

CLASS 9 SCIENCE

CHAPTER 9

ATOMIC FOUNDATIONS OF MATTER

NCERT QUESTIONS & ANSWERS

Chapter coverage: Law of Conservation of Mass • Law of Constant Proportions • Dalton's Atomic Theory • molecules • covalent bonding • ionic bonding • ions • chemical formulae • molecular/formula-unit mass • properties of ionic and covalent compounds.

CLEAN PDF: This recreated version contains **no internal file-citation codes, source markers, or hidden reference text** anywhere in the PDF.

CHAPTER-END QUESTIONS & ANSWERS

Revise • Reflect • Refine — Chapter 9

1. A particular element A has one electron in its third shell. Another element B has six electrons in its second shell. (i) How many electrons does A tend to give or take? (ii) What ion does it form? (iii) How many electrons does B tend to give or take? (iv) What ion does it form? (v) What kind of bond forms between A and B? (vi) What is the formula?

Answer: A has configuration 2,8,1 and tends to **give 1 electron**, forming cation A^{+} . B has configuration 2,6 and tends to **take 2 electrons**, forming anion B^{2-} . The bond is **ionic**. Two A^{+} ions are required for one B^{2-} ion, so the formula is A_2B .

2. An element X has six electrons in its outer shell and forms a diatomic molecule. (i) Why? (ii) What kind of bond? (iii) Draw its structure. (iv) An element Y has two electrons in its second shell. Draw the structure of the molecule X forms with Y.

Answer: X has six valence electrons and needs two more to complete its outer shell. Two X atoms therefore share two pairs of electrons, forming a **double covalent bond**, represented as $X=X$. Y has configuration 2,2 and can share two electrons. The compound formed with X has the arrangement $X=Y=X$, with Y as the central atom.

3. You want to design an ionic compound with total positive charge 6+ and total negative charge 6-. Which combination gives the correct number of ions? (i) 2 Al^{3+} and 3 Cl^{-} (ii) 3 Mg^{2+} and 1 PO_4^{3-} (iii) 2 Fe^{3+} and 3 O^{2-} (iv) 3 Ca^{2+} and 2 SO_4^{2-} .

Answer: (iii). 2 Fe^{3+} gives a total positive charge of +6 and 3 O^{2-} gives a total negative charge of -6. Thus the charges balance exactly.

4. Choose the correct statement(s) and correct the false statements. (i) Elements are made up of molecules and compounds are made up of atoms. (ii) A molecule of a compound is always made up of two or more atoms of the same kind. (iii) One molecule of nitrogen gas contains three nitrogen atoms. (iv) Water is made of two hydrogen atoms covalently bonded with one oxygen atom.

Answer: Only (iv) is correct.

(i) False — elements may exist as individual atoms or molecules; compounds contain atoms of different elements chemically combined.

(ii) False — a compound molecule contains atoms of different elements.

(iii) False — nitrogen gas is N_2 , containing two nitrogen atoms.

(iv) Correct — water is H_2O .

5. Write the chemical formulae for: (i) Aluminium nitrate (ii) Calcium oxide (iii) Ferric oxide.

Answer:

(i) Aluminium nitrate = $Al(NO_3)_3$

(ii) Calcium oxide = CaO

(iii) Ferric oxide = Fe_2O_3

Exam Tip: Balance ionic charges before writing a formula. Remember: atomic number = protons; mass number = protons + neutrons; for ions, adjust the number of electrons according to the charge.

6. Write the formulae of compounds formed from: (i) Ca^{2+} and Br^{-} (ii) Al^{3+} and CO_3^{2-} (iii) K^{+} and SO_4^{2-} (iv) NH_4^{+} and Cl^{-} .

Answer:

(i) $CaBr_2$

(ii) $Al_2(CO_3)_3$

(iii) K_2SO_4

(iv) NH_4Cl

7. Which option correctly represents the chloride ion, Cl^{-} , if chlorine has atomic number 17?

Answer: (ii). A neutral chlorine atom has 17 electrons. A chloride ion gains one electron, so Cl^{-} has 18 electrons with electronic configuration 2,8,8.

8. Determine the formula unit mass of: (i) ammonium nitrate NH_4NO_3 (ii) phosphoric acid H_3PO_4 (iii) sodium hydrogencarbonate $NaHCO_3$.

Answer:

(i) $NH_4NO_3 = 14 + 4(1) + 14 + 3(16) = 80$ u.

(ii) $H_3PO_4 = 3(1) + 31 + 4(16) = 98$ u.

(iii) $NaHCO_3 = 23 + 1 + 12 + 3(16) = 84$ u.

9. Write formulae for compounds formed by: (i) magnesium and nitrogen (ii) lithium and nitrogen (iii) sodium and sulfur (iv) aluminium and oxygen.

