Chapter 15: Metals

C15

1. Mention the differences between physical properties of metals and non-metals.

Metals	Non-metals
1. Metals are solids at solids at room temperature (except mercury & gallium)	1. Occurs as solids, liquids & gases
2. Sonorous	2. Non sonorous
3. Generally malleable & ductile	3. Non-malleable & non-ductile, brittle
4. Generally good conductors of electricity	4. Non conductors of electricity (except graphite)
5. Generally good conductors of heat	5. Non conductors of heat (except graphite & diamond)
6. Lustrous	6. Non lustrous

2. Mention the differences between chemical properties of metals and non-metals.

Metals	Non-metals
1. They donate electrons	1. They accept electrons
2. They are electropositive	2. They are electronegative
3. They form ionic bond	3. They form both ionic and covalent bond
4. Generally they displace hydrogen from dilute acids (except copper, gold, silver, platinum)	4. Do not displace hydrogen from dilute acids.
5. Aqueous solution of metal oxides turns red litmus blue.	5. Aqueous solution of non-metal oxides turns blue litmus red.
6. Some metal oxides of metals in aqueous solution react with zinc to produce hydrogen.	6. Aqueous solution of oxides of non-metals reacts with carbonates producing carbon dioxide.

3. Which property of metals is used in the following?

a) Silver foil is spread over sweets – Metals are malleable

b) Copper is used as cables – Metals are good conductors of electricity

c) Aluminium is used in making utensils – Metals are good conductors of heat

d) Gold is used in making ornaments – Metals are lustrous

4. Give reason:

a) Metals are electropositive.

Electropositive element has the tendency to lose electrons and form cation.Metals are electron donors. Hence they are electropositive.

b) Non-metals are electronegative.

Electronegative element has the tendency to gain electrons and form anions. Non-metals are electron acceptors. Hence they are electronegative.

c) Even though hydrogen is a non-metal, it is electropositive.

At low temperatures hydrogen shows metallic properties.

d) Sodium is electropositive.

Sodium is electropositive because donates electrons from last orbit to another element and becomes electropositive.

5. What are amphoteric oxides?

Oxides of zinc and aluminium are called amphoteric oxides.

6. Classify the following into acidic, basic, neutral and amphoteric oxides.

Magnesium oxide, carbon dioxide, carbon monoxide, sulphur dioxide, zinc oxide, calcium oxide.

Acidic oxide –Sulphur dioxide, carbon dioxide

Basic oxide – Magnesium oxide, Calcium oxide

Neutral oxide – Carbon monoxide.

Amphoteric oxide – Zinc oxide.

7. Which property of copper and aluminium makes them suitable?

a) For making cooking utensils and boilers.

Good conductor of heat.

b) For making electric wires.

Good conductor of electricity.

8. How do metals react with oxygen?

Metals react with oxygen of air to form their respective oxides

$4\ Na + O_2 \longrightarrow 2Na_2O$

$2\ Mg + O_2 \longrightarrow 2MgO$

$4\ Fe + 3O_2 \longrightarrow 2Fe_2O_3$

9. What happens when?

a) Sodium is exposed to air.

When a piece of sodium is cut and placed exposed to air, the shining surface of the metal becomes dull and becomes powder of sodium carbonate.

$$4Na + O_2\ 2Na_2O;\ 2Na_2O + CO_2 \longrightarrow Na_2CO_3$$

b) Sodium is burnt in excess of oxygen.

When sodium burns in excess of oxygen, it produces sodium peroxide

$$2Na + O_2 \longrightarrow Na_2O_2$$

c) A piece of magnesium ribbon is burnt in air.

It burns brightly in air forming magnesium oxide. A small amount of magnesium nitride is also formed due to high temperature.

$$2\ Mg + O2 \xrightarrow{Heat} 2MgO$$

d) A foil of copper is burnt in air.

When a foil of copper is heated in a flame, a black layer of copper oxide is formed.

$$2Cu + O_2 \xrightarrow{Heat} 2CuO$$

e) Aluminium powder is heated in sparklers.

Aluminium powder of a sparkler, crackers and fireworks burn with a white light.

$$4Al + 3O_2 \longrightarrow 2Al_2O_3$$

10. What is meant by rust? Write its chemical formula.

Rust is hydrated oxide of iron formed on iron articles when they are exposed to moist air for a long time.

The formula of rust is $Fe_2O_3\ 2H_2O$

11. Give reason:

a) Iron exposed to air rusts quickly during rainy season.

Due to the presence of excess water vapour.

b) Iron nail kept in a closed jar containing calcium chloride does not rust.

As air is dry because of the presence of anhydrous calcium chloride.

c) Tin is used to coat the inner walls of brass and copper utensils.

To avoid corrosion or rusting.

