

Name of the Student: _____

Max. Marks : 19 Marks

Time : 19 Minutes

Q1.

Compounds **V**, **W**, **X** and **Y** are isomers with the molecular formula $C_5H_{10}O_2$

Isomers **V** and **W** are carboxylic acids with formulas that can be written as C_4H_9COOH

(a) Give an equation for the reaction of C_4H_9COOH with sodium hydrogencarbonate.

(1)

(b) Isomer **V** has an asymmetric carbon atom.

Deduce the structure of **V**.

(1)

(c) Isomer **W** has four peaks in its 1H NMR spectrum.

Deduce the structure of **W**.

Deduce the integration ratio for the four peaks in the 1H NMR spectrum of **W**.

Structure

Integration ratio _____

(2)

(d) Isomer **X** has three singlets with integration ratio 1:3:6 in its 1H NMR spectrum.

Deduce the structure of **X**.

Explain why the peaks in the 1H NMR spectrum are singlets.

Structure

Explanation _____

(2)

- (e) The table below shows information about the peaks in the ^1H NMR spectrum of isomer **Y**.

Chemical shift δ / ppm	Integration ratio	Splitting pattern
3.65	2	singlet
1.19	3	singlet

Draw the parts of the structure of **Y** that can be deduced from each of these peaks.

Deduce the structure of **Y**.

State how many peaks are in the ^{13}C NMR spectrum of **Y**.

Part of structure from peak at $\delta = 3.65$ ppm

Part of structure from peak at $\delta = 1.19$ ppm

Structure of **Y**

Number of peaks in ^{13}C NMR spectrum of **Y** _____

(6)

(Total 12 marks)

Q2.

This question is about rates of reaction.

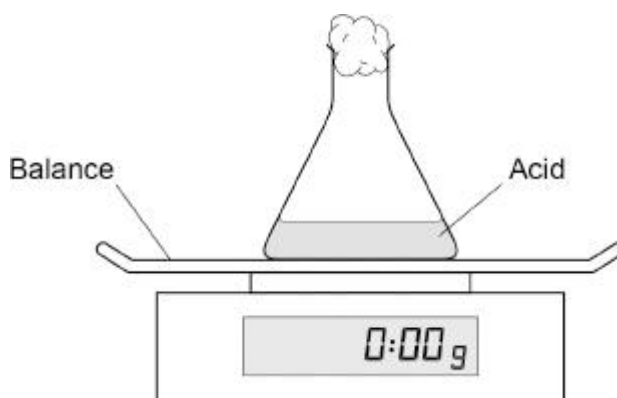
Figure 1 shows apparatus used to measure the rate of reaction when an acid reacts with an excess of solid sodium hydrogencarbonate, NaHCO_3

When different monoprotic organic acids are used, the rates at which gas escapes can be used to compare the strengths of the acids.

A timer is started when the NaHCO_3 is added to the acid and the mass of CO_2 gas lost is recorded at regular intervals.

(It is assumed that any change in mass is due to the loss of CO_2)

Figure 1

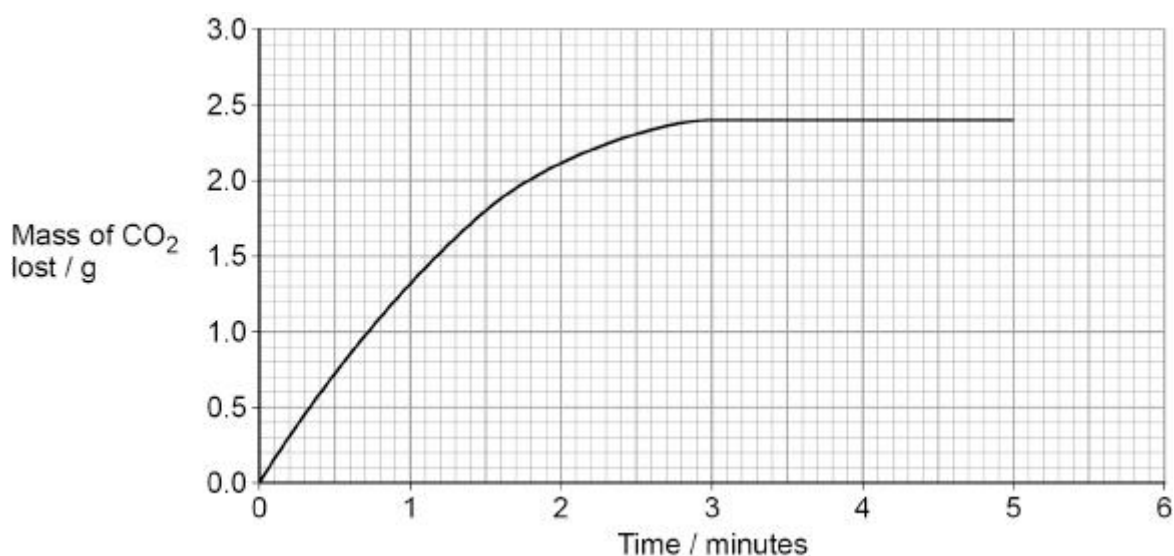


- (a) Suggest a reason why using a conical flask instead of a beaker would give more accurate results in this experiment.

(1)

Figure 2 shows the results of this experiment when 25.0 cm^3 of a 2.23 mol dm^{-3} solution of ethanoic acid reacts with an excess of NaHCO_3

Figure 2



- (b) Use **Figure 2** to calculate the rate of reaction at 2 minutes.

Deduce the units of your calculated rate.

Rate _____ Units _____

(3)

- (c) Chloroethanoic acid is a stronger acid than ethanoic acid.

Sketch, on **Figure 2**, the curve you would expect when 25.0 cm^3 of a 2.23 mol dm^{-3} solution of chloroethanoic acid reacts with an excess of NaHCO_3

Suggest why chloroethanoic acid is a stronger acid than ethanoic acid.

(3)

(Total 7 marks)