than tin.
- (c) Zinc is more reactive than tin.
- (d) Zinc is less reactive than tin.

Ans. (c) Zinc is more reactive than tin, that is why, tin is used.

5. You are given a hammer, a battery, a bulb, wires and a switch.

- (a) How would you use them to distinguish between samples of metals and non-metals?
- (b) Assess the usefulness of these tests in distinguishing between metals and non-metals.

- Ans. (a)
- Take the sample of metal. Hammer it for long time. Observe the metal after sometime.
 - Take the sample of non-metal and hammer it a little.
- You will observe that metal changes into sheets on hammering, i.e. it is malleable whereas non-metal is brittle and it breaks on hammering.



Insert sample to be tested

- Set the apparatus as shown in the figure above. Take the sample of metal and put it between the clips. Switch on the current and observe the bulb.
- Now take the sample of non-metal and insert it between clips. Switch on the current and observe the bulb.
- You will observe that the bulb glows when current is switched on in case of metal sample. The bulb does not glow in case of non-metal sample.
- This shows metals are good conductors of electricity whereas non-metals are bad conductors of electricity.
- (b) These two tests can be used to distinguish between metals and non-metals. Hammering can be used in most of metals except in case of sodium, potassium and lithium. Conduction of electricity can be used in classification of most of the metals and non-metals except in graphite which is a non-metallic conductor.

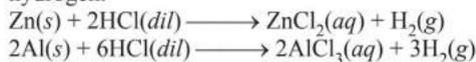
6. What are amphoteric oxides? Give two examples of amphoteric oxides.

Ans. The oxides which act as both acidic as well as basic are called amphoteric oxides, e.g. Al_2O_3 and ZnO are amphoteric oxides.

7. Name two metals which will displace hydrogen from dilute acids, and two metals which will not.

Ans. Zn and Al will displace hydrogen from dilute acids because they are more reactive than hydrogen whereas Cu and Ag cannot displace hydrogen from

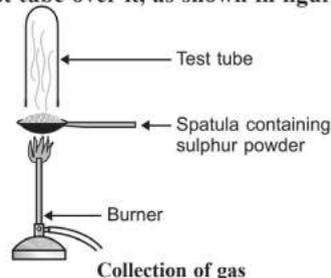
dilute acids because they are less reactive than hydrogen.



8. In the electrolytic refining of a metal M, what would you take as the anode, cathode and electrolyte?

Ans. Impure metal acts as anode, pure metal acts as cathode. Soluble salt of metal acts as electrolyte.

9. Pratyush took sulphur powder on a spatula and heated it. He collected the gas evolved by inverting a test tube over it, as shown in figure below.

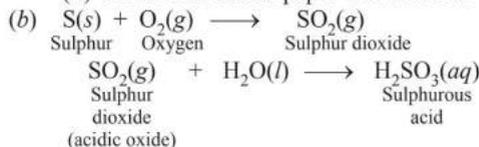


- (a) What will be the action of gas on
- dry litmus paper?
 - moist litmus paper?

(b) Write a balanced chemical equation for the reaction taking place.

Ans. (a) (i) There will be no effect of gas on dry litmus paper.

(ii) Moist blue litmus paper will turn red.



Sulphurous acid turns blue litmus red.

10. State two ways to prevent the rusting of iron.

- Ans. (i) **Painting:** Iron articles are painted so that surface does not come in contact with air and water and it does not get rusted.
- (ii) **Galvanisation:** It is a process in which iron articles are coated with zinc metal so as to prevent them from rusting. Zinc is more reactive than iron, therefore, it loses electrons more readily and prevents iron from rusting.

11. What type of oxides are formed when non-metals combine with oxygen?

Ans. Mostly acidic oxides are formed when non-metal combines with oxygen.

12. Give reasons.

- Platinum, gold and silver are used to make jewellery.
- Sodium, potassium and lithium are stored under oil.

(iii) Aluminium is a highly reactive metal, yet it is used to make utensils for cooking.

(iv) Carbonate and sulphide ores are usually converted into oxides during the process of extraction.

- Ans. (i) It is because they are highly lustrous and least reactive.
(ii) They are highly reactive. They catch fire and start burning when kept open in the air. To prevent their reaction with oxygen, moisture and carbon dioxide of air, they are stored under oil.
(iii) It is because aluminium is a good conductor of heat.
(iv) It is because it is easier to reduce oxide ores as compared to carbonates and sulphides.

