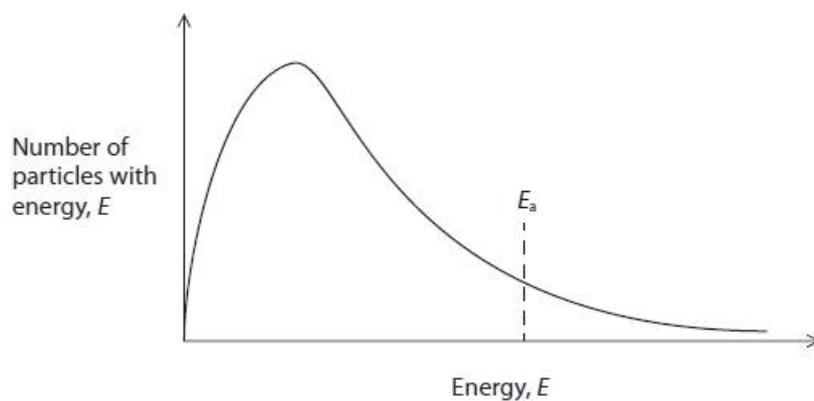**Questions**

Q1.

This question is about the oxidation of ammonia.

The diagram shows a Maxwell-Boltzmann distribution of particle energies, including the activation energy, E_a , for a reaction.

(1)

An increase in temperature will

(1)

☒ **A**   increase the area under the curve.
☒ **B**   move the peak of the curve to the right.
☒ **C**   raise the height of the peak.
☒ **D**   move the position of the activation energy, E_a , to the left.

(Total for question = 2 marks)

Q2.

Answer the question with a cross in the box you think is correct ⊠. If you change your mind about an answer, put a line through the box ⊠ and then mark your new answer with a cross ⊠.

This question is about reaction kinetics.

The best way to describe the activation energy of a reaction is

(1)

☒ **A**   the average energy of the particles when they react

☒ **B**   the difference in energy between the reactants and the products

☒ **C**   the minimum energy required to make the particles collide

☒ **D**   the minimum energy required for a reaction to occur

(Total for question = 1 mark)

Q3.

Answer the questions with a cross in the boxes you think are correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

This question is about reaction kinetics.

The diagrams show two reaction profiles for the same reversible reaction involving gaseous reactants.

Shown on each diagram are the reaction profiles for the pathway without a catalyst and the pathway catalysed by a heterogeneous catalyst.
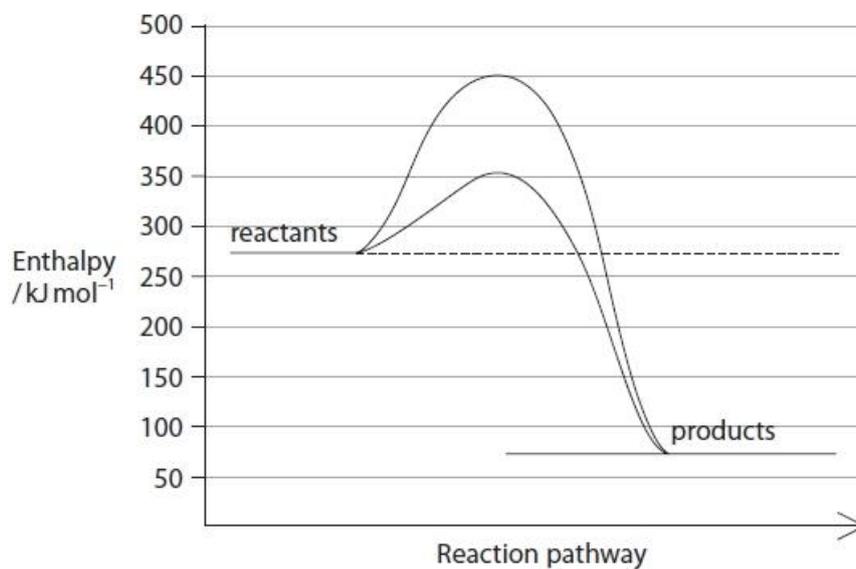
(i) In which diagram does the arrow represent the activation energy for the backward reaction when a catalyst is present?