12. What are the methods of preventing rusting of iron?

Iron articles can be coated with zinc or chromium.

By painting the iron articles.

By heating and dipping in molten coal tar.

13. Why is iron grill painted frequently?

To prevent rusting of iron.

14. Give reason: Metallic articles which are exposed to air over long period of time lose their lustre.

Due to the formation of oxide, hydroxide and carbonate layers.

15. A student has been collecting silver coins and copper coins. One day she observes a black coating on silver coins and a green coating on copper coins. Which chemical phenomenon is responsible for these coatings? Write the names of black and green coatings.

The phenomenon is called corrosion. Silver gets tarnished when exposed to atmosphere which forms a black coating of silver oxide. Copper forms a green deposit on its surface when exposed to moist air. The green coating is copper sulphate.

16. Why is sodium preserved in kerosene?

Sodium is highly reactive in air. It reacts with air gradually forming sodium carbonate. It catches fire and burns when exposed to air. It does not react with kerosene so sodium is preserved in kerosene.

17. Petrol is not selected for preserving sodium or potassium metal. Why?

Petrol evaporates easily and is costly hence kerosene is used.

18. Give reason: During burning of magnesium not only magnesium oxide is formed but also magnesium nitride is formed.

Due to high temperature the triple bond between nitrogen atoms is broken and a small quantity of magnesium nitride is formed.

19. Give reason: Magnesium ribbon should not be kept near bottles containing volatile chemicals.

Magnesium is a reactive metal therefore it should not be kept near bottles containing volatile chemicals.

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

Gold does not corrode when exposed to atmosphere. It is a highly unreactive metal and is unaffected by air, water vapour and other gases in atmosphere.

21. How do metals react with nitrogen?

Metals react with nitrogen forming respective nitrides at high temperature.

Magnesium reacts with nitrogen to form magnesium nitride.

$$3Mg + N_2 \xrightarrow{Heat} Mg_3N_2$$

22. How do metals react with hydrogen?

Metals react with hydrogen to form respective hydrides.

Calcium reacts with hydrogen to form calcium hydride.

$$Ca + H_2 \xrightarrow{Heat} CaH_2$$

23. How do metals react with chlorine?

Metals react with chlorine to form respective chlorides.

Aluminium reacts with chlorine to form aluminium chloride.

$$2Al + 3Cl_2 \xrightarrow{Heat} 2AlCl_3$$

24. What happens when heated aluminium powder is sprinkled into a jar of chlorine gas?

As heated aluminium powder comes in contact with chlorine, bright flashes are seen forming aluminium chloride.

$$2Al + 3Cl_2 \xrightarrow{Heat} 2AlCl_3$$

25. How do metals react with sulphur?

Metals react with sulphur forming respective sulphides.

Iron reacts with sulphur forming ferrous sulphide.

$$Fe + S \xrightarrow{Heat} FeS$$

26. How do metals react with water?

Metals react with water differently.

a) Sodium reacts vigorously with water giving sodium hydroxide and hydrogen.

$$2Na + 2H_2O \longrightarrow 2NaOH + H_2\uparrow$$

b) Magnesium reacts with boiling water to form magnesium oxide & hydrogen.

$$Mg + 2H_2O \longrightarrow Mg(OH)_2 + H_2\uparrow$$

c) Zinc reacts with steam forming zinc oxide & hydrogen.

$$Zn + H_2O \longrightarrow ZnO + H_2\uparrow$$

d) Magnesium reacts with steam to form magnesium oxide & hydrogen.

$$Mg + H_2O \longrightarrow MgO + H_2$$

e) Red hot iron reacts with steam forming iron oxide & hydrogen,

$$3\ Fe + 4H2O \xrightarrow{Heat} Fe3O4 + 4H_2\uparrow$$

27. Choose a metal out the following which reacts with hot water but not cold water: Sodium, Magnesium & Iron. Mention the products formed during the reaction.

Magnesium reacts with hot water but not with cold water. The products formed are magnesium hydroxide and hydrogen.

$$Mg + 2H_2O \longrightarrow Mg(OH)_2 + H_2\uparrow$$

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

X is sodium. Y is Magnesium and Z can be iron, Aluminium or zinc.

Increasing order of reactivity is sodium, magnesium and iron.

29. What happens when a piece of sodium is gently dropped into a trough of water?

Sodium floats on water with a hissing noise forming sodium hydroxide & hydrogen.

$$2Na + 2H_2O \longrightarrow 2NaOH + H_2\uparrow$$

30. 5 grams of iron filings is taken in hard glass tube in a horizontal position. One end of horizontal tube is connected to a boiler filled with water and other end of the horizontal tube is connected to a delivery tube fixed to a balloon.

i) What happens during the experiment?

