Name of the Student:_____
Max. Marks : 17 Marks **Time : 17 Minutes**

Q1.

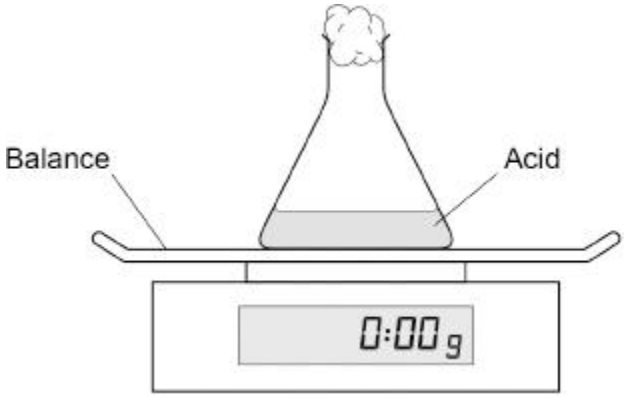
This question is about rates of reaction.

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

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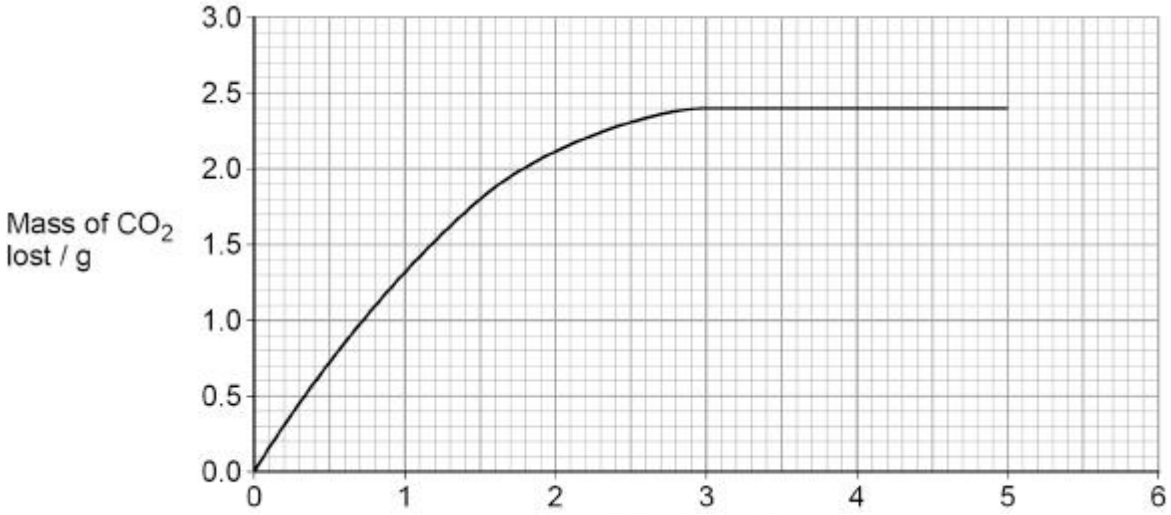

(b) Use **Figure 2** to calculate the rate of reaction at 2 minutes.

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)

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Q2.

The molar enthalpy of vaporisation (ΔH_{vap}) of a liquid is the enthalpy change when one mole of liquid is converted to vapour at the boiling point of the liquid.

A student does an experiment to determine ΔH_{vap} for water.

The student:

- places a large beaker on a balance
- pours 500 cm^3 of water into the beaker
- uses a 2.4 kW heater to raise the temperature of the water to 100 °C
- records the mass of the beaker and hot water
- uses the 2.4 kW heater to boil the water for 100 s
- records the mass of the beaker and remaining water.

The loss in mass is 103 g

(a) Calculate ΔH_{vap} for water.

[1 kW = 1 kJ s^{-1}]

ΔH_{vap} _____ kJ mol^{-1}

(3)

The table below shows some data about three compounds that all contain the same number of electrons.

Compound	CH_3CH_2OH	$CH_3CH_2NH_2$	CH_3OCH_3
Boiling point / K	352	290	248

(b) All three compounds in the table above are polar.
Ethanol is the most polar and ethylamine is the least polar.

Explain why all three molecules are polar and why ethylamine is the least polar.
In your answer refer to the shapes around, and relative electronegativities of, the most electronegative atoms.

_____

_____

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(4)

(c) Explain the trend in the boiling points of the three compounds.
Refer to the intermolecular forces in all three compounds in your answer.

(3)

(Total 10 marks)

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