(1)
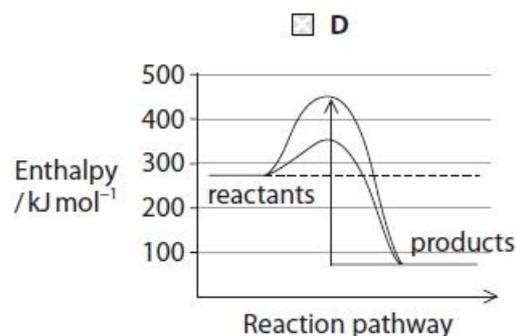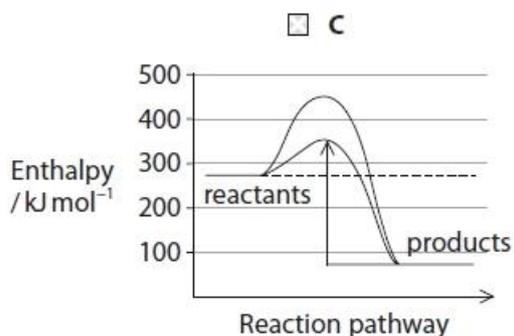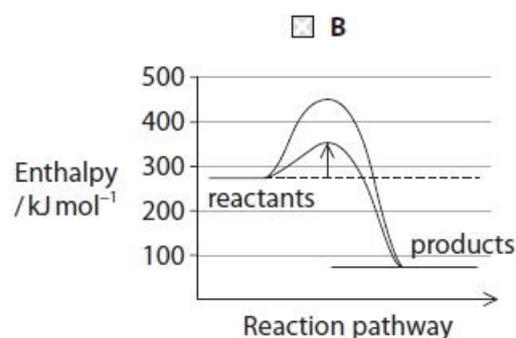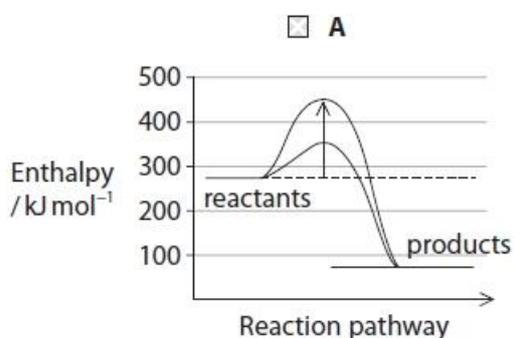
(ii) Estimate, using the diagram, the **decrease** in the activation energy for the forward reaction when a catalyst is added.
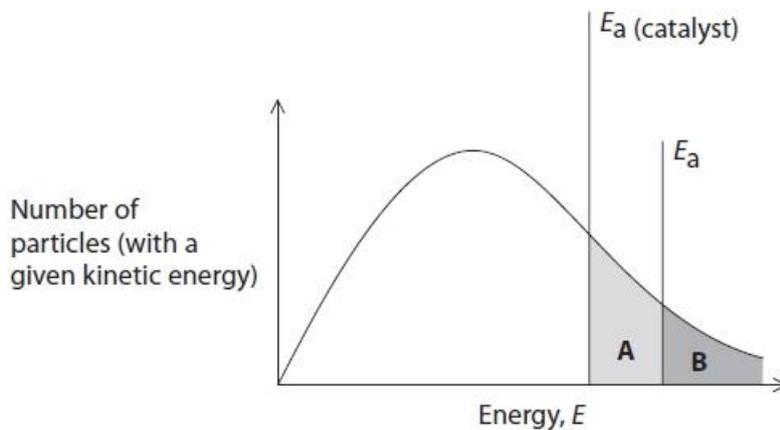
(1)

☒ **A**   75 kJ mol⁻¹

☒ **B**   100 kJ mol⁻¹

☒ **C**   175 kJ mol⁻¹

☒ **D**   200 kJ mol⁻¹

(Total for question = 2 marks)

Q4.

This is a question about catalytic converters in car exhaust systems.

Which area in the Maxwell-Boltzmann distribution diagram represents the **increase** in the number of particles with sufficient energy to react in the presence of a catalyst?

(1)

☒ **A**   area A

☒ **B**   area B

☒ **C**   area A − area B

☒ **D**   area A + area B

(Total for question = 1 mark)

Q5.

This question is about reaction kinetics.

A heterogeneous catalyst is often added to a reaction between gases.

A heterogeneous catalyst

(1)

- ☒ **A**   increases the rate without taking part in the reaction
- ☒ **B**   increases the yield of the reaction at equilibrium
- ☒ **C**   is in the same phase as the reaction mixture
- ☒ **D**   is often a porous material, so increasing the surface area

(Total for question = 1 mark)

Q6.

This question is about how catalysts work.

