

CHEMISTRY NOTES FOR CLASS 10TH (FOR SINDH)

CHAPTER

6

Metals and Their Extraction

You will learn in this chapter about:

- ✦ Metals and non-metals and their physical, chemical differences between metals and non-metals.
- ✦ Minerals and ores, occurrence of metals like Fe, Cu, Al and Cr.
- ✦ Metallurgy, primary preparations of ores.
- ✦ Metallurgy of iron i.e. extraction of iron from haematite (Fe_2O_3).
- ✦ Pig iron, cast iron, wrought iron and steel. Difference between iron, steel and tempering.
- ✦ Extraction of copper metal from copper pyrite and refining of blister copper.
- ✦ Extraction of aluminium metal from its bauxite ore. Alloys and some common alloys like bronze, brass and nichrome.

Section - A

Multiple Choice Questions (M.C.Qs.)

Choose the correct answer for each from the given options:

1. The formula of iron rust is :
 (a) Fe_2O_3 (b) Fe_3O_4 (c) $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ (d) FeO
2. The most important ore of copper is :
 (a) Cu_2O (b) CuFeS_2 (c) Cu_2S (d) $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$
3. The formula of potash mica is :
 (a) $\text{K}_2\text{O} \cdot 3\text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2 \cdot 2\text{H}_2\text{O}$ (b) $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$
 (c) $\text{K}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$ (d) Al_2O_3
4. Chromite is found in Pakistan at :
 (a) Azad Kashmir (b) Punjab (c) Sindh (d) Baluchistan.
5. Iron metal obtained from blast furnace is impure and is called as :
 (a) Cast iron (b) Pig iron (c) Steel (d) Wrought iron
6. Stainless steel is an alloy of iron with :
 (a) Cr and Mn (b) Ni and Cr (c) Mn and S (d) C and S
7. Which one is the reduction reaction in the manufacture of blister copper :
 (a) $2\text{Cu}_2\text{S} + 3\text{O}_2 \longrightarrow 2\text{Cu}_2\text{O} + 2\text{SO}_2(\text{g})$ (b) $\text{FeO} + \text{SiO}_2 \longrightarrow \text{FeSiO}_3$
 (c) $2\text{Cu}_2\text{O} + \text{Cu}_2\text{S} \longrightarrow 6\text{Cu} + \text{SO}_2(\text{g})$ (d) $4\text{CuFeS}_2 + 5\text{O}_2 \longrightarrow 2\text{Cu}_2\text{S} + 2\text{FeO} + 2\text{FeS} + 4\text{SO}_2(\text{g})$
8. The chief ore of Al has the formula:
 (a) $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ (b) Al_2O_3 (c) $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ (d) Na_3AlF_6

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9. Nichrome is an alloy that contains major percentage of:

(a) Cr	(b) Fe	(c) Ni	(d) Zn
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10. The medal given at third position in any event is made up of:

(a) Bronze	(b) Brass	(c) Nichrome	(d) Copper
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11. Metals are found on the _____ of the periodic table.

(a) right	(b) left	(c) top	(d) bottom
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12. Nonmetals are found on the _____ of the periodic table.

(a) right	(b) left	(c) top	(d) bottom
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13. Metals have _____ densities.

(a) low	(b) medium	(c) high	(d) average
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14. Diamond is the hardest known substance and has a melting point:

(a) 2000 °C	(b) 2500 °C	(c) 3000 °C	(d) 3500 °C
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15. Metals form that oxides.

(a) acidic	(b) basic	(c) amphoteric	(d) neutral
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16. Metals form positive ions by the _____ of electrons.

(a) gain	(b) sharing	(c) loss	(d) transference
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17. Metals have _____ electrons in their valence shells.

(a) few	(b) more	(c) four	(d) five
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18. Some metals react with dilute acid to liberate a gas.

(a) oxygen	(b) chlorine	(c) hydrogen	(d) nitrogen
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19. How many elements in the periodic table are metals?

(a) one-third	(b) one half	(c) two-thirds	(d) three-fourths
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20. Metals are generally _____ agents.

(a) oxidizing	(b) reducing	(c) reactive	(d) unreactive
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21. Metallic chlorides are that compounds.

(a) ionic	(b) covalent
(c) amphoteric	(d) coordinate covalent
22. The second most abundant metal in the earth's crust:

(a) aluminum	(b) copper	(c) iron	(d) zinc
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23. The most common ore of iron is:

(a) Magnetite	(b) limonite	(c) siderite	(d) haematite
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24. The formula for haematite is:

(a) Fe_2O_3	(b) Fe_3O_4	(c) FeS_2	(d) FeCO_3
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25. The formula for magnetite is:

(a) Fe_2O_3	(b) Fe_3O_4	(c) FeS_2	(d) FeCO_3
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26. The formula for siderite is:

(a) Fe_2O_3	(b) Fe_3O_4	(c) FeS_2	(d) FeCO_3
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27. The formula for iron pyrite is:

(a) Fe_2O_3	(b) Fe_3O_4	(c) FeS_2	(d) FeCO_3
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28. The formula for limonite is:

