



Metals & Non-Metals

CH 3 Science | Class 10

Notes + 10 Years Integrated PYQ's



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Metals and Non-Metals

Metals

Metals are elements that conduct heat and electricity and are malleable and ductile.

- All metals → Solid (except mercury.)
- Metals are electropositive.
- Metals are the elements (except hydrogen) which form +ve ions by losing electrons.
- Most abundant metal in Earth's crust is Al.

Non-Metals

They do not conduct heat and electricity and are neither malleable nor ductile.

- Out of 22 non-metals, 10 are solids, 1(bromine) is a liquid whereas remaining 11 are gases.
- Non-metals are electronegative.
- H is only non-metal which loses electron.

Physical Properties

Metals	Non-Metals
① They are malleable and ductile, and can be beaten and drawn into thin sheets and wires.	① Neither malleable nor ductile.
② They are good conductors of heat and electricity.	② They do not conduct heat and electricity (except graphite).
③ They are lustrous and can be polished.	③ They are not lustrous.
④ They are hard (except sodium and potassium).	④ They are generally soft (except diamond).

⑤ They have high Melting and Boiling point (except Sodium and Potassium).	⑤ They have comparatively low Melting and Boiling point (except diamond).
⑥ They are Sonorous.	⑥ They are non-sensorous.

Some other Properties of Non-Metals

- ① They can be solid, liquids or gases at Room Temperature.
- ② They have low densities i.e. they are light substances.
- ③ Non-Metals have many different colours:

Sulphur - Yellow

Phosphorus - White / Red

Graphite - Black etc.

QUESTIONS

1. Give an example of a metal which
 - (i) is a liquid at room temperature.
 - (ii) can be easily cut with a knife.
 - (iii) is the best conductor of heat.
 - (iv) is a poor conductor of heat.
2. Explain the meanings of malleable and ductile.

Answers

- ① i) Mercury
ii) Sodium
iii) Copper and Aluminium
iv) Lead
- ② Malleable means which is able to be hammered or pressed into shape without breaking or cracking.
A metal that can be drawn out into a thin wire is called ductile.

Chemical Properties

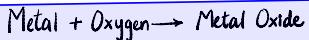
Reaction with Oxygen



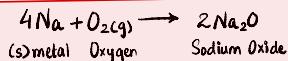
Reaction with water



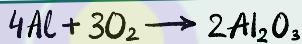
① Reaction of Metal with oxygen



- * When metal are burnt in air, they react with oxygen in air to form metal oxide.
- Metal oxides turn red litmus blue and they are basic in nature.



Aluminium burns in air, to form aluminium oxide.

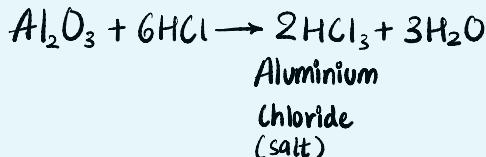


Amphoteric Oxides

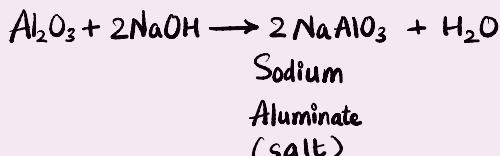
Oxides that show basic as well as acidic behaviour are known as Amphoteric oxides.

Aluminium Oxide is one of them.

Zinc also forms amphoteric oxides.



In this reaction, Al_2O_3 behaves as a basic oxide.



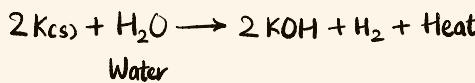
Here Al_2O_3 , behaves as an acidic oxide.

② Reaction of metal with water:

- * When metal reacts with water (cold/hot) the products formed are metal hydroxide and hydrogen gas.



- * When a metal reacts with steam, then products are metal oxide and hydrogen gas.



- The reaction is exothermic.
- The reaction of calcium with water is less violent.
- The heat evolved is not sufficient for H₂ gas to catch fire.



Calcium starts floating because bubbles of hydrogen gas stick to the surface of metals.

- Metals like Al, Fe and Zn do not react with hot or cold water.
- But they react with steam to form metal oxide and hydrogen [Also, lead, Gold, Silver → no reaction]

③ Reaction of Metal with Acids:



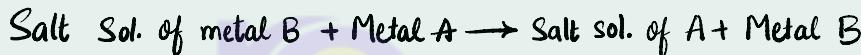
- * Magnesium reacts quite rapidly with dil. HCl acid forming magnesium chloride and hydrogen gas.



