CHAPTER 5 KINETICS

1 The gas-phase reaction between hydrogen and chlorine is very slow at room temperature.

$$H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$$

(a) Define the term *activation energy*.

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(2 marks)

(b) Give **one** reason why the reaction between hydrogen and chlorine is very slow at room temperature.

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(1 mark)

(c) Explain why an increase in pressure, at constant temperature, increases the rate of reaction between hydrogen and chlorine.

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(2 marks)

(d) Explain why a small increase in temperature can lead to a large increase in the rate of reaction between hydrogen and chlorine.

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(2 marks)

(e) Give the meaning of the term *catalyst*.

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(1 mark)

(f) Suggest **one** reason why a solid catalyst for a gas-phase reaction is often in the form of a powder.

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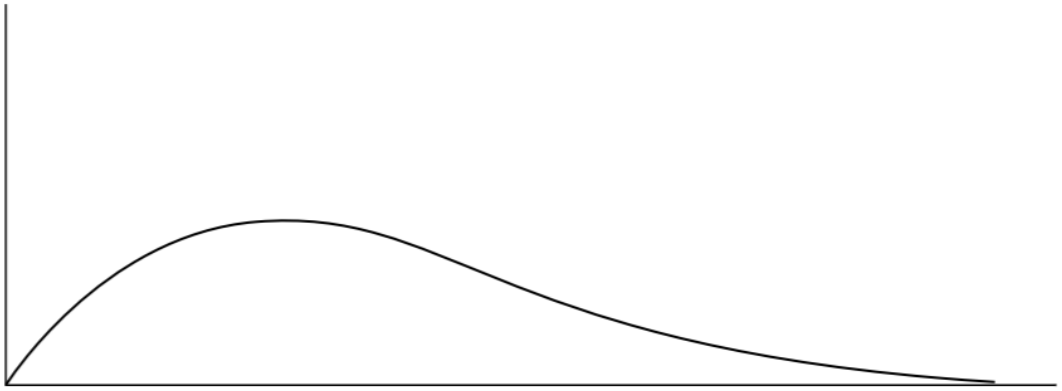
(1 mark)

2 The diagram below represents a Maxwell–Boltzmann distribution curve for the particles in a sample of a gas at a given temperature. The questions below refer to this sample of particles.



(a) Label the axes on the diagram. *(2 marks)*

(b) On the diagram draw a curve to show the distribution for this sample at a **lower** temperature. *(2 marks)*

(c) In order for two particles to react they must collide. Explain why most collisions do not result in a reaction.

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(1 mark)

(d) State one way in which the collision frequency between particles in a gas can be increased without changing the temperature.

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(1 mark)

(e) Suggest why a small increase in temperature can lead to a large increase in the reaction rate between colliding particles.

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(2 marks)

(f) Explain in general terms how a catalyst works.

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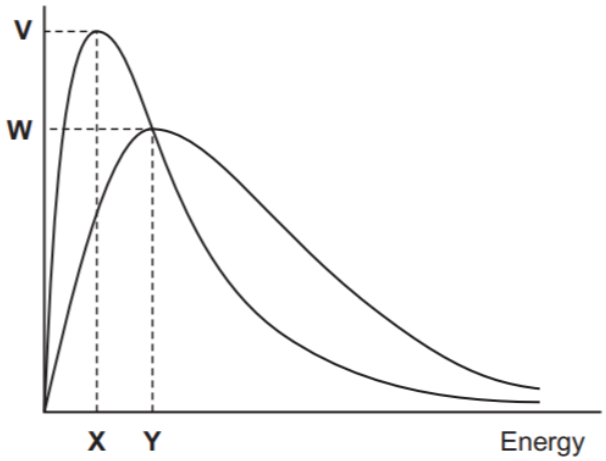
(2 marks)

3 The diagram shows the Maxwell–Boltzmann distribution of molecular energies in a gas at two different temperatures.



(a) One of the axes is labelled. Complete the diagram by labelling the other axis.

(1 mark)

(b) State the effect, if any, of a solid catalyst on the shape of either of these distributions.

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(1 mark)

(c) In the box, write the letter, **V**, **W**, **X** or **Y**, that represents the most probable energy of the molecules at the lower temperature.

(1 mark)

(d) Explain what must happen for a reaction to occur between molecules of two different gases.

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(2 marks)

(e) Explain why a small increase in temperature has a large effect on the initial rate of a reaction.

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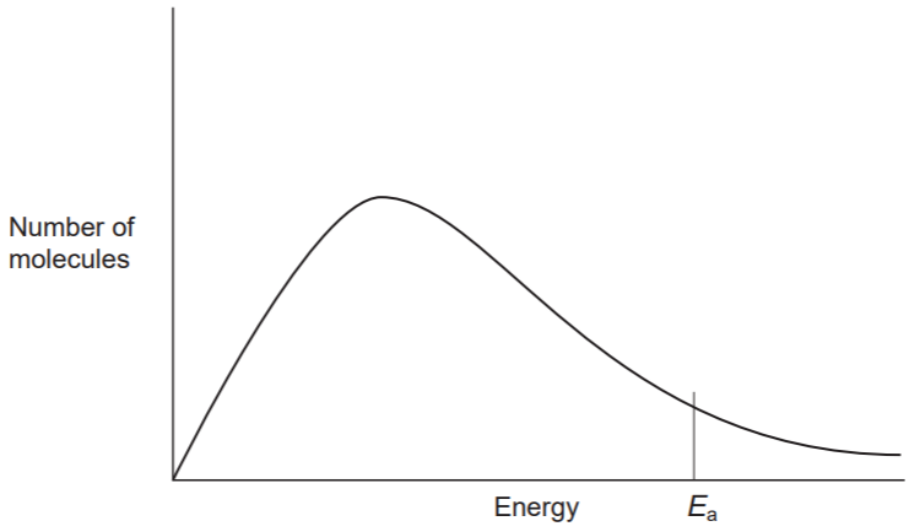
(1 mark)

4 The diagram shows the Maxwell–Boltzmann distribution for a sample of gas at a fixed temperature.
E_a is the activation energy for the decomposition of this gas.



E_{mp} is the most probable value for the energy of the molecules.

(a) On the appropriate axis of this diagram, mark the value of E_{mp} for **this** distribution.

On this diagram, sketch a new distribution for the same sample of gas at a **lower** temperature.

(3 marks)

(b) With reference to the Maxwell–Boltzmann distribution, explain why a decrease in temperature decreases the rate of decomposition of this gas.

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(2 marks)