GCE AS LEVEL CHEMISTRY

S21- B410

Assessment Resource C

Energy, Rate and Carbon Compounds

1. Draw the structure of a hydrocarbon that has five carbon atoms and exhibits *E*-*Z* isomerism. [1]

2. Draw the repeat unit of the polymer formed from the monomer CH_3CHCH_2. [1]

3. Species can be classified as electrophiles, nucleophiles or radicals.

(a) Explain what is meant by an *electrophile*. [1]

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(b) Give an example of an electrophile. [1]

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4. 3,4-Dimethylpentan-2-ol is a secondary alcohol.

(a) Draw the **skeletal** formula for 3,4-dimethylpentan-2-ol. [1]

(b) State why it is classified as a secondary alcohol. [1]

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5. Name **two** compounds formed during the **incomplete** combustion of propane. [1]

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6. Ethanoic acid, CH_3COOH, is a typical organic acid.

Write the equation for the reaction between ethanoic acid and magnesium oxide. [1]

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7. *(a)* A student is asked to prepare a sample of ethanal by oxidising ethanol.

(i) Write an equation for this reaction. [1]

Use [O] to represent the oxidising agent and show the structure of the organic product.

(ii) Describe, giving brief experimental details, how he can carry out the reaction. [4]

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(iii) Ethanol can also be oxidised to ethanoic acid. Describe how the student could use a chemical test to confirm that his sample of ethanal did **not** contain ethanoic acid. [2]

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(b) State a difference and a similarity between the ^{13}C NMR spectra of ethanal and ethanol. [2]

Difference .....

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Similarity .....

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(c) Ethanol is widely used as a biofuel in some countries.

(i) The equation for its combustion is given below.

$$C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$$

Use the average bond enthalpy values given in the table below to calculate the enthalpy of combustion for ethanol. [3]

Bond	Average bond enthalpy / kJ mol^{-1}
C—C	348
C—H	412
C—O	360
O—H	463
O=O	496
C=O	743

$\Delta_c H$ ethanol = ... kJ mol^{-1}

(ii) Give a disadvantage of biofuels compared with fossil-based fuels. [1]

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(d) Ethanol and hexan-1-ol are both primary alcohols. Explain why ethanol is soluble in water but hexan-1-ol is not. [2]

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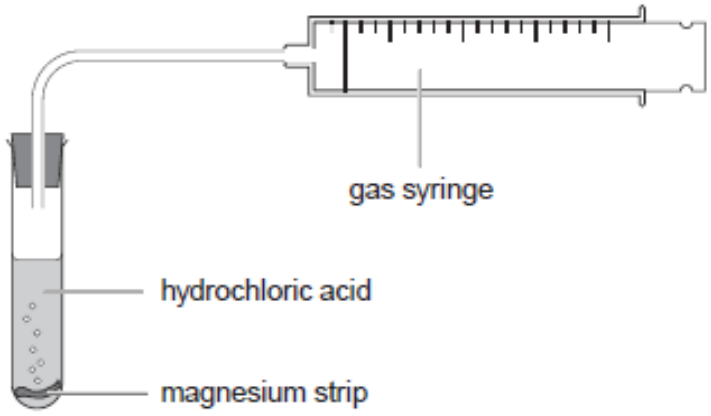
8. A student carried out an experiment to study the reaction between magnesium and hydrochloric acid.

$$Mg(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g) \qquad \Delta H = -467 \text{ kJ mol}^{-1}$$

He used the following apparatus to measure the volume of hydrogen produced over time.

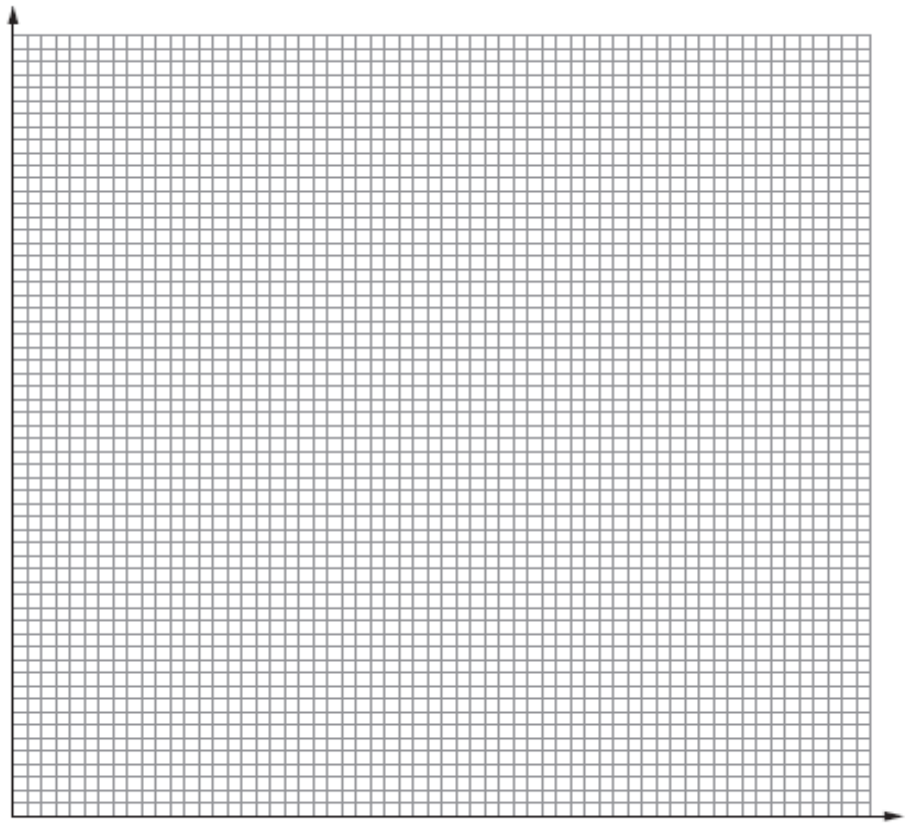


The experiment was carried out at a temperature of 25 °C and 1 atm pressure. The amount of acid used was sufficient to react with all the magnesium.

These are the results obtained.

Time / s	Volume of hydrogen / cm^3
0	0
10	32
20	50
30	64
40	75
60	88
80	92
100	100
120	100

(a) Plot the results for the experiment and draw a line of best fit. Label it **A**. [4]



(b) Use the graph to calculate the rate of reaction at 20 seconds in $cm^3\ s^{-1}$. [2]

Rate = ... $cm^3\ s^{-1}$

(c) When he repeated the experiment, it took him 8 seconds to replace the bung in the tube and start the stopwatch after adding the magnesium.

On the graph, sketch the curve that would be obtained if the results of this experiment were plotted. Label it **B**. [2]

(d) Calculate the mass of the magnesium strip used in the experiment. [2]

Mass = ... g

(e) The rates of some reactions can be determined from the loss of mass over a period of time. However, the student said that he could not use this method as he only had a two decimal place balance. Is he correct? Justify your answer. [2]

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(f) He repeated the experiment using the same mass of magnesium and the same volume and concentration of acid, in order to collect 100 cm^3 of hydrogen, but over a longer period of time.

State **one** method of slowing down the reaction and use collision theory to explain this change of rate. [3]

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(g) On the axes below, sketch the energy profile for this reaction, labelling the enthalpy change of reaction, $\Delta_r H$. [2]