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, Ka/Kb and buffer calculations
- electrochemical cell potentials
- spectroscopy, bonding and organic mechanisms

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4. 3.162 g of calcium carbonate, $CaCO_3(s)$, is reacted with 20.0 cm^3 of 4.00 mol dm^{-3} hydrochloric acid, HCl(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 1.00×10^5 Pa.
Calculate the amount, in moles, of the compound. Use sections 1, 2 and 4 of the data booklet. [2]

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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 $n = 0.00220$ mol, although this is not the correct answer. [1]

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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:

$$3NaHCO_3(s) + C_6H_8O_7(aq) \rightarrow Na_3(C_6H_5O_7)(aq) + 3CO_2(g) + 3H_2O(l)$$

(a) (i) Determine the limiting reactant when 1.00 g of this powder reacts. [3]

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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. [2]

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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]