Water boils producing steam. Steam reacts with iron filings forming hydrogen gas. Hydrogen gas fills in the balloon.

ii) Name the gas produced

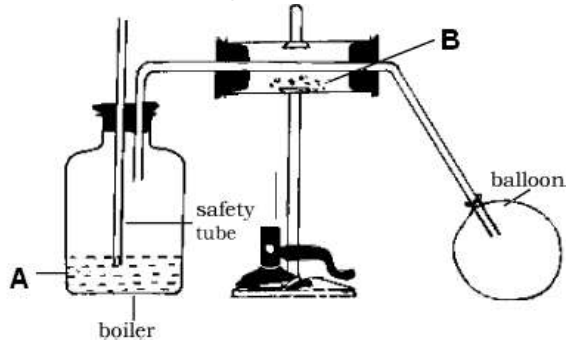
Hydrogen

iii) How do you know that the gas is hydrogen?

When the mouth of the balloon is tied and released, the balloon goes up and sticks to the roof as hydrogen is the lightest gas.

31. In the figure of Lane process of manufacture of hydrogen, identify the parts labelled A and B.

Part A is water and Part B is iron filings.



32. Briefly explain the Lane process of manufacture of hydrogen.

In a hard glass borosilicate tube with both sides open, take 5g of iron filings in a horizontal position and arrange the apparatus as shown in the figure. When water is boiled in the jar containing water, steam is produced which passes through the horizontal tube containing iron filings. Iron filings react with steam forming hydrogen.

33. Name the products of electrolytic decomposition of acidified water.

Hydrogen and oxygen

34. How do metals react with dilute hydrochloric acid?

Metals react with dilute hydrochloric acid to produce respective metallic chlorides and hydrogen.

a) Magnesium reacts readily to form magnesium chloride.

$$Mg + 2HCl \longrightarrow MgCl_2 + H_2\uparrow$$

b) Zinc reacts readily to form zinc chloride.

$$Zn + 2HCl \longrightarrow ZnCl_2 + H_2\uparrow$$

c) Iron reacts slowly to form iron chloride.

$$2Fe + 6HCl \longrightarrow 2FeCl_3 + 3H_2\uparrow$$

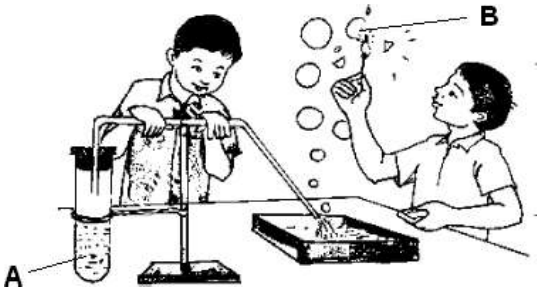
35. What happens when concentrated hydrochloric acid is poured into a test tube containing zinc granules?

Zinc reacts with concentrated hydrochloric acid vigorously forming and the chemicals spill out of the test tube.

36. In the diagram identify the parts labelled A and B.

Part A is Zinc granules and concentrated hydrochloric acid.

Part B is Soap bubbles filled with hydrogen.



37. In a test tube about 10g of zinc granules is taken. Dilute hydrochloric acid is added to the test tube up to half its volume. A one holed cork is fixed to the test tube. A rubber tube is taken out of the test tube and passed through a trough containing soap solution.

i) What do you observe?

Zinc reacts with dilute hydrochloric acid forming zinc chloride and hydrogen gas. As hydrogen gas pass through soap solution, soap bubbles filled with hydrogen rises up.

ii) Write the chemical equation for the reaction.

$$Zn + 2HCl \longrightarrow ZnCl_2 + H_2\uparrow$$

iii) What happens when you ignite the soap bubbles with a match stick?

When the soap bubbles are ignited with a burning match stick, it makes a pop sound as hydrogen is a combustible gas.

38. Give reason:

a) Magnesium reacts more vigorously with hydrochloric acid than zinc or copper.

The reactivity of magnesium is higher than that of zinc. Hence it reacts with hydrochloric acid more vigorously.

b) Iron takes more time to react with dilute hydrochloric acid than magnesium and zinc

As iron has lowest reactivity when compare to magnesium and zinc.

39. Sodium displaces hydrogen from dilute acids violently but copper does not displace hydrogen from dilute acids. Why?

Sodium is highly reactive than copper. Hence reaction with sodium reacts violently then that of copper.

40. How do metals react with dilute sulphuric acid?

Metals displace hydrogen from dilute sulphuric acid and form respective metallic sulphates.

$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2\uparrow$

41. Write the equations of chemical reactions taking place between

a) Magnesium and dilute sulphuric acid

$Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2\uparrow$

b) Iron and dilute sulphuric acid

$Fe + H_2SO_4 \longrightarrow FeSO_4 + H_2\uparrow$

42. Write the reaction between

a) Copper and concentrated sulphuric acid.