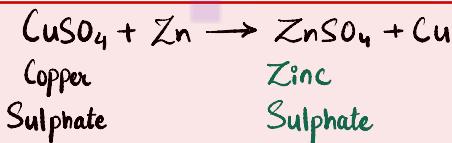
Aqua Regia

- It is freshly prepared mixture of 1 part of concentrated nitric acid and 3 parts of concentrated hydrochloric acid.
- Aqua regia can dissolve even gold and platinum metals but alone they can't do the same.
(साध रहे के बर्बाद मचाते हैं!)

④ Reaction of Metal with Salt solution :



- A more reactive metal displaces a less reactive metal from its salt solution.
- Reaction of zinc with copper sulphate solution.



Reactivity Series

- Arrangement of metals in a vertical column in order of decreasing reactivities is called REACTIVITY SERIES OF METALS.
- Most reactive is placed at the top.
- Least reactive is placed at the bottom.

Q U E S T I O N S

1. Why is sodium kept immersed in kerosene oil?
2. Write equations for the reactions of
 - (i) iron with steam
 - (ii) calcium and potassium with water
3. Samples of four metals A, B, C and D were taken and added to the following solution one by one. The results obtained have been tabulated as follows.



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

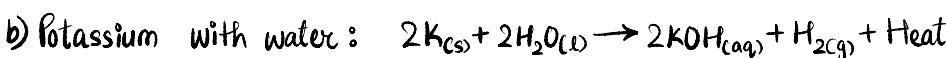
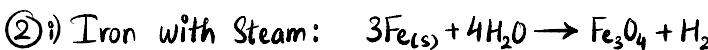
Use the Table above to answer the following questions about metals A, B, C and D.

- (i) Which is the most reactive metal?
- (ii) What would you observe if B is added to a solution of Copper(II) sulphate?
- (iii) Arrange the metals A, B, C and D in the order of decreasing reactivity.
4. Which gas is produced when dilute hydrochloric acid is added to a reactive metal? Write the chemical reaction when iron reacts with dilute H_2SO_4 .
5. What would you observe when zinc is added to a solution of iron(II) sulphate? Write the chemical reaction that takes place.

Answers

① Sodium is a highly reactive element, that reacts with oxygen when comes in contact with air and burns.

Therefore, it is kept immersed in kerosene for prevention.

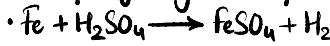


③ i) B - It gives displacement reaction with iron(II) sulphate.

ii) Displacement reaction will take place, blue colour of copper(II) Sulphate solution will fade and red-brown deposit of copper will form on B.

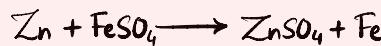
iii) B, A, C, D.

④ Hydrogen gas is produced.



⑤ When it is added in the solution, the colour of iron sulphate solution changes.

- As zinc is more reactive than iron, so it displaces iron from its solution and a grey precipitate of iron and a colourless zinc sulphate is formed.



How do metals and non-metals react?

• When metals react with non-metals, they form ionic compounds and when non-metal reacts with a non-metal, they form covalent compounds.

Causes of Chemical Bonding

- An atom can achieve the inert gas electron arrangement in three ways:

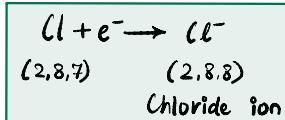
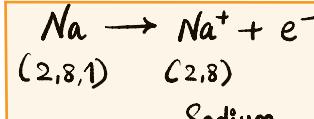
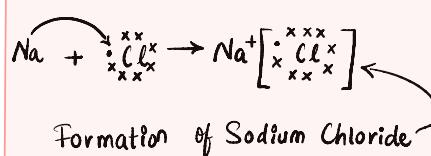
- by losing one or more electron.
- by gaining one or more electron.
- by sharing one or more electron.

Tons

→ An ion is an electrically charged atom.

- It is formed by loss or gain of electrons by an atom.
- So it contains an unequal number of electrons or protons.
- +vely charged ion is known as cation.
- vely charged ion is known as anion.

Ex: If Sodium and chlorine were to react



Ionic Compounds

→ Compounds having ionic bonds are known as **Ionic bonds**.

- They are formed by transfer of electrons from one atom to another.
- They are also known as **Electrovalent Compounds**.

Properties of Ionic Compounds

- ① Ionic compounds are usually crystalline solids because the oppositely charged ions attracts one another strongly and form a regular crystal.
- ② Ionic compounds have high melting and boiling point.
- ③ Ionic compounds are usually soluble in water but insoluble in organic solvent.
- ④ When we dissolve ionic solid in water or melt it, the crystal structure is broken down and ions become free to move and to conduct electricity.



