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Metals And Non-Metals



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Previous Years Questions

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Q. Compare in tabular form the reactivities of the following metals with cold and hot water:
[CBSE 2020]

- (a) Sodium
- (b) Calcium
- (c) Magnesium

Ans.

	Metal	Reaction with water
(a)	Sodium	Reacts violently with cold water $2\text{Na}_{(s)} + 2\text{H}_2\text{O}_{(l)} \rightarrow 2\text{NaOH}_{(aq)} + \text{H}_{2(g)}$
(b)	Calcium	Reacts less violently with cold water $\text{Ca}_{(s)} + 2\text{H}_2\text{O}_{(l)} \rightarrow \text{Ca(OH)}_{2(aq)} + \text{H}_{2(g)}$
(c)	Magnesium	Does not react with cold water, it reacts with hot water $\text{Mg}_{(s)} + 2\text{H}_2\text{O}_{(l)} \xrightarrow{\text{Heat}} \text{Mg(OH)}_{2(aq)} + \text{H}_{2(g)}$

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

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

Ag < Cu < Fe < Zn < X or Ag < Cu < Fe < X < Zn.

Q. Carbon cannot reduce the oxides of sodium, magnesium and aluminium to their respective metals. Why? Where are these metals placed in the reactivity series? How are these metals obtained from their ores? Take an example to explain the process of extraction along with chemical equations.
[CBSE 2019]

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

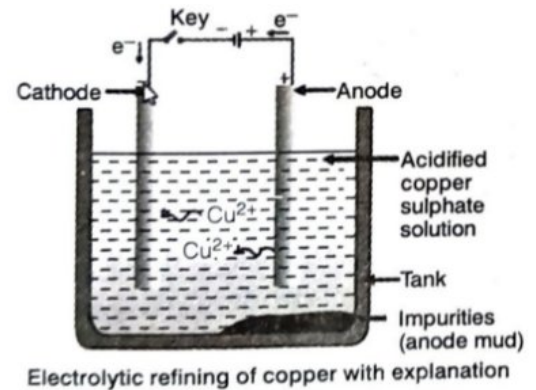


Q. Describe electrolytic refining of copper with chemical equations. Draw a well labelled diagram for it. [CBSE 2014, 17, 18]

Ans. In the electrolytic refining of copper, impure metal is used as anode, a strip of pure metal is used as cathode and soluble salt of metal is used as electrolyte (acidified copper sulphate solution). On passing electric current through the electrolyte. Cations move towards cathode, gain electrons and pure metal (copper) gets deposit on cathode. The soluble impurities go into the solution, whereas, the insoluble impurities settledown at the bottom of the anode and are known as anode mud.

At anode : $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$

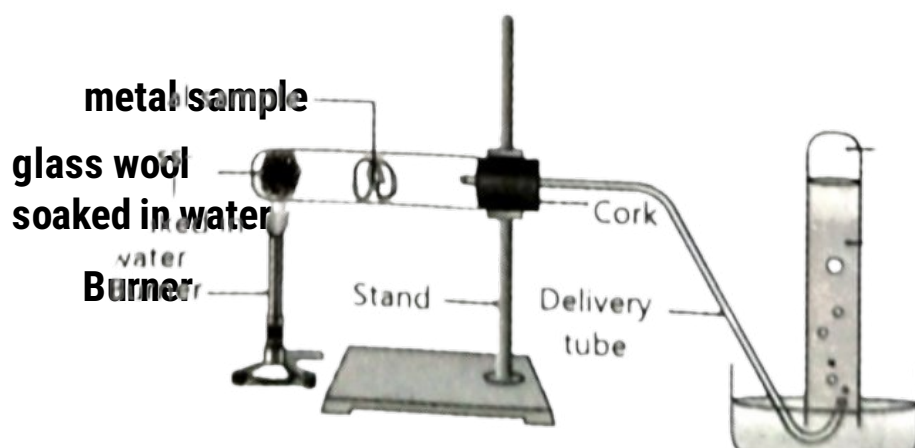
At cathode: $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$



Q. Compose an activity to arrange Ca, Mg and Fe metals in the decreasing order of reactivity with water. Write suitable balanced chemical equation and draw diagrams. [CBSE 2014]

Ans. Take some metals like Ca, Mg and Fe etc. Place separately small pieces of these metals in beakers with small amount of water in them. If the metals react with the cold water, then the reaction is vigorous. If metal does not react with cold water, then treat it with hot water. Record the observations and arrange the metals in decreasing order of reactivity.

