Class 10 Science Chapter 3: Metals and Non-metals - Notes, Important Questions and MCQs (2026-27)

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These Class 10 Science Chapter 3 PDF Notes cover Metals and Non-metals completely: physical and chemical properties, the reactivity series, how metals and non-metals form ionic compounds, the extraction and refining of metals, and how corrosion is prevented.

Questions on the reactivity series, electron-dot structures of ionic compounds and the steps of metallurgy appear in almost every board paper, so this chapter rewards careful revision.

Use the table of contents below to jump to the part you need, or read top to bottom for a complete revision of the chapter.

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Chapter Overview

Elements are broadly classified as metals and non-metals. Metals are lustrous, hard, malleable, ductile and good conductors; non-metals are mostly the opposite. A few elements break the general rules, which are favourite exam questions.

The chapter then explains how metals react with oxygen, water, acids and salt solutions, arranges them in a reactivity series, shows how metals give electrons to non-metals to form ionic compounds, and describes how metals are extracted from ores and protected from corrosion.

Important Topics and Concepts

Physical properties of metals

- Metallic lustre (shiny surface) and generally hard.
- Malleable (beaten into sheets) and ductile (drawn into wires); gold and silver are the most malleable and ductile.
- Good conductors of heat (silver and copper best) and electricity.
- Sonorous: they make a ringing sound.
- Exceptions: sodium and potassium are soft and can be cut with a knife; mercury is liquid at room temperature; gallium and caesium melt on the palm; lead and mercury are poor conductors of heat.

Physical properties of non-metals

- Exist as solids, liquids (bromine) or gases (oxygen, nitrogen).
- Not lustrous, not sonorous, brittle and poor conductors.
- Exceptions: iodine is lustrous; diamond (carbon) is the hardest natural substance; graphite (carbon) conducts electricity.

Metals with oxygen

Metal + oxygen → metal oxide (basic). $2Cu + O_2 \rightarrow 2CuO$; $4Al + 3O_2 \rightarrow 2Al_2O_3$. Some oxides like Al_2O_3 and ZnO react with both acids and bases; they are amphoteric. Sodium and potassium react so vigorously that they are kept under kerosene. Silver and gold do not react with oxygen even at high temperature.

Metals with water

Metal + water → metal oxide/hydroxide + hydrogen. Sodium and potassium react violently with cold water ($2Na + 2H_2O \rightarrow 2NaOH + H_2$ + heat). Calcium reacts less violently and floats due to hydrogen bubbles. Magnesium reacts with hot water. Aluminium, iron and zinc react only with steam ($3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$). Lead, copper, silver and gold do not react with water.

Metals with acids

Metal + dilute acid → salt + hydrogen. Hydrogen is not evolved with nitric acid (except with Mg and Mn and very dilute HNO_3) because HNO_3 is a strong oxidising agent. Aqua regia (3 parts conc. HCl : 1 part conc. HNO_3) dissolves gold and platinum.

Reactivity series

The metals arranged in decreasing reactivity: K, Na, Ca, Mg, Al, Zn, Fe, Pb, [H], Cu, Hg, Ag, Au. A more reactive metal displaces a less reactive metal from its salt solution, e.g. $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$.

How metals and non-metals react: ionic compounds

Metals lose electrons to form positive ions and non-metals gain electrons to form negative ions, so that each gets a stable noble-gas configuration. Na (2,8,1) loses one electron to Cl (2,8,7): $Na^+ + Cl^- \rightarrow NaCl$. Mg (2,8,2) gives two electrons, one to each Cl atom, forming $MgCl_2$.

Properties of ionic compounds

- Solid and hard, but brittle, because of strong attraction between ions.
- High melting and boiling points.
- Generally soluble in water, insoluble in kerosene and petrol.
- Conduct electricity in molten state or in water, not as solids, because the ions can move only then.

Occurrence and extraction of metals

Minerals are naturally occurring compounds; ores are minerals from which a metal can be extracted profitably. Ores contain impurities called gangue. Steps: enrichment of ore → conversion to metal → refining.

Extraction by reactivity

- Low reactivity (Hg, Cu): heat the sulphide ore. $2HgS + 3O_2 \rightarrow 2HgO + 2SO_2$; $2HgO \rightarrow 2Hg + O_2$.
- Middle reactivity (Zn, Fe, Pb): convert sulphide ore to oxide by roasting (heating in excess air) and carbonate ore by calcination (heating in limited air), then reduce with carbon: $ZnO + C \rightarrow Zn + CO$.
- High reactivity (Na, Mg, Ca, Al): electrolytic reduction of molten chlorides or oxides; metal deposits at the cathode.
- Thermit reaction: $Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3 + heat$; used to join railway tracks.

