Thermochem and Collision theory Study Guide

What is enthalpy? (define it and indicate its symbol)

What is thermochemistry?

What is an exothermic reaction?

Explain why an exothermic reaction have a negative enthalpy change?

What is an endothermic reaction?

Explain why an endothermic reaction have a positive enthalpy change?

Complete the following chart:

<table>
<thead>
<tr>
<th>Type of Reaction</th>
<th>Sign of $\Delta H_{rxn}$</th>
<th>Which has more energy: reactants or products?</th>
<th>What temperature change would you see?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exothermic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endothermic</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Make enthalpy diagrams for the two chemical reactions from above, showing clearly the amount of energy released or gained.

Exothermic Change

Endothermic Change

Does the energy go from the surrounding to the chemicals or from the chemicals to the surroundings in an exothermic reaction?

Does the energy go from the surrounding to the chemicals or from the chemicals to the surroundings in an endothermic reaction?

Classify each of the following as an exothermic or endothermic process.

Melting ice cubes ________________ Baking Bread ________________

Burning a candle ________________ Splitting a gas molecule apart ________________

Evaporation of water ________________ Formation of snow in clouds ________________

What type of reactions are the following based on the enthalpy?

$C + H_2O \rightarrow CO + H_2 \quad \Delta H_{rxn} = +113 \text{ kJ}$

$2H_2O_2 \rightarrow 2H_2O + O_2 \quad \Delta H = -190 \text{ kJ}$

$6CO_2 + 6H_2O + 2803 \text{ kJ} \rightarrow C_6H_{12}O_6 + 6O_2$

$3NO_2 + H_2O \rightarrow 2HNO_3 + NO + 138 \text{ kJ}$

$P_4 + 5O_2 \rightarrow 3013 \text{ kJ} + P_4O_{10}$
For the following energy diagrams, indicate if the reactions are endothermic or exothermic, label the activation energy, the enthalpy change, reactants and products on the graph and then answer the questions about each one.

How much activation energy is required for this reaction?

What is the enthalpy change for this reaction?

Draw Energy diagrams for the following reactions. Make sure to label reactants, products, activation energy, and enthalpy change. And to label and scale the axes.

\[2\text{SO}_3 + 800 \text{kJ} \rightarrow 2\text{S} + 3\text{O}_2\]

activation energy = 950 kJ
enthalpy of reactants: 200 kJ

\[\text{NO} + \text{O}_3 \rightarrow \text{NO}_2 + \text{O}_2 \quad \Delta H = -199 \text{kJ}\]

Activation energy = 100 kJ
Enthalpy of reactants = 450 kJ
Collision Theory

The collision theory states that *(fill in the spaces)*:
For a reaction to occur the reactant particles need to ________________. For the collision to be effective, these ________________ must occur with greater energy than the ________________ for the reaction, AND, the colliding molecules must be in the proper _________________.

The rate of a reaction can be increased by four factors *(list them below)*:

1) __________________________________________________
2) __________________________________________________
3) __________________________________________________
4) __________________________________________________

For each scenario below, state which factor is being changed to alter the reaction rate.
(a) Firewood is chopped into small pieces to make lighting a fire easier.

(b) A black powder called manganese dioxide causes hydrogen peroxide to decompose faster than normal. The powder is not used up during the reaction.

(c) Food left in the fridge lasts longer than food left out.

(d) Coal dust can cause explosions.

(e) A 1cm piece of magnesium ribbon takes longer to react and disappear in 20mL of 2 mol L⁻¹ HCl mixed with 20mL water, than it does in 40mL of 2 mol L⁻¹ HCl.

Explain how temperature affects the rate of a reaction using collision theory:

Explain how surface area affects the rate of a reaction using collision theory:

Explain how concentration affects the rate of a reaction using collision theory:

Explain what a catalyst is and how a catalyst affects the rate of a reaction using collision theory:

Explain what is meant by the ACTIVATION ENERGY of a reaction and HOW it affects reaction rate.

Use the collision theory to explain the following observations:

(a) A piece of magnesium metal burns faster and brighter in a jar of pure oxygen that in air.

(b) In 2 M HCl, iron wool produces hydrogen gas faster than an iron nail of the same mass.
(c) Hydrogen peroxide takes longer to decompose when it is left in the fridge.

(d) A mixture of gasoline and oxygen does not combust until a spark is added.

(e) Marble chips (calcium carbonate) react slowly with ethanoic acid, whereas powdered calcium carbonate reacts vigorously with the same acid.

Show how the curve on the following enthalpy diagram would change with the addition of a catalyst:

Explain why collision one results in a reaction while collision two and three do not:

Collision one: effective

Collision two: ineffective

Collision three: ineffective: