

# Reaction Rates

**DO NOT REMOVE**

## A. Potential Energy Diagrams

The potential energy of substances involved in a reaction can be plotted versus the progress of the reaction, as the process moves from initial reactants, through activated complex, to final products.

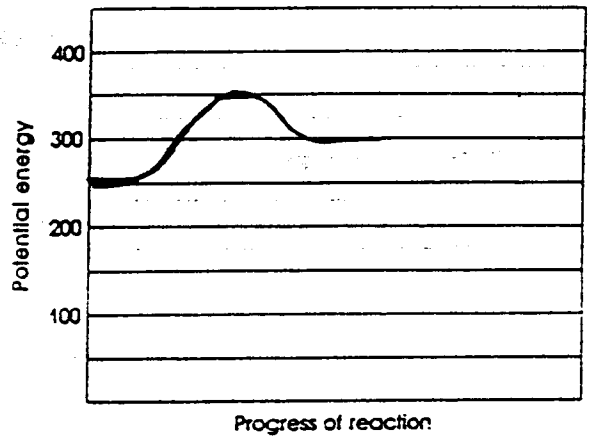
On the grids below, plot energy diagrams for 1-3 below, given the following information, and answer the questions. For number 4, study the energy diagram and answer the questions.

1. Potential energy of reactants: 250  
 Potential energy of activated complex: 350  
 Potential energy of products: 300

Is the reaction exothermic or endothermic? How can you tell?  
 What is the value of  $\Delta H$ ?

endothermic, products have more potential energy than reactants

$\Delta H = +50$



If a catalyst were added, what would happen to the diagram? What would happen to the energies of reactants, products, and activated complex, and to the rate? Explain the effect on the rate.

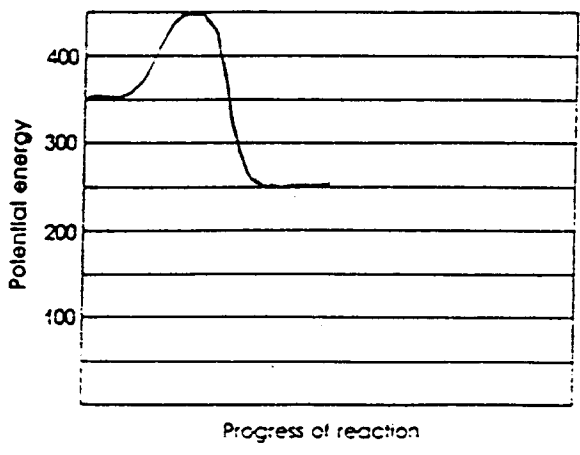
catalyst lowers the energy of the activated complex, more particles will have sufficient energy to react and the rate will increase. The energies of reactants and products will not change.

2. Potential energy of reactants: 350  
 Activation energy (energy needed to form activated complex from reactants): 100  
 Potential energy of products: 250

Is this reaction exothermic or endothermic? Why? What is the value of  $\Delta H$ ?

exothermic, the products have less potential energy than reactants.

$\Delta H = -100$



What is the potential energy of the activated complex? 450

If the concentration of the reactants were increased, what would happen to the diagram? What would happen to the energies of reactants, products, and activated complex, and to the rate?

Explain the effect on the rate. Increasing the concentration would not change the diagram or the energies of reactants, products, or activated complex. The rate would increase because more particles could be available to collide!

3. Potential energy of reactants: 200  
 Potential energy of activated complex: 400

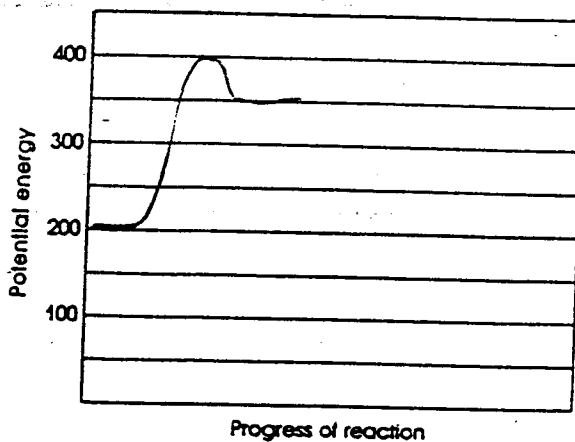
$\Delta H = +150$

Is this reaction exothermic or endothermic? Why?

endothermic,  $\Delta H$  is positive

What is the potential energy of the products? \_\_\_\_\_

350



What is the activation energy? 200

If temperature were increased, what would happen to the diagram? What would happen to the energies of reactants, products, and activated complex, and to the rate? Explain the effect on the rate.

The diagram, energies of reactants, products and activated complex would be unchanged. The rate would increase because more particles would have enough kinetic energy to form the activated complex.

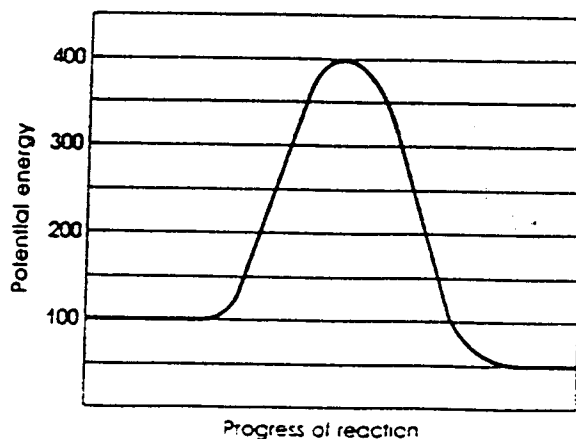
4. Potential energy of reactants: 100

Potential energy of activated complex: 400

Activation energy: 300

Potential energy of products: 50

$\Delta H$ : -50



Is the reaction exothermic or endothermic? Why? Exothermic, the products have less potential energy than the reactants

complex, and to the rate. Explain the effect on the rate.

The energies would be unchanged but the rate would decrease. Inhibitors decrease the concentration of reactants, decreasing collision frequency + rate

DO NOT REMOVE!!

## B. Factors Affecting Rate

The rates of chemical reactions depend upon a number of factors. These factors can be controlled by scientists in order to cause processes to proceed at desired rates. For each of the following factors, write its probable effect (increase, decrease, no effect) on rate, and then explain the effect on the basis of collision theory.

FACTOR	EFFECT ON RATE	EXPLANATION
decreased concentration	<u>decreased</u>	<u>lower collision frequency</u>
increased gas pressure	<u>increased</u>	<u>greater collision frequency</u>
decreased temperature	<u>decreased</u>	<u>lower kinetic energy, fewer particles with exceed the energy threshold</u>
decreased surface area	<u>decreased</u>	<u>lower collision frequency</u>
addition of catalyst	<u>increased</u>	<u>introduces alternate mechanism requiring a lower activation mechanism</u>
addition of inhibitor	<u>decreased</u>	<u>see above</u>