$Cu + 2H_2SO_4 \xrightarrow{Heat} CuSO_4 + SO_2\uparrow + 2H_2O$

61. b) Zinc and concentrated sulphuric acid.

$Zn + 2H_2SO_4 \xrightarrow{Heat} ZnSO_4 + SO_2\uparrow + 2H_2O$

43. How do metals react with nitric acid?

a) Very dilute nitric acid reacts with very active metals like magnesium and zinc to give their metallic nitrates and hydrogen gas.

$Zn + 2HNO_3 \longrightarrow Zn(NO_3)_2 + H_2\uparrow$

$Mg + 2HNO_3 \longrightarrow Mg(NO_3)_2 + H2\uparrow$

b) Moderately dilute nitric acidreacts with metals to give their nitrates and nitric oxide.

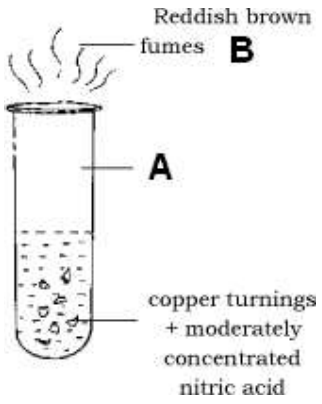
$3Cu + 8HNO_3 \longrightarrow Cu(NO_3)_2 + 2NO + 4H_2O$

c) Concentrated nitric acid reacts with metals on heating to give their nitrates, water and nitrogen dioxide.

$Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

44. In the diagram identify the parts labelled A and B

Part A is colourless nitric oxide gas.



Part B is reddish brown fumes of nitrogen dioxide.

45. In a test tube 10g of copper turnings is taken. Moderately concentrated nitric acid is added to it.

i) Name the gas released.

Nitric oxide

ii) Name the gas formed at the mouth of the test tube?

Nitric oxide cones in contact with oxygen and forms reddish brown nitrogen dioxide gas.

ii) Write the chemical equation of the reaction.

$2NO + O_2 \longrightarrow 2NO_2$

46. What happens when gold ornament is heated with dilute nitric acid?

The copper constituent of the ornament reacts with the acid forming greenish copper nitrate solution and reddish brown fumes of nitrogen dioxide. Gold remains unaffected.

47. What happens when a iron nail or a piece of aluminium wire is dipped in concentrated nitric acid?

Iron nail or aluminium wire does not react with concentrated nitric acid. It makes iron more passive.

48. Give reason: Aluminium / Iron become passive when immersed in concentrated nitric acid.

Since concentrated nitric acid is a powerful oxidising agent, it forms a protective oxide layer on the metal instantly.

49. Name the gases produce in the following chemical reactions.

a) Copper reacts with sulphuricacid.

Sulphur dioxide

b) Copper reacts with concentrated nitricacid.

Nitrogen dioxide

50. Give an example of displacement reaction of iron.

OR

What happens when an iron nail is immersed in?

a) Copper sulphate solution

When an iron nail is placed in copper sulphate solution, iron displaces copper from copper sulphate solution.

$Fe + CuSO_4 \longrightarrow FeSO_4 + Cu \downarrow$

b) silver nitrate solution

When an iron nail is placed in silver nitrate solution, iron displaces silver from silver nitrate solution,

$Fe + AgNO_3 \longrightarrow Fe(NO_3)_2 + 2Ag \downarrow$

51. Give reason: Iron displaces copper from copper sulphate solution.

Iron is more reactive than copper. Hence it displaces copper from copper sulphate solution.

52. In a solution of silver nitrate, a copper plate was dipped. After some time, silver from the solution was deposited on the copper plate. Which metal is more reactive – copper or silver?

More reactive metal displaces a less reactive metal. Hence copper metal is more reactive.

53. A solution of CuSO4 was kept in an iron pot. After a few days, the iron pot was found to have a number of holes in it. Write the equation that took place. Explain.

Iron metal is more reactive than copper. The equation for the displacement is:

$CuSO4 + Fe \longrightarrow FeSO4 + Cu$

Iron displaces copper from copper sulphate solution.

54. Which of the following pairs will give displacement reaction?

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.

Copper metal is more reactive than silver metal. So displacement reaction will take place.

55. Give reason: Some metals are more reactive than others.

Metals are electropositive and have tendency to donate electrons. Some elements give up their valence electrons and hence more reactive.

56. Name some metals which do not displace hydrogen from dilute acids.

Platinum, gold, silver, mercury & copper do not displace hydrogen from dilute acids.