(a) Fe_2O_3	(b) Fe_3O_4	(c) $\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$	(d) FeO
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29. The most important ore of copper is:

(a) copper pyrite	(b) cuprite	(c) chalcocite	(d) azurite
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30. The formula for copper pyrite is:

(a) Cu_2O	(b) CuFeS_2	(c) Cu_2S	(d) $\text{Cu}_7\text{S} \cdot \text{CuS} \cdot \text{FeS}$
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31. The formula for cuperite is:

(a) Cu_2O	(b) CuFeS_2	(c) Cu_2S	(d) $\text{Cu}_7\text{S} \cdot \text{CuS} \cdot \text{FeS}$
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32. The formula for chalcocite is:
 (a) Cu_2O (b) CuFeS_2 (c) Cu_2S (d) $\text{Cu}_2\text{S}, \text{CuS}, \text{FeS}$
33. The formula for bornite is:
 (a) Cu_2O (b) CuFeS_2 (c) Cu_2S (d) $\text{Cu}_2\text{S}, \text{CuS}, \text{FeS}$
34. The formula for malachite is:
 (a) Cu_2O (b) CuFeS_2 (c) Cu_2S (d) $\text{CuSO}_4 \cdot \text{Cu}(\text{OH})_2$
35. Aluminium is the _____ most abundant element in the earth's crust.
 (a) top (b) second (c) third (d) fourth
36. The chief ore for the extraction of aluminium is:
 (a) cryolite (b) alunite (c) bauxite (d) kaolin
37. The formula for corundum is:
 (a) Al_2O_3 (b) Na_3AlF_6 (c) $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$ (d) $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$
38. The formula for diaspore is:
 (a) Al_2O_3 (b) Na_3AlF_6 (c) $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$ (d) $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$
39. The formula for Kaolin is:
 (a) Al_2O_3 (b) Na_3AlF_6 (c) $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$ (d) $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$
40. The formula for cryolite is:
 (a) Al_2O_3 (b) Na_3AlF_6 (c) $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$ (d) $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$
41. The main ore of chromium is:
 (a) nichrome (b) chromite (c) chromatid (d) chrome
42. Concentration of the ore is performed only for _____ ores.
 (a) chloride (b) sulphide (c) carbonate (d) sulphate
43. The impurities react with silica to form:
 (a) matte (b) slag (c) gangue (d) ores
44. The remaining molten mass left when the impurities have been removed is called:
 (a) matte (b) slag (c) gangue (d) ores
45. The formula of zinc blend is:
 (a) ZnCO_3 (b) ZnSO_4 (c) ZnS (d) ZnFeS_2
46. The % of pig iron converted into steel is:
 (a) 70 (b) 80 (c) 90 (d) 100
47. Carbon is present in pig iron up to:
 (a) 2 % (b) 3 % (c) 4 % (d) 5 %
48. The purity of Blister copper is about:
 (a) 96 % (b) 97 % (c) 98 % (d) 99 %
49. The alloy of copper and zinc is:
 (a) bronze (b) brass (c) nichrome (d) solder

Answers of M.C.Qs.

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|--------|---------|---------|---------|
| 1. (c) | 8. (a) | 15. (b) | 22. (c) |
| 2. (b) | 9. (c) | 16. (c) | 23. (d) |
| 3. (a) | 10. (a) | 17. (a) | 24. (a) |
| 4. (d) | 11. (b) | 18. (c) | 25. (b) |
| 5. (b) | 12. (a) | 19. (b) | 26. (d) |
| 6. (a) | 13. (c) | 20. (b) | 27. (c) |
| 7. (c) | 14. (d) | 21. (a) | 28. (c) |
| | | | 29. (a) |
| | | | 30. (b) |
| | | | 31. (a) |
| | | | 32. (c) |
| | | | 33. (d) |
| | | | 34. (d) |
| | | | 35. (c) |
| | | | 36. (c) |
| | | | 37. (a) |
| | | | 38. (d) |
| | | | 39. (c) |
| | | | 40. (b) |
| | | | 41. (b) |
| | | | 42. (b) |
| | | | 43. (b) |
| | | | 44. (a) |
| | | | 45. (c) |
| | | | 46. (c) |
| | | | 47. (d) |
| | | | 48. (c) |
| | | | 49. (b) |

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Section - B/C Short / Descriptive Answer Questions

Q1. Define (i) mineral (ii) ore (iii) gangue (iv) metallurgy.

Ans. (i) **Mineral**: The form of soil or rock stone which contains different compounds of metals is called a mineral.

(ii) **Ore**: Minerals that are used for the commercial production of metals are called ores.

(iii) **Gangue**: Freshly mined ore contains various amounts of worthless sand and rock is called gangue.

(iv) **Metallurgy**: Metallurgy involves the various procedures used to separate metals from their ores.

Q2. Write down the occurrence of iron and the names of its most common ores.