13. You must have seen tarnished copper vessels being cleaned with lemon or tamarind juice. Explain why these sour substances are effective in cleaning the vessels.

- Ans. It is because basic copper carbonate formed on copper vessel reacts with acid present in lemon or tamarind juice and gets dissolved and green layer is removed.

14. Differentiate between metal and non-metal on the basis of their chemical properties.

Metals	Non-metals
(i) Metals can lose electrons easily to form positive ions.	(i) Non-metals can gain electrons easily to form negative ions.

(ii) Metals form basic oxides.	(ii) Non-metals form acidic oxides.
(iii) Metals can displace hydrogen from dilute acids.	(iii) Non-metals cannot displace hydrogen from dilute acids.
(iv) Reactive metals can displace hydrogen from water or steam.	(iv) Non-metals cannot displace hydrogen from water.

15. A man went door to door posing as a goldsmith. He promised to bring back the glitter of old and dull gold ornaments. An unsuspecting lady gave a set of gold bangles to him which he dipped in a particular solution. The bangles sparkled like new but their weight was reduced drastically. The lady was upset but after a futile argument the man beat a hasty retreat. Can you play the detective to find out the nature of the solution he had used?

- Ans. The solution he had used was aqua regia, which is a freshly prepared mixture of concentrated hydrochloric acid and concentrated nitric acid in the ratio 3 : 1. Aqua regia is one of the few reagents that is able to dissolve gold. When the person claimed to be goldsmith dipped bangles in aqua regia, some of the gold got dissolved and hence weight of the bangles got reduced.

16. Give the reason why copper is used to make hot water tanks and not steel (an alloy of iron).

- Ans. Copper is better conductor of heat than steel therefore, it is used for making hot water tanks.

SELECT NCERT EXEMPLAR PROBLEMS

1. Which one of the following metals do not react with cold as well as hot water?

- (a) Na (b) Ca (c) Mg (d) Fe

- Ans. (d) It reacts with steam.

2. Generally metals react with acids to give salt and hydrogen gas. Which of the following acids does not give hydrogen gas on reacting with metals (except Mn and Mg)? [KVS]

- (a) H_2SO_4 (b) HCl
(c) HNO_3 (d) All of these

- Ans. (c)

3. Which of the following metals exist in their native state in nature? [KVS]

- (i) Cu (ii) Au
(iii) Zn (iv) Ag
(a) (i) and (ii) (b) (ii) and (iii)
(c) (ii) and (iv) (d) (iii) and (iv)

- Ans. (c) These are less reactive.

4. Metals are refined by using different methods. Which of the following metals are refined by electrolytic refining?

- (i) Au (ii) Cu
(iii) Na (iv) K
(a) (i) and (ii) (b) (i) and (iii)
(c) (ii) and (iii) (d) (iii) and (iv)

- Ans. (a)

5. Which of the following metals are obtained by electrolysis of their chlorides in molten state?

- (i) Na (ii) Ca
(iii) Fe (iv) Cu
(a) (i) and (iv) (b) (iii) and (iv)
(c) (i) and (iii) (d) (i) and (ii)

- Ans. (d) Because Na and Ca are strong reducing agents.

6. 2 mL each of concentrated HCl, HNO₃ and a mixture of concentrated HCl and concentrated HNO₃ in the ratio of 3 : 1 were taken in test tubes labelled as A, B and C. A small piece of metal was put in each test tube. No change occurred in test tubes A and B but the metal got dissolved in test tube C respectively. The metal could be

- (a) Al (b) Au
(c) Cu (d) Ag

Ans. (b) Cold is soluble in aqua regia.

7. An electrolytic cell consists of
(i) positively charged cathode
(ii) negatively charged anode
(iii) positively charged anode
(iv) negatively charged cathode

- (a) (i) and (ii) (b) (iii) and (iv)
(c) (i) and (iii) (d) (ii) and (iv)

Ans. (b)

8. An element A is soft and can be cut with a knife. This is very reactive to air and cannot be kept open in air. It reacts vigorously with water. Identify the element from the following [KVS]

- (a) Mg (b) Na
(c) P (d) Ca

Ans. (b) $2\text{Na} + 2\text{H}_2\text{O} \longrightarrow 2\text{NaOH} + \text{H}_2$

9. Alloys are homogeneous mixtures of a metal with a metal or non-metal. Which of the following alloys contain non-metal as one of its constituents?