57. Which gas is always produced if a metal reacts with water or dilute acid?

Hydrogen

58. Given below are metals in order of reactivity.

a) Which element is stored in kerosene?

sodium

b) Which element will react with cold water?

Sodium, calcium

c) Which element will react with steam but not cold water?

Iron

59. Name the metal which has been placed:

a) At the bottom of the reactivity series

Platinum

b) At the top of the reactivity series

Potassium

c) Just below copper in the reactivity series

Mercury

60. **$2Fe_2O_3 + 4Al \longrightarrow 2Al_2O_3 + 4Fe$; $CuSO_4 + Fe \longrightarrow FeSO_4 + Cu$;**

$AgNO_3 + Cu \longrightarrow Cu(NO_3)_2 + 2Ag$

Observe the above chemical equations and arrange the metals in the reactions in their increasing order of reactivity.

Iron, Copper & Silver

61. **What is an ore?**

The compound of a metal from which the metal can be extracted economically is called an ore.

62. **Name the ores of the following metals and their composition.**

Name of metal	Name of ore	composition
Aluminium	Bauxite (Oxide ore)	$Al_2O_3\ 2H_2O$
Iron	Haematite Magnetite(Oxide ore)	Fe_2O_3 Fe_3O_4
Gold	Native form	-
Platinum		
Copper	Cholcopyrites or copperpyrites (Sulphide ore)	$CuFeS_2$
Manganese	Pyrolusite (Oxide ore)	MnO_2
Chromium	Chromite	$FeOCr_2O_3$
Magnesium	Magnesite (carbonate ore)	$MgCO_3$

63. **Give reason: Gold occurs in native form.**

Gold is low in the reactivity series. It is least reactive or unreactive. Hence gold is found in free state.

64. **Define metallurgy.**

The technology of extraction of metals from their ores and refining them to required form is called metallurgy.

65. **Explain the following terms with reference to metallurgy.**

a) Gangue

The unwanted impurities present in the ore are called gangue.

b) Concentration of ore

The process of removing the gangue particles to increase the percentage of desired component of the ore is called concentration of the ore.

c) Roasting

The process of heating the ore just below its melting point in the presence of air is called roasting.

Ex: Zinc blende (ZnS) is roasted in the air to convert it into zinc oxide (ZnO).

d) Calcination

The process of heating the ore just below its melting point in the absences of air with a purpose of driving away volatile matter like water and carbon dioxide is called calcination.

Ex: Oxide ores containing water vapour are calcined. Carbonate ores calcined to drive away carbon dioxide.

e) Flux

The substance that is added to the ore before heating with a purpose of removing certain unwanted impurities which are not removed during concentration of ore is called flux.

f) Slag

The substance formed by the combination of impurities like sand is called slag.

66. Differentiate between roasting and calcination.

Roasting	Calcination
The process of heating the ore just below its melting point in the presence of air	The process of heating the ore just below its melting point in the absences of air with a purpose of driving away volatile matter like water and carbon dioxide

67. What happens when?

a) A cleaned iron plate or iron nail is kept in 10g of copper sulphate solution.

After a few hours a coating of copper is seen on iron nail/plate. It is based on displacement reaction.

b) A pinch of mercuric oxide is kept in a test tube.

After some time a mirror of mercury on the cooler part of the test tube is formed. It is based on displacement reaction.

c)A small crystal of silver nitrate is dissolved in distilled water and a drop of ammonium hydroxide & a pinch of glucose powder are added.

A coating of silver on the inner walls of the test tube. Aldehyde group in glucose reduced silver nitrate to metallic silver.

68. How is iron ore concentrated?

The chief ore of iron is haematite. Haematite ore is concentrated by hydraulic washing. The crushed ore is washed with a stream of water, lighter gangue particles will be washed away and the heavy iron ore particles also with silica settles down during washing.

69. Briefly explain the extraction of iron with chemical equations.

Calcined iron ore is mixed with limestone and coke. The mixture is called charge. Charge is transferred to a blast furnace.

A blast of hot air is sent through the charge.

a) Coke present in the charge catches fire to form carbon dioxide with a large amount of heat.

$C + O_2 \longrightarrow 2CO$

b) Carbon dioxide gas formed reacts with more coke forming carbon monoxide.

$CO_2 + C \longrightarrow 2CO$

c) Limestone decomposes to form calcium oxide and carbon dioxide.

$CaCO_3 \longrightarrow CaO + CO_2$

d) Calcium oxide combines with silica present in the ore to form calcium silicate (slag)

$CaO + SiO_2 \longrightarrow CaSiO_3$

e) At a temperature between 400 and 750oC, carbon monoxide reduces iron oxide to form iron metal.

$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$

The molten iron metal is collected at the bottom of the furnace is called cast or pig iron,

70. What is charge?

The mixture of haematite, lime stone and coke is called charge.

