Homework 6 Answer Key

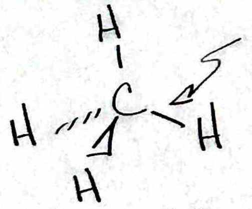
Chapter 6 - 25, 26, 29, 31, 33, 38, 39, 41, 43, 45, 46, 47, 49, 52, 53, 55, 59, 63, 71, 72, 73, 74, 75, 77, 81, 85, 86, 87, 89, 95, 97.

26) What is the difference between a calorie and a Calorie?

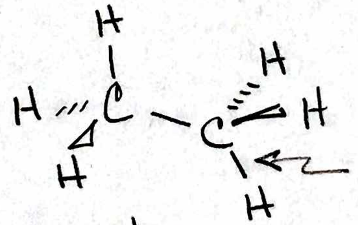
1 Calorie = 1000 calorie = 1 kcalorie

w/ 1 calorie = amount of energy required to raise 1g H_2O 1°C.

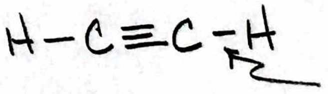
38) Using the given bond dissociation energies, rank the indicated bonds in order of increasing strength.



ΔH = 104 kcal/mole

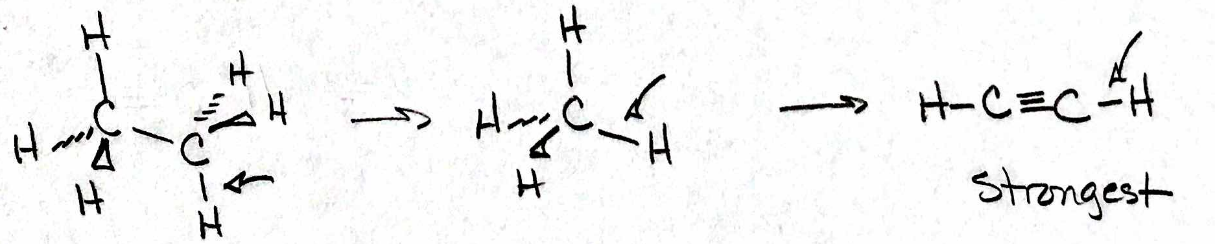


ΔH = 98 kcal/mole



ΔH = 125 kcal/mole

Bond dissociation energy is the energy required to break a chemical bond. The higher the energy, the stronger the bond.



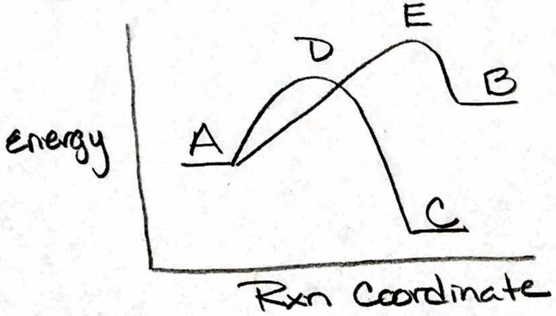
Weakest
98 kcal/mole

104 kcal/mole

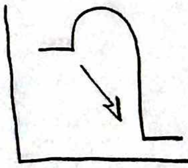
Strongest

125 kcal/mol

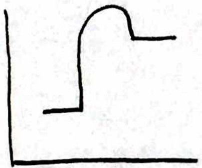
46) Compound A can be converted to either B or C. The energy diagrams for both processes are drawn on the graph below



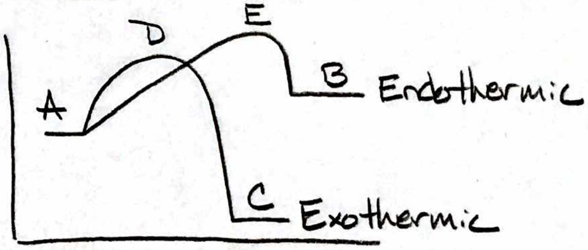
a. Label each rxn as exothermic or endothermic.