Metal	Reaction	Observation	Chemical reaction
Fe	Steam	Fe_3O_4 and $\text{H}_2(\text{g})$	$3\text{Fe}(\text{s}) + 4\text{H}_2\text{O}(\text{g}) \rightarrow \text{Fe}_3\text{O}_4(\text{s}) + \text{H}_2(\text{g})$
Mg	Hot water	$\text{Mg}(\text{OH})_2(\text{aq})$ and $\text{H}_2(\text{g})$	$\text{Mg}(\text{s}) + 2\text{H}_2\text{O}(\text{hot}) \rightarrow \text{Mg}(\text{OH})_2(\text{aq}) + \text{H}_2(\text{g})$
Ca	Cold water	$\text{Ca}(\text{OH})_2(\text{aq})$ and $\text{H}_2(\text{g})$	$\text{Ca}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{OH})_2(\text{aq}) + \text{H}_2(\text{g})$



Q. (a) "Sodium is a highly reactive metal and it cannot be obtained from its oxide by heating with carbon." Give reason.

(b) How can sodium be obtained from sodium chloride? [CBSE 2014]

Ans. (a) Metallic compounds like sodium cannot be reduced by carbon or any other reducing agent due to their high affinity with oxygen.

(b) Sodium is obtained from sodium chloride by electrolytic reduction. Sodium chloride in molten form is electrolysed. Sodium is deposited at cathode and chlorine is liberated at anode.

At cathode : $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$

At anode : $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$

Q. Why the sulphide and carbonate ores are converted into oxides? [CBSE 2013]

Ans. It is because it is easier to obtain a metal from its oxide, as compared to its sulphide and carbonates.

Q. Why oxides of high reactive metals cannot be reduced by carbon? [CBSE 2013]

Ans. This is because these metals have more affinity for oxygen than carbon.

Q. Calcium is an element with atomic number 20. Stating reason answer each of the following questions [CBSE 2012,16]

(i) Is calcium a metal or non-metal?

(ii) Will its atomic radius be larger or smaller than that of potassium with atomic number 19?

(iii) Write the formula of its oxide.

Ans. (i) Calcium is a metal since it has two electrons in its outermost shell which it can lose easily.

(ii) K (19) is placed before Ca (20) in the same period (fourth period). Since the atomic radius decreases along a period, the atomic radius of calcium is smaller than that of potassium.

(iii) The formula of oxide of calcium is CaO , because the valency of calcium as well as that of oxygen is 2.

Q. Write the chemical name of the coating that forms on silver and copper articles when these are left exposed to moist air. [CBSE 2012]

Ans. Silver sulphide, copper carbonate coating is formed on silver and copper article.

Q. Explain what is galvanization? What purpose is served by it? [CBSE 2012]

Ans. Galvanization is method of a protecting steel and iron from rusting by coating them with a thin layer of zinc. The galvanized article is protected against rusting even if the zinc coating is broken.

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

Ans. The ore on treatment with dilute hydrochloric acid produces brisk effervescence hence, it must be a carbonate ore. Calamine (ZnCO_3) is an important carbonate ore of zinc.

Steps required to obtain metal from the enriched carbonate Are:

(a) Conversion of the carbonate ore into metal oxide : This is done by calcination (for carbonate ores).

Calcination is the process of heating the ore strongly in the absence or limited supply of air. The zinc carbonate on heating decomposes to form zinc oxide

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

Q. (a) Define corrosion.

[Board Term I, 2017]

(b) What is corrosion of iron called?

(c) How will you recognise the corrosion of silver?

(d) Why corrosion of iron is a serious problem?

(e) How can we prevent corrosion of iron?

