ANSWER KEY & MARKING SCHEME · CBSE CLASS 9

Atoms and Molecules

Science · Chapter 3 · Use this with the Board Paper · Companion to Quick Drill

HOW TO USE

Attempt the Board Paper first (closed-book, full time). Then come here. For 2-mark+ questions, compare your answer to the model. For 3-4 mark questions, also consult the **Topper Templates** below — these show the exact step-by-step structure that scores full marks per CBSE marking-scheme conventions.

MODEL ANSWERS · BOARD PAPER

Section A — MCQ

Q1. What is the value of Avogadro's number? [1 mark]

Ans: 6.022×10^{23} particles per mole.

Q2. Name the law that states reactants' mass equals products' mass. [1 mark]

Ans: Law of Conservation of Mass (Lavoisier, 1789).

Q3. State the formula of calcium carbonate. [1 mark]

Ans: $CaCO_3$ (Ca^{2+} with carbonate CO_3^{2-}).

Q4. What is the molecular mass of H_2O? (H = 1, O = 16) [1 mark]

Ans: 18 u (2 × 1 + 16).

Q5. Name the scientist who gave the first modern atomic theory. [1 mark]

Ans: John Dalton (1808).

Section B — Short Answer-I (2 marks)

Q6. Calculate the molecular mass of H_2SO_4. (H = 1, S = 32, O = 16) [2 marks]

Ans: Molecular mass = 2(1) + 32 + 4(16) = 2 + 32 + 64 = 98 u.

Q7. How many moles are present in 22 g of CO_2? (M = 44 g/mol) [2 marks]

Ans: n = m/M = 22/44 = 0.5 mol of CO_2.

Q8. Write the chemical formulae of (i) magnesium chloride (ii) potassium nitrate. [2 marks]

Ans: (i) $MgCl_2$ — Mg^{2+} + 2 Cl^-. (ii) KNO_3 — K^+ + NO_3^-.

Q9. Define mole. State Avogadro's number. [2 marks]

Ans: A mole is the amount of substance that contains as many particles as there are atoms in exactly 12 g of pure ^{12}C. Avogadro's number N_A = 6.022×10^{23} particles per mole.

Section C — Short Answer-II (3 marks)

Q10. Calculate the number of molecules in 9 g of water. (H = 1, O = 16; N_A = 6.022×10^{23}) [3 marks]

Ans: Molar mass of H_2O = 2(1) + 16 = 18 g/mol. Number of moles n = 9/18 = 0.5 mol. Number of molecules N = n × N_A = $0.5 \times 6.022 \times 10^{23} = 3.011 \times 10^{23}$ molecules. (Award 1 mark each for molar mass, moles, molecules.)

Q11. State the Law of Conservation of Mass. Verify it: 5.3 g of Na_2CO_3 reacts with 6 g of CH_3COOH to give 2.2 g of CO_2, 0.9 g of H_2O and 8.2 g of CH_3COONa. [3 marks]

Ans: Law: In a chemical reaction, the total mass of the reactants equals the total mass of the products. Verification: Mass of reactants = 5.3 + 6 = 11.3 g. Mass of products = 2.2 + 0.9 + 8.2 = 11.3 g. They are equal — the law is verified. (1 mark for the statement + 1 mark for reactant sum + 1 mark for product sum and equality.)

Q12. State any three postulates of Dalton's atomic theory. Mention one limitation. [3 marks]

> **Ans:** Postulates (any three): (i) All matter is made of indivisible atoms. (ii) Atoms of the same element are identical in mass and properties. (iii) Atoms combine in whole-number ratios to form compounds. (iv) Atoms are conserved in reactions. Limitation (any one): Atoms ARE divisible (protons, neutrons, electrons exist) OR atoms of the same element can have different masses (isotopes). (1 mark per postulate + 0 to 0.5 reduction if limitation missing.)

Section D — Long Answer (4-5 marks)

Q13. (a) Define molar mass. (b) Calculate the number of moles, molecules and atoms in 88 g of CO_2. (C = 12, O = 16; N_A = 6.022 × 10^{23}) [5 marks]

> **Ans:** (a) Molar mass is the mass in grams of one mole of a substance — numerically equal to molecular/formula mass in g/mol. (b) Molar mass of CO_2 = 12 + 2(16) = 44 g/mol. Number of moles n = 88/44 = 2 mol. Number of molecules N = 2 × 6.022 × 10^{23} = 1.2044 × 10^{24} molecules. Number of atoms (each CO_2 has 3 atoms) = 3 × 1.2044 × 10^{24} = 3.6132 × 10^{24} atoms. (1 mark for definition + 1 for molar mass + 1 for moles + 1 for molecules + 1 for atoms.)

Q14. Write the chemical formulae of: (i) aluminium oxide (ii) calcium nitrate (iii) sodium carbonate. Explain the criss-cross method using one of the above as an example. [3 marks]

> **Ans:** Formulae: (i) Al_2O_3 (ii) $Ca(NO_3)_2$ (iii) Na_2CO_3. Criss-cross method (using Al_2O_3): Al has valency 3 (Al^{3+}), O has valency 2 (O^{2-}). Write Al and O side by side with valencies as superscripts. Bring each valency down as a SUBSCRIPT on the OTHER symbol: Al^3 becomes the subscript 3 on O, and O^2 becomes the subscript 2 on Al → Al_2O_3. Verify: 2(+3) + 3(−2) = +6 − 6 = 0 — net charge is zero, formula is correct. (0.5 each for three formulae + 1.5 for criss-cross explanation.)

★ TOPPER ANSWER TEMPLATES

2 TEMPLATES · MEMORISE THE FORMAT

MARKING SCHEME — GENERAL NOTES

- Numerical questions: 0.5 mark for writing the correct formula (n = m/M, N = n × N_A), 1 mark for correct substitution with units, 0.5 mark for final answer with correct unit (mol / molecules / atoms / g).
- Mass-conservation verification: 1 mark for stating the law correctly, 1 mark for summing reactant masses, 1 mark for summing product masses and showing equality.
- Molecular/formula unit mass: deduct 0.5 mark if atomic masses used are not quoted, or if 'u' (atomic mass unit) is missing in the final answer.
- Criss-cross formulae: award full marks only when polyatomic ions in brackets where subscript > 1 — e.g. $Ca(NO_3)_2$ correct, $CaNO_{32}$ wrong.
- Dalton's postulates: any three valid postulates earn 1 mark each; any two limitations earn 0.5 mark each.
- Symbol/IUPAC name questions: spelling errors that do NOT change the meaning attract no penalty; wrong symbols (Na vs N) cost a full mark.