Formulae and Hydrated Salts Map

OCR A Level Chemistry A · 2.1.3 Amount of substance · Formulae and hydrated salts

1 Empirical formula

2.1.3 (b)(i)

- **Simplest whole-number ratio** of atoms
- $C_6H_{12}O_6 \rightarrow CH_2O$
- $C_2H_6 \rightarrow CH_3$
- Ionic compounds: always empirical
- From experiment, not drawn



2 From masses and percentages

2.1.3 (c)

- Mass of each element ÷ A_r: **moles**
- **Divide by the smallest**
- Percentages: take **100 g**
- Missing element **by difference**
- Keep 3 s.f. until the end

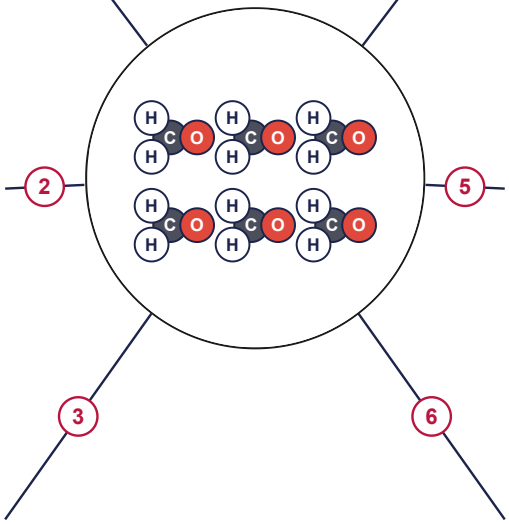


3 Awkward ratios

2.1.3 (c)

- .5: × 2; .33 or .67: × 3
- .25 or .75: × 4; .2 or .4: × 5
- Multiply **every** value
- Never round 1.5
- Fe 1 : 1.5 → Fe_2O_3

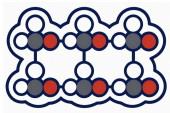




4 Molecular formula

2.1.3 (b)(ii), (c)

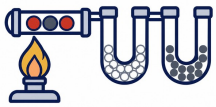
- **Actual** atoms in one molecule
- n = M_r ÷ empirical mass
- Multiply every subscript by n
- M_r given, or M = m ÷ n
- $CH_2O \times 6 = C_6H_{12}O_6$



5 Combustion analysis

2.1.3 (c)

- All C → CO_2: n(C) = n(CO_2)
- All H → H_2O: n(H) = **2** × n(H_2O)
- O **by difference** in mass
- Then the ratio, then M_r
- 0.880 g CO_2 + 0.450 g H_2O: C_2H_5



6 Hydrated salts

2.1.3 (d)

- **Hydrated**: holds **water of crystallisation**
- **Anhydrous**: no water
- Heat to **constant mass**
- x = n(H_2O) ÷ n(salt)
- Water left in: x too low



From data to formula

empirical formula mass × n = M_r; n and x are always whole numbers

Compound	Data	Ratio	M_r	Formula
glucose	C 40.0 %, H 6.7 %, O 53.3 %	CH_2O	180	$C_6H_{12}O_6$
ethanoic acid	C 40.0 %, H 6.7 %, O 53.3 %	CH_2O	60	$C_2H_4O_2$
butane	0.880 g CO_2, 0.450 g H_2O	C_2H_5	58	C_4H_{10}
benzene	C 92.3 %, H 7.7 %	CH	78	C_6H_6
copper(II) sulfate crystals	2.50 g → 1.60 g on heating	1 : 5	249.6	$CuSO_4 \cdot 5H_2O$
washing soda	62.9 % water	1 : 10	286.0	$Na_2CO_3 \cdot 10H_2O$

Worked examples

From masses

- 2.80 g Fe, 1.20 g O
- 0.0502 : 0.0750 = 1 : 1.5
- **Fe_2O_3**

By difference

- C 54.5 %, H 9.1 %: O 36.4 %
- 4.54 : 9.1 : 2.28
- **C_2H_4O**

Hydrated salt

- $MgCl_2 \cdot xH_2O$: 53.1 % water
- 2.95 mol H_2O : 0.492 mol $MgCl_2$
- **$MgCl_2 \cdot 6H_2O$**

M_r values come from M = m ÷ n and from gas volumes (2.1.3 Solutions and gases).

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