I. KINETICS AND EQUILIBRIUM	
Knowledge	**Application**
○ The **Collision Theory** states that a chemical reaction is most likely to occur if **reactant particles** collide with the proper energy and orientation.	
○ The **rate** (speed) of a chemical reaction depends on several factors: temperature, concentration, nature of reactants, surface area, and the presence of a **catalyst**. ○ Ionic compounds generally react faster than covalent (molecular) compounds ○ A catalyst provides an alternate reaction pathway, which has lower **activation energy** than an uncatalyzed reaction.	○ Use the Collision Theory to explain how factors such as temperature, surface area, and concentration influence the rate of reaction *Ex: Increasing the temperature, surface area, or concentration all lead to an increase in the rate of a reaction because they all increase the **number of effective collisions between reactant particles**.* ○ Explain, in terms of the number of bonds broken, why ionic compounds generally react faster than covalent compounds ○ Explain how a catalyst speeds up a reaction
○ Energy released or absorbed during a chemical reaction can be represented by a **potential energy diagram**. ○ The difference in PE of the products and reactants is called the **heat of reaction (ΔH)** ΔH = PE products – PE reactants ○ ΔH values for many chemical reactions are listed in Table I	○ Read and interpret a potential energy diagram ○ Draw and label the following parts of a potential energy diagram for both an endothermic and exothermic reaction € PE of reactants and PE of products € heat of reaction (ΔH) € activation energy (for both the **forward and reverse reactions**) € activation energy with a catalyst present
○ At equilibrium, the rate of the **forward reaction** equals the rate of the **reverse reaction** and the measurable quantities of reactants and products remain constant at equilibrium	○ Describe what is happening to the concentrations or amounts of reactants and products in a system at equilibrium ○ Describe the rates of opposing reactions in a system at equilibrium
○ **LeChatelier's principle** can be used to predict the effect of a **stress** (such as a change in pressure, volume, concentration, or temperature) on a system at equilibrium. ○ According to LeChatelier's principle, a system at equilibrium will "**shift**" to reduce the effects of a stress placed on the system. It will "shift" AWAY from an INCREASE and will "shift"*toward* a *decrease* in concentration or temperature ("shift" means that either the forward or the reverse reaction will be "**favored**" (go *faster*) until the rates are again equal and equilibrium is re-established). ○ Changing the pressure or volume only affects systems that contain gases	○ Describe, in terms of LeChatelier's principle, the effects of stress on a given system at equilibrium, including: € Changing the temperature/heating/cooling € Changing the concentration of a reactant or product € Changing the pressure or volume (this affects systems involving gases) ○ Also be able to explain why any shifting occurs in terms of Collision Theory
○ **Systems in nature tend to undergo changes toward lower energy**	

Name: _____ **Date:** _____

Chemistry ~ *Ms. Hart* **Class:** Anions or Cations

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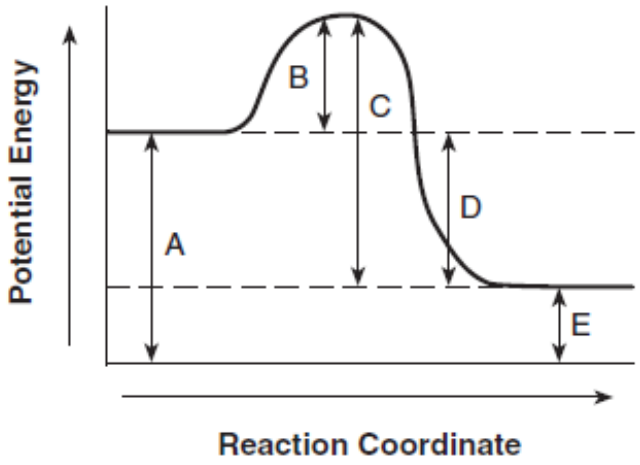
7.6 REVIEW

The chemical reaction between methane and oxygen is represented by the potential energy diagram and balanced equation below.



$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell) + 890.4\ kJ$$

60 Which potential energy interval in the diagram represents the activation energy of the forward reaction? [1]

61 Explain, in terms of collision theory, why a lower concentration of oxygen gas *decreases* the rate of this reaction. [1]

Several steps are involved in the industrial production of sulfuric acid. One step involves the oxidation of sulfur dioxide gas to form sulfur trioxide gas. A catalyst is used to increase the rate of production of sulfur trioxide gas. In a rigid cylinder with a movable piston, this reaction reaches equilibrium, as represented by the equation below.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) + 392\ kJ$$

79 Explain, in terms of collision theory, why increasing the pressure of the gases in the cylinder increases the rate of the forward reaction. [1]

80 Determine the amount of heat released by the production of 1.0 mole of $SO_3(g)$. [1]

81 State, in terms of the concentration of $SO_3(g)$, what occurs when more $O_2(g)$ is added to the reaction at equilibrium. [1]

For #79, you need to use the words: collisions, reaction rate and concentration in your answer!