Ans. (a) The process of slowly eating up of metals due to their conversion into oxides, carbonates, sulphides, etc., by the action of atmospheric gases and moisture is called corrosion.

(b) The corrosion of iron is called rusting.

(c) Silver articles become black after sometime when exposed to air. This is due to formation of a coating of black silver sulphide (Ag_2S) on its surface by the action of H_2S gas present in the air.

(d) Corrosion of iron is a serious problem. Every year large amount of money is spent to replace damaged iron articles. Corrosion causes damage to car bodies, bridges and iron railings, ships and to all objects made of metals specially those of iron.

(e) Corrosion of iron is prevented by coating it with a layer of oil. The reason being that the layer of oil does not allow air and water to react the surface of iron. Corrosion of iron can also be prevented by painting, greasing, galvanising, anodising, electroplating or making alloys.

Q. (a) Metals like iron, silver and copper get corroded on exposure to air. Write the chemical name of the substance deposited on their surface respectively with its colour, in each case.

[Board Term I, 2013]

(b) List four ways by which rusting can be prevented.

Ans. (a) Iron gets corroded and forms ferric oxide which is rust, it is reddish brown in colour. For silver and copper

(b) The various methods used for preventing the rusting of iron are given below:

(i) By applying paint : Materials like railings, iron gates, iron bridges, bodies of cars, buses and trucks, etc. are all painted to protect them from rusting. Painting the metal surface does not allow them to come in contact with the moist air and thus, prevents rusting.

(ii) Greasing and oiling : When some grease or oil is applied on the surface of an iron object, then moisture and air cannot come in contact with it and hence, rusting is prevented.

(iii) Galvanization : It is a method of protecting iron from rusting by coating them with a thin layer of zinc. The iron coated with zinc is called galvanized iron.

(iv) Electroplating : It is another technique used to prevent articles from rusting. In this process, metals like tin, nickel and chromium which do not corrode are electroplated on iron.

Q. State reasons for the following: **[CBSE 2019,17,13]**

(i) Electric wires are covered with rubber like material.

(ii) From dilute hydrochloric acid, zinc can liberate hydrogen gas but copper cannot.

(iii) Sulphide ore of a metal is first converted to its oxide to extract the metal from it.

Ans. (i) It is because rubber is an insulator and does not allow current to flow through it.

(ii) Zinc is more reactive than hydrogen. Therefore, it can displace hydrogen from dilute HCl whereas copper cannot, because it is less reactive than hydrogen. ,

(iii) It is because it is easier to reduce oxide ore as compared to sulphide ore.

Q. (a) Are all pure liquids bad conductors of electricity ?

Name a liquid which is a good conductor of electricity but does not undergo electrolysis on passing electric current.

If pure water is used, no electrolysis takes place. Why ?

Ans. Name one practical application based on the phenomenon of electrolysis.

No, there are exceptions also. Mercury in pure state a good conductor of electricity.

Mercury is a good conductor of electricity but does not undergo electrolysis.

Pure water (H_2O) does not dissociate into ions on passing electric current.

Q. Define an alloy. How are alloys prepared? How do the properties of iron change when:

[CBSE 2012]

(i) small quantity of carbon is mixed?

(ii) nickel and chromium are mixed with it?

Ans. Alloy is a homogeneous mixture of two or more metals or a metal and a non-metal. It is prepared by first melting the primary metal and then dissolving the other elements in it in definite proportion. It is then cooled to room temperature.

(i) On mixing carbon it becomes hard and strong.

(ii) On mixing nickel and chromium, it becomes hard and does not rust.

Q. Why do ionic compounds have high melting points? **[NCERT, CBSE 2010, 13]**

Ans. Ionic compounds are made up of two opposite charged ions i.e., cations (+) and anions (-), which are held together with strong electrostatic force of attraction. To break this strong bonding of ions, large amount of heat energy is required, hence the melting point of ionic compounds is high.