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Ans. Occurrence of Iron: Iron is the second most abundant element (5%) after aluminium (8%). It is not found in the free metallic state except in meteorites. It is not found in the free metallic state except in meteorites. It is also present in clay as iron silicates. In living matter, it is a constituent of the pigments haemoglobin in animals and chlorophyll in plants. High grade iron ores are found in Chitral, Kohistan and in Baluchistan.

Common Ores of iron:

- | | | |
|--|---|-----------------------------------|
| 1. Haematite (Fe_2O_3) | 2. Magnetite (Fe_3O_4) | 3. Iron pyrite (FeS_2) |
| 4. Siderite or spathic (FeCO_3) | 5. Limonite ($\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$) | |

Q3. Write down the Chief Ores of copper.

Ans. Chief Ores of Copper:

- | | |
|---|---|
| 1. Copper pyrite CuFeS_2 | 2. Copper glance CuS |
| 3. Chalcocite Cu_2S | 4. Cuprite Cu_2O |
| 5. Malachite $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$ (green) | 6. Azurite $[2\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2]$ (blue) |

Q4. Write down the occurrence of aluminium and its important ores. Karachi Board : 2010

Ans. Occurrence of Aluminum: Aluminum is the third most abundant element (after oxygen and silicon) in the earth's crust. It is the most abundant metal (about 8%) in the earth's crust. It is not found free in nature. It is found in the combined state as silicates in rocks and clays. Aluminium generally occurs as aluminosilicate minerals. The chief ore for the extraction of aluminium metal is bauxite. Bauxite is found in Pakistan near Khilla village (Muzaffarabad, Azad Kashmir), Gian and Salhan villages Tehsil Kohli (Rawalpindi in Margallah hills), Surge (district Attock) and in Tharparkar and Dadu districts (Sindh).

Important Ores of Aluminum:

1. **Silicate Ores:**

- | | |
|--|---|
| (i) Kaolin $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$ | (ii) Potash Feldspar $\text{K}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$ |
| (iii) Potash Mica $\text{K}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2 \cdot 2\text{H}_2\text{O}$ | |

2. **Fluoride Ore:**

- (i) Cryolite Na_3AlF_6

3. **Sulphate Ore:**

- (i) Alunite $\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 4\text{Al}(\text{OH})_3$

4. **Oxide Ores:**

- | | | |
|---|--|--|
| (i) Bauxite $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ | (ii) Diaspore $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ | (iii) Corundum Al_2O_3 |
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Q5.

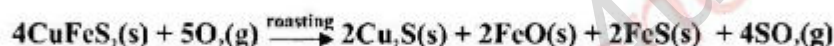
Write down the preliminary operation or preparations involved in the metallurgy of metals from their ores. Discuss concentration of the ore and the roasting of the concentrated ores.

Ans. Preliminary Preparations in Metallurgy : After mining, an ore is usually crushed and grinded for the preliminary operation. Separating metals from their ores requires the following steps:

1. **Concentration of the ore : (Froth Floatation Process) :** It is performed only for sulphide ores. A sophisticated technique for the concentration of the ore is the froth floatation process.

Froth Floatation Process : Finely crushed ore is agitated with water and oil. The oil sticks to the particles of sulphide, but not to the gangue. When air is blown into the mixture, oil-coated ore particles stick to the bubbles, and rise to the surface where they can be skimmed off. The gangue settles to the bottom and is removed at intervals.

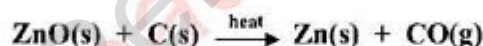
2. **Roasting :** Roasting is done in a furnace to purify the ore by heating it in the air. Sulphur and carbon are removed as SO_2 and CO_2 gases respectively leaving behind the oxides of the metals. Arsenic and antimony if present are also burnt off during the roasting. e.g.



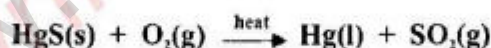
3. **Smelting the Ore :** Smelting is melting an ore to remove impurities. The roasted ore is mixed with sand and coke and is heated until it melts. The impurities react with silica to form slag, which is removed from the surface. The remaining molten mass is called matte.

4. **Reduction:** To get free metals reduction is carried out. There are three methods of reduction.

(i) **Chemical reduction:** The less electropositive metals, e.g. Pb, Fe, Sn, Zn, etc. are usually obtained by reducing their oxides with coke or carbon monoxide.



(ii) Some metals are reduced from their ores by direct heating.

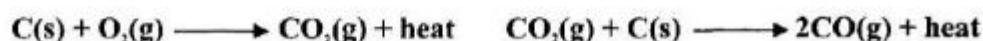


(iii) **Electrolytic reduction:** More electropositive metals like Na, K, Ca, Mg, etc. are obtained by passing electric current through their molten salts.

Q6. How is iron obtained from blast furnace Process?

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Ans. Extraction of iron (Blast Furnace) : The iron ore is first roasted in air so that ferric oxide (Fe_2O_3) is produced. The iron oxide (Fe_2O_3), coke and limestone (CaCO_3) are loaded into the furnace from the top while a blast of hot air is introduced into it from the bottom through small pipes. The temperature inside the furnace varies from 2000°C near the bottom to about 200°C at the top. In the lower part white hot coke is oxidized by the oxygen in the hot air blast to liberate carbon monoxide (CO) and a lot of heat.

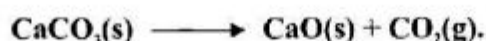


As the gas mixture moves up, CO_2 is reduced by the white hot coke to carbon monoxide. CO then reacts with ferric oxide (Fe_2O_3), reducing it to iron.

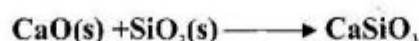


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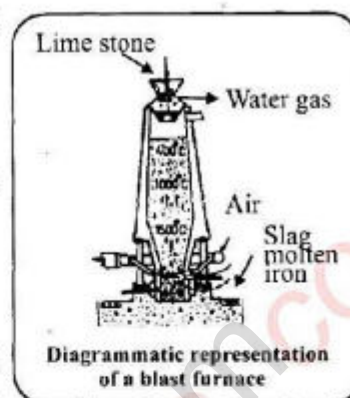
Limestone (CaCO_3) decomposes at the high temperature to yield calcium oxide (CaO).



Calcium oxide (CaO) combines with the silica (SiO_2), which is an impurity of iron, to form calcium silicate (CaSiO_3).



The molten iron sink to the bottom of the furnace and is tapped off. calcium silicate and other impurities form a molten slag which floats on the molten iron and is tapped off separately.



Q7. Describe different types of iron.

Ans. Types of Iron :

1. Pig Iron : Pig iron is the iron which is obtained directly from the blast furnace and is quite impure. It contains upto 95% Iron, which is present both as graphite and as iron carbide, (Fe_3C), together with impurities like phosphorous, sulphur, silicon and manganese in varying proportion depending on the ores and the operating temperature. The presence of these impurities lowers the melting point of the iron from 1530°C to about 1200°C . Pig iron is hard and brittle and has limited industrial uses. About 90% of the Pig iron is converted into steel.

Impurities in Pig Iron :

Impurities	Percentage
Carbon	3 - 5
Silicon	1 - 2
Sulphur	0.05 - 0.10
Phosphorous	0.05 - 1.5
Manganese	0.50 - 1.0

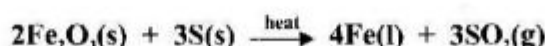
Main Components of Pig Iron :

Components	Percentage
Iron	94 - 96%
Carbon	3.5 - 4%
Silica (Silicon)	1.2%
Phosphorous	0.05 - 0.1%
Manganese	0.05 - 1.5%

2. Cast Iron : Cast iron is obtained from pig iron which has been remelted with some scrap iron and then cooled in moulds of required shapes. If cooling is done rapidly, it is changed into white cast iron and if cooled slowly it is changed to grey iron.

Cast iron is brittle and cannot be welded or forged. It expands slightly when cooled and fills every part of the mould into which it is poured. The objects made from cast iron include: tools, lamp posts, gates, pipes, railings, etc.

3. Wrought Iron : It is obtained by heating cast iron in a furnace with haematite (Fe_2O_3). The impurities carbon and sulphur are oxidized to carbon dioxide and sulphur dioxide respectively.



While the impurities of phosphorous and silicon are converted into phosphates and silicates which are removed as a slag.

Wrought iron is the purest commercial iron containing only 0.1% carbon. It is soft and malleable. It is easily welded and forged. The objects made from wrought iron are nails, chains, iron rods, sheets, etc.

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Q8. How is steel made? Name its types.

Ans. Steel Making: Steel is made from pig iron. There are several methods of making steel, e.g.

(i) the basic oxygen process.

(ii) the open hearth process.

(iii) the electric furnace process. However, they are all based on the same general process, i.e. to remove all the impurities from molten pig iron by oxidation and then to add known quantities of carbon and other elements to the molten iron to obtain steel of the desired composition.

Types of Steels :

1. **Mild Steels :** They are the commonest type of steels containing 0.1 - 0.25% carbon. They are soft, malleable and ductile.

Uses : In making tin plates, corrugated sheets, car bodies, nails, screws, steel pipes, etc.

2. **Medium Steels :** They contain 0.25 - 0.6% carbon.

3. **Hard Steels :** They contain 0.6 - 1.5% carbon.

Uses : They are used for making tools and most alloy steels. The other steels include: stainless steels magnetic steels, hard steels, manganese steels, spring steels, molybdenum steels, etc.

Q9. What is tempering?

Ans. Tempering : To remove the brittleness and increase its tensile strength, the steel is reheated to certain temperatures and allowed to cool. This is known as tempering. The hardness and tensile strength of the steel depends on the temperature to which it is heated and the rate at which it is heated and cooled during tempering.

Q10. What is the difference between iron and steel?

Ans. Difference between Iron and Steel:

Iron: Iron is a white lustrous solid. It is very malleable and ductile. It has a high tensile strength. Iron is a good conductor of heat and electricity and can be magnetized easily.

Steel: Steel is hard, tough and strong. Its properties depend on its carbon content, the heat treatment it receives (tempering) and the presence of other metals. Hardness and brittleness increase as the carbon content in the steel increases.

Q11. Name some common types of stainless steels with their composition.

Ans. Types of Stainless Steels : Stainless steels are made by adding chromium (Cr) and nickel (Ni) to iron (Fe). There are three main types of stainless steels which have different percentage of base metals.

1. Stainless steel containing 13% Cr and 0.1 - 0.4% Ni.

2. Stainless steels containing 17% Cr and 2% Ni.

3. Stainless steels containing 18% Cr and 6% Ni.

Q12. Write down the metallurgy of copper / How is copper extracted from its ore?

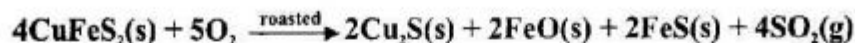
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Ans. Metallurgy of copper / Extraction of Copper : Copper is usually extracted from its sulphide ore, the copper pyrite (CuFeS_2), which contains about 0.6% copper. The extraction of copper involves the following processes.

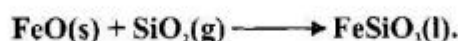
1. **Concentration of the Ore :** Copper pyrite (CuFeS_2) is concentrated by froth floatation process. In this process the ore is crushed and mixed with water and pine oil or creosote oil. Air is blown into the mixture, the sulphide ore particles are coated with oil, which form froth, and rises to the surface. The froth is skimmed off, and dried to get the concentrated ore while the gangue particles sink to the bottom.

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2. **Roasting of the Ore :** The concentrated ore is roasted on an open hearth furnace. Part of sulphur and other impurities like arsenic and antimony are burnt off and removed as their oxides.



3. **Smelting :** The roasted ore is then charged into a blast furnace together with little coke(C) and silica (SiO_2). In this process, the sulphide ore is oxidized to oxide of iron which combines with silica to form slag of iron called iron silicate (FeSiO_3).



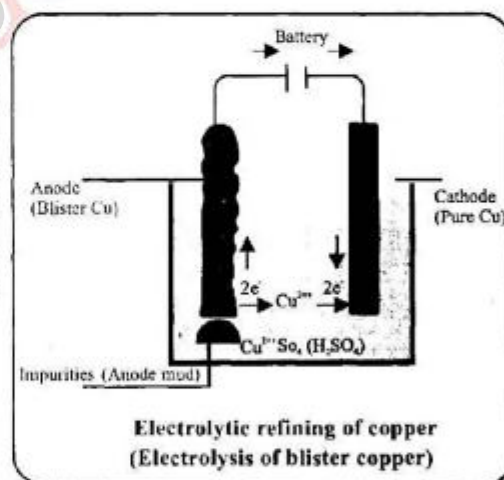
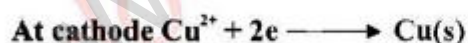
The molten mass below the slag comprises cuprous sulphide (Cu_2S) mixed with some ferrous sulphid (FeS).

4. **Reduction :** The iron sulphide (FeS) converts to FeSiO_3 (iron silicate) as given above. The cuprous sulphide (Cu_2S) is converted to Cu_2O (Cuprons oxide) by the blast of hot air which reacts with the remaining Cu_2S to give metallic copper.



The molten copper is poured into sand mould which solidifies on cooling to give blister copper which is 98% pure.

5. **Refining of Blister Copper :** Blister copper contains Fe, Zn, Pb, Ag and Au as impurities. It is refined by electrolysis. The blister copper is made anode while the pure copper sheet is made the cathode. Both the anode and the cathode are dipped into CuSO_4 (copper sulphate) solution. The cat ions move from anode to cathode and deposited as Cu metal.



The copper obtained by electrolytic refining is 100% pure.

- Q13. Write down the physical properties of copper.**

Ans. Physical Properties of Copper :

1. It is a reddish metal.
2. It is malleable and ductile.
3. Its melting point is 1085°C .
4. Its boiling point is 2582°C .
5. It is a good conductor of heat and electricity.

- Q14. Describe the extraction of aluminium metal from its bauxite ore. Give details including purification and electrolysis of pure alumina.**

Ans. Extraction of Aluminium : Aluminium is extracted from its hydrated oxide, $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$, called bauxite. The industrial proces for the extraction of aluminium is called Hall Heroult Process. It is carried out in two stages.

CHEMISTRY NOTES FOR CLASS 10TH (FOR SINDH)

1. Purification of Bauxite :

(i) Impure bauxite ore is crushed and mixed with hot sodium hydroxide solution under pressure to produce sodium aluminate.

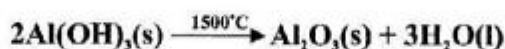


(ii) The mixture is filtered to remove insoluble ferric oxide (Fe_2O_3) and silica (SiO_2).

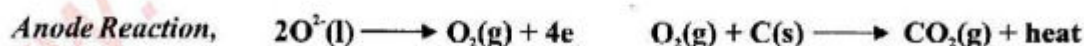
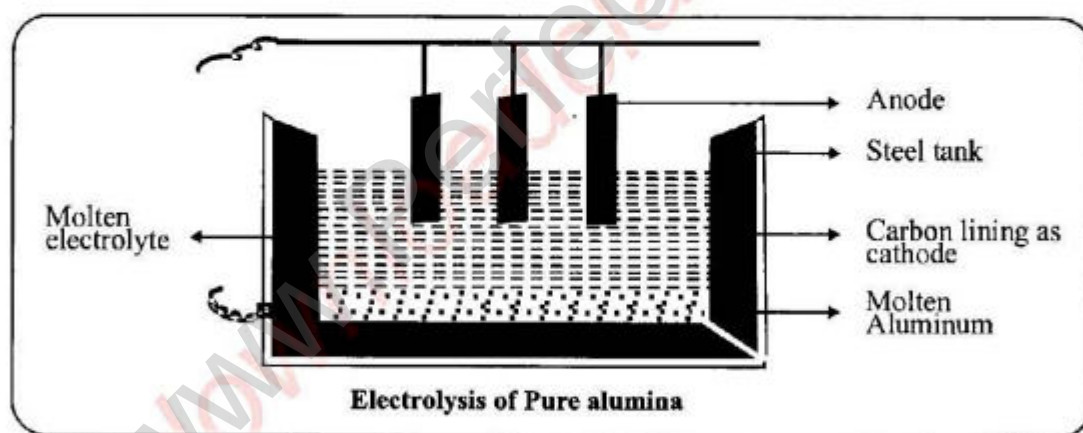
(iii) Water is added to the clear solution which causes the aluminium hydroxide $\text{Al}(\text{OH})_3$ to precipitate out.



(iv) Aluminium hydroxide is heated to produce pure white aluminium oxide called alumina.



2. **Electrolysis of Pure Alumina :** Alumina (Al_2O_3) is mixed with cryolite (Na_2AlF_6) and some fluorspar (CaF_2). Cryolite lowers the melting point of Al from 2000°C to 950°C , while fluorspar increases the fluidity of Al. The electrolysis of alumina is carried out in a steel tank lined inside with graphite which acts as cathode. The anodes are the graphite rods dipped in the molten mixture of alumina, cryolite and fluorspar. During electrolysis, the aluminium ions migrate towards the graphite cathode, the molten aluminium flows down the cell. At the anode, oxygen gas collects.



The graphite (C) anode blocks are burnt by oxygen to produce carbon dioxide which have to be replaced periodically. However, the generated heat helps to maintain the temperature of the cell.

Q15. What do you mean by an alloy?

Ans: Alloy : A solid solution comprising a mixture of two or more metals is called an alloy. Some alloys also contain certain nonmetals such as carbon, manganese, silicon, etc. The physical properties of alloys are generally different from constituent components, e.g. colour, melting points, specific gravity, elasticity, strength toughness, electrical conductivity, resistance to corrosion, expansion heating, magnetic properties, etc. are different from their constituent elements.

CHEMISTRY NOTES FOR CLASS 10TH (FOR SINDH)

Q16. Describe the composition and applications of important alloys of Copper?

Karachi Board : 2010

Ans. Composition and Applications of Important Alloys of Copper:

1. **Brass:** It is an alloy of copper and zinc. It contains 60-80% copper and 20-40% zinc. Brass is stronger and more malleable than copper. It is of yellow colour.

Uses/Applications:

(i) It is used for making moving parts of clocks and watches and nuts and bolts and rods.

(ii) It is also used in making musical instruments, ornaments, household utensils.

(iii) It is used in making water taps and some parts of ships.

(iv) It is also used in making decoration pieces.

2. **Bronze:** It is an alloy of copper and tin. It comprises 90-95 % copper and 5-10% tin. It is not easily corroded.

Uses/Applications:

(i) It is used for making coins, medals and sculptures.

(ii) It is also used in making propellers of ships.

Q17. What is nichrome?

Karachi Board : 2010

Ans. Nichrome: It is an alloy of nickel. It contains 60% nickel, 25% iron and 15% chromium. It is a shiny white alloy. It has a high melting point. It is resistant to corrosion and the passage of electric current.

Uses/Application: It is used in making heating elements for electric heaters and making of wires.

Q18. Write down the physical differences between metals and nonmetals.

Ans. Physical Differences Between Metals and Nonmetals:

Karachi Board : 2011, 2010, 2008

Metals	Nonmetals
1. Position in the periodic table	
Metals are on the left side of the periodic table.	Nonmetals are on the right side of the periodic table.
2. Physical state	
Metals are generally found in the solid state at room temperature. However, few metals are liquid, e.g. mercury (Hg).	Nonmetals are found in all the three physical states at room temperature. e.g. sulphur (S), phosphorous (P) are solids. Bromine (Br ₂) is a liquid. Nitrogen (N ₂), chlorine (Cl ₂) are gases.
3. Lustre	
Metals are lustrous. They can be polished to shine.	Nonmetals have no lustre except iodine (I ₂) and graphite (C).
4. Density	
Metals have often high densities.	Nonmetals have relatively low densities.
5. Malleability and ductility	
Metals are malleable and ductile - they can be hammered into sheets and wires.	Nonmetals are neither malleable nor ductile. They are rather brittle.
6. Sonorous	
On hitting with a hammer, metals give off notes.	Nonmetals are not sonorous and break on hitting.