Refining by electrolysis

The impure metal is the anode, a thin strip of pure metal is the cathode, and a solution of its salt is the electrolyte. Pure metal deposits on the cathode; insoluble impurities settle below the anode as anode mud.

Corrosion and its prevention

Silver turns black (silver sulphide), copper gets a green basic copper carbonate layer, and iron rusts in the presence of both air and moisture. Prevent by painting, oiling, greasing, galvanising (zinc coating), chrome plating, anodising and alloying. Alloys: brass (Cu + Zn), bronze (Cu + Sn), solder (Pb + Sn), stainless steel (Fe + Ni + Cr), amalgam (any alloy with mercury). Pure gold is 24 carat; ornaments are usually 22 carat.

Metals vs Non-metals

Property	Metals	Non-metals
Lustre	Lustrous	Dull (except iodine)
State at room temperature	Solid (except mercury)	Solid, liquid (bromine) or gas
Malleability and ductility	Malleable and ductile	Brittle
Conductivity	Good conductors	Poor conductors (except graphite)
Oxides	Basic (some amphoteric)	Acidic or neutral
Ions formed	Positive ions (lose electrons)	Negative ions (gain electrons)
Reaction with dilute acids	Usually give H_2	Do not displace hydrogen

Important Definitions and Terms

Term	Meaning
Malleability	Property of being beaten into thin sheets
Ductility	Property of being drawn into thin wires
Sonorous	Producing a ringing sound when struck
Amphoteric oxide	An oxide that reacts with both acids and bases, e.g. Al_2O_3, ZnO
Reactivity series	List of metals in order of decreasing reactivity
Ionic bond	Bond formed by transfer of electrons from a metal to a non-metal
Mineral	A naturally occurring element or compound in the earth's crust
Ore	A mineral from which a metal is extracted profitably
Gangue	Impurities such as soil and sand in an ore
Roasting	Heating sulphide ore strongly in excess air to form oxide
Calcination	Heating carbonate ore strongly in limited air to form oxide
Alloy	A homogeneous mixture of two or more metals, or a metal and a non-metal
Aqua regia	Mixture of conc. HCl and conc. HNO_3 in 3 : 1 that dissolves gold

Short Answer Questions

Q1. Why is sodium kept immersed in kerosene oil?

Sodium reacts so vigorously with oxygen and moisture that it can catch fire in open air. Kerosene keeps air and water away from it.

Q2. Give an example of a metal that is liquid at room temperature and one that can be cut with a knife.

Mercury is liquid at room temperature. Sodium (and potassium) are soft enough to be cut with a knife.

Q3. Why do ionic compounds have high melting points?

Their oppositely charged ions are held together by strong electrostatic forces. A lot of energy is needed to break these forces, so the melting points are high.

Q4. Why does calcium start floating when it reacts with water?

Bubbles of hydrogen gas formed during the reaction stick to the surface of calcium and make it float.

Q5. What happens when iron nails are put into copper sulphate solution?

Iron displaces copper because it is more reactive. The blue solution turns pale green ($FeSO_4$) and a reddish-brown coating of copper forms on the nails.

Q6. Why is hydrogen gas not evolved when a metal reacts with nitric acid?

Nitric acid is a strong oxidising agent. It oxidises the hydrogen produced to water and is itself reduced to nitrogen oxides.

Q7. Why are copper and aluminium wires used for electrical wiring?

Q8. What is galvanisation?

Galvanisation is coating iron or steel with a thin layer of zinc. The zinc protects the iron from rusting, even if the coating is scratched.

Long Answer Questions

Q1. Show the formation of NaCl and MgO by the transfer of electrons.

Sodium (2,8,1) loses one electron to become Na^+ (2,8). Chlorine (2,8,7) gains that electron to become Cl^- (2,8,8). The oppositely charged ions attract to form NaCl.

Magnesium (2,8,2) loses two electrons to become Mg^{2+} (2,8). Oxygen (2,6) gains two electrons to become O^{2-} (2,8). Mg^{2+} and O^{2-} attract each other to form MgO.

Tip: In the exam, draw electron-dot structures showing the outermost electrons with dots and crosses and arrows for the transfer.

Q2. Explain the extraction of metals of middle reactivity with equations.

Metals such as zinc, iron and lead are found as sulphides or carbonates. It is easier to obtain a metal from its oxide, so these ores are first converted to oxides.

Roasting (sulphide ore, excess air): $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$.

Calcination (carbonate ore, limited air): $ZnCO_3 \rightarrow ZnO + CO_2$.