- (a) Brass (b) Bronze
(c) Amalgam (d) Steel

Ans. (d) Steel is an alloy of Fe and C.

10. Which among the following alloys contain mercury as one of its constituents?

- (a) Stainless steel (b) Alnico
(c) Solder (d) Zinc amalgam

Ans. (d) Amalgam contains mercury.

11. Reaction between X and Y, forms compound Z. X loses electron and Y gains electron. Which of the following properties is not shown by Z? [KVS]

- (a) Has high melting point
(b) Has low melting point
(c) Conducts electricity in molten state
(d) Occurs as solid

Ans. (b) It cannot have low melting point.

12. The electronic configurations of three elements X, Y and Z are X — 2, 8; Y — 2, 8, 7 and Z — 2, 8, 2. Which of the following is correct?

- (a) X is a metal
(b) Y is a metal
(c) Z is a non-metal
(d) Y is a non-metal and Z is a metal

Ans. (d) X can gain electron; Z can lose electrons.

13. Although metals form basic oxides, which of the following metals form an amphoteric oxide?

- (a) Na (b) Ca
(c) Al (d) Cu

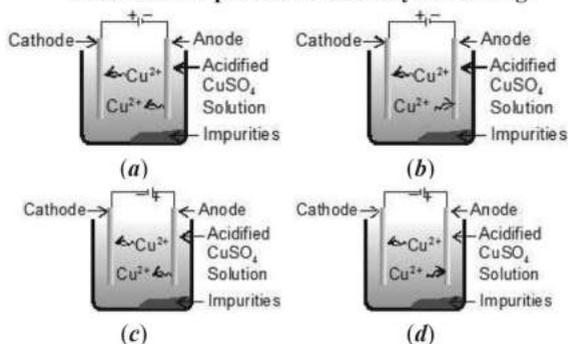
Ans. (c) Al₂O₃ is amphoteric.

14. Which of the following can undergo a chemical reaction? [KVS]

- (a) MgSO₄ + Fe (b) ZnSO₄ + Fe
(c) MgSO₄ + Pb (d) CuSO₄ + Fe

Ans. (d) $\text{Fe} + \text{CuSO}_4 \longrightarrow \text{FeSO}_4 + \text{Cu}$

15. Which one of the following figures correctly describes the process of electrolytic refining?



Ans. (c) Impure Cu as anode; Pure Cu as cathode

16. Which of the following property is generally not shown by metals?

- (a) Electrical conduction
(b) Sonorous in nature
(c) Dullness
(d) Ductility

Ans. (c) Dullness is not shown by metals. Metals are mostly lustrous. [KVS]

17. The ability of metals to be drawn into thin wire is known as

- (a) ductility (b) malleability
(c) sonorosity (d) conductivity [KVS]

Ans. (a) Ductility is ability of metals to be drawn into wires.

18. What happens when calcium is treated with water?

- (i) It does not react with water
(ii) It reacts violently with water
(iii) It reacts less violently with water
(iv) Bubbles of hydrogen gas formed stick to the surface of calcium

- (a) (i) and (iv) (b) (ii) and (iii)
(c) (i) and (ii) (d) (iii) and (iv) [KVS]

Ans. (d) $\text{Ca} + 2\text{H}_2\text{O} \longrightarrow \text{Ca(OH)}_2 + \text{H}_2 + \text{Heat}$

