

1.

Compound **X**, an anhydrous Group 2 bromide, is dissolved in water and titrated against aqueous silver nitrate.

A solution containing 0.250 g of **X** requires 33.65 cm³ of 0.0500 mol dm⁻³ AgNO₃(aq) for complete reaction.

Identify **X**.

Show your working.

$$\text{moles of AgNO}_3 = \frac{33.65}{1000} \times 0.0500 (= 1.68(25) \times 10^{-3})$$

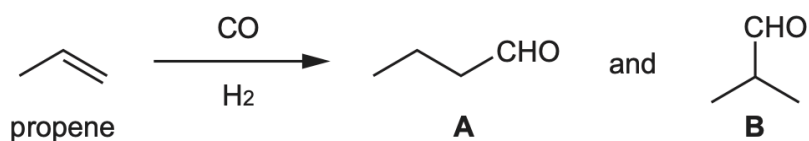
$$\text{moles of X} = \frac{1}{2} \times \text{moles of AgNO}_3 = 0.250 \div M_r(\text{X}) \quad \therefore M_r(\text{X}) = 297.2$$

A_r of Group 2 element is $297.2 - 2(79.9) = 137.4$ AND **X** is BaBr₂

2.

Alkenes undergo an addition reaction with a 1:1 mixture of CO and H₂ to form aldehydes.

Fig. 3.1 shows the reaction of propene with a 1:1 mixture of CO and H₂.



The complete reaction of propene with a 1:1 mixture of CO and H₂ produces **A** and **B** only. The product mixture contains 96% **A** and 4% **B**.

Calculate the mass of **A** produced in this reaction when 5.00×10^3 kg of propene is used.

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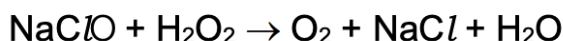
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Balanced equation:



- No of mol of C₃H₆ = $(5 \times 10^3 \times 10^3) / 42 = 119047.619$
- No of mol of A = $(119047.619 / 25) \times 24 = 114285.7142$
- Mass of A = $114285.7142 \times 72 = 8228571.422 = 8229$ kg

3.



A sample of bleach **W** contains an unknown concentration of sodium chlorate(I).

10.0 cm³ of **W** is diluted with distilled water to make a total volume of 100 cm³ of bleach solution. 25.0 cm³ of this diluted bleach solution is added to an excess of hydrogen peroxide and the volume of gas produced measured under room conditions. The experiment is repeated and on average 25.0 cm³ of diluted bleach solution produces 42.0 cm³ of gas.

Calculate the concentration, in g dm⁻³, of sodium chlorate(I) in **W**.

$$\text{no. of mol of O}_2 = \frac{42}{1000} \div 24 = 1.75 \times 10^{-3}$$

$$\text{no. of mol of NaClO in 25 cm}^3 \text{ of dil.} = 1.75 \times 10^{-3}$$

$$\text{no. of mol of NaClO in 100 cm}^3 \text{ of dil.} = 1.75 \times 10^{-3} \times 4 \\ = 7 \times 10^{-3}$$

$$\text{no. of mol of NaClO in 10 cm}^3 \text{ of conc.} = 7 \times 10^{-3}$$

$$\therefore \text{conc of W} = \frac{7 \times 10^{-3}}{10 \times 10^{-3}} = 0.7 \text{ mol/dm}^3$$

$$0.7 \times (23 + 35.5 + 16) = 52.15 \text{ g/dm}^3 = 52.2 \text{ g/dm}^3$$

4.

0.020 mol of element **Z** reacts with excess Cl₂ to form 0.020 mol of a liquid chloride.

The liquid chloride has formula **ZCl_n**, where *n* is an integer.

ZCl_n reacts vigorously with water at room temperature to give an acidic solution and a white solid.

When excess AgNO₃(aq) is added to the solution, 11.54 g of AgCl(s) forms.

Calculate the value of *n* in **ZCl_n**.

M1: $11.54 \div 143.4 = 0.0805$

M2: so ratio **Z:Cl** is $1:4/n = 4$