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Multiple Choice Questions

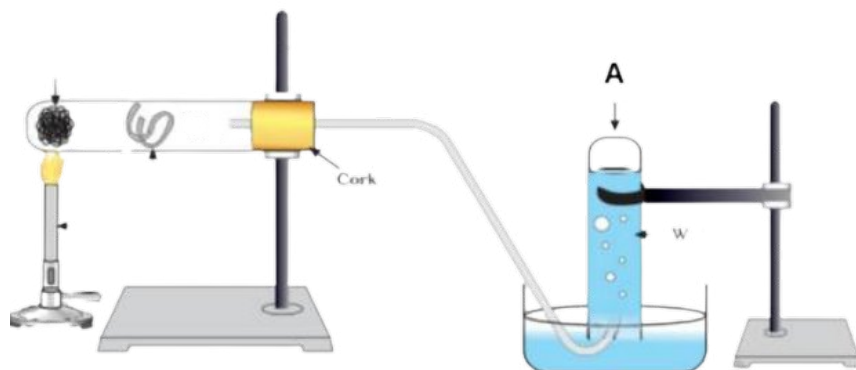
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1. Identify the gas evolved A

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



2. Aluminium is used for making cooking utensils. Which of the following properties of aluminium are responsible for the same?

- 1. Good thermal conductivity
- 2. Good electrical conductivity
- 3. Ductility
- 4. High melting point

- (a) 1 and 2
- (b) 1 and 3
- (c) 2 and 3
- (d) 1 and 4

3. 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) 1 and 4
- (b) 2 and 3
- (c) 1 and 2
- (d) 3 and 4

4. The basic copper carbonate layer coating on copper is of which colour

- (a) Blue
- (b) black
- (c) green
- (d) Colourless

5. Which among the following statements is incorrect for magnesium metal?

- (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.

6. A metal M of moderate reactivity is present as its sulphide X. On heating in air, X converts into oxide Y and a gas evolves. On heating Y and X together, the metal M is produced. X and Y respectively are

- (a) X cuprous sulphide, Y cuprous oxide
- (b) X cuprous sulphide, Y cupric oxide
- (c) X sodium sulphide, Y sodium oxide
- (d) X calcium sulphide, Y calcium oxide

7. An element X (atomic number 12) reacts with another element Y (atomic number 17) to form compound Z. Which of the following statements are true regarding this compound?

- i. Molecular formula of Z is XY_2 .
- ii. It is soluble in water.
- iii. X and Y are joined by sharing of electrons.
- iv. It will conduct electricity in the molten state.

- (a) 2 and 3
- (b) 1 and 3
- (c) 1, 3 and 4
- (d) 1 and 4

8. The composition of aqua-regia is

- (a) Dil. HCl: Conc. HNO_3 (3: 1)
- (b) Conc. HCl: Dil. HNO_3 (3:1)
- (c) Conc. HCl: Conc. HNO_3 (3:1)
- (d) Dil. HCl: Dil. HNO_3 (3:1)



9. 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

10. 2 mL each of concentrated HCl, HNO_3 and a mixture of concentrated HCl and concentrated HNO_3 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) Silver
- (b) gold
- (c) aluminium
- (d) manganese

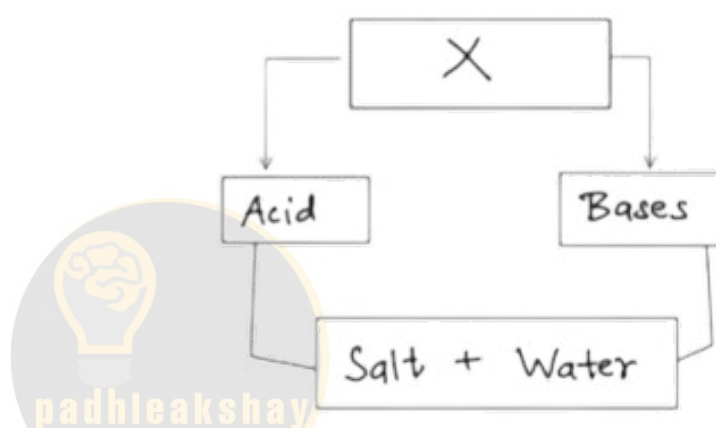
11. Which of the following matches is correct if the metals listed react with water?