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1 Mark Questions

1. Arrange the following metals in the decreasing order of reactivity: Na, K, Cu, Ag. [1M, 2009]

A1. K > Na > Cu > Ag

2. What is the valency of silicon with atomic number 14? [1M, 2010]

A2. Its valency is equal to 4.

3. Why does calcium float in water? [1M, 2011]

A3. Calcium sticks to the surface because hydrogen gas is formed which sticks to the surface of calcium, therefore it floats.

4. Name two metals which are found in nature in the free state. [1M, 2011]

A4. Gold and Silver are the two metals which are found in nature in the free state.

5. Make a distinction between metals and non-metals with respect to the nature of their oxide.

[1M, 2011]

A5. Metallic oxides are basic, few are amphoteric. **Non-metallic oxides** are acidic, few are neutral.

6. Name a non-metal which is lustrous and a metal which is non-lustrous.

[1M,2011]

A6. Iodine (I) is the non-metal which is lustrous , sodium (Na) metal is non-lustrous.

7. A green layer is gradually formed on a copper plate left exposed to air for a week in a bathroom. What could this green substance be?

[1M,2012]

A7. It is due to the formation of basic copper carbonate $[\text{CuCO}_3 \cdot \text{Cu(OH)}_2]$.

8. What happens when calcium is treated with water? [NCERT Exemplar]

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

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

A8. (d). (iii) and (iv)

9. Which one of the following metals would be displaced from the solution of its salts by other three metals? [NCERT Exemplar]

- (a). Mg
- (b). Ag
- (c). Zn
- (d). Cu

A9. (d). Cu

10. Which of the following oxide(s) of iron would be obtained on prolonged reaction of iron with steam? [1M,2020 Delhi]

- (a). FeO
- (b). Fe_2O_3
- (c). Fe_3O_4
- (d). Fe_2O_3 and Fe_3O_4

A10. (c) Fe_3O_4

11. An element 'X' reacts with O_2 to give a compound with a high melting point. This compound is also soluble in water. The element 'X' is [1M,2020 Delhi]

- (a) Iron
- (b) Calcium
- (c) Carbon

(d) silicon

A11. (b) Calcium.

3 Marks Questions

12. (a) Sodium chloride is an ionic compound which does not conduct electricity in solid state whereas it does conduct electricity in molten state as well as in aqueous solution.

(b) Reactivity of aluminium decreases if it is dipped in nitric acid.

(c) Metals like calcium and magnesium are never found in their free state in nature.

[3M,2019]

A 12. (a) Sodium chloride does not conduct electricity in solid state whereas it does conduct electricity in molten state as well as in aqueous solution. This is because in solid state movement of ions is not possible due to rigid structure. Movement of ions is what causes electricity. In molten and aqueous state, ions are free to move and so they conduct electricity.

(b) Reactivity of aluminium decreases if it is dipped in nitric acid, because nitric acid is a strong oxidising agent. As a result, when

aluminium is dipped in nitric acid, a layer of aluminium oxide is formed which prevents further reaction of aluminium.

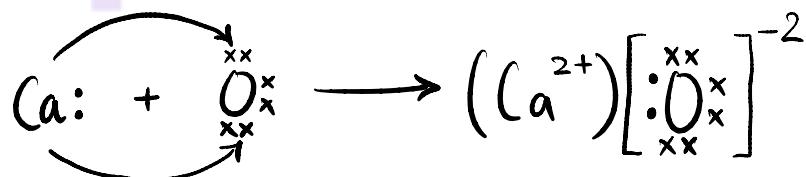
(c) Metals like calcium and magnesium are **never** found in their free state in nature. This is because they are **highly reactive** metals and form compounds with almost all elements.

13. (a) Explain the formation of ionic compound CaO with electron dot structure. Atomic numbers of calcium and oxygen are 20 and 8 respectively.
(b) Name the constituent metals of bronze.

[3M,2012]

A13.

(a) Calcium (20) – 2,8,8,2 Oxygen (8) – 2,6



- (b) Bronze is made up of copper and tin.
-

14. (i) Ionic compounds in general have high melting and boiling points.
(ii) Highly reactive metals cannot be obtained from their oxides by heating

them with carbon.

(iii) Copper vessels get a green coat when left exposed to air in the rainy season.

[3M,2009]

A14. (i) Ionic compounds have high melting and boiling points due to strong force of attraction between oppositely charged ions.

(ii) It is because these metals themselves are strong reducing agents. Therefore, it cannot be reduced by reducing agents like carbon.