19. Which one of the following properties is not generally exhibited by ionic compounds?

- (a) Solubility in water
(b) Electrical conductivity in solid state

- (c) High melting and boiling points
(d) Electrical conductivity in molten state
- Ans. (b) Ionic solids do not conduct electricity in solid state because ions are not free to move.
20. Which among the following statements is incorrect for magnesium metal? [KVS]
- (a) It burns in oxygen with a dazzling white flame
(b) It reacts with cold water to form magnesium oxide and evolves hydrogen gas
(c) It reacts with hot water to form magnesium hydroxide and evolves hydrogen gas
(d) It reacts with steam to form magnesium hydroxide and evolves hydrogen gas
- Ans. (b) Mg reacts with hot water and not cold water.
21. Generally, non-metals are not conductors of electricity. Which of the following is a good conductor of electricity?
- (a) Diamond (b) Graphite
(c) Sulphur (d) Fullerene
- Ans. (b) Graphite conducts electricity because electrons are free to move.
22. Electrical wires have a coating of an insulating material. The material, generally used is
- (a) Sulphur (b) Graphite
(c) PVC (d) All can be used
- Ans. (c) PVC is insulator.
23. Which of the following non-metals is a liquid? [KVS]
- (a) Carbon (b) Bromine
(c) Phosphorus (d) Sulphur
- Ans. (b) Bromine is liquid non-metal.
24. Iqbal treated a lustrous, divalent element M with sodium hydroxide. He observed the formation of bubbles in reaction mixture. He made the same observations when this element was treated with hydrochloric acid. Suggest how can he identify the produced gas. Write chemical equations for both the reactions.
- Ans. $M + 2NaOH \longrightarrow Na_2MO_2 + H_2(g)$
 $M + 2HCl \longrightarrow MCl_2 + H_2(g)$
 Bring a burning candle near the gas. If it burns with pop sound, the gas is hydrogen and the element is a metal.
25. During extraction of metals, electrolytic refining is used to obtain pure metals.
- (a) Which material will be used as anode and cathode for refining of silver metal by this process?
(b) Suggest a suitable electrolyte also.
(c) In this electrolytic cell, where do we get pure silver after passing electric current?
- Ans. (a) Pure silver rod will be used as cathode and impure silver rod will be used as anode.
(b) $AgNO_3(aq)$ can be used as electrolyte.
- (c) Pure silver will be formed at cathode.
 At anode : $Ag \longrightarrow Ag^+ + e^-$
 At cathode : $Ag^+ + e^- \longrightarrow Ag$
26. Why should the metal sulphides and carbonates be converted to metal oxides in the process of extraction of metal from them?
- Ans. It is because it is easier to reduce metal oxides to get free metals as compared to metal sulphides and metal carbonates.
27. Compound X and aluminium are used to join railway tracks.
- (a) Identify the compound X.
(b) Name the reaction.
(c) Write down its reaction. [HOTS, CBSE 2020]
- Ans. (a) 'X' is Fe_2O_3 .
(b) It is called thermite reaction.
(c) $2Al(s) + Fe_2O_3(s) \longrightarrow Al_2O_3(s) + 2Fe(l) + \text{heat}$
 (molten)
 Molten iron is used to form broken railway tracks.
28. When a metal X is treated with cold water, it gives a basic salt Y with molecular formula XOH (molecular mass = 40) and liberates a gas Z which easily catches fire. Identify X, Y and Z and also write the reaction involved.
- Ans. Both sodium (Na) and potassium (K) react with cold water to give basic salt NaOH and KOH respectively.
 Since the molecular mass of XOH is 40, therefore, the metal X is Na. Since, the molecular mass of NaOH is 40 ($23 + 16 + 1 = 40$). Therefore, Y is NaOH and the gas liberated during reaction is hydrogen. Thus, Z is H_2 .
 $2Na + 2H_2O \longrightarrow 2NaOH + H_2 + \text{Heat energy}$
29. The following reaction takes place when aluminium powder is heated with MnO_2 :
- $$3MnO_2(s) + 4Al(s) \longrightarrow 3Mn(l) + 2Al_2O_3(l) + \text{Heat}$$
- (Molten) (Molten)
- (a) Is aluminium getting reduced?
(b) Is MnO_2 getting oxidised?
- Ans. (a) No, aluminium is getting oxidised.
(b) No, MnO_2 is getting reduced.
30. A metal A, which is used in thermite process, when heated with oxygen gives an oxide B, which is amphoteric in nature? Identify A and B. Write down the reactions of oxide B with HCl and NaOH. [HOTS]
- Ans. 'A' is aluminium.
 $4Al(s) + 3O_2(g) \xrightarrow{\text{heat}} 2Al_2O_3(s)$
 'B' is Al_2O_3 , amphoteric in nature.
 $Al_2O_3 + 6HCl \longrightarrow 2AlCl_3 + 3H_2O$
 $Al_2O_3 + 2NaOH \longrightarrow 2NaAlO_2 + H_2O$ [CBSE 2023]
31. Give the formulae of the stable binary compounds that would be formed by the combination of following pairs of elements:

