Metals and Non-Metals

CHAPTER 3

NCERT FOCUS

ANSWERS

Topic 1

1. **Malleable :** The property due to which a substance can be beaten into sheets is known as malleability. Metals are malleable in nature.

Ductile : The property due to which a substance can be drawn into wires is known as ductility. Metals are ductile in nature.

2. Sodium reacts both with air and water. It is a highly reactive metal. When kept in open, it readily combines with oxygen present in air to form its oxide. Similarly, it reacts with water or moisture to form sodium hydroxide.

$4Na_{(s)} + O_{2(g)} \longrightarrow 2Na_2O_{(s)}$

$2Na_{(s)} + 2H_2O_{(l)} \longrightarrow 2NaOH_{(aq)} + H_{2(g)}$

In order to preserve sodium metal, we generally keep it under kerosene so that neither air nor moisture may come in its contact.

3. (a) $3Fe_{(s)} + 4H_2O_{(g)} \xrightarrow[\text{(steam)}]{} Fe_3O_{4(s)} + 4H_{2(g)}$

(b) $Ca_{(s)} + 2H_2O_{(l)} \longrightarrow Ca(OH)_{2(aq)} + H_{2(g)}$

$2K_{(s)} + 2H_2O_{(l)} \longrightarrow 2KOH_{(aq)} + H_{2(g)}$

4. Based on the activity series, the relative position of the metals involved in solutions is : Zn > Fe > Cu > Ag.

Metal *A* is more reactive than copper and less reactive than iron.

Metal *B* is more reactive than iron and less reactive than zinc.

Metal *C* is more reactive than silver only and less reactive than other metals.

Metal *D* is the least reactive in nature.

Thus, we can conclude that

(a) metal *B* is the most reactive.

(b) since metal *B* is more reactive than iron, it is also more reactive than copper. This means that it would displace copper from copper(II) sulphate solution. The blue colour of solution will slowly fade.

(c) The decreasing order of reactivity of metals is : *B* > *A* > *C* > *D*.

5. Hydrogen gas (H_2) is produced when a reactive metal reacts with dilute hydrochloric acid.

$Zn_{(s)} + 2HCl(dil.) \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$

Zinc — Hydrochloric acid — Zinc chloride — Hydrogen

Iron and dilute H_2SO_4 react as follows :

$Fe_{(s)} + H_2SO_4(dil.) \longrightarrow FeSO_{4(aq)} + H_{2(g)}$

6. The green colour of the solution would slowly disappear. Zinc would gradually dissolve and iron would get precipitated at the bottom of the beaker.

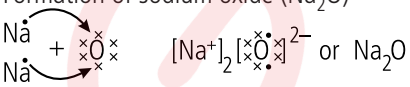
$Zn_{(s)} + FeSO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + Fe_{(s)}$

7. (i) Sodium : $\dot{N}a$

Oxygen : $\times\underset{\times}{\overset{\times}{\underset{\times}{\overset{\times}{O}}}}\times$

Magnesium : Mg:

(ii) Formation of sodium oxide (Na_2O)



$[Na^+]_2[\times\underset{\times}{\overset{\times}{\underset{\times}{\overset{\times}{\bullet}}}}\times]^{2-}$ or Na_2O

Formation of magnesium oxide (MgO)

$[Mg]^{2+}[\times\underset{\times}{\overset{\times}{\underset{\times}{\overset{\times}{\bullet}}}}\times]^{2-}$ or MgO

(iii) Na_2O : Na^+ and O^{2-} ions

MgO : Mg^{2+} and O^{2-} ions

8. In the formation of ionic compounds, positive ions (cations) and negative ions (anions) participate. These are closely packed and the ionic compounds exist as crystalline solids. They have strong interionic forces of attraction and a large amount of energy is required to overcome these forces. Thus, the melting points of ionic compounds are quite high.

9. Magnesium (Mg) will displace both zinc (Zn) and copper (Cu) from their oxides.

$Mg + ZnO \longrightarrow MgO + Zn$

$Mg + CuO \longrightarrow MgO + Cu$

Zinc will displace copper from copper oxide.

$Zn + CuO \longrightarrow ZnO + Cu$

Copper is least reactive and will not participate in displacement reaction.

10. (a) Metals can be hammered to form sheets. *i.e.*, they are malleable. Non-metals cannot be flattened into sheets, they are brittle.

By making an electrical circuit, it can be tested for the electrical conductance of metals and non-metals. If the bulb glows the sample is metal, a good conductor of electricity. If, on the other hand, the bulb does not glow, the sample is non-metal, a bad conductor of electricity.

(b) Iron and many other metals being malleable can be cast into sheets for roofing, for making trunks, boxes and for storing articles of daily use. Metals are good conductor of electricity so, the metal wires made up of copper and aluminium are used for carrying electricity.