(iii) Copper vessels react with CO_2 , O_2 and moisture to form green-coloured basic copper carbonate
 $[\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2]$.

15. State three reasons for the following facts

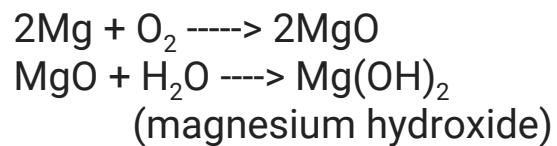
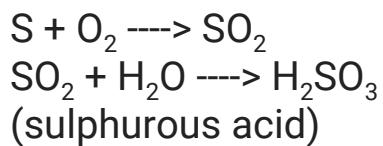
- (i) Sulphur is a non-metal
(ii) Magnesium is a metal

One of the reasons must be supported with a chemical equation.

[3M, 2015]

A15.

Sulphur (non-metal)	Magnesium (metal)
1. Sulphur is neither malleable, nor ductile.	1. Magnesium is malleable and ductile
2. It is poor conductor of heat and electricity.	2. It is a good conductor of heat and electricity
3. Sulphur dioxide is basic in nature.	3. Magnesium oxide is acidic in nature.



5 Marks Questions

16. With the help of a suitable example, explain how ionic compounds are formed. State any three general properties of ionic compounds. [5M, 2011]

A16. Ionic compounds are formed by transfer of electrons from metal to non-metals.

Three general properties of ionic compounds are as follows:

- (i) They are solids having high melting point.
- (ii) They are soluble in water.

(iii) They conduct electricity in molten state as well as in aqueous solution.

17. (i) Aluminium oxide is called an amphoteric oxide.
(ii) An iron strip dipped in a blue copper sulphate solution turns the blue solution pale green.
(iii) Hydrogen gas is not evolved when most metals react with nitric acid.
(iv) Calcium does not occur in a free state in nature.
(v) Sodium or potassium metals are kept immersed under kerosene.

[SQP 2020]

A17. (i). Aluminium oxide is known as 'amphoteric oxide' due to its reaction with **both** acids and bases.

(ii). The iron strip which dipped in the "blue copper sulphate solution" turned into the "blue solution **pale green**". This is due to the fact that there is "formation of iron sulphate" takes place **inside** the solution.

(iii). When metals react with the nitric acid, it is oxidised by nitrate ion and not by hydrogen ion.

(iv). Calcium doesn't occur in any 'free state' in nature, because it is "highly reactive in nature".

(v). Sodium and potassium metals are reactive and act violently in presence of air.

-
18. (a) (i) Write two properties of gold which make it the most suitable metal for ornaments.

- (ii) Name two metals which are the best conductors of heat.
(iii) Name two metals which melt when you keep them on your palm.
- (b) Explain the formation of ionic compound CaO with electron-dot structure. Atomic numbers of calcium and oxygen are 20 and 8 respectively. [5M, 2020]

A18.

- (i). The property of gold used in making ornaments is ductility and lustre.
- (ii). Silver and copper are the best conductors of heat.
- (iii). Gallium and cesium are the metals that melt when kept on palm.
- (iv) Atomic no. of Ca - 20, Electronic Configuration - 2,8,8,2

Atomic no. of O - 8 Electronic Configuration - 2,6

19.

Statement (A): Sodium and Potassium are highly reactive metals.

Statement (B): Sodium and Potassium are stored underwater.

- (a). Statement 'A' is true, statement 'B' is false
- (b). Statement 'B' is false, statement 'A' is true
- (c). Both statements, 'A' and 'B' are true
- (d). Both statements 'A' and 'B' are false

A.19 (a). Statement 'A' is true, statement 'B' is false

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R) . Mark the correct choice as:

- (a) Both assertion (A) and reason (R) are correct and reason is the correct explanation of assertion.
- (b) Both assertion (A) and reason (R) are correct but reason is not the correct explanation of assertion.
- (c) Assertion (A) is correct, reason (R) is incorrect
- (d) Assertion (A) is incorrect, reason (R) is correct

20.

Assertion: When soft iron nails are dipped in a strong solution of copper sulphate, a greenish black solution is formed.

Reason: Iron replaces copper from copper sulphate solution forming iron sulphate

A.20 (a). Both assertion and reason are correct and reason is the correct explanation of assertion.

21. Assertion: Aluminium is more reactive than iron, it's corrosion is less than that of iron

Reason: Aluminium is covered with a strong protective layer of oxide which protects the metal from further corrosion.

- A. 21 (a) Both assertion (A) and reason (R) are correct and reason is the correct explanation of assertion.

