Class 10 Chemistry Stoichiometry Essentials Notes

Chapter 15 focus / Moles and reacting masses

Use a balanced equation to connect the amount of one substance to another. Practise converting between mass, amount in moles and number of particles.

The mole and molar mass

One mole contains exactly $6.02214076 \times 10^{23}$ specified entities. For the calculations in this pack, use $\mathbf{N_A \approx 6.02 \times 10^{23}\ mol^{-1}}$. Always state the entity: atoms, molecules, ions or formula units.

Molar mass M is mass per mole, in g/mol when mass is in grams. Add the atomic masses for every atom in the formula. Use these rounded values here: H = 1, C = 12, O = 16, Na = 23, Mg = 24, Cl = 35.5 and Ca = 40.

Task	Relation
Mass to amount	n = m/M; n in mol, m in g, M in g/mol.
Amount to mass	m = nM.
Amount to particles	$N = nN_A$; use the specified type of particle.
Particles to amount	$n = N/N_A$.

A balanced equation gives mole ratios

$2H_2 + O_2 \rightarrow 2H_2O$
2 mol H_2 react with 1 mol O_2 to produce 2 mol H_2O. The coefficients express particle and mole ratios, not direct mass ratios.

Never change subscripts to balance an equation. Changing H_2O to H_2O_2 creates a different substance. Adjust only the coefficients in front of chemical formulas.

A repeatable calculation method

Balance the equation. Convert the given mass to moles. Apply the coefficient ratio to find the required moles. Convert to the requested unit. For these exercises, assume the other reactant is supplied in sufficient quantity and the stated reaction goes to completion.

Worked calculations and practice

Use the rounded atomic masses given on page 1

Worked example 1 Count molecules

How many water molecules are in 9.0 g H_2O?
$M(H_2O) = 2(1) + 16 = 18$ g/mol.
$n = 9.0/18 = 0.50$ mol.
$N = 0.50 \times 6.02 \times 10^{23} =$ **3.01×10^{23} molecules**.

Worked example 2 Calculate a reacting mass

Find the mass of CO_2 formed when 12 g carbon reacts completely with sufficient oxygen.
$C + O_2 \rightarrow CO_2$. $n(C) = 12/12 = 1.0$ mol.
The mole ratio $C:CO_2$ is 1:1, so $n(CO_2) = 1.0$ mol.
$M(CO_2) = 12 + 2(16) = 44$ g/mol.
$m(CO_2) = 1.0 \times 44 =$ **44 g**. The extra mass comes from oxygen.

Worked example 3 Read the coefficients

For $2Mg + O_2 \rightarrow 2MgO$, 4.8 g Mg is $4.8/24 = 0.20$ mol.
$n(O_2) = 0.20 \times (1/2) =$ **0.10 mol**.
$n(MgO) = 0.20 \times (2/2) = 0.20$ mol.
$M(MgO) = 40$ g/mol, so $m(MgO) =$ **8.0 g**.

Independent practice

1. Calculate the molar mass of $CaCO_3$.

2. Find the amount in moles in 11 g CO_2.

3. How many molecules are in 0.20 mol O_2?

4. How many oxygen atoms are in that same sample?

5. Find the mass of 0.50 mol NaCl.

6. For $2H_2 + O_2 \rightarrow 2H_2O$, calculate the mass of water produced from 4.0 g H_2 with sufficient O_2.

7. For $CaCO_3 \rightarrow CaO + CO_2$, find the mass of CO_2 formed from 25 g $CaCO_3$ decomposing completely.

Answers and error checks

Keep particles, moles and grams separate

1. $M(CaCO_3) = 40 + 12 + 3(16) =$ **100 g/mol**.

2. $M(CO_2) = 44$ g/mol. $n = 11/44 =$ **0.25 mol**.

3. $N = 0.20 \times 6.02 \times 10^{23} =$ **1.204×10^{23} O_2 molecules**, or about 1.20×10^{23}.

4. Each O_2 molecule contains two oxygen atoms. Number of atoms $= 2 \times 1.204 \times 10^{23} =$ **2.408×10^{23}**, or about 2.41×10^{23}.

5. $M(NaCl) = 23 + 35.5 = 58.5$ g/mol. $m = 0.50 \times 58.5 =$ **29.25 g** before rounding, or 29 g to two significant figures.

6. $M(H_2) = 2$ g/mol. $n(H_2) = 4.0/2 = 2.0$ mol. H_2:H_2O is 2:2, so $n(H_2O) = 2.0$ mol. $m = 2.0 \times 18 =$ **36 g**.

7. $n(CaCO_3) = 25/100 = 0.25$ mol. The ratio $CaCO_3$:CO_2 is 1:1. Thus $n(CO_2) = 0.25$ mol and $m(CO_2) = 0.25 \times 44 =$ **11 g**.

Common errors

Oxygen gas is O_2, with molar mass 32 g/mol using the values here; an oxygen atom has a different mass. Use formula units for ionic NaCl rather than molecules. Read coefficients only after balancing. A 2:1 mole ratio is not automatically a 2:1 mass ratio.

Check conservation of mass

In worked example 3, 0.10 mol O_2 has mass 3.2 g. The total reactant mass is 4.8 + 3.2 = 8.0 g, equal to the mass of MgO produced. This is a useful independent check.

Scope and reference

Focus: mole conversions and equation-based reacting quantities within Chapter 15. Limiting reactants and yield are not covered.

Curriculum reference: PECTAA Grade 10 ALP, session 2026-27 / exam 2027, dated 14 November 2026. Checked 15 November 2026. See the official Curriculum and Compliance page and Grade 10 notification.

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