Formulae and relative masses

AQA 8462 Separate Chemistry · Foundation and Higher

Show your working where needed. Check the worked answers when you finish.

Name _____ Date _____

1. Read a formula

How many atoms of each element are represented by the formula $Mg(OH)_2$?

2. Build a neutral formula

Aluminium ions are Al^{3+} and oxide ions are O^{2-}. Work out the formula of aluminium oxide and show that its overall charge is zero.

3. Polyatomic ions

Calcium ions are Ca^{2+} and nitrate ions are NO_3^-. Write the formula of calcium nitrate and check that the charges balance.

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Try a core or harder question. Use clues and worked answers.

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4. Relative formula mass

Calculate the relative formula mass of $Al_2(SO_4)_3$. Use A_r values Al = 27, S = 32 and O = 16.

5. Percentage of a metal

Calculate the percentage by mass of iron in Fe_2O_3. Use A_r values Fe = 56 and O = 16.

6. Compare magnesium content

A gardener wants the higher percentage of magnesium by mass. Compare MgO with $MgCO_3$. Use A_r values Mg = 24, C = 12 and O = 16. Round to one decimal place.

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7. Mass on the balance

Hydrochloric acid reacts with marble chips in an open flask. The measured mass falls from 153.8 g to 151.6 g. Identify what escaped and calculate its mass. Assume there were no other losses.

8. Check a supplier’s label

Two pure powders are labelled $CaCO_3$ and $Ca(OH)_2$. Analysis shows that one contains 54.1% calcium by mass. Identify it. Use A_r values Ca = 40, C = 12, O = 16 and H = 1.

9. Extra challenge · Audit a delivery

Two pure oxides have formulae Fe_2O_3 and Fe_3O_4. A supplier reports 72.4% iron by mass and labels the sample Fe_2O_3. Test the label using calculations. Find the mass of iron in 350 g of the oxide that matches the analysis. Use Ar values Fe = 56 and O = 16.

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Worked answers

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1. Read a formula

1 magnesium atom, 2 oxygen atoms and 2 hydrogen atoms. The subscript 2 applies to everything inside the brackets.

2. Build a neutral formula

Al_2O_3. Two Al^{3+} ions give +6 and three O^{2-} ions give −6. This is the simplest whole-number ratio with zero overall charge.

3. Polyatomic ions

$Ca(NO_3)_2$. One Ca^{2+} has charge +2 and two NO_3^- ions have total charge −2. The subscript 2 applies to the whole nitrate group.

4. Relative formula mass

$M_r = 2 \times 27 + 3 \times (32 + 4 \times 16) = 342$. Relative formula mass has no units.

5. Percentage of a metal

$M_r = 2 \times 56 + 3 \times 16 = 160$. Iron contributes 112 of this total. Percentage by mass = (112 ÷ 160) × 100 = 70.0%.

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Worked answers

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6. Compare magnesium content

MgO has M_r 40, so its magnesium percentage is 24 ÷ 40 × 100 = 60.0%.

$MgCO_3$ has M_r 84, so its percentage is 24 ÷ 84 × 100 = 28.6%. MgO has the higher percentage.

7. Mass on the balance

Carbon dioxide was produced and escaped into the air. Its mass was 153.8 − 151.6 = 2.2 g. The reaction still conserves total mass when the escaped gas is counted.

8. Check a supplier's label

$CaCO_3$ has M_r 100 and contains 40.0% calcium. $Ca(OH)_2$ has M_r 74 and contains 40 ÷ 74 × 100 = 54.1% calcium to one decimal place. The sample is $Ca(OH)_2$.

9. Extra challenge · Audit a delivery

Fe_2O_3 contains 112 ÷ 160 × 100 = 70.0% Fe. Fe_3O_4 contains 168 ÷ 232 × 100 = 72.4% Fe to one decimal place, so the analysis matches Fe_3O_4, not the label.

Iron in 350 g of Fe_3O_4 = 350 × 168 ÷ 232 ≈ 253 g.

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