Practice Question Set For A-Level
Subject : Chemistry
Paper-2 Topic: Kinetics

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Name of the Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

Q1.

A student investigates the effect of changing the temperature on the rate of hydrolysis of 1-iodobutane.

The student follows this method:

- Add 5 cm^3 of ethanol and 4 drops of 1-iodobutane to a test tube.
- Mark this test tube with a cross (below the level of the liquid).
- Add 5 cm^3 of 0.05 mol dm^{-3} silver nitrate solution to a separate test tube.
- Place a stopper in both test tubes.
- Place both test tubes in a beaker of water at a known temperature (between 5 and 60 °C).
- After 5 minutes, pour the silver nitrate solution into the test tube containing 1-iodobutane and start a timer.
- Look through the transparent reaction mixture in the test tube towards the cross.
- Stop the timer when the cross is no longer visible due to the yellow precipitate formed.

(a) Identify the yellow precipitate formed in the reaction.

_____

The student repeats the experiment at different temperatures.

The table below shows the student's results.

Temperature / °C	**Time *t* / s**	$\frac{1}{t}$ **/ s^{-1}**
6	125	0.0080
15	83	0.0120
28	50	0.0200
34	38	0.0263
42	26	0.0385

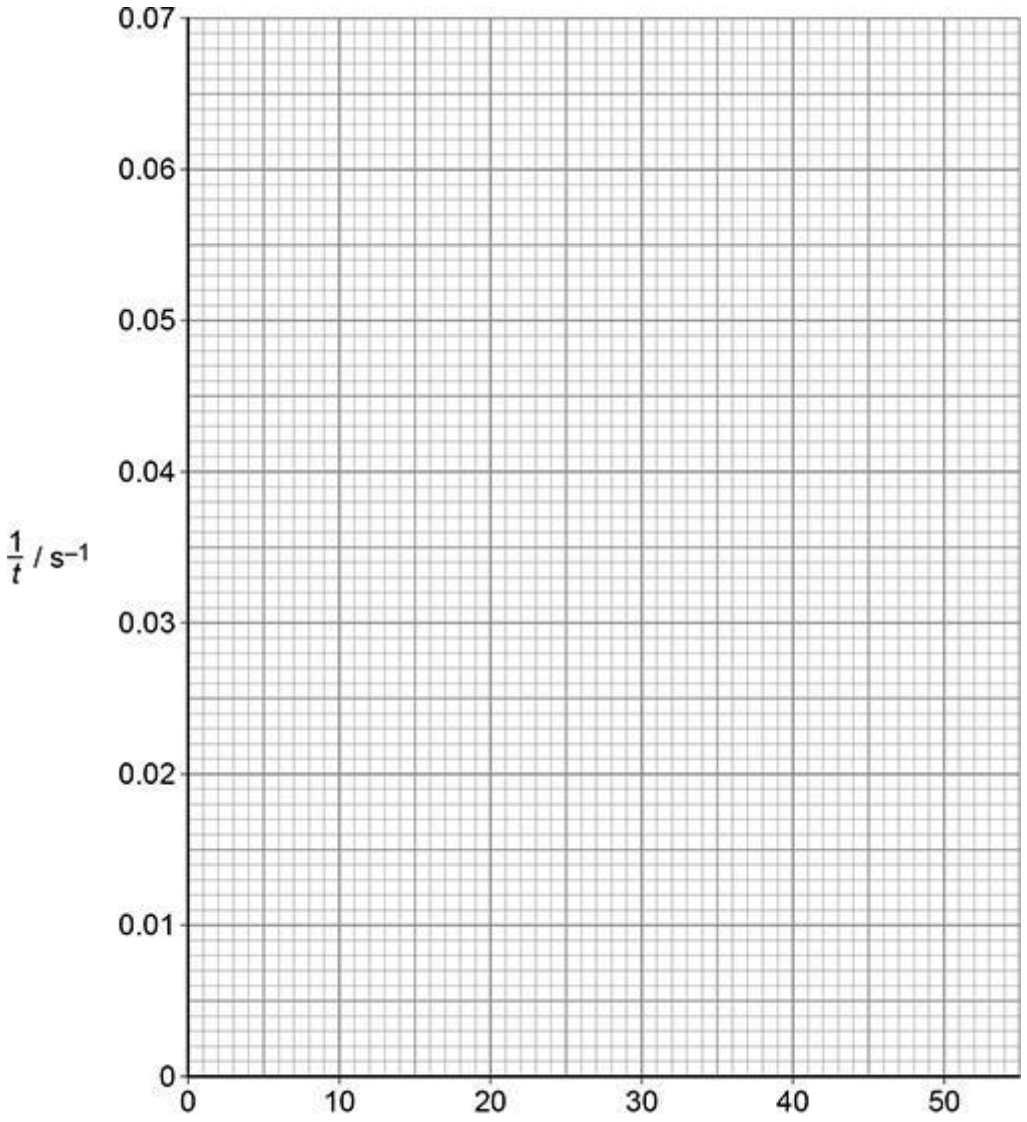
(1)

(b) Plot the values of $\frac{1}{t}$ against temperature on the grid.