CHEMISTRY NOTES FOR CLASS 10TH (FOR SINDH)

Metals	Nonmetals
7. Conductivity Metals are generally good conductors of heat and electricity.	Nonmetals are poor conductors of heat and electricity except graphite which is a very good conductor of electricity and heat.
8. Melting and boiling points Metals have high melting and boiling points e.g. Tungsten (W) has m.p. 3380°C.	Nonmetals have low melting and boiling points. However, m.p. of Diamond is very high (3500°C).
9. Alloy Metals form alloys easily. e.g. Brass is an alloy of copper (Cu) and zinc (Zn).	Nonmetals do not form alloys except carbon (C), silicon (Si) and phosphorous (P). These nonmetals combine with metals to form alloys.

Q19. Write down the chemical differences between metals and nonmetal.

Ans. Chemical Differences Between Metals and Nonmetals:

Metals	Nonmetals
1. Electropositive : All metallic elements readily lose electrons and form positively charged ions or cations. Such elements are called electropositive. e.g. $\text{Na} \longrightarrow \text{Na}^+ + \text{e}^-$ $\text{Mg} \longrightarrow \text{Mg}^{2+} + 2\text{e}^-$, $\text{Al} \longrightarrow \text{Al}^{3+} + 3\text{e}^-$	1. Electronegative : All nonmetallic elements, except hydrogen, readily gain electrons and form negatively charged ions or anions. Such elements are called electronegative. e.g. $\text{Cl}_2 + 2\text{e}^- \longrightarrow 2\text{Cl}^-$ $\text{S} + 2\text{e}^- \longrightarrow \text{S}^{2-}$, $\text{N}_2 + 6\text{e}^- \longrightarrow 2\text{N}^{3-}$
2. Basic Oxides : Metals form basic oxides which are ionic. The soluble bases in water form alkalies. e.g. CaO , Na_2O .	2. Acidic Oxides : Nonmetals usually form acidic oxides which are covalent compounds e.g. CO_2 , SO_2 , SO_3 and oxides of N_2 form acid in water.
3. Reducing Agents : Metals are generally reducing agents as they have a tendency to donate electrons during chemical reactions.	3. Oxidizing Agents : Nonmetals are generally oxidizing agents because they accept electrons during chemical reactions.
4. Metallic Hydrides : Generally metals do not react with hydrogen to form metal ionic hydrides, which are basic in character. However, Na, K and Ca form stable hydrides.	4. Nonmetallic Hydrides : Nonmetals react with hydrogen to form their stable covalent hydrides, which may be acidic, neutral or basic in nature. e.g. HCl (acidic), H_2O (neutral) NH_3 (basic).

CHEMISTRY NOTES FOR CLASS 10TH (FOR SINDH)

<i>Metals</i>	<i>Nonmetals</i>
5. Reaction with water :	
Certain metals generally react with water at certain temperatures to produce H_2 gas. e.g. $2Na(s) + 2H_2O(l) \longrightarrow 2NaOH(aq) + H_2(g)$	Nonmetals generally do not react with water. However, red hot carbon (C) decomposes steam (H_2O) to produce water gas (a mixture of CO and H_2). $C(s) + H_2O(g) \xrightarrow{1000^\circ C} CO(g) + H_2(g)$
6. Reaction with Dilute Acids :	
Metals react with dilute acids to form their corresponding salts and liberate hydrogen gas. $Zn(s) + H_2SO_4(aq) \longrightarrow ZnSO_4(aq) + H_2(g)$	Nonmetals generally do not react with dilute acids.
7. Metallic chlorides :	
Many metallic halides are ionic compounds. e.g. $NaCl$, KBr , $CaCl_2$. Their aqueous solutions are electrolytes.	7. Nonmetallic chlorides : Nonmetallic halides are covalent and therefore volatile and are nonelectrolytes. Several of them react with water. e.g. PCl_3 and PCl_5 .

Textbook Exercise

1. Fill in the blanks by the correct answer :

- (i) Aluminum is the member of group III A of the periodic table.
- (ii) During the extraction of Al, bauxite is purified by dissolving in NaOH solution, the insoluble impurities are removed by filtration.
- (iii) Elements in the periodic table are classified mainly as metals and non-metals.
- (iv) Metals are good conductors of heat and electricity.
- (v) Metals have greater tendency to lose electrons and generally are reducing agents.
- (vi) The combine forms of metals with less definite chemical impurities are known as minerals, with more earthy impurities are called ores.
- (vii) The formula of haemetic is Fe_2O_3 .
- (viii) Na_3AlF_6 is the formula of cryolite.
- (ix) $CaO + SiO_2 \longrightarrow$ $CaSiO_3$.
- (x) Bronze contains 90-95% copper and 5-10% tin.