11. These are the oxides which can act both as acids and bases. For example, aluminium oxide (Al_2O_3) and zinc oxide (ZnO). The amphoteric character of zinc oxide is shown by the following reactions :

$$\underset{\text{(Basic nature)}}{ZnO_{(s)}} + \underset{\text{Acid}}{2HCl_{(aq)}} \rightarrow \underset{\text{Zinc chloride}}{ZnCl_{2(aq)}} + H_2O_{(l)}$$

$$\underset{\text{(Acidic nature)}}{ZnO_{(s)}} + \underset{\text{Base}}{2NaOH_{(aq)}} \rightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_{2(aq)}} + H_2O_{(l)}$$

12. Metals such as Mg, Al, Zn, Fe, etc. which lie above hydrogen in the activity series are more reactive than hydrogen and hence can displace hydrogen from dilute acids.
For example,

$$\underset{\text{Zinc}}{Zn_{(s)}} + \underset{\text{Sulphuric acid}}{H_2SO_{4(aq)}} \rightarrow \underset{\text{Zinc(II) sulphate}}{ZnSO_{4(aq)}} + \underset{\text{Hydrogen}}{H_{2(g)}}$$

$$\underset{\text{Iron}}{Fe_{(s)}} + \underset{\text{Hydrochloric acid}}{2HCl_{(aq)}} \rightarrow \underset{\text{Iron(II) chloride}}{FeCl_{2(aq)}} + \underset{\text{Hydrogen}}{H_{2(g)}}$$

Metals such as Cu, Hg, Ag, Au, etc. which lie below hydrogen in the activity series are less reactive than hydrogen and hence, cannot displace hydrogen from dilute acids.

Cu, Hg, Ag, Au, etc. $\xrightarrow{\text{Dilute acids}}$ No reaction

13. When sulphur is heated in air, sulphur dioxide gas is formed.

(a) (i) The gas has no effect on dry litmus paper.
(ii) The gas turns the moist blue litmus to red. On prolonged contact with the gas, the litmus paper gets decolourised.

(b) $S_{(s)} + O_{2(g)} \xrightarrow{\Delta} SO_{2(g)}$

$$SO_{2(g)} + \underset{\substack{\text{(Moist}\\\text{litmus paper)}}}{H_2O_{(l)}} \rightarrow \underset{\text{(turns blue litmus red)}}{H_2SO_{3(aq)}}$$

14. The oxides are generally acidic in nature which means that when dissolved in water, their solutions turn blue litmus red. For example,

$$\underset{\text{(Non-metal)}}{C} + O_2 \rightarrow \underset{\text{(Acidic oxide)}}{CO_2}$$

$$CO_2 + H_2O \rightarrow \underset{\text{Carbonic acid}}{H_2CO_3}$$

15.

	Property	Metals	Non-metals
1.	With oxygen, (nature of oxides)	Metals form basic oxides, some of which form alkalies when dissolved in water.	Non-metals form acidic or neutral oxides.
2.	Displacement of hydrogen	Metals displace hydrogen from acids.	Non-metals do not displace hydrogen from acids.
3.	With chlorine	Metals form chlorides which are ionic compounds.	Non-metals form chlorides or chloro compounds which are covalent in nature.
4.	With hydrogen	Few metals form hydrides which are ionic (electrovalent) in nature.	Non-metals form stable covalent hydrides.
5.	Chemical nature	Metals are reducing agents.	Non-metals are oxidising agents except carbon and hydrogen which are good reducing agents.

16. The man had actually used the solution of aqua regia (mixture of conc. HCl and conc. HNO_3 in the ratio of 3 : 1 by volume) which dissolved the gold forming soluble auric chloride ($AuCl_3$). Since gold actually reacted, there was a loss in weight of the gold bangles. With the removal of the dull layer of gold from the surface, there was original shine on the bangles.

17. Metals when react with sodium hydroxide or hydrochloric acid give hydrogen gas which can be identified by bringing a burning splinter near the gas. Hydrogen gas burns with a pop sound.

$$\underset{\text{(Metal)}}{M} + 2NaOH \rightarrow Na_2MO_2 + H_2\uparrow$$

$$M + 2HCl \rightarrow MCl_2 + H_2\uparrow$$

18. Molecular mass of XOH is 40. It means the salt Y is NaOH.
X = Na, Y = NaOH, Z = H_2
$2Na + 2H_2O \rightarrow 2NaOH + H_2\uparrow$ + heat

19. X = carbon,
Y = diamond, the hardest natural substance
Z = graphite, good conductor of electricity

20. (a) $\underset{(A)}{N_{2(g)}} + 3H_{2(g)} \underset{}{\overset{\text{Fe, }\Delta}{\rightleftharpoons}} \underset{(B)}{2NH_{3(g)}}$

$$\underset{(A)}{N_2} + O_2 \rightarrow \underset{(C)}{2NO}$$

$$\underset{(C)}{2NO} + O_2 \rightarrow 2NO_2$$

$$4NO_2 + 2H_2O + O_2 \rightarrow \underset{(D)}{4HNO_3}$$

(b) Nitrogen belongs to group 15 of the periodic table.

