

Counting atoms with the mole

Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Lab

Name: _____ Date: _____ Class: _____

A mole is always the same number of particles, but is it always the same mass? In this lab you weigh out 0.10 mol of four kitchen substances, compare the measured masses with the values you calculate, and see how close an ordinary balance can come to an exact amount of substance.

Level: Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** HS-PS1-7, GCSE C3

Aim

To weigh 0.10 mol of four common substances and show that equal amounts of substance have very different masses.

Equipment

- Top-pan balance reading to 0.01 g, weighing boats, spatulas
- Table salt (sodium chloride), sugar (sucrose, $C_{12}H_{22}O_{11}$), baking soda (sodium hydrogencarbonate) and distilled water
- Calculator, goggles

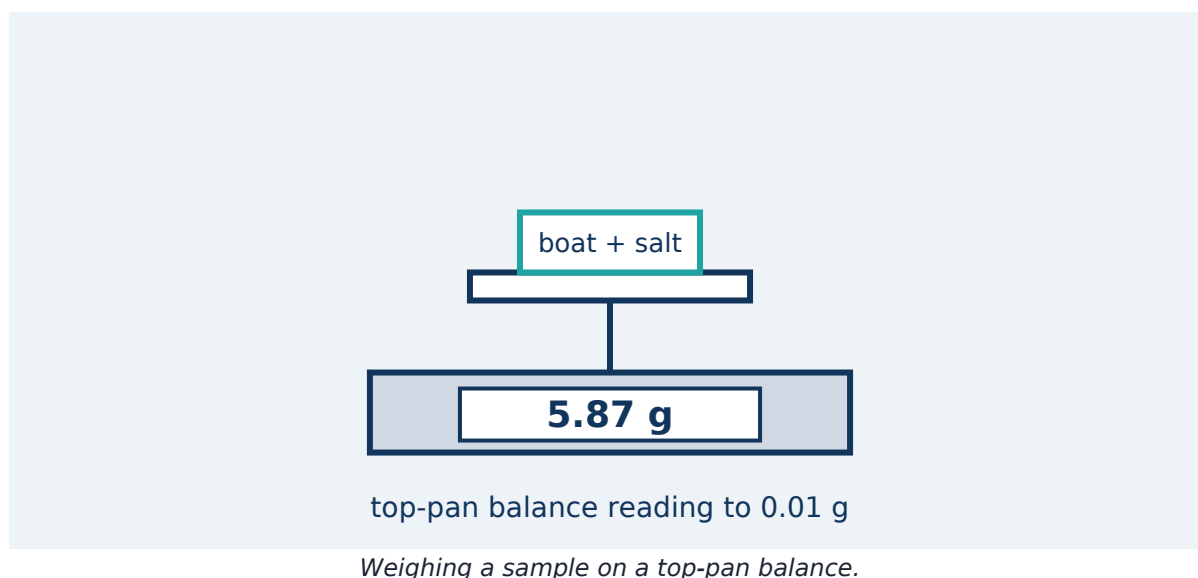
Safety

Safety

Wear goggles. Do not taste any of the samples, even though they are kitchen chemicals. Wipe spills straight away and wash your hands at the end.

Method

1. Use A_r values to calculate the molar mass of each substance, then the mass that equals 0.10 mol.
2. Place a weighing boat on the balance and press tare (zero).
3. Add the substance with a spatula until the display is as close as possible to the target mass and record the reading.
4. Repeat for each substance, using a measuring cylinder and balance for the water.



Results

Sample results from Chiamaka's group:

Substance	M / g/mol	Target mass / g	Measured mass / g
Sodium chloride, NaCl	58.5	5.85	5.87
Sucrose, C ₁₂ H ₂₂ O ₁₁	342	34.2	34.31
Sodium hydrogencarbonate, NaHCO ₃	84	8.40	8.38
Water, H ₂ O	18	1.80	1.82

Analysis questions

Question 1 Check the molar masses

Show how the molar mass of sucrose, C₁₂H₂₂O₁₁, and of sodium hydrogencarbonate are found (C 12, H 1, O 16, Na 23).

Question 2 Target masses

Show that the target mass for 0.10 mol of NaCl is 5.85 g.

Question 3 Actual amounts

Calculate the actual amount in moles for the measured mass of each substance.

Question 4 Percentage difference

Calculate the percentage difference from 0.100 mol for water and for sodium

hydrogencarbonate.

Question 5 Number of particles

Calculate the number of formula units of sodium chloride in 0.100 mol.

Question 6 Same number, different mass

All four samples contain about 6.02×10^{22} particles. Explain why their masses range from 1.8 g to 34 g.

Question 7 Biggest error

Explain why water had the biggest percentage difference.