71. State the role of lime stone in the extraction of iron from haematite.

Or

Why is lime stone added during the extraction of iron?

Limestone reacts with the sand present as impurity in the ore forming calcium silicate which is taken out of the blast furnace as slag.

72. What happens when lime stone is not added during the extraction of iron?

If limestone is not added to charge during the extraction of iron, the blast furnace will get blocked.

73. Why is flux used in the blast furnace?

Flux in extraction of iron is limestone. Limestone reacts with the sand present as impurity in the ore forming calcium silicate which is taken out of the blast furnace as slag.

74. What is the role of coke in the extraction of iron?

Coke is a good reducing agent. It reduces iron oxide to iron. It is also a good fuel which supplies heat energy for the chemical reactions.

75. Why is slag collected above molten iron?

Slag is lighter than molten iron and collects above molten iron. Slag prevents oxidations of molten iron back into iron oxide.

76. How is the slag obtained in the extraction of iron useful?

Slag obtained in blast furnace is used as one of theraw materials of glass and cement.

77. Mention the uses of cast iron.

Cast iron is used for:

a) Making stands for wooden benches and desks.

b) Making dosa pan

c) Making lid for covering manholes of sewage system.

d) Making machinery parts.

78. Name the impurities present in cast iron. How can these impurities be removed?

Cast iron contains sulphur, phosphorous, silicon and carbon.

The impurities present in the blast furnace can be removed by using Bessemer converter, open hearth process or electric furnace.

79. Draw a neat diagram of the blast furnace used in the extraction of iron from haematite.

80. Mention the uses of aluminium salts.

a) Aluminium salts are used as mordant in textile industry (to bind the dye to the cloth).

b) Potash alum is used to prevent bleeding from small cuts by coagulating the blood at the surface.

81. What is a mordant?

A mordant is a substance which helps to bind the dye to the cloth.

82. What is alumina? Write its molecular formula.

Alumina is chemically hydrated oxide of aluminium. Its formula is $Al_2O_3.2H_2O$.

83. Why is extraction of aluminium not commercially viable by using reducing agents like coke?

OR

Coke is used in the extraction of iron but not in the extraction of aluminium. Why?

OR

Aluminium cannot be extracted by heating bauxite and coke. Why?

Oxygen of aluminium oxide cannot be easily taken away by reducing agents like coke.

84. How is bauxite converted into alumina?

Powdered bauxite is dissolved in hot sodium hydroxide solution to get a solution of sodium aluminate.

$Al_2O_3 + 2NaOH \longrightarrow 2NaAlO_2 + H_2O$

The gangue particles are filtered out.

Carbon dioxide is passed through the filtrate to get a gel like precipitate of aluminium hydroxide.

$2NaAlO_2 + CO_2 + 3H_2O \longrightarrow 2Al(OH)_3 + Na_2CO_3$

Sodium carbonate is separated by filtration.

The precipitate of aluminium hydroxide is heated to get pure alumina.

$2Al(OH)_3 \longrightarrow Al_2O_3 + 3H_2O$

85. Why is pure alumina needed for the extraction of aluminium?

For electrolysis of we need pure alumina. Hence bauxite is converted into alumina by chemical process.

86. What is the difficulty in obtaining aluminium from alumina?

Pure alumina melts at 2323K. At this temperature, aluminium vapourises and there will be considerable loss. It consumes more energy and also molten aluminium is not a very good conductor of electricity.

87. What is the role of molten cryolite in the extraction of aluminium?

When pure alumina is mixed with molten cryolite, it forms an electrolyte at 1223K. Molten cryolite also acts as a solvent for alumina.

88. What is cryolite? Write its chemical formula.

Cryolite is chemically sodium aluminium fluoride. Its molecular formula is Na_3AlF_6.

89. Briefly explain the extraction of aluminium from alumina with chemical equations.

Aluminium oxide dissolved in molten cryolite is taken in a chamber with gently sloped base.The inner wall is made of carbon lining.

Graphite rods are introduced in the electrolyte bath.

The carbon lining is connected to the cathode and graphite rods are connected to the anode.

A strong source of direct current is passed.

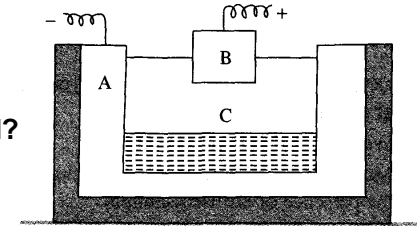
Molten aluminium collects at the lining and flows out of the gently sloped base.

90. Name the process by which the refining of aluminium is done. Name the material used for the process.

Aluminium is refined by electrolytic refining. Carbon lining acts as the cathode and the graphite rods act as anode.