Topic 2

1. **(i) Mineral :** Naturally occurring compounds of metals mixed with earthy material are called minerals.
(ii) Ore : The minerals from which metals can be conveniently and profitably extracted are called ores.
(iii) Gangue : The earthy impurities such as mud, sand and clay associated with the ore are called gangue.

2. The metals are gold (Au) and platinum (Pt).

3. The chemical process is known as reduction. This reaction can be done either by heating with carbon or by using highly reactive metals such as Na, Ca, Al, etc. For example,

$ZnO_{(s)} + C_{(s)} \longrightarrow Zn_{(s)} + CO_{(g)}$

$3MnO_{2(s)} + 4Al_{(s)} \longrightarrow 3Mn_{(l)} + 2Al_2O_{3(s)} + \text{heat}$
This reaction is highly exothermic.

4. **Anode :** A thick slab of crude metal *M*.
Cathode : A thin sheet of pure metal *M*.
Electrolyte : A solution of a stable salt of metal *M*.

5. (a) Impure silver - Anode (Thick plate)
Pure silver - Cathode (Thin plate)
(b) Electrolyte - Silver salt like acidified $AgNO_3$, $Na[Ag(CN)_2]$
(c) Pure silver is obtained at cathode during electrolysis.
$AgCl \longrightarrow Ag^+ + Cl^-$
$Ag^+ + e^- \longrightarrow Ag$ (at cathode)

6. It is easier to obtain metal from its oxide by reduction as compared from its sulphides and carbonates.

7. (a) $ZnCO_3 \xrightarrow{\text{Heat}} ZnO + CO_2$
This reaction is known as calcination.

(b) $2Cu_2O + Cu_2S \xrightarrow{\text{Heat}} 6Cu + SO_2$
This is known as auto - reduction of Cu_2O to give Cu.

Topic 3

1. Metals such as gold (Au) and platinum (Pt) present at the bottom of the activity series do not corrode easily.

2. Alloys are the homogeneous mixture of two or more metals or even metals and non-metals.

3. (i) By applying a coating of grease or paint on the surface of iron.
(ii) By depositing a layer of zinc on the surface of iron. The process is called galvanisation.

4. Copper metal slowly reacts with water, carbon dioxide and oxygen present in air to form basic copper carbonate which is green in colour. Its layer slowly gets deposited on the surface of the metal.

$2Cu + H_2O + \underset{\text{(Present in air)}}{CO_2} + O_2 \rightarrow \underset{\substack{\text{Basic copper carbonate}\\\text{(Green)}}}{CuCO_3 \cdot Cu(OH)_2}$

Now as lemon is acidic, hence when we rub the tarnished copper vessel with lemon, the basic copper oxide or copper carbonate reacts with the acid present in lemon to form a salt which is washed away with water.

5. Copper is a better conductor of heat than steel which is an alloy of iron. Though copper is costlier than steel, it is used to make hot water tanks for storing hot water in preference to steel.

6. Solder is an alloy of lead and tin. Low melting point of solder makes it suitable for welding electrical wires.

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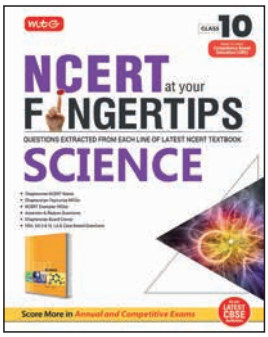

