

STOICHIOMETRY SL & HL (Core)

1. The drug AHA is a potent enzyme inhibitor, which consists of 20.2% carbon, 11.4% nitrogen, 65.9% oxygen and 2.50% hydrogen by mass. Determine the empirical formula of AHA, showing your working.

[3]

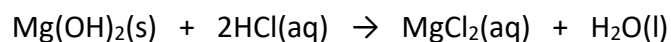
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2. A sample of a compound gas, T, is investigated. At 0°C and 1.00×10^5 Pa, 0.817g of compound T occupies a volume of 0.686 dm^3 . Calculate the molar mass of compound T.

[2]

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3. Magnesium hydroxide can be used to neutralise hydrochloric acid. 0.400mol of $\text{Mg}(\text{OH})_2$ is mixed with 0.600mol of $\text{HCl}(\text{aq})$ and the following reaction occurs:



(a) State the limiting reactant, explain your reasoning.

[1]

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(b) Determine the amount (in moles) of excess reactant that remains.

[1]

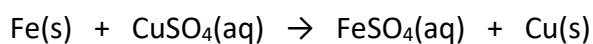
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(c) Calculate the mass of $MgCl_2$ produced.

[2]

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4. Iron undergoes a replacement reaction with copper sulfate solution:



2.46g of iron powder are added to 800cm^3 of 0.800 mol dm^{-3} copper sulfate solution. The resulting copper is filtered off and dried.

(a) Show that the copper sulfate is in excess.

[2]

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(b) 2.32g of copper is obtained. Determine the percentage yield.

[2]

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5. Alkanes, like butane, are used as fuels.

(a) Formulate an equation to show butane, C_4H_{10} , reacting completely with oxygen to produce carbon dioxide and water.

[1]

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(b) 4.845g of butane is completely combusted with excess oxygen. The resulting carbon dioxide is captured and stored at STP. Calculate the volume of the stored carbon dioxide.

(Molar volume of an ideal gas at STP = $22.7\text{dm}^3\text{ mol}^{-1}$)

[3]

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6. Ammonium nitrate, NH_4NO_3 , is widely used in fertilisers and explosives. Calculate the percentage by mass of nitrogen in ammonium nitrate. Give your answer to 3 significant figures.

[2]

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PTO

Questions 7, 8 and 9 are more challenging questions.

7. The percentage by mass of calcium carbonate in a sample of eggshell was determined by adding excess hydrochloric acid to ensure that all the calcium carbonate had reacted. The excess acid left was then titrated with aqueous sodium hydroxide. Initially, 13.60 cm^3 of $0.400 \text{ mol dm}^{-3}$ HCl was added to 0.180 g of eggshell.

(a) Calculate the amount, in mol, of HCl initially added.

[1]

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(b) The excess acid required 23.40 cm^3 of $0.100 \text{ mol dm}^{-3}$ NaOH for neutralization. Calculate the amount, in mol, of acid that is in excess.

[1]

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(c) Determine the amount, in mol, of HCl that reacted with the calcium carbonate in the eggshell.

[1]

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(d) Formulate an equation for the reaction between the calcium carbonate and the hydrochloric acid, and hence determine the amount, in mol, of calcium carbonate in the sample of the eggshell.

[3]

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9. 13.91g of hydrated sodium carbonate crystals, $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$, were dissolved in water and made up to 1000cm^3 . A titration was carried out: 25.00 cm^3 of the sodium carbonate solution required an average of 24.40 cm^3 of $0.2000\text{ mol dm}^{-3}$ hydrochloric acid for neutralisation:



(a) Calculate the concentration, in mol dm^{-3} , of the sodium carbonate solution neutralised by the hydrochloric acid.

[3]

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(b) Calculate the total mass of sodium carbonate present in the 1000cm^3 of solution.

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(c) Calculate the mass of water in the original hydrated sodium carbonate crystals, and hence find the value of x . Show your working.

[4]

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