Draw a line of best fit.

Use your graph to predict the time, in s, when the cross is no longer visible at 50 °C

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Time _____ s

(3)

(c) The student repeats the investigation using 1-bromobutane instead of 1-iodobutane.

State and explain how the rate of reaction for 1-bromobutane compares with the rate for 1-iodobutane.

Predict how the graph will differ for 1-bromobutane compared to 1-iodobutane.

How rate of reaction for 1-bromobutane will compare _____

_____

Explanation _____

_____

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How graph for 1-bromobutane will differ _____

_____

(3)

(Total 7 marks)

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Q2.

Draw the Maxwell–Boltzmann distribution curves for a fixed mass of a gas at two different temperatures.
This gas decomposes when heated.

By reference to these distribution curves, explain why the rate of decomposition of this gas increases at higher temperatures.

(Total 6 marks)

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Q3.

This question is about ethanoic anhydride.

In the gas phase, ethanoic anhydride $(CH_3CO)_2O$ decomposes to form ethenone.

The equation is

$$(CH_3CO)_2O \rightarrow \underset{\text{Ethenone}}{H_2C{=}C{=}O} + CH_3COOH$$

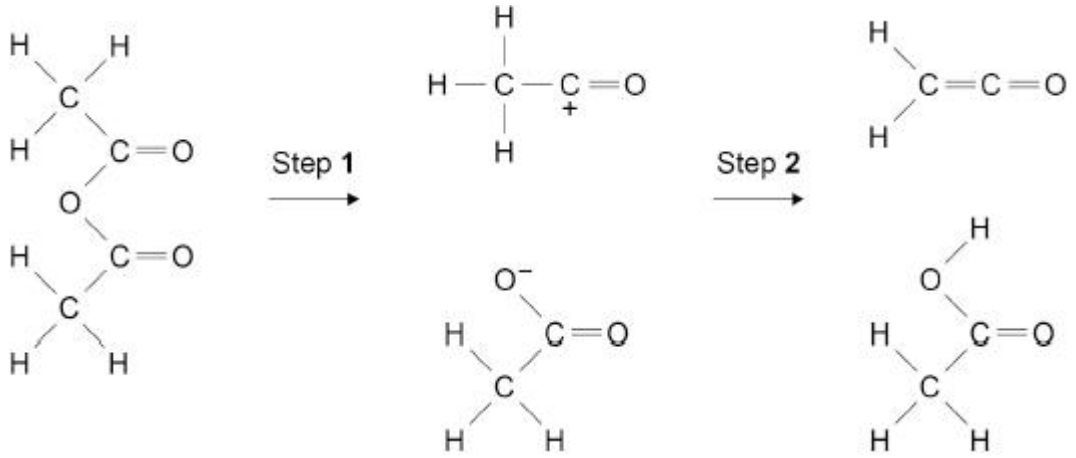
(a) Ethenone is the simplest member of the ketene homologous series.
Ketenes all contain one C=C double bond and one C=O double bond.

Deduce the general formula for the ketene homologous series.

_____

(1)

(b) The figure below shows an incomplete suggested mechanism for the decomposition of ethanoic anhydride.



Complete the mechanism in the figure above by adding three curly arrows and any relevant lone pairs of electrons.

(3)

(c) For a chemical reaction the relationship between the rate constant, k, and the temperature, T, is shown by the Arrhenius equation.

$$k = Ae^{\frac{-E_a}{RT}}$$

For the decomposition of gaseous ethanoic anhydride

the activation energy, E_a = 34.5 kJ mol^{-1}
the Arrhenius constant, A = 1.00 × 10^{12} s^{-1}

At temperature T_1 the rate constant, k = 2.48 × 10^{8} s^{-1}

Calculate T_1

The gas constant, R = 8.31 J K^{-1} mol^{-1}

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T_1 _____ K

(3)

(d) Sketch the Maxwell–Boltzmann distribution of molecular energies for gaseous ethanoic anhydride at temperature T_1 and at a higher temperature T_2

Include a label for each axis, and mark on the appropriate axis a typical position for the activation energy.

Explain why the rate of reaction is faster at T_2



Explanation

_____

_____

_____

(5)

(Total 12 marks)

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