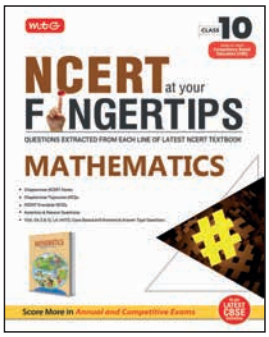

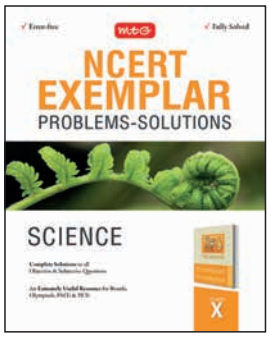

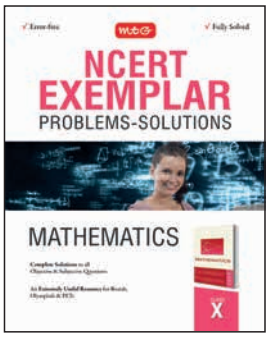

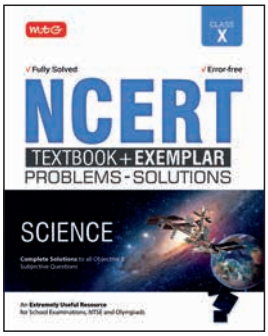

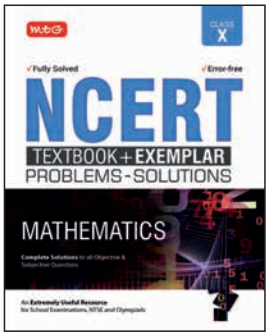

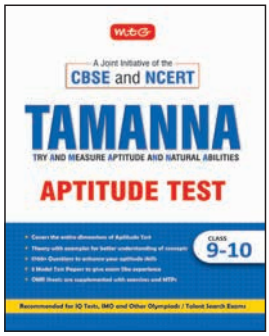

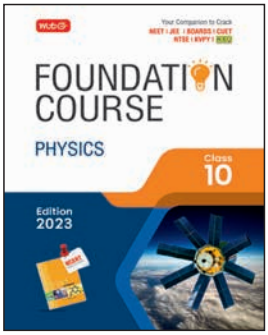

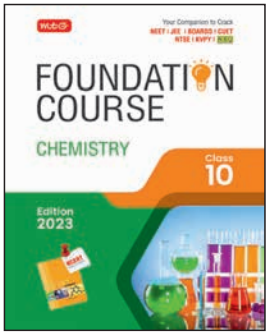

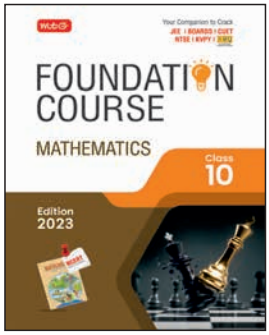

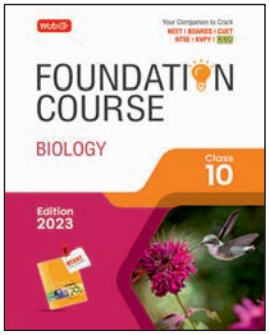

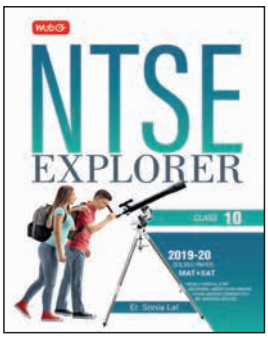

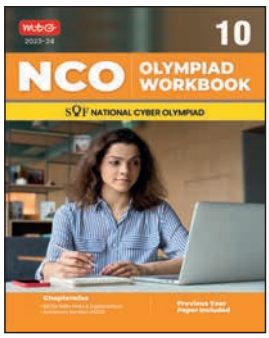

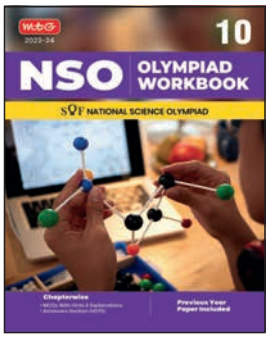

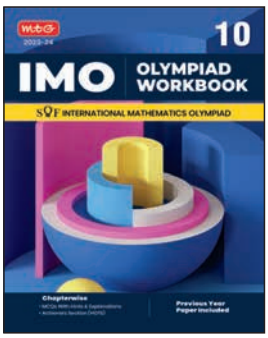

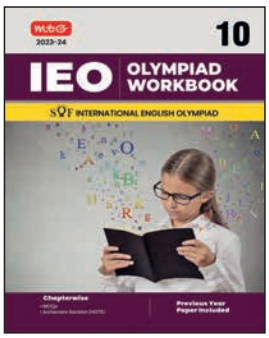

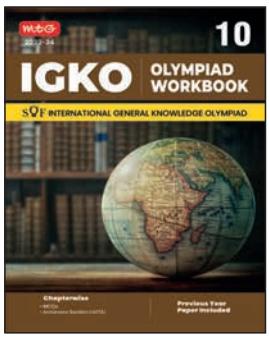

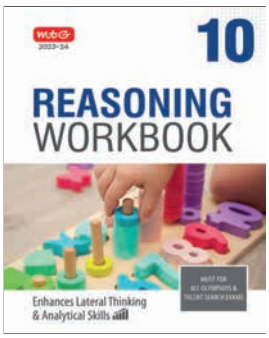

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