

IB Chemistry HL

Stoichiometry Calculation Practice

Curated from Paper 2 HL Master 2010-2025

Included:

- mole and mass calculations
- limiting and excess reactants
- theoretical yield and percentage yield
- gas stoichiometry and $PV = nRT$ / molar volume
- empirical and molecular formula calculations
- concentration, titration and back-titration
- gravimetric / redox stoichiometry calculations

Excluded:

- enthalpy, entropy, calorimetry and Gibbs free energy
- equilibrium constants and equilibrium calculations
- kinetics and rate calculations
- pH, K_a/K_b and buffer calculations
- electrochemical cell potentials
- spectroscopy, bonding and organic mechanisms

Contents

01. 2025 May - Limiting reactant and gas volume
02. 2025 May - Empirical formula, gas amount and molar mass
03. 2024 May - Limiting reactant, gas volume and percentage yield
04. 2024 May - Empirical formula and molecular formula from gas data
05. 2024 Nov - Ideal gas mole-volume calculation
06. 2023 May - Double salt composition and gravimetric stoichiometry
07. 2023 May - Winkler titration calculation
08. 2022 Nov - Mass percentage to amount of product
09. 2021 May - Gas stoichiometry and neutralization calculations
10. 2021 Nov - Combustion analysis: empirical and molecular formula
11. 2021 Nov - Winkler method: mole ratio and concentration
12. 2020 Nov - Limiting/excess reagent and STP gas volume
13. 2018 Nov - Limiting reactant and percentage yield
14. 2016 May - Moles, limiting reagent, excess reagent and STP gas
15. 2015 May - Hydrated acid titration and formula of hydrate
16. 2015 Nov - Redox titration stoichiometry of ascorbic acid

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- 17. 2014 Nov - Limiting reactant and product mass
- 18. 2013 May - Combustion analysis and molecular formula
- 19. 2012 May - Amount, theoretical yield and percentage yield
- 20. 2012 May - Limiting reactant and theoretical gas yield
- 21. 2012 Nov - Combustion analysis: empirical and molecular formula
- 22. 2011 Nov - Airbag gas stoichiometry
- 23. 2011 Nov - Combustion/precipitation composition analysis
- 24. 2010 May - Back titration of eggshell calcium carbonate
- 25. 2010 Nov - Empirical and molecular formula from gas data

4. 3.162 g of calcium carbonate, $\text{CaCO}_3(\text{s})$, is reacted with 20.0 cm^3 of 4.00 mol dm^{-3} hydrochloric acid, $\text{HCl}(\text{aq})$.

(a) (i) Write an equation for the reaction, including all state symbols. [2]

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(ii) Deduce which reactant is limiting. Use sections 1, 4 and 7 of the data booklet. [2]

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(iii) Calculate the volume, in dm^3 at STP, of the gas produced. Use section 2 of the data booklet. [1]

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7. An unknown organic compound contains only carbon, hydrogen and oxygen.

- (a) 4.32 g of the compound was combusted completely in oxygen and produced 9.49 g of CO_2 and 5.18 g of H_2O .
Determine the empirical formula of the compound, using sections 1 and 7 of the data booklet.

[3]

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- (b) The same organic compound was vaporized completely at a controlled temperature and pressure.

- (i) 0.108 g of the vaporized compound was found to have a volume of 55.7 cm^3 at 100°C and a pressure of $1.00 \times 10^5 \text{ Pa}$.
Calculate the amount, in moles, of the compound. Use sections 1, 2 and 4 of the data booklet.

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- (ii) Determine the molar mass of the organic compound, using section 1 of the data booklet.
If you did not get an answer to (i), use $n = 0.00220 \text{ mol}$, although this is not the correct answer.

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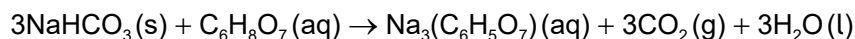
1. A powder has the following percentage composition by mass:

30.0 % sucrose, $C_{12}H_{22}O_{11}$

45.0 % citric acid, $C_6H_8O_7$

25.0 % sodium hydrogencarbonate, $NaHCO_3$

In the presence of water, the powder effervesces as the citric acid reacts with the sodium hydrogencarbonate:



- (a) (i) Determine the limiting reactant when 1.00 g of this powder reacts.

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- (ii) Determine the volume, in dm^3 at SATP, of carbon dioxide released in the reaction in (a)(i). Use sections 1 and 2 of the data booklet.

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(Question 1 continued)

- (iii) Calculate the percentage yield obtained by a student who collected $0.043 dm^3$ of carbon dioxide from 1.00 g of the powder.

If you did not obtain an answer to (a)(ii), use $0.068 dm^3$, but this is not the correct value.

[1]