Name:_____ per:___

Worksheet- Reaction Rates

Use this reaction for the questions below: **$C_6H_{12}O_6$ (s) + 6 O_2(g) → 6 H_2O (g) + 6 CO_2 (g)**

1. What happens to the concentrations of:
   a. $C_6H_{12}O_6$ & O_2 as the reaction proceeds →? decreases
   b. H_2O + CO_2 as the reaction proceeds →? increases

2. According to the collision theory, what **3** circumstances are needed for $C_6H_{12}O_6$ & O_2 to react?
the particles must collide, they must collide with sufficient kinetic energy, and they must collide in the correct orientation

3. What is the **activation energy** for a chemical reaction?
it is the amount of kinetic energy needed for a reaction to occur between particles

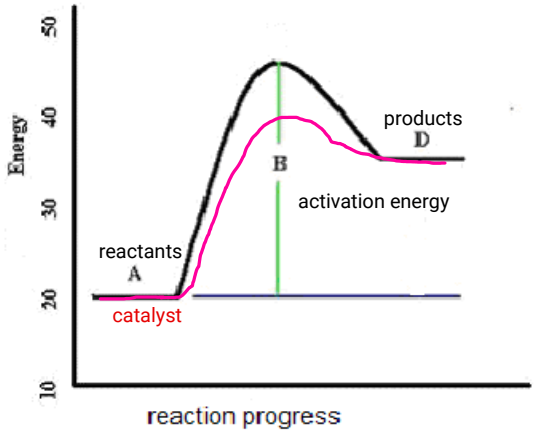
4. Use the equation & the **collision theory** to explain:

$C_6H_{12}O_6$ (s) + 6 O_2(g) → 6 H_2O (g) + 6 CO_2 (g)

Change in condition:	Does this **increase** or **decrease** the rate of reaction?	Explain why
a. **Increasing the temperature**	Ex: Increases (speeds up)	Ex: Molecules move faster & collide more = Increased rxn rate
b. **Increasing the concentration** of $C_6H_{12}O_6$	increase	more particles will collide - increased rate
c. **Decreasing the concentration** of O_2	decrease	less particles will collide - decreased rate
d. **Increase the surface area** by chewing up food in your mouth	increase	more area for the reaction to occur
e. **Decreasing the temperature**	decrease	particles will have less kinetic energy
f. **Increasing the pressure** in the container	increase	more collisions will occur
g. **Decreasing the concentration** of H_2O	decrease	less collisions will occur
h. **Increasing the volume** of the container the reaction occurs in	decrease	collisions will occur less frequently
i. **Increasing the concentration** of CO_2	increase	more collisions occur/they will happen more often
j. **Using a catalyst** (like salivary amylase)	increase	will lower the minimum activation energy

5. **On** the accompanying energy diagram, **label** the following terms:
   a. reactants b. products c. activation energy

6. On the graph to the right, **draw** and **label** what this diagram would look like if a **catalyst** was added to the reaction.



7. Graph reading
   a. How much energy (#) do the reactants have?
   20 units of energy
   b. How much energy (#) do the products have?
   roughly 35 units of energy
   c. How much energy (#) is required to activate this un-catalyzed reaction?
   roughly 45 units of energy
   d. Is this reaction endothermic or exothermic? How do you know?
   this reaction is endothermic because the products having more energy than the reactants --> showing that energy was **absorbed**

Equilibrium & Le Chatelier's Principle

1. What 2 characteristics define a system at equilibrium?

   when there are balanced products and reactants, and when there is no change in things like pressure or temperature

2. What 3 factors are considered to be stresses on an equilibrium system?

   a change in the amount of **reactants/products,** a change in **temperature,** and a change in **pressure/concentration**

3. According to Le Chatelier, how does a system at equilibrium respond to a stress?

   by making an adjustment or **shift** to restore equilibrium

4. Complete the chart below: **Reaction**	**Products** of → (forward) reaction	**Products** of ← (reverse) reaction	Is the → (forward) reaction **endothermic/ exothermic?**
a. **CH_4 + O_2 <--> CO_2 + H_2O + heat** (890.3 kJ)	CO2 + H2O + heat	CH4 + O2	exothermic
b. **NaCl (s) + heat <--> Na^+ + Cl^-**	Na + Cl	NaCl (s) + heat	endothermic
c. **H_2O(l) + heat <--> H_2O(g)**	H2O(g)	H2O(l) + heat	endothermic

Using Le Chatelier's principle, predict how each of the changes would affect the equilibrium systems
Ex: **Shifts to right (towards products), shifts to left (towards reactants), or No change occurs**

5. **N_2(g) + 3 H_2(g) <--> 2 NH_3(g) + 92 kJ**	6. **CH_3OH (l) + 18 kJ <--> CO (g) + 2 H_2 (g)**
a. Stress: Adding extra H_2 Relief: use excess H_2 How: Shifts →	a. Stress: Adding CO Relief: use excess CO How: shift <--
b. Stress: Extra NH_3 (ammonia) is added Relief: use excess NH3 How: shift <--	b. Stress: Removing heat Relief: produce more CH3OH How: shift <--
c. Stress: Adding extra N_2 Relief: use excess N2 How: shift ->	c. Stress: Removing CH_3OH Relief: produce more CH3OH How: shift <--
d. Stress: Removing H_2 Relief: produce more H2 How: shift <--	d. Stress: Decrease the volume of the container Relief: produce more products How: shift -->
e. Stress: The pressure is increased Relief: produce more NH3 How: shift -->	e. Stress: Adding Heating Relief: produce more reactants How: shift <--
f. Stress: Increase the volume of the container Relief: produce more N2 and H2 How: shift <--	f. Stress: Decreasing the pressure Relief: produce more reactants How: shift <--
g. Stress: Heating the system Relief: produce more N2 ands H2 How: shift <--	g. Stress: Removing H_2 Relief: produce more H2 How: shift -->

7. **C_2H_4 (g) + H_2 (g) <--> C_2H_6 (g) + heat**

What stresses would force the reaction to **shift → (to the right)?**

a) Pressure (increase/decrease):

pressure **increase**

b) Temperature:

temperature **decrease**

c) Concentrations (of **C_2H_6, C_2H_4, H_2**)

increase c2h4 and h2
decrease c2h6