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

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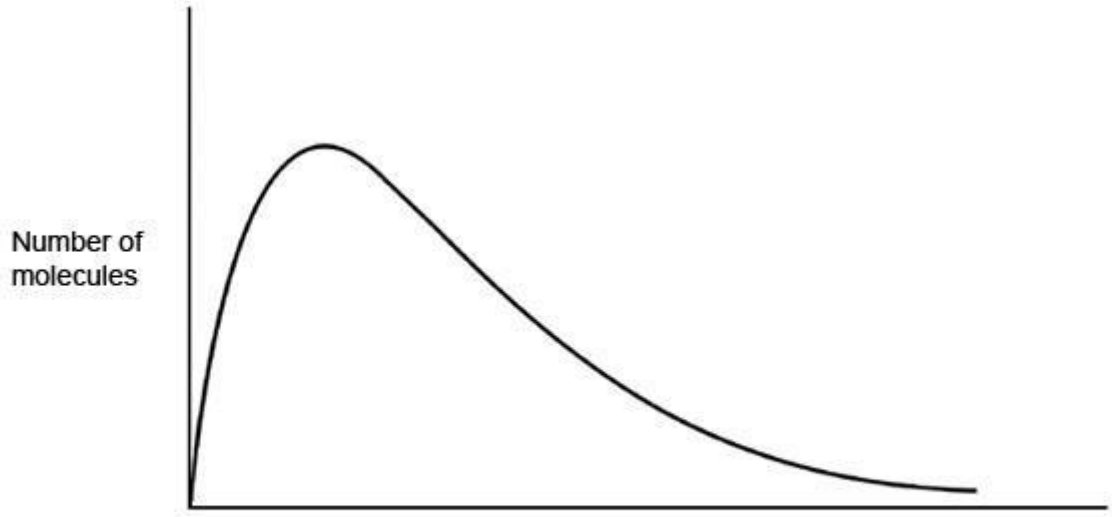
Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Q1.

The graph shows the Maxwell−Boltzmann distribution of molecular energies in a sample of gas at a fixed temperature.



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(a) Label the horizontal axis on the graph.

(1)

(b) On the graph, sketch a distribution of molecular energies for this sample of gas at a higher temperature.

(2)

(c) This gas decomposes on heating.

Explain why an increase in temperature increases the rate at which this gas decomposes.

_____

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(2)
(Total 5 marks)

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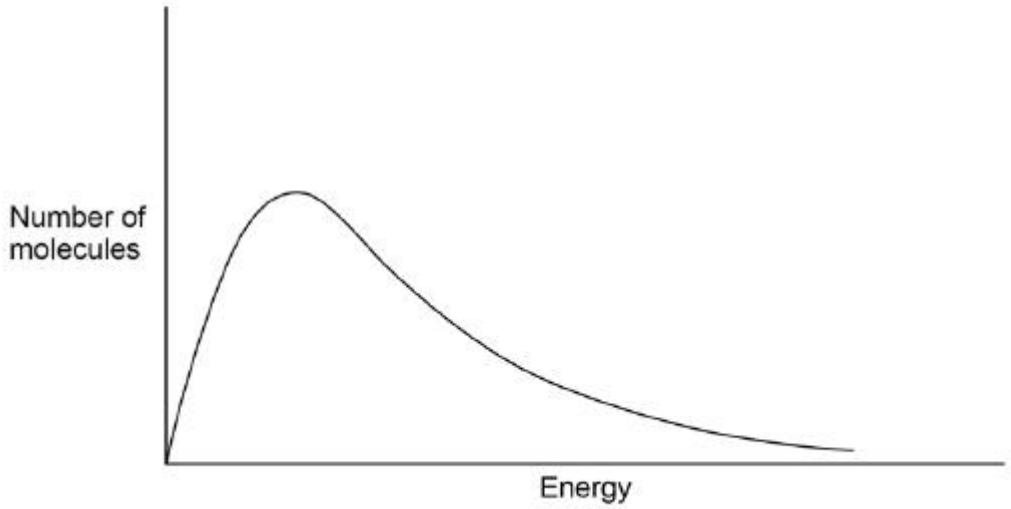
Q2.

Nitryl chloride reacts with nitrogen monoxide according to the equation:

$$ClNO_2(g) + NO\ (g) \longrightarrow NO_2(g) + ClNO(g)$$

The Maxwell–Boltzmann distribution curve in **Figure 1** shows the distribution of molecular energies in 1 mol of this gaseous reaction mixture (sample **1**) at 320 K.

