Chemistry

Standard level

Paper 2

Practice paper

Topic: Stoichiometric Relationships (Topic 1)

1. Combustion analysis of a 1.50 g sample of an unknown organic compound containing only carbon, hydrogen, and oxygen yielded 2.20 g of CO_2 and 0.90 g of H_2O.

(a) Calculate the masses of carbon and hydrogen in the sample. **[2]**

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(b) Determine the mass of oxygen in the sample by subtraction. **[1]**

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(c) Determine the empirical formula of the compound. **[3]**

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2. Sodium azide, NaN_3, is used in automobile airbags. Upon impact, it decomposes:

$2NaN_3(s) \rightarrow 2Na(s) + 3N_2(g)$

(a) Calculate the volume of N_2 gas produced at 300 K and 100 kPa from the decomposition of 65.0 g of NaN_3. **[4]**

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3. Iron is extracted from its ore in a blast furnace:

$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(l) + 3CO_2(g)$

1000 kg of Fe_2O_3 is reacted with 500 kg of CO.

(a) Determine the limiting reactant. **[3]**

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(b) Calculate the maximum mass of iron that can be produced. **[2]**

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4. The Solvay process produces sodium carbonate. One step is:

$2NaHCO_3(s) \rightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$

(a) Define atom economy. **[1]**

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(b) Calculate the atom economy for the production of Na_2CO_3 in this reaction. **[2]**

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5. A weather balloon is filled with 10.0 dm^3 of helium at 25 °C and 101 kPa. It rises to an altitude where the temperature is -40 °C and the pressure is 20 kPa.

(a) Predict, with a reason, the change in volume of the balloon. **[1]**

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(b) Calculate the new volume of the balloon. **[2]**

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6. A 1.00 mol dm^{-3} solution of $CuSO_4$ is diluted to produce 100 cm^3 of a 0.050 mol dm^{-3} solution.

(a) Calculate the volume of the original solution required. **[2]**

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(b) Outline the steps to prepare this solution using a volumetric flask. **[2]**

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7. A 0.50 g antacid tablet containing $CaCO_3$ was dissolved in 50.0 cm^3 of 0.20 mol dm^{-3} HCl (excess). The excess acid required 10.0 cm^3 of 0.10 mol dm^{-3} NaOH for neutralization.

(a) Calculate the moles of HCl added originally. **[1]**

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(b) Calculate the moles of HCl that were in excess (reacted with NaOH). **[1]**

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(c) Determine the mass of $CaCO_3$ (M_r=100.1) in the tablet. **[3]**

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