



GCE AS LEVEL CHEMISTRY

S21- B410

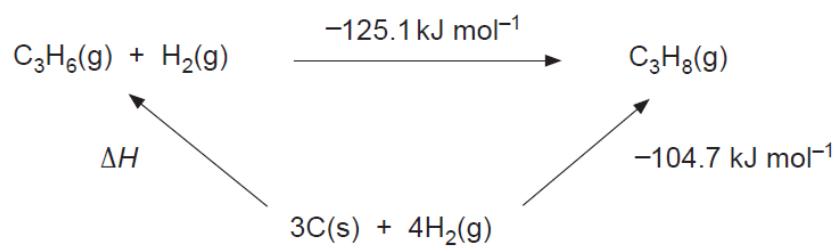
Assessment Resource D

Energy, Rate and Carbon Compounds

1. (a) State Hess's Law. [1]

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(b) Determine the value of ΔH , in kJ mol^{-1} , in the energy cycle below. [1]



$\Delta H = \dots\dots\dots \text{kJ mol}^{-1}$

2. (a) Discuss how 1-bromobutane can react with hydroxide ions under different conditions to give two different organic products.

Draw the mechanism for the formation of **one** of the organic products. [6 QER]

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(b) Chloroethane is formed when ethane reacts with chlorine in sunlight. However, during the reaction a mixture of products is obtained.

(i) Name the type of reaction mechanism taking place. [1]

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(ii) Explain why butane can also form during this reaction. [2]

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(c) Halogenoalkanes can also be formed from alkenes.

When 3-methylbut-1-ene is reacted with hydrogen bromide a mixture of two different products is formed.

(i) Identify the products. [2]

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(ii) State and explain which of the two products is more likely to be formed. [1]

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(d) Halogenoalkanes containing both chlorine and fluorine are known as CFCs. One of the most abundant CFCs in the atmosphere is trichlorofluoromethane, CCl_3F .

Explain why CCl_3F remains longer in the troposphere (lower atmosphere) of the Earth than in the stratosphere (upper atmosphere). [2]

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3. A student carried out an experiment to determine the enthalpy change of reaction for the decomposition of aqueous hydrogen peroxide.



Since the reaction is very slow, she was told to use aqueous iron(III) nitrate as a catalyst. It is an amber colour originally but turns a dark reddish-brown during the decomposition.

She used the following method.

- Use a burette to measure 50.0 cm³ of aqueous hydrogen peroxide (3% w/v) into a polystyrene cup.
- Place a 1 °C graduated thermometer in the solution and record the temperature.
- Add 50.0 cm³ of aqueous iron(III) nitrate to the solution.
- Stir the mixture with the thermometer and record the maximum temperature reached.

Her results are shown below.

Initial temperature of the aqueous hydrogen peroxide = 19.0 °C

Final temperature of the aqueous hydrogen peroxide = 27.5 °C

- (a) The student said that it is not necessary to ensure that the hydrogen peroxide and the iron(III) nitrate are at the same temperature before addition.

Is she correct? Justify your answer. [1]

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- (b) A concentration of "3% w/v" means that there are 3 g of hydrogen peroxide in 100 cm³ of solution.

Calculate the concentration of the aqueous hydrogen peroxide in mol dm⁻³. [2]

Concentration = mol dm⁻³

- (c) Calculate the value, in kJ mol^{-1} , for the enthalpy change of reaction for the decomposition of hydrogen peroxide.

Give your answer to an **appropriate** number of significant figures. [4]

(If you do not have an answer in part (b) assume that the concentration is $0.790 \text{ mol dm}^{-3}$. This is **not** the correct answer.)

$\Delta H = \dots\dots\dots \text{kJ mol}^{-1}$

- (d) State why she accurately measured the volume of the catalyst. [1]

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- (e) State how the student would know that the decomposition reaction had finished. [1]

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(f) Suggest **two** improvements that would make the experiment more accurate. Justify both improvements. [4]

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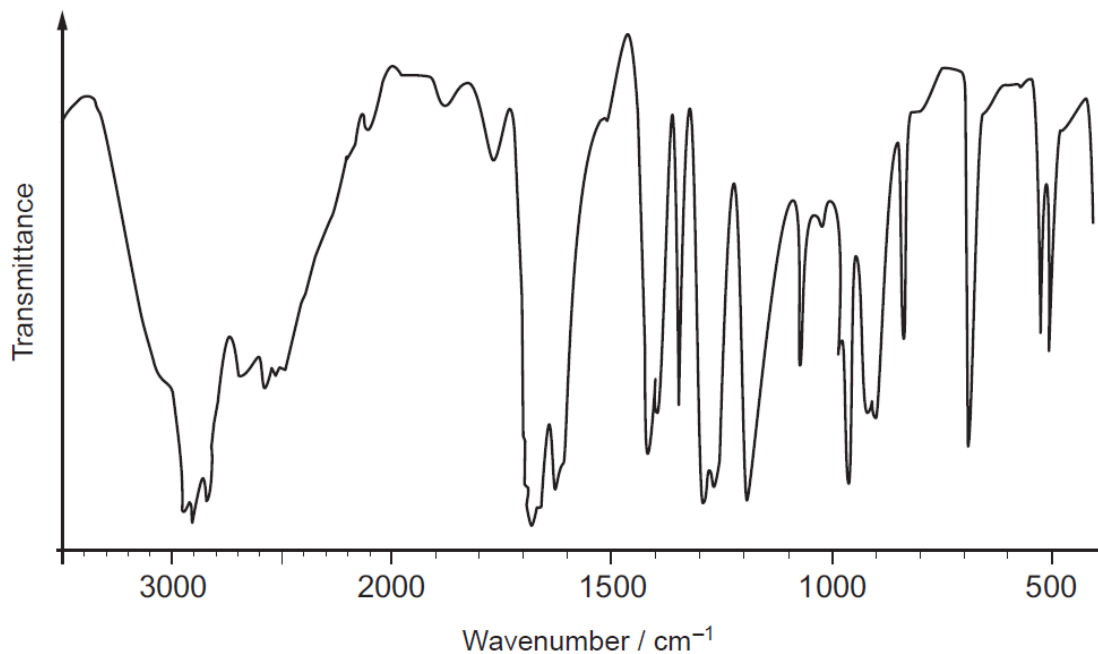
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(g) State how the value of the enthalpy change would be affected if the experiment were repeated using a different catalyst. [1]

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4. Compound **A** contains 55.8% carbon, 7.00% hydrogen and 37.2% oxygen by mass.
Part of its infrared spectrum is shown below.



- An aqueous solution of compound **A** has a pH of less than 7.
- In an addition reaction, 2.00 g of compound **A** reacts with 3.71 g of bromine in a 1:1 molar ratio.