Answer:

(i) Mg_3N_2

(ii) Li_3N

(iii) Na_2S

(iv) Al_2O_3

10. Complete the table for Li^{+} , Al^{3+} and Cu^{2+} with NO_3^{-} , SO_4^{2-} and PO_4^{3-} .

Answer:

Li⁺: LiNO₃, Li₂SO₄, Li₃PO₄.

Al³⁺: Al(NO₃)₃, Al₂(SO₄)₃, AlPO₄.

Cu²⁺: Cu(NO₃)₂, CuSO₄, Cu₃(PO₄)₂.

Each formula is written so that total positive and negative charges are equal and the ratio is reduced to the simplest whole numbers.

Exam Tip: Balance ionic charges before writing a formula. Remember: atomic number = protons; mass number = protons + neutrons; for ions, adjust the number of electrons according to the charge.

11. 5.3 g sodium carbonate and 6.0 g acetic acid react to produce 2.2 g CO₂, 0.9 g water and 8.2 g sodium acetate. Verify the law of conservation of mass.

Answer:

Total mass of reactants = 5.3 + 6.0 = **11.3 g**.

Total mass of products = 2.2 + 0.9 + 8.2 = **11.3 g**.

Since both masses are equal, the **Law of Conservation of Mass** is verified.

12. A species has 11 protons, 12 neutrons and 10 electrons. Find (i) atomic number and mass number (ii) whether it is neutral, a cation or an anion (iii) electronic configuration (iv) name the species.

Answer:

(i) Atomic number $Z = 11$; mass number $A = 11 + 12 = 23$.

(ii) It has one fewer electron than protons, so it is a **cation**.

(iii) Electronic configuration = **2,8**.

(iv) It is the **sodium cation, Na⁺**.

13. Elements A and B have electronic configurations A: 2,8,5 and B: 2,8,7. (i) Which is more reactive? (ii) Ionic or covalent bond? (iii) Predict the formula.

Answer:

(i) **B** is more reactive because it needs only one electron to complete its outer shell.

(ii) Both are non-metals, so they form a **covalent bond** by sharing electrons.

(iii) A needs three shared electrons and B needs one, so the formula is **AB₃**.

14. Assertion (A): Copper sulfate conducts electricity in the molten state but not in the solid state. Reason (R): Copper and sulfate ions are fixed in the lattice in the molten state, while in the solid state they can move freely. Choose the correct option.

Answer: (iii). Assertion is true but the reason is false. In the **solid state**, ions are fixed in the lattice and cannot move freely. In the **molten state**, ions are mobile and can conduct electricity.

15. The species ²⁷Al, ⁸⁰Br and ²⁰¹Hg²⁺ have 13, 35 and 80 protons respectively. Find the numbers of electrons and neutrons.

Answer:

²⁷Al: electrons = 13; neutrons = 27 – 13 = **14**.

⁸⁰Br: electrons = 35 + 1 = **36**; neutrons = 80 – 35 = **45**.

²⁰¹Hg²⁺: electrons = 80 – 2 = **78**; neutrons = 201 – 80 = **121**.

Exam Tip: Balance ionic charges before writing a formula. Remember: atomic number = protons; mass number = protons + neutrons; for ions, adjust the number of electrons according to the charge.

QUICK REVISION — CHAPTER 9

High-priority concepts, laws, bonding and formulae

Law of Conservation of Mass: In a chemical reaction, total mass of reactants equals total mass of products.

Law of Constant Proportions: Elements in a pure compound combine in a fixed ratio by mass.

Dalton's Atomic Theory: Matter is made of atoms; atoms combine in simple whole-number ratios; chemical reactions rearrange atoms.

Covalent bond: electrons are shared. **Ionic bond:** electrons are transferred and oppositely charged ions are held by electrostatic attraction.

Formula essentials: Cation is written first. Total positive charge must equal total negative charge. Use brackets for repeated polyatomic ions, e.g. $\text{Al}(\text{SO}_4)_3$.

Key answers: Q1 $\text{A} \times \text{B}$ • Q3 (iii) • Q4 (iv) • Q5 $\text{Al}(\text{NO}_3)_3$, CaO , Fe_2O_3 • Q6 CaBr_2 , $\text{Al}(\text{CO}_3)_3$, K_2SO_4 , NH_4Cl • Q7 (ii) • Q8 80 u, 98 u, 84 u • Q9 Mg_3N_2 , Li_3N , Na_2S , Al_2O_3 • Q11 11.3 g • Q12 Na_2 • Q13 B, covalent, AB_3 • Q14 (iii) • Q15 13e/14n, 36e/45n, 78e/121n.