	METALS	PRODUCTS
(i)	Aluminium (Al)	$\text{Al}_2\text{O}_3 (\text{s}) + \text{H}_2 (\text{g})$
(ii)	Iron (Fe)	NO REACTION
(iii)	Potassium (K)	$\text{KOH} (\text{aq}) + \text{H}_2 (\text{g})$
(iv)	Sodium (Na)	$\text{Na}_2\text{O} (\text{s}) + \text{H}_2 (\text{g})$

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

12. 'X' can be oxide of which of the following metals?

- (a) Zinc
- (b) Aluminium
- (c) It can be both of above
- (d) Gold and Platinum



13. Which among the following statement is incorrect?

- (a) Iodine is a liquid at room temperature
- (b) Na & Li can be easily cut with a knife
- (c) Ga and Cs have very low M.P.
- (d) Pb & Hg are poor conductor of heat

14. Name the process of forming a thick oxide layer of aluminium?

- (a) Galvanisation
- (b) dissolution
- (c) Anodising
- (d) Rectification

ANSWERS

1.D
2.D
3.D
4.C
5.B
6.A
7.B
8.C
9.B
10.B

11. a
12. c
13. a
14. b



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Case-Based Questions

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Read the following and answer the following questions

QUESTIONS 1:

Ionic compound is a chemical compound in which ions are held together by ionic bonds. An ionic bond is the type of chemical bond in which two oppositely charged ions are held through electrostatic forces. We know that, tuetal atoms have loosely bound valence electrons in their valence shell and non-metal atoms need electrons in their valence shell to attain noble gas configuration. The metal atom loses the valence electrons while non-metal atom accepts these electrons. By losing electrons, metal atoms change to cations and by accepting electrons, non-metals form anions. Ionic compounds are generally solid and exist in the form of crystal. They have high melting and boiling points.

(i) Which of the following can change to a cation?

- (a) Fluorine**
- (b) Oxygen**
- (c) Potassium**
- (d) Neon**

(ii) Which of the following can change to an anion?

- (a) Iodine**
- (b) Magnesium**
- (c) Calcium**
- (d) Xenon**

(iii) Tonic compounds are soluble in

- (a) Kerosene**
- (b) Petrol**
- (c) Water**
- (d) None of these**

(iv) Which of the following statements is correct about ionic compounds?

I. They conduct electricity in solid state.

II. They conduct electricity in solutions.

III. They conduct electricity in molten state.

- (a) I only**
- (b) II only**
- (c) III only**
- (d) II and III only**

ANSWERS

i. c

ii. a

iii. c

iv. d

QUESTIONS 2:

On the basis of reactivity of different metals with oxygen, water and acids as well as displacement reactions, the metals have been arranged in the decreasing order of their reactivities. This arrangement is known as activity series or reactivity series of metals.

The basis of reactivity is the tendency of metals to lose electrons. If a metal can lose electrons easily to form positive ions, it will react readily with other substances. Therefore, it will be a reactive metal. On the other hand, if a metal loses electrons less rapidly to form a positive ion, it will react slowly with other substances. Therefore, such a metal will be less reactive.

(i) Which of the following metals is less reactive than hydrogen?

- (a) Copper
- (b) Zinc
- (c) Magnesium
- (d) Lead

(ii) Which of the following metals is more reactive than hydrogen?

- (a) Mercury
- (b) Platinum
- (c) Iron
- (d) Gold

(iii) Which of the following metals reacts vigorously with oxygen?

- (a) Zinc
- (b) Magnesium
- (c) Sodium
- (d) Copper

(iv) Which of the following represents the correct order of reactivity for the given metals?

- (a) $\text{Na} > \text{Mg} > \text{Al} > \text{Cu}$
- (b) $\text{Mg} > \text{Na} > \text{Al} > \text{Cu}$
- (c) $\text{Na} > \text{Mg} > \text{Cu} > \text{Al}$
- (d) $\text{Mg} > \text{Al} > \text{Na} > \text{Cu}$

ANSWERS

i. a

ii. c

iii. c

iv. a