2. Write True or False for the following statements :

- (i) Blister copper is refined by electrolytic process. (true)
- (ii) Ore is the pure form of a metal oxide. (false)
- (iii) The chief ore of iron is magnetite. (false)

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- (iv) Pig iron is hard and brittle. (true)
 (v) Brass is of silvery white colour. (false)
 (vi) CaSiO_3 and FeSiO_3 are known as slags. (true)
 (vii) Metals are usually soft and brittle. (false)
 (viii) Non-metals can not be polished like metals. (true)
 (ix) An ore can be concentrated also by magnetic separator. (true)
 (x) Impurities of Au, Ag & Zn are removed from blister copper by roasting. (false)

3. Tick the correct answer :

Ans: See MCQs 1 to 10.

4. (a) Define the following terms.

- (i) mineral (ii) Ores (iii) Metallurgy

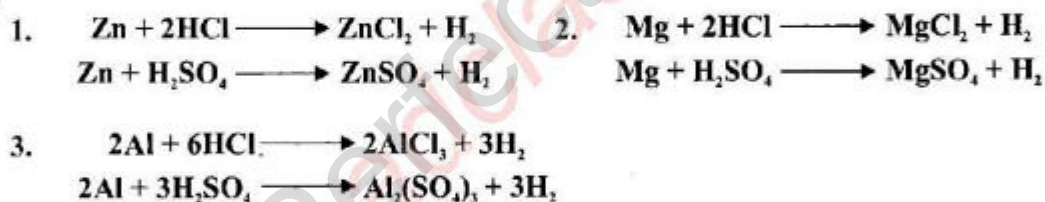
Ans: See Q.1.

(b) Write down the preliminary operations or preparations involved in the metallurgy of metals from their ores. Discuss only concentration of the ore and the roasting of the concentrated ores?

Ans: See Q.5.

(c) What happens when metals Zn, Mg and Al react with dilute HCl and H_2SO_4 . Give reactions.

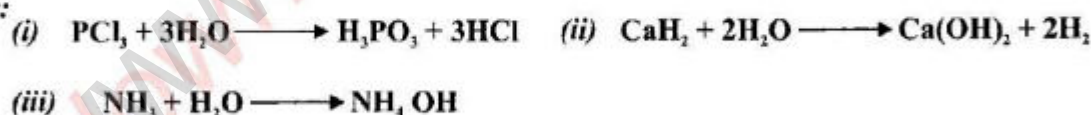
Ans:



(d) Give the reactions of the following with water.

- (i) PCl_3 (ii) CaH_2 (iii) NH_3

Ans:



5. (a) What are the chief ores of iron? How is iron obtained by the blast furnace?

Ans: See Q.2 and 6.

(b) What are the main components of pig iron?

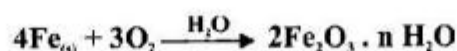
Ans: See Q.7.

(c) Differentiate between wrought iron and steel.

Ans: See Q.10.

6. (a) What is rusting? How is rusting controlled?

Ans: When Iron exposed to moist air, It gets rusted & form hydrated Iron oxide.



Rust can be controlled by:

- (i) Painting the iron (ii) Waxing the iron (iii) Making alloys

CHEMISTRY NOTES FOR CLASS 10TH (FOR SINDH)

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(b) Before the extraction of a metal begins, ores must be purified and concentrated. Mention two different process by which it is done.

Ans: See Q.5.

(c) Why does in metal extraction often slag is produced?

Ans: Impurities are removed as slag (silicates) in metal extraction.

7. (a) What are the different ores of copper? Name some of the chief ores of copper from which copper is extracted?

Ans: See Q.3.

(b) How is copper ore concentrated by froth flotation process?

Ans: See Q.12 (1).

(c) Discuss various steps involved in obtaining blister copper.

Ans: See Q.12.

(d) How is blister copper further purified? Write down the process of purification of blister copper.

Ans: See Q.12 (5).

8. (a) What are the different ores of aluminium? What is the percentage of Al-compounds present in the earth's crust?

Ans: See Q.4.

(b) Describe the extraction of aluminium metals from its bauxite ore? Give details including purification and electrolysis of pure alumina.

Ans: See Q.14.

(c) Write down the formula of the following:

(i) Lime stone

Ans: CaCO_3

(ii) Iron silicate

Ans: Fe_2SiO_3

(iii) Alumina

Ans: Al_2O_3

(iv) Iron pyrite

Ans: FeS_2

(v) Copper pyrite

Ans: CuFeS_2

(vi) Chromite

Ans: FeOCr_2O_3

9. (a) What do you mean by alloy? Describe the composition and applications of important alloys of copper.

Ans: See Q.15 and 16.

(b) What is nichrome?

Ans: See Q.17.

(c) Give the physical characteristics of copper metal.

Ans: See Q.13.

(d) What are three common stainless steels and their composition?

Ans: See Q.11.

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