Potential Energy Diagrams

Name_____

Date: _____Period_____

Part I: Potential Energy Diagrams

The energy changes involved in chemical reactions can be conveniently examined using potential energy diagrams. The total potential energy of all the reactants in the reaction is illustrated at the left of the diagram, the total potential energy of the products is at the right side, and the activation energy change or changes are illustrated in between.

On the grids below, plot energy diagrams illustrating the reactions decribed at left.

Reaction 1:

Potential energy of reactants = 250 KJ

Potential energy of activated complex = 350KJ

Potential energy of products = 300KJ

Is this reaction exothermic or endothermic?

How can you tell?

What is the value of ΔH for this reaction?

P.E. (KJ)

400

300

200

100

0

Progress of reaction

What is the activation energy for this reaction?

In the presence of a catalyst for this reaction, how would the diagram change? Explain which of the following would be changed, and how: energy of reactants, energy of products, energy of activated complex, rate of reaction.
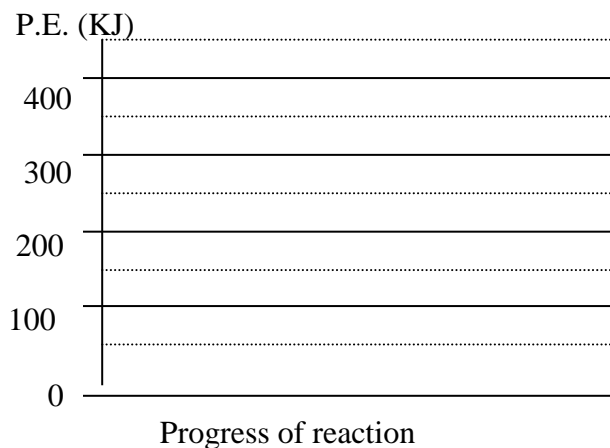
Reaction 2:

Potential energy of reactants = 350KJ

Activation energy = 100KJ

Potential energy of products = 250KJ

Is this reaction exothermic or endothermic?

How can you tell?

What is the value or ΔH for this reaction?

P.E. (KJ)

400

300

200

100

0

Progress of reaction

What is the energy of the activated complex for this reaction?

Suppose the concentrations of reactants were increased. Explain which of the following would be changed, and how: energy of reactants, energy of products, energy of activated complex, rate of reaction.

Reaction 3:
Potential energy of reactants = 200 KJ
Potential energy of activated complex = 400KJ
ΔH = +150KJ

Is this reaction exothermic or endothermic?

How can you tell?

What is the energy of products for this reaction?

What is the activation energy for this reaction?

P.E (KJ)

400

300

200

100

0

Progress of reaction

Reaction 4:
Potential energy of reactants =
Potential energy of activated complex =
Potential energy of products =

Is this reaction exothermic or endothermic?

How can you tell?

What is the value of ΔH for this reaction?

What is the activation energy for this reaction?

P.E. (KJ)

400

300

200

100

0

Progress of reaction
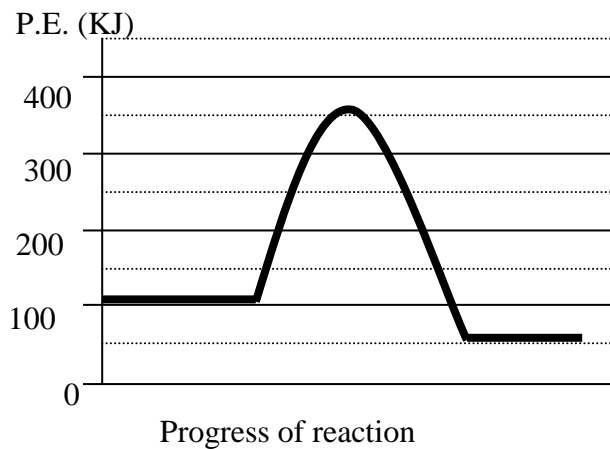
Selected Answers:

Rxn 1: Endothermic…products at higher PE than reactamts. $\Delta H = + 50$ kJ, $E_a = 100$kJ. With catalyst, E_a would be less, increasing the rate of reaction.

Rxn 2: exothermic…products at lower PE. $\Delta H = -100$kJ, PE of activated complex = 450kJ. Conc. Changes would affect the rate only. Rxn 4 (next page): PE of reactants = 100kJ, of activated complex = 350kJ, of products = 50kJ. $\Delta H = -50$kJ, $E_a = 250$kJ