Gaseous reactants attach to the catalytic surface by the process of

(1)

- ☒ **A**   absorption
- ☒ **B**   activation
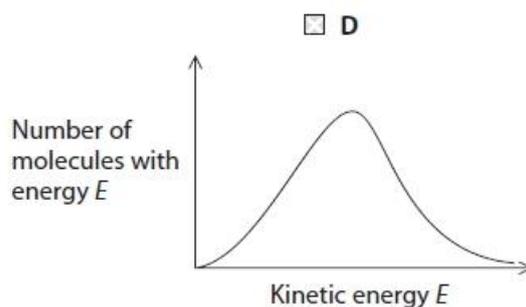- ☒ **C**   adsorption
- ☒ **D**   desorption
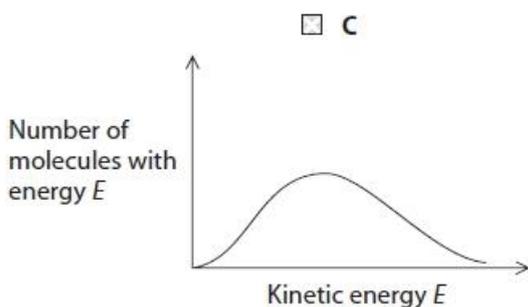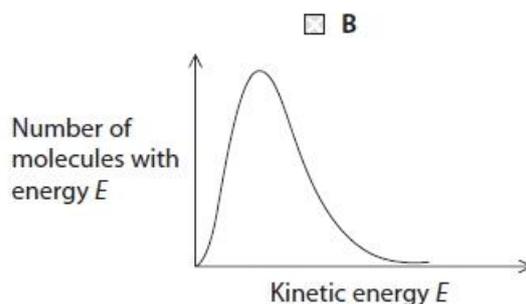
(Total for question = 1 mark)

Q7.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

The Maxwell-Boltzmann distribution of molecular energies for the reactant molecules in an uncatalysed reaction is shown.
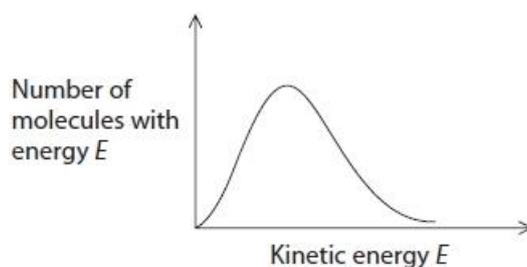
Which of these Maxwell-Boltzmann distributions would you expect for the same molecules in the presence of a catalyst at the same temperature and pressure?
All diagrams are drawn to the same scale.

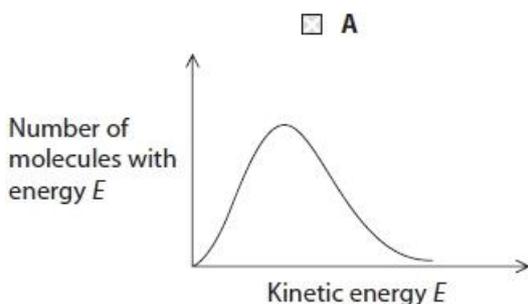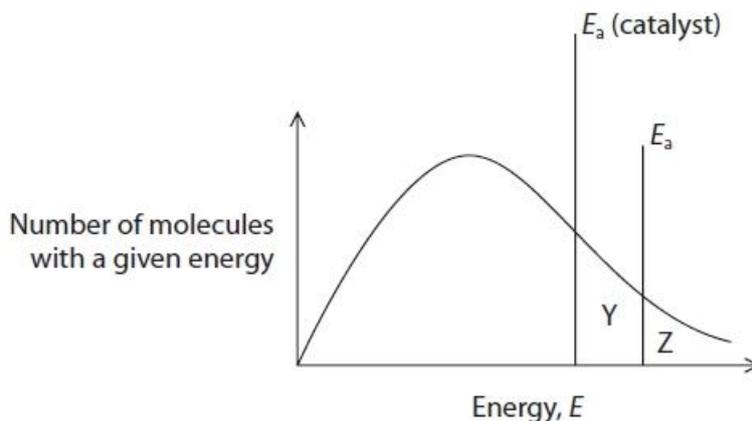**(Total for question = 1 mark)**

Q8.

Answer the questions with a cross in the boxes you think are correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

This question is about reaction kinetics.

The diagram shows a Maxwell-Boltzmann distribution of molecular energies for gaseous molecules.

(i) Which is the area of the graph corresponding to the number of molecules with sufficient energy to react when a catalyst is present?

(1)

☒ **A**　Y

☒ **B**　Y – Z

☒ **C**　Y + Z

☒ **D**　Z

(ii) Which would always result in a **decrease** in the number of molecules contained within area Y?

(1)

☒ **A**　decreasing the temperature of the gas

☒ **B**　increasing the pressure of the gas

☒ **C**　putting the gas in a smaller container

☒ **D**　removing a quarter of the catalyst

(Total for question = 2 marks)