Equations and relative formula mass

Student activity • calculation workshop

YEAR 10 / LESSON 41 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

The question

How do formulae, coefficients and relative masses describe different things?

Use atom counts to balance equations, then calculate relative formula masses. Preserve every formula when balancing. Distinguish dimensionless relative mass from molar mass with units.

Equipment

- Booklet, calculator and periodic table
- Optional coloured atom counters or pencil diagrams

Desk activity only. Keep counters out of mouths and off the floor.

Course coverage: 1.25–1.26: word/symbol equations, state symbols, and relative formula mass from relative atomic masses.

Plan, model or apparatus sketch

Draw particle models to explain a balanced equation.

Method and reasoning

Read the whole sequence before starting

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1. Use the supplied A_r values consistently. Identify each element and its subscript in the formula before doing arithmetic.

2. Calculate the relative formula masses in the table. Brackets multiply every atom inside them; a coefficient in front of a formula is not part of its M_r.

3. Balance $Mg + O_2 \rightarrow MgO$ and $Al + O_2 \rightarrow Al_2O_3$ using coefficients only. Check each element on both sides.

4. Write a word equation and a balanced symbol equation for magnesium reacting with aqueous hydrochloric acid to make aqueous magnesium chloride and hydrogen gas. Add the stated physical states.

5. Explain the difference between $2H_2O$ and H_2O_2 with atom counts and substance identity.

6. Compare $M_r(CO_2) = 44$ with $M(CO_2) = 44\ g\ mol^{-1}$ for classroom calculations; attach units only to the latter.

7. Check a partner's answer by independently recounting atoms and evaluating each mass term. Correct any altered subscripts.

Cleanup

- Retain worked solutions and corrections; return shared tables/counters.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Use rounded A_r: H 1, C 12, N 14, O 16, Na 23, Mg 24, Al 27, S 32, Cl 35.5, Ca 40. Relative masses A_r and M_r have no units. At this precision, molar mass M has the same numerical value in g mol^{-1}. State symbols: (s), (l), (g), (aq).

Formula	Expanded sum of A_r	M_r (no unit)
NaCl		
$Ca(OH)_2$		
$Al_2(SO_4)_3$		
NH_4NO_3		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Calculate M_r for all four table formulae, showing bracket multipliers.

2. Balance $Mg + O_2 \rightarrow MgO$ and $Al + O_2 \rightarrow Al_2O_3$ without changing formulae.

3. Write the magnesium/hydrochloric-acid equation with state symbols.

4. Compare atom counts and meanings of $2H_2O$ and H_2O_2.

5. Explain why "M_r of CO_2 = 44 g" and "M_r of $2CO_2$ = 88" are misleading.

6. Identify one check that detects a wrong subscript and one that detects an arithmetic error.