91. Draw a neat diagram of the electrolytic tank used in the extraction of aluminium from alumina.

92. The following is a sketch of an electrolytic cell used in the extraction of aluminium:



a) What is the substance of which the electrodes A and B are made?

A is made of carbon, B is made of graphite.

b) At which electrode (A or B) is the aluminium formed?

Aluminium is formed at cathode or A

c) What are the two aluminium compounds in the electrolyte C?

Molten cryolite and alumina

93. Mention the methods of obtaining ultra pure metal.

a) Fractional crystallization or zone refining.

b) Vacuum melting

c) Distillation
d) Chemical vapour deposition
e) Liquation process

94. What is meant by liquation process?

Liquation is a process of obtaining ultra pure metal. It is based on the principle that metals are readily fusible where as the impurities are infusible at the temperature at which the metals fuse.

95. What is meant by zone refining or fractional crystallization?

Zone refining is a technique of obtaining ultra pure metal. It is based on the principle of differences in solubility of impurities in liquid and solid states of the metal.

96. Explain the process of zone refining. Name one metal refined by this method.

The apparatus used for zone refining consists of a circular heater fitted around the rod of impure metal at one end. The circular heater is slowly moved to the other end. At the heated zone, the rod melts and as the heater passes on, pure metal crystallizes and impurities insoluble in solid metal passes into the adjacent molten part.

A metal refined by zone refining is germanium.

97. What is electrolytic refining?

Electrolytic refining is a technique of ultra refining of metal. In this method, impure metal is taken as anode and pure metal are taken as cathode. Electric current is passed through the electrolyte to obtain pure metal at the cathode.

98. Briefly explain the electrolytic refining of copper.

Copper is purified by electrolytic refining. The apparatus consists of an electrolytic tank containing copper sulphate solution as electrolyte. A set of thick blocks of impure copper is made anode (connected to the positive terminal of the battery) and a set of pure copper plates is made as cathode (connected to the negative terminal of the battery). On passing direct current through the electrolyte, the positively charged copper ions from copper sulphate go to the cathode and gets deposited on cathode giving pure copper. The process continues. Impure anode becomes thinner and pure cathode becomes thicker. The impurities collect at the bottom.

99. Draw a neat diagram of the apparatus used in the electrolytic refining of copper.

100. What is an alloy?

An alloy is a homogenous mixture of two or more metals or metal with a non-metal.

Example: Brass is an alloy of two metals copper and zinc. Steel is an alloy of a metal iron and non-metal carbon.

101. How is an alloy formed?

Alloysare prepared by mixing the various metals in their molten state and cool them to room temperature. Better quality can be made by mixing metals using ultrasonics.

102. Why are alloys made?

Alloys give desired properties to the metal. It improves the properties of metals.

103. Give reason: Metals belonging to the same group form good alloys.

As metals belonging to the same group in the periodic table have similarities in electronic configuration.

104. How are the properties of alloys different from those of metals?

Copper is reddish and zinc is grayish in colour where as brass which is an alloy of copper and zinc is golden yellow in colour.

Iron is a magnetic substance but stainless steel, an alloy of iron is non magnetic.

105. Mention the alloys of iron, their composition and uses.

Alloy	Composition	Uses
Stainless steel	Iron, carbon, chromium, nickel	Making surgical instruments & utensils.
Invar steel	Iron, carbon, nickel	Used in precision measuring tapes
Nickel steel	Iron, carbon, nickel	making machinery parts

106. What property of stainless steel is used in making surgical instruments?

Surgical steel is not attacked by mild chemicals easily and it does not corrode.

107. What property of invar steel is used in making pendulums and measuring tapes?

Invar steel has the least co-efficient of linear expansion.

108. Mention the alloys of copper, their composition and uses.

Alloy	Composition	Uses
Brass	Copper, zinc	Electrical contact parts, utensils and decorative articles
Bronze	Copper, tin	Statues, medals and utensils

109. Which metal is present both in brass and bronze?

Copper

110. Mention the alloys of aluminium, their composition and uses.

Alloy	Composition	Uses
Duralumin	Aluminium, copper, magnesium, manganese	Aeroplane body, railway & bus coaches
Alnico	Aluminium, nickel, iron, cobalt	Permanent magnets

111. Name the alloy used in the following

a) Electrical appliances–Brass b) Surgical instruments– Stainless steel

c) Measuring tapes/pendulums – Invar steel d) Permanent magnets – Alnico

e) Aircraft construction – Duralumin

112. Why is 6% to 8% copper added to gold in making ornaments?

Pure gold is very soft, it cannot be used to make artistic ornaments. To make it hard, improve the looks and colour, 6 to8% copper is added to ornamental gold.