Figure 1



(a) On the same axes, draw a curve for sample **1** at a lower temperature.

(2)

(b) Explain the effect that lowering the temperature would have on the rate of reaction.

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_____

(2)

(c) A Maxwell–Boltzmann distribution curve was drawn for a second sample of the reaction mixture in the same reaction vessel. **Figure 2** shows the results.

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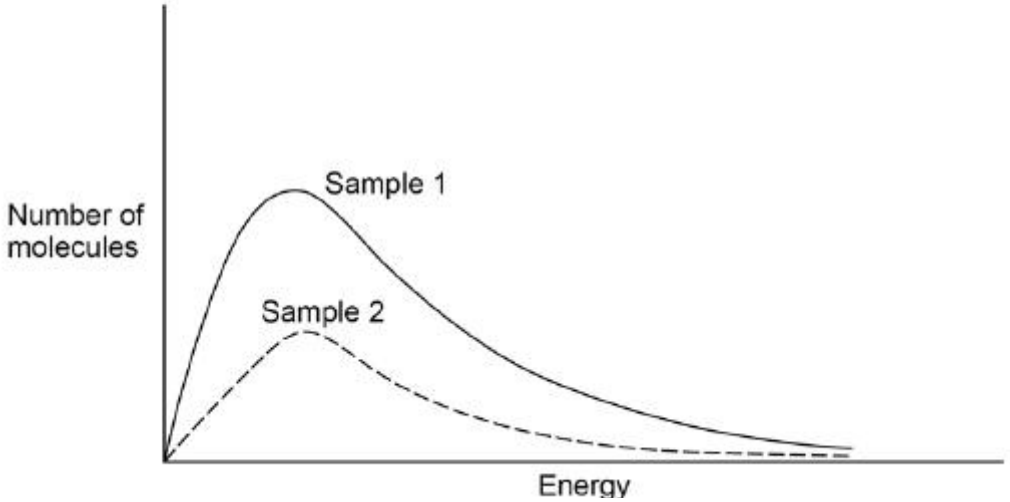
Figure 2



Deduce the change that was made to the reaction conditions.

Explain the effect that this change has on the rate of reaction.

Change _____

_____

Explanation _____

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

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Q3.

This question involves the use of kinetic data to deduce the order of a reaction and calculate a value for a rate constant.

The data in **Table 1** were obtained in a series of experiments on the rate of the reaction between compounds **A** and **B** at a constant temperature.

Table 1

Experiment	**Initial concentration of A / mol dm^{-3}**	**Initial concentration of B / mol dm^{-3}**	**Initial rate / mol dm^{-3} s^{-1}**
1	0.12	0.26	2.10×10^{-4}
2	0.36	0.26	1.89×10^{-3}
3	0.72	0.13	3.78×10^{-3}

(a) Show how these data can be used to deduce the rate expression for the reaction between **A** and **B**.

(3)

The data in **Table 2** were obtained in two experiments on the rate of the reaction between compounds **C** and **D** at a constant temperature.

Table 2

Experiment	**Initial concentration of C / mol dm^{-3}**	**Initial concentration of D / mol dm^{-3}**	**Initial rate / mol dm^{-3} s^{-1}**
4	1.9×10^{-2}	3.5×10^{-2}	7.2×10^{-4}
5	3.6×10^{-2}	5.4×10^{-2}	To be calculated

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The rate equation for this reaction is

$$rate = k[\mathbf{C}]^2[\mathbf{D}]$$

(b) Use the data from experiment **4** to calculate a value for the rate constant, k, at this temperature. Deduce the units of k.

k = _____ Units = _____

(3)

(c) Calculate a value for the initial rate in experiment **5**.

Initial rate = _____ mol dm^{-3} s^{-1}

(1)

(d) The rate equation for a reaction is

$$rate = k[\mathbf{E}]$$

Explain qualitatively why doubling the temperature has a much greater effect on the rate of the reaction than doubling the concentration of **E**.

_____

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_____

(3)

(e) A slow reaction has a rate constant $k = 6.51 \times 10^{-3}$ mol^{-1} dm^3 at 300 K.

Use the equation $\ln k = \ln A - E_a / RT$ to calculate a value, in kJ mol^{-1}, for the activation energy of this reaction.

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The constant $A = 2.57 \times 10^{10}$ mol^{-1} dm^3.
The gas constant $R = 8.31$ J K^{-1} mol^{-1}.

Activation energy = _____

(2)

(Total 12 marks)

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