Class 9 Science Chapter 9: Atomic Foundations of Matter - Notes, Important Questions and MCQs (2026-27)

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These Class 9 Science Chapter 9 notes cover “Atomic Foundations of Matter” from the new NCERT textbook Exploration (2026-27): the law of conservation of mass, the law of constant proportions, Dalton’s atomic theory, covalent and ionic bonding, writing chemical formulae, properties of ionic and covalent compounds, molecular mass and formula unit mass – with worked examples, 10 MCQs and a free PDF.

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Chapter Overview

Building on the structure of the atom (Chapter 8), this chapter explains how atoms combine. Lavoisier’s law of conservation of mass and Proust’s law of constant proportions led John Dalton to propose his atomic theory.

Atoms combine to complete their outer shells either by sharing electrons (covalent bonds) or by transferring electrons (ionic bonds). Valencies help write chemical formulae, and atomic masses are added to find molecular mass or formula unit mass.

Important Topics and Concepts

Laws of Chemical Combination

- Law of conservation of mass (Lavoisier): mass can neither be created nor destroyed in a chemical reaction – total mass of reactants equals total mass of products.
- Law of constant proportions (Proust): in a compound, elements are always present in a fixed ratio by mass, whatever the source – e.g. water always has hydrogen : oxygen = 1 : 8 by mass.

Dalton’s Atomic Theory

- All matter is made of tiny particles called atoms.
- Atoms cannot be created or destroyed in a chemical reaction.
- Atoms of an element are identical in mass and properties; atoms of different elements differ.
- Atoms combine in small whole-number ratios to form compounds.
- The relative number and kinds of atoms are constant in a given compound.
- Later discoveries (subatomic particles, isotopes) modified some postulates.

Covalent Bonds (Sharing Electrons)

- Atoms share pairs of electrons to complete their outer shells.
- Single bond: H–H (H_2), Cl–Cl (Cl_2); double bond: O=O (O_2); triple bond: N≡N (N_2).
- Compounds: H_2O, NH_3, CH_4, CO_2 are covalent.
- Shared pairs are shown with lines or electron-dot (Lewis) structures.

Ionic Bonds (Transfer of Electrons)

- Metals with 1–3 valence electrons lose them to form positive ions (cations); non-metals gain electrons to form negative ions (anions).
- Oppositely charged ions attract strongly – an ionic bond.
- Example: Na (2,8,1) gives one electron to Cl (2,8,7) → Na^+ and Cl^- → NaCl.
- Example: Mg gives two electrons to O → Mg^{2+} and O^{2-} → MgO.

Formulae, Properties and Masses

- Writing formulae: write symbols, write valencies below, cross them over (criss-cross) and simplify; e.g. Al (3) and O (2) → Al_2O_3.
- Polyatomic ions keep brackets when more than one is needed, e.g. $Ca(NO_3)_2$.
- Ionic compounds: high melting and boiling points, usually soluble in water, conduct electricity when molten or dissolved.
- Covalent compounds: generally low melting and boiling points, often insoluble in water, poor conductors.
- Molecular mass (covalent): sum of atomic masses – H_2O = 2(1) + 16 = 18 u; CO_2 = 12 + 2(16) = 44 u.
- Formula unit mass (ionic): Na_2O = 2(23) + 16 = 62 u; $Ca(NO_3)_2$ = 40 + 2(14 + 48) = 164 u.

Covalent vs Ionic Compounds

Most-asked comparison.

Property	Ionic	Covalent
Bond formation	Transfer of electrons	Sharing of electrons
Particles	Ions	Molecules
Melting/boiling point	High	Generally low
Solubility in water	Usually soluble	Often insoluble
Electrical conductivity	Conduct when molten or in solution	Usually poor
Examples	NaCl, MgO, $CaCl_2$	H_2O, CH_4, CO_2

Common Ions and Valencies

Cation	Valency	Anion	Valency
Na^+, K^+, H^+, NH_4^+	1	Cl^-, OH^-, NO_3^-	1
Mg^{2+}, Ca^{2+}, Cu^{2+}	2	O^{2-}, SO_4^{2-}, CO_3^{2-}	2
Al^{3+}	3	PO_4^{3-}	3

Worked Mass Calculations

Substance	Calculation	Mass
H_2O	$2 \times 1 + 16$	18 u
CO_2	$12 + 2 \times 16$	44 u
NH_3	$14 + 3 \times 1$	17 u
NaCl	$23 + 35.5$	58.5 u
Na_2O	$2 \times 23 + 16$	62 u
$Ca(NO_3)_2$	$40 + 2(14 + 3 \times 16)$	164 u

Important Definitions and Terms

Term	Meaning
Law of conservation of mass	Mass is neither created nor destroyed in a chemical reaction
Law of constant proportions	Elements in a compound are in a fixed mass ratio
Covalent bond	Bond formed by sharing electron pairs
Ionic bond	Bond formed by transfer of electrons and attraction between ions
Cation	Positively charged ion
Anion	Negatively charged ion
Polyatomic ion	Group of atoms carrying a charge, e.g. SO_4^{2-}
Molecular mass	Sum of atomic masses in a molecule
Formula unit mass	Sum of atomic masses in the formula of an ionic compound

Short Answer Questions

Q1. State the law of conservation of mass.

Mass can neither be created nor destroyed in a chemical reaction; total mass of reactants equals total mass of products.

Q2. In water, hydrogen and oxygen combine in what mass ratio?

1 : 8 by mass.

Q3. What type of bond is present in N_2? How many electrons are shared?

A triple covalent bond; three pairs (six electrons) are shared.

Q4. How is NaCl formed?

Sodium loses one electron to become Na^+ and chlorine gains it to become Cl^-; the oppositely charged ions attract to form an ionic bond.

Q5. Write the formula of aluminium oxide.

Al (valency 3), O (valency 2) → criss-cross → Al_2O_3.

Q6. Calculate the molecular mass of NH_3 (N = 14 u, H = 1 u).

$14 + 3 \times 1 = 17$ u.

Q7. Why do ionic compounds conduct electricity in solution but not as solids?

In solution or molten state the ions are free to move and carry charge; in solids they are fixed.

Q8. Which postulate of Dalton’s theory was modified by isotopes?

That all atoms of an element are identical in mass – isotopes have different masses.

Long Answer Questions

Q1. State the postulates of Dalton’s atomic theory and mention two limitations.

Matter consists of tiny indivisible atoms.

Atoms are neither created nor destroyed in chemical reactions.

Atoms of an element are identical; atoms of different elements differ.

Atoms combine in small whole-number ratios to form compounds.

Limitations: atoms are divisible (electrons, protons, neutrons); isotopes show that atoms of an element can differ in mass.

Q2. Differentiate between covalent and ionic bonds with examples.

Covalent bonds form by sharing electron pairs; ionic bonds form by transfer of electrons.

Covalent compounds exist as molecules; ionic compounds as ions arranged in a lattice.

Covalent compounds generally have low melting points; ionic compounds have high melting points.

Ionic compounds conduct electricity when molten or dissolved; covalent ones usually do not.

Examples: covalent – H_2O, CH_4; ionic – NaCl, MgO.

$Ca(NO_3)_2$: Ca = 40, N = 14, O = 16.

NO_3 = 14 + 48 = 62; two NO_3 = 124.

Formula unit mass = 40 + 124 = 164 u.

CO_2 = 12 + 2 × 16 = 44 u.

Ionic compounds use “formula unit mass”; covalent use “molecular mass”.

MCQs with Answers

1. The law of conservation of mass was given by(a) Proust (b) Lavoisier (c) Dalton (d) RutherfordAnswer: (b) Lavoisier

2. The law of constant proportions was given by(a) Proust (b) Lavoisier (c) Dalton (d) BohrAnswer: (a) Proust

3. Hydrogen : oxygen mass ratio in water is(a) 1 : 2 (b) 1 : 8 (c) 2 : 1 (d) 8 : 1Answer: (b) 1 : 8

4. The bond in O_2 is(a) single (b) double (c) triple (d) ionicAnswer: (b) double

5. NaCl is formed by(a) sharing electrons (b) transfer of electrons (c) sharing protons (d) nuclear fusionAnswer: (b) transfer of electrons

6. Formula of aluminium oxide is(a) AlO (b) Al_2O_3 (c) Al_3O_2 (d) AlO_3Answer: (b) Al_2O_3

7. Molecular mass of CO_2 is(a) 28 u (b) 44 u (c) 32 u (d) 22 uAnswer: (b) 44 u

8. Formula unit mass of Na_2O is(a) 39 u (b) 62 u (c) 46 u (d) 78 uAnswer: (b) 62 u

9. Ionic compounds generally have(a) low melting points (b) high melting points (c) no charge (d) weak forcesAnswer: (b) high melting points

10. Which is a covalent compound?(a) NaCl (b) MgO (c) CH_4 (d) $CaCl_2$Answer: (c) CH_4

Quick Revision Points

- Conservation of mass (Lavoisier); constant proportions (Proust).
- Dalton’s atomic theory postulates and limitations.
- Covalent = sharing (H_2, O_2 double, N_2 triple).
- Ionic = transfer → cation + anion (NaCl, MgO).
- Criss-cross valencies to write formulae.
- Molecular mass (covalent) vs formula unit mass (ionic).

Chapter Summary

Atomic Foundations of Matter explains how atoms combine. The laws of conservation of mass and constant proportions led to Dalton’s atomic theory. Atoms complete their outer shells by sharing electrons (covalent bonds) or by transferring them (ionic bonds).

Valencies are used to write chemical formulae, and the properties of ionic and covalent compounds differ in melting point, solubility and conductivity. Molecular mass and formula unit mass are found by adding atomic masses.

Exam Tips and PYQ Pattern

- Formula-writing and mass-calculation questions are guaranteed.
- Learn the common ions table with charges.
- Covalent vs ionic differences make an easy 3-mark answer.
- Draw electron-dot structures for H_2, O_2, N_2, H_2O, NaCl.
- Mole concept is not in this chapter; focus on masses in u.

Frequently Asked Questions

Is this chapter in the 2026-27 CBSE syllabus?

Yes. It is part of the new NCERT Class 9 Science textbook “Exploration” (first edition 2026), prescribed for the 2026-27 session.

Can I download these notes as a PDF?

Yes. Use the free PDF link at the top of this page – no signup needed.

What is the difference between covalent and ionic bonds?

Covalent bonds involve sharing electrons; ionic bonds involve transfer of electrons and attraction between ions.

How do you calculate molecular mass?

Add the atomic masses of all atoms in the molecule, e.g. $H_2O = 2 \times 1 + 16 = 18$ u.

Conclusion

Atomic Foundations of Matter is the key to chemical formulae and bonding. Learn the ion table, practise formula and mass questions here and save the free PDF.

More Notes: Class 9 Science Chapter 8: Journey Inside the Atom notes | Class 9 Science Chapter 10: Sound Waves: Characteristics and Applications notes | All Class 9 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 9 Science textbook, Exploration (First Edition 2026, NCF-SE 2023), and the CBSE syllabus for the 2026-27 session. Last checked on 17 November 2026.