Exothermic

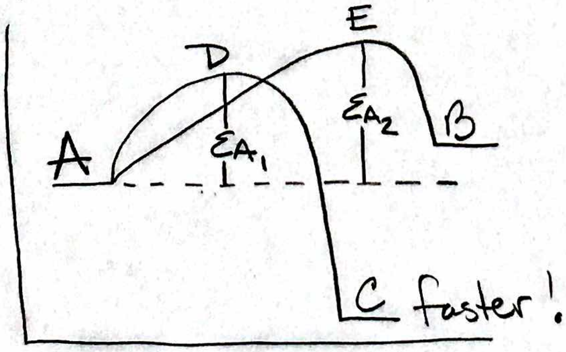


Endothermic



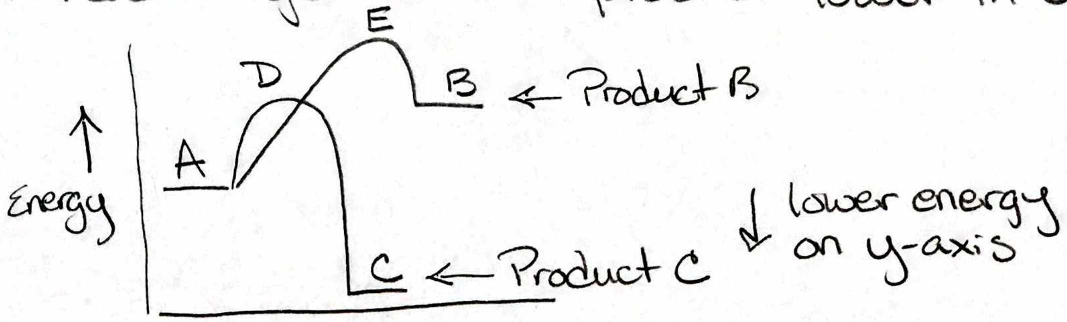
b. Which rxn is faster?

Reaction rate is inversely proportional to the E_A. Rate $\propto \frac{1}{E_A}$ Highe E_A means slower rate. Smaller E_A means faster rate



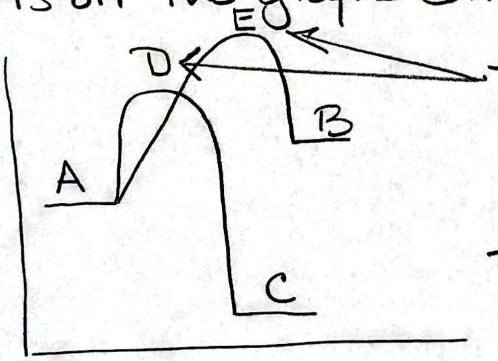
E_A is measured from ‡ to reactant A for both rxns. Because $E_{A_1} < E_{A_2}$, the reaction of A → C will be faster.

46) c. Which reaction generates a product lower in energy?



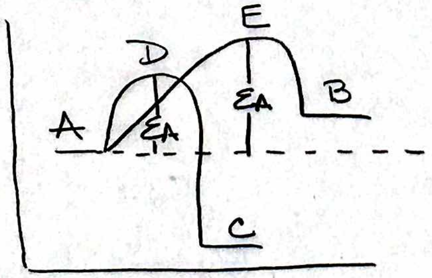
Product C is lowest in energy.

d. Which points on the graphs correspond to transition states?



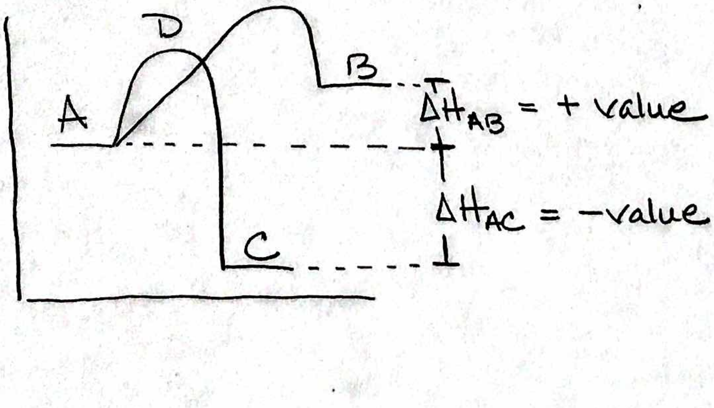
The top of the curve is called the transition state (‡). Points E & D are the transition states.

e. Label the energy of activation for each reaction.



The energy of activation E_A is measured from the ‡ to A.

f. Label ΔH for each reaction.



