

IB Chemistry S1.1 Experimental Practice

Empirical Formula from Experimental Data – 4 Structured Questions

For each question, use the raw quantitative data to calculate: the mass of the substance heated, the mass of oxygen or water involved, the amount in moles, the simplest whole-number ratio, and the final empirical formula or hydrate formula. Show all working clearly.

Relative atomic or formula masses: H = 1.01, O = 16.00, Mg = 24.31, Zn = 65.38, Fe = 55.85, CuSO₄ = 159.61, H₂O = 18.02.

Question 1. Magnesium oxide

A student heated magnesium in a crucible with a lid until it reacted with oxygen. Use the data below to determine the empirical formula of the oxide formed.

Measurement	Mass / g (± 0.001 g)
Mass of crucible + lid	28.642
Mass of crucible + lid + magnesium	28.786
Mass of crucible + lid + magnesium oxide	28.881

- Calculate the mass of the sample heated.
- Calculate the mass of oxygen gained or the mass of water lost.
- Calculate the amount, in moles, of each substance.
- Determine the simplest whole-number ratio.
- Write the empirical formula or hydrate formula.

Question 2. Zinc oxide

A student heated zinc powder strongly in a crucible. Use the data below to determine the empirical formula of the oxide produced.

Measurement	Mass / g (± 0.001 g)
Mass of crucible + lid	31.250
Mass of crucible + lid + zinc	31.577
Mass of crucible + lid + zinc oxide	31.657

- Calculate the mass of the sample heated.
- Calculate the mass of oxygen gained or the mass of water lost.
- Calculate the amount, in moles, of each substance.
- Determine the simplest whole-number ratio.
- Write the empirical formula or hydrate formula.

Question 3. Iron oxide

A student heated iron wool in a crucible until it fully reacted. Use the data below to determine the empirical formula of the iron oxide formed.

Measurement	Mass / g (± 0.001 g)
Mass of crucible + lid	29.400
Mass of crucible + lid + iron	29.736
Mass of crucible + lid + iron oxide	29.880

- Calculate the mass of the sample heated.
- Calculate the mass of oxygen gained or the mass of water lost.
- Calculate the amount, in moles, of each substance.
- Determine the simplest whole-number ratio.
- Write the empirical formula or hydrate formula.

Question 4. Hydrated copper sulfate

A hydrated sample of copper sulfate was heated strongly in an evaporating dish until it became anhydrous. Use the data below to determine the formula of the hydrate.

Measurement	Mass / g (± 0.001 g)
Mass of evaporating dish	42.880
Mass of dish + hydrated copper sulfate	45.377
Mass of dish + anhydrous copper sulfate	44.473

- Calculate the mass of the sample heated.
- Calculate the mass of oxygen gained or the mass of water lost.
- Calculate the amount, in moles, of each substance.
- Determine the simplest whole-number ratio.
- Write the empirical formula or hydrate formula.