Reduction with carbon: $ZnO + C \rightarrow Zn + CO$. Highly reactive metals like aluminium can also be used as reducing agents (thermit reaction).

Q3. What is corrosion? Describe an activity to show that both air and water are needed for rusting.

Corrosion is the gradual eating away of metals by air, moisture and chemicals.

Activity: take three test tubes with clean iron nails. Tube A: nail in tap water, open (air + water). Tube B: nail in boiled distilled water covered with oil (no air). Tube C: nail with anhydrous calcium chloride, corked (no moisture).

After a few days, only the nail in tube A rusts. This shows that both air and water are needed for rusting.

MCQs with Answers

1. Which metal is the best conductor of electricity?(a) Copper (b) Aluminium (c) Silver (d) IronAnswer: (c) Silver

2. Which non-metal is a good conductor of electricity?(a) Sulphur (b) Iodine (c) Graphite (d) PhosphorusAnswer: (c) Graphite

3. An amphoteric oxide among these is(a) Na_2O (b) MgO (c) Al_2O_3 (d) CO_2Answer: (c) Al_2O_3

4. Which metal reacts only with steam?(a) Sodium (b) Calcium (c) Iron (d) CopperAnswer: (c) Iron

5. Aqua regia is a mixture of(a) HCl and H_2SO_4 in 3:1 (b) HCl and HNO_3 in 3:1 (c) HNO_3 and H_2SO_4 in 1:3 (d) HCl and HNO_3 in 1:3Answer: (b) HCl and HNO_3 in 3:1

7. Solder is an alloy of(a) Copper and zinc (b) Lead and tin (c) Copper and tin (d) Iron and nickelAnswer: (b) Lead and tin

8. Ionic compounds conduct electricity in(a) Solid state (b) Molten state (c) Kerosene (d) Gaseous stateAnswer: (b) Molten state

9. Which metal can be extracted only by electrolysis?(a) Copper (b) Zinc (c) Sodium (d) IronAnswer: (c) Sodium

10. The thermit reaction is used to(a) Make steel (b) Weld railway tracks (c) Galvanise iron (d) Refine copperAnswer: (b) Weld railway tracks

Quick Revision Points

- Exceptions: Hg liquid; Na and K soft; Ga and Cs melt on palm; graphite conducts; iodine lustrous; diamond hardest.
- Metal oxides are basic; Al_2O_3 and ZnO are amphoteric.
- Reactivity: K > Na > Ca > Mg > Al > Zn > Fe > Pb > H > Cu > Hg > Ag > Au.
- Ionic compounds: high melting point, soluble in water, conduct when molten or dissolved.
- Roasting = sulphide in excess air; calcination = carbonate in limited air.
- Electrolytic refining: impure anode, pure cathode, anode mud.
- Rusting needs both air and water.

Chapter Summary

Metals are lustrous, malleable, ductile and conducting, while non-metals are mostly dull, brittle and insulating, with a few well-known exceptions. Metals react with oxygen, water, acids and salt solutions to different extents, which gives us the reactivity series.

Metals form ionic compounds with non-metals by transferring electrons. Their extraction depends on reactivity: heating for the least reactive, carbon reduction for the middle group and electrolysis for the most reactive, followed by electrolytic refining. Corrosion is controlled by coating, galvanising and making alloys.

Exam Tips and PYQ Pattern

- Electron-dot formation of NaCl, MgO or $MgCl_2$ is a frequent 3-mark question.
- Expect a flowchart-style question on extraction steps based on reactivity.
- Know the rusting activity with three test tubes, and why aluminium is used despite being reactive (protective oxide layer).
- Reactivity series questions often appear as displacement predictions.

Frequently Asked Questions

Why is gold not affected by air and water?

Gold is very low in the reactivity series, so it does not react with oxygen, water or most acids.

Is aluminium more reactive than iron? Then why does it not corrode easily?

What is anodising?

Anodising is making a thick oxide layer on aluminium by electrolysis, which protects it and can be dyed for an attractive finish.

Conclusion

Metals and Non-metals connects atomic structure to real-world materials. Remember the exceptions, practise electron-dot diagrams, and learn the reactivity series by heart; together these cover most of the questions asked from this chapter.

More Notes: Class 10 Science Chapter 2: Acids, Bases and Salts notes | Class 10 Science Chapter 4: Carbon and its Compounds notes | All Class 10 Science notes

Author Bio: Written and reviewed by the Nextoper Editorial Team, a group of CBSE science educators who build chapter notes directly from the NCERT textbook and past board paper patterns.

Freshness Note: These notes follow the NCERT Class 10 Science textbook (Reprint 2026-27) and the CBSE syllabus for the 2026-27 session. Last checked on 7 November 2026.