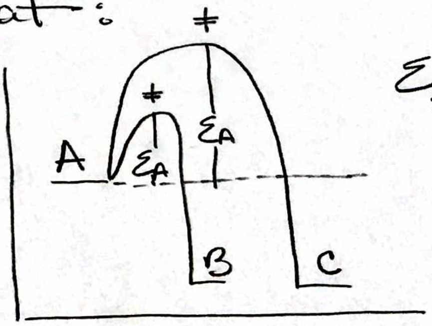
$\Delta H = H_{product} - H_{reactant}$

$\Delta H_{AB} = H_B - H_A = +$

$\Delta H_{AC} = H_C - H_A = -$

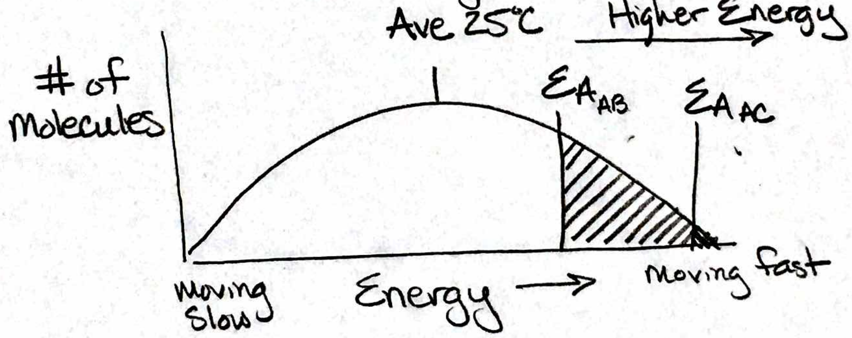
52) Explain whay a higher energy of activation causes a reaction to be slow.

Let's consider two reactions with different activation energies $A \rightarrow B$ & $A \rightarrow C$ such that:



$E_{A_{AB}} < E_{A_{AC}}$

Now let's look at those E_A values on a distrobution of molecules A for a given Sample at 25°C



Molecules to the right of $E_{A_{AB}}$ ▨ have the required energy to go through the rxn and produce B. However, only molecules to the right of $E_{A_{AC}}$ ◢ Can form C.

- More molecules with required energy = more Sucessful Collisions.
- More Collisions = faster rate!

Therefore lower E_A means more molecules have required energy, more sucessful collisions and faster rate.

72) Write an expression for the equilibrium constant for each reaction.

a. $HBr + H_2O \rightleftharpoons H_3O^{\oplus} + Br^{\ominus}$

$$k = \frac{[H_3O^{\oplus}][Br^{\ominus}]}{[HBr][H_2O]}$$

b. $2\,HCl \rightleftharpoons H_2 + Cl_2$

$$k = \frac{[H_2][Cl_2]}{[HCl]^2}$$

The general form of the equilibrium expression is:

$$aA + bB \rightleftharpoons cC + dD$$

$$k = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

74) Use each expression for the equilibrium constant to write a chemical equation.

a.

$$k = \frac{[AB_2]^{2 \leftarrow \text{Coefficient}}}{[A_2][B_2]^{2}} \leftarrow \text{Coefficient} \quad \text{Always} \ \frac{\text{Products}}{\text{Reactants}}$$

$$A_2 + 2B_2 \rightleftharpoons 2AB_2$$

b.

$$k = \frac{[A_2B_3]}{[A]^2[B]^3}$$

$$2A + 3B \rightleftharpoons A_2B_3$$

86) Consider the exothermic reaction

$$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$$

What effect does each of the following changes have on the direction of equilibrium?

a. Decrease HI

⇒ Reaction will shift to make more HI

⇒ Shift towards products

b. Increase H_2

⇒ Reaction will shift to remove H_2

⇒ Shift towards products

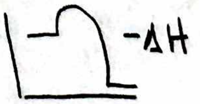
c. Decrease I_2

⇒ Reaction will shift to make more I_2

⇒ Shift towards reactants

d. Increase temp

⇒ Rxn exothermic



⇒ Rxn will shift to lower heat

⇒ Rxn shifts to reactants

e. Decrease temp

⇒ Rxn will shift to increase heat

⇒ Rxn will shift to products

86) f. Increase Pressure

$$\underbrace{H_{2(g)} + I_{2(g)}}_{\text{2 moles gas}} \longrightarrow \underbrace{2\,HI_{(g)}}_{\text{2 moles gas}}$$

Because there are the same number of moles of gas on both sides of equation, changing pressure has no effect on the equilibrium. The reaction cannot shift to relieve the pressure, so there is no net effect.