

Name of the Student: _____

Max. Marks : 19 Marks

Time : 19 Minutes

Q1.

The rate of a chemical reaction is influenced by the size of the activation energy. Catalysts are used to increase the rates of chemical reactions but are not used up in the reactions.

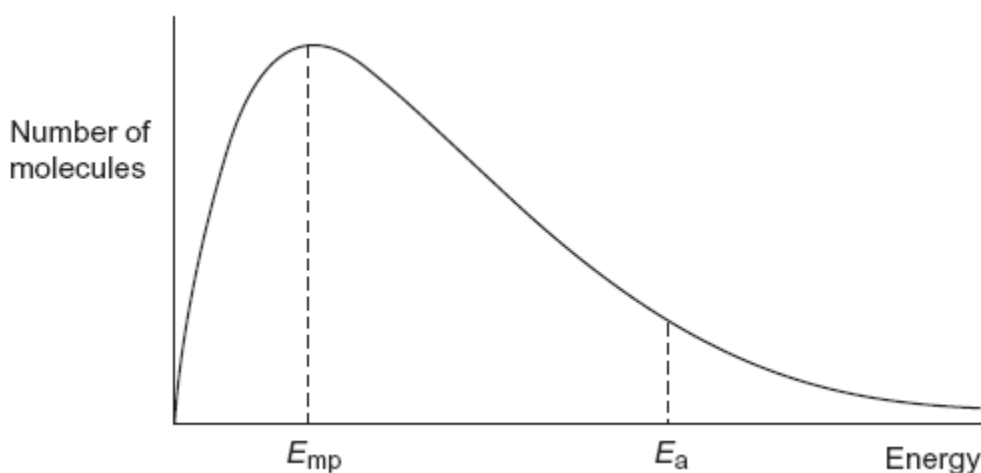
- (a) Give the meaning of the term *activation energy*.

(2)

- (b) Explain how a catalyst increases the rate of a reaction.

(2)

- (c) The diagram below shows the Maxwell–Boltzmann distribution of molecular energies, at a constant temperature, in a gas at the start of a reaction.
On this diagram the most probable molecular energy at this temperature is shown by the symbol E_{mp}
The activation energy is shown by the symbol E_a



To answer the questions (c)(i) to (c)(iv), you should use the words **increases**, **decreases** or **stays the same**. You may use each of these answers once, more than once or not at all.

- (i) State how, if at all, the value of the most probable energy (E_{mp}) changes as the total number of molecules is increased at constant temperature.

(1)

- (ii) State how, if at all, the number of molecules with the most probable energy (E_{mp}) changes as the temperature is decreased without changing the total number of molecules.

(1)

- (iii) State how, if at all, the number of molecules with energy greater than the activation energy (E_a) changes as the temperature is increased without changing the total number of molecules.

(1)

- (iv) State how, if at all, the area under the molecular energy distribution curve changes as a catalyst is introduced without changing the temperature or the total number of molecules.

(1)

- (d) For each of the following reactions, identify a catalyst and name the organic product of the reaction.

- (i) The fermentation of an aqueous solution of glucose.

Catalyst _____

Name of organic product _____

(2)

- (ii) The hydration of but-2-ene.

Catalyst _____

Name of organic product _____

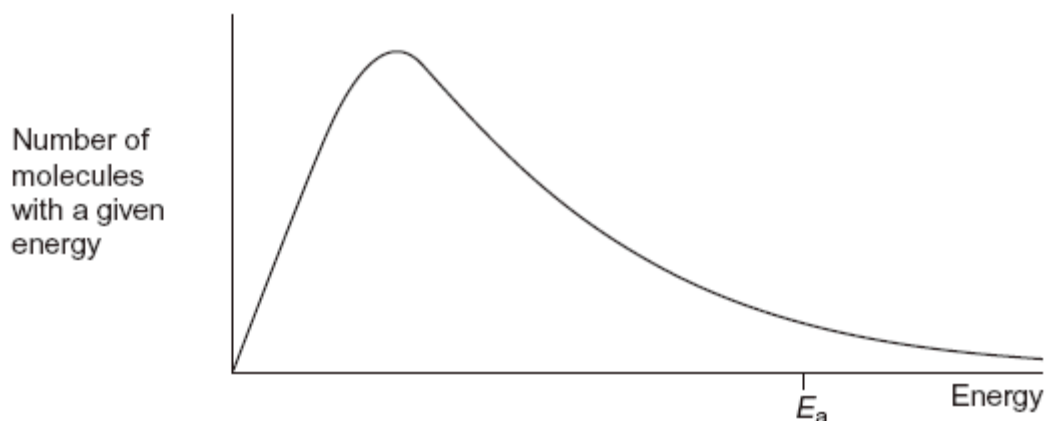
(2)

(Total 12 marks)

Q2.

The diagram below shows a Maxwell–Boltzmann distribution for a sample of gas at a fixed temperature.

E_a is the activation energy for the decomposition of this gas.



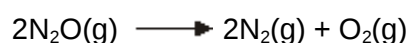
- (a) (i) On this diagram, sketch the distribution for the same sample of gas at a higher temperature.

(2)

- (ii) With reference to the Maxwell–Boltzmann distribution, explain why an increase in temperature increases the rate of a chemical reaction.

(2)

- (b) Dinitrogen oxide (N_2O) is used as a rocket fuel. The data in the table below show how the activation energy for the decomposition of dinitrogen oxide differs with different catalysts.



	$E_a / \text{kJ mol}^{-1}$
Without a catalyst	245
With a gold catalyst	121
With an iron catalyst	116
With a platinum catalyst	136

- (i) Use the data in the table to deduce which is the most effective catalyst for this decomposition.

(1)

(ii) Explain how a catalyst increases the rate of a reaction.

(2)

(Total 7 marks)