113. Write a note on contributions of Indians to metallurgy.

a) Romans used armour and cutlery made from Indian iron.

b) Indian metallurgist Nagarjuna wrote the book 'Rasaratnakara' in 9th century BC which explained the preparation of various metallic compounds, the extraction and purification of metals.

c) Indians were the first to develop the method of extracting zinc and using it in alloys.

d) The famous iron pillar at New Delhi near Qutab Minar constructed by Vikramadithya about 1600 years ago has withstood the action of weather.

114. What are memory alloys? How are they useful?

Certain alloys which regain their original shape when deformed are called memory alloys.

Preparation of memory alloys saves energy of melting and recasting of used articles.

Fill in the blanks:

1. An example of a liquid metal is **Mercury/gallium**.
2. A metal which is soft is **sodium**.
3. A metal which lacks ductility is **sodium**.
4. A non-metal which is lustrous is **graphite/iodine**.
5. An example of a non-metal which is a good conductor of electricity is **graphite**.
6. An example of a non-metal which is lustrous is **iodine/graphite**.
7. Metals are electron **donors**.
8. Metals are electropositive.
9. Non-metals are electron **acceptors**.
10. Non-metals are **electronegative**.
11. Metals displace **hydrogen** from **dilute acids**.
12. Magnesium librates **hydrogen** gas on reacting with hot boiling water.
13. Metals turn red litmus blue.
14. Non-metals turn **blue litmus red**.
15. Oxides of **zinc** and **aluminium** are called **amphoteric** oxides.
16. A metal oxide which is amphoteric is zinc **oxide or aluminium oxide**.
17. Ordinary aluminium strips are not attacked by water because of the presence of a layer of **aluminium oxide** on the surface of aluminium.

18. An example of non-metallic oxide is **carbon dioxide**.
19. Non-metallic oxide oxides are **acidic**.
20. An example of neutral oxide is **nitrous oxide/carbon monoxide**.
21. The oxide that can form salt and water with a base as well as an acid is **carbon monoxide**.
22. The formula of rust is **Fe_2O_3 $2H_2O$**.
23. Rusting is a process of **oxidation**.
24. Corrosion of iron is called **rusting**.
25. Iron exposed to air rusts rapidly in rainy season than in summer due to **increase in humidity**.
26. Sodium is preserved in **kerosene**.
27. The gas produced when steam is passed over red hot iron is **Hydrogen**.
28. The metal that does not liberate hydrogen with dilute acids is **copper**.
29. The metal that does not react with air is **platinum/gold**.
30. The metal that does not react with water is **platinum/gold**.
31. The oxide of iron obtained in Lane process of manufacture of hydrogen is called **ferric oxide or ferrosoferric oxide**.
32. The gas obtained with sodium reacts with water is **hydrogen**.
33. If X is a metal, then litmus will turn **red to blue**.
34. If X is a non-metal, then litmus will turn **blue to red**.
35. The compound of a metal from which the metal can be extracted economically is called an **ore**.
36. An example of a metal that occurs in native or elemental form is **gold/platinum**.
37. The metal extracted from bauxite is **aluminium**.
38. The metal extracted from pyrolusite is **chromium**.
39. The technology of extraction of metals from their ores and refining them to required form is called **metallurgy**.
40. The unwanted impurities present in the ore are called **gangue**.
41. The process of heating the ore just below its melting point in the presence of air is called **roasting**.
42. The process of heating the ore just below its melting point in the absences of air is called **calcination**.
43. The substance that is added to the ore before heating with a purpose of removing certain unwanted impurities is called **flux**.
44. The substance formed by the combination of impurities like sand is called **slag**.
45. The metal which is referred to as poor man's silver is **aluminium**.
46. The 3rd most abundant element is **aluminium**.
47. The electrode at which aluminium metal is produced is **cathode**.
48. The gas produced during the extraction of aluminium is **oxygen**.
49. Oxygen gas is produced during the extractionof aluminium is produced at **anode**.
50. Limestone is used as **flux** in extraction of iron.
51. CaSiO3 is known as **slag** in extraction of iron.
52. The anode in the electrolytic refining of copper is **impure copper plates**.
53. The cathode in the electrolytic refining of copper is **pure copper plates**.
54. Goldsmiths mix a small quantity of copper to pure gold to make it **hard**.

55. Iron pillar near Qutab Minar in Delhi has not got rusted till now due to coating of **Fe_3O_4** on its surface.
56. Brass is an alloy of **copper and zinc**.
57. Bronze is an alloy of **copper and tin**.
58. The non metal present in stainless steel is **carbon**.
59. Aluminium+ copper+ magnesium+ manganese is useful in making **aircraft bodies**.
60. Ornamental gold is an **alloy**.

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