

Name: _____

Date: _____

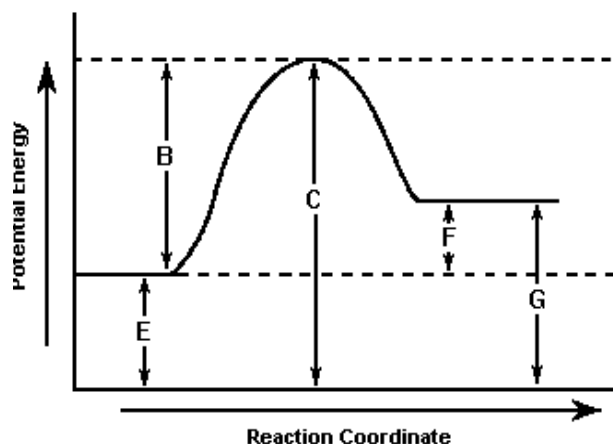
Heat of Reaction & Heat Measurement

Homework Unit 9 - Topic 2

Potential Energy (PE) Diagrams

Match a letter from the diagram to each description below:

1. _____ Bond Energy (PE) of the reactants
2. _____ Bond Energy (PE) of the products
3. _____ Bond Energy (PE) of the activated reactants
4. _____ Activation Energy
5. _____ Heat of Reaction ($\Delta H = \text{PE of products} - \text{PE of reactants}$)



6. Is the sign of ΔH in this reaction positive or negative? *Explain* how you know.

7. Is the PE diagram for an endo- or exothermic process? *Explain* how you know.

8. Sketch a dashed line on the diagram above to show how it would change if a CATALYST were used to assist the reaction.

9. Sketch an arrow on the diagram above to label the activation energy of the REVERSE reaction. Would the reverse reaction be endothermic or exothermic? *Explain* how you know.

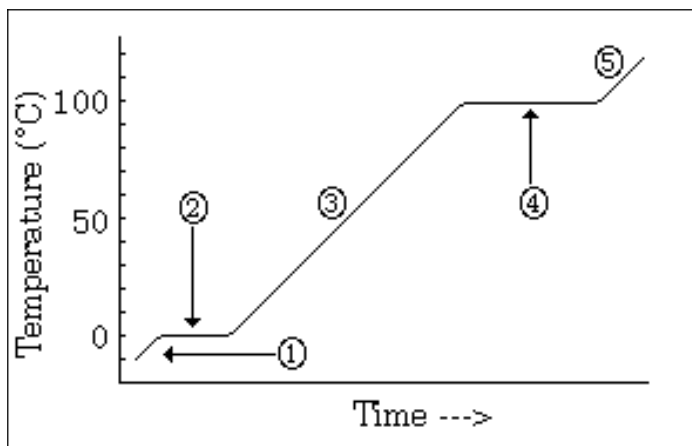
Name: _____

Date: _____

	Endothermic	Exothermic
Sketch PE Diagram		
Heat is written into the chemical equation on which side?		
ΔH value is (positive or negative?)		
Compound formed is (more or less?) stable than the reactants		
Surrounding area will feel...		

Heating Curves

What is the measured quantity implied when you hear the words 'average kinetic energy'?



- Based on the diagram:
 - What is the melting point temperature? _____
 - What is the boiling point temperature? _____
 - How do you know this substance is water? _____
- During section (3), what is it about the heating curve that tells you the 'average KE' of particles is increasing? _____
- What is the name of the process happening during section (4)? _____
- When a given quantity of water is heated at a constant rate, the phase change from liquid to a gas takes longer than the phase change from solid to liquid because
 - The heat of vaporization is less than the heat of fusion.
 - The heat of fusion is greater than the heat of vaporization.
 - It takes more energy to weaken intermolecular attractions than it does to overcome them.
 - It takes more energy to overcome intermolecular attractions than it does to weaken them.

Name: _____

Date: _____

Heat Calculations

1. How much heat (q) is required to raise the temperature of 186 grams of water from 36°C to 48°C ?
2. How much heat is liberated (given off) when 37 grams of water cools from 87°C to 59°C ?
3. If 187 joules of heat are added to 15 grams of water, what is the temperature change observed?
4. If 27.0 grams of a material increases in temperature by 6°C when 182 joules of heat is added, what is the specific heat of the material?
5. A flask containing molecules of gas A and a separate flask containing molecules of gas B are both at the same temperature. Molecules of gases A and B must have equal
 - (1) volumes
 - (2) masses
 - (3) pressures
 - (4) average kinetic energies

Name: _____

Date: _____

Advanced uses of Table I

*Helpful hint at the bottom of Table I!!

Task: Number the reactions in Table I as #1-25, from top to bottom.

Use #1: Identify a reaction as endothermic or exothermic using the sign of the ΔH value.

Reactions #1-7 are all for the burning or 'combustion' of common compounds used as fuels.

- _____ Is the combustion of methane endo- or exothermic?
- _____ Is the combustion of octane endo- or exothermic?
- _____ Cellular respiration is a combustion of *glucose* done in 'controlled' fashion inside the cell's mitochondria. Is it an endo- or exothermic process?
- What is typically the purpose of burning fuel? Why does it make sense that ALL combustion reactions are exothermic? _____

Reactions #8-18 are for the formation of certain compounds from their elements.

- _____ Is the formation of ethene endo- or exothermic?

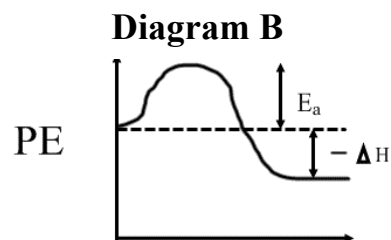
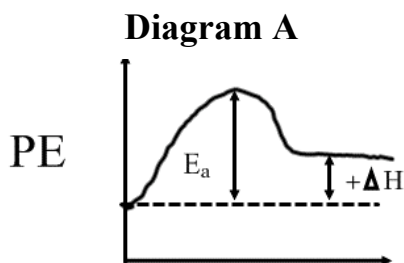
Reactions #19-24 are for the dissolving of some common electrolytes.

- _____ Is the dissolving of ammonium nitrate endo- or exothermic?

Reaction #25 is for the reaction that occurs when an acid reacts with a base.

- What is the name of the reaction that occurs when an acid reacts with a base?

Use #2: - Linking a ΔH value to an appropriate PE diagram.



- _____ Which diagram is appropriate for the formation of **nitrogen II oxide** from N_2 and O_2 ?

Name: _____

Date: _____

Use #3: ΔH and moles

Look at the reaction for the combustion of **propane**.

9. If one mole of propane is to be burned up by a gas grill, then:
- (a) How many moles of O_2 will also be needed? _____
 - (b) How many moles of CO_2 will be formed? _____
 - (c) How many moles of H_2O will be formed? _____
 - (d) How much heat will be released to the surroundings (grill, air, hamburger, etc.)?

Use #4: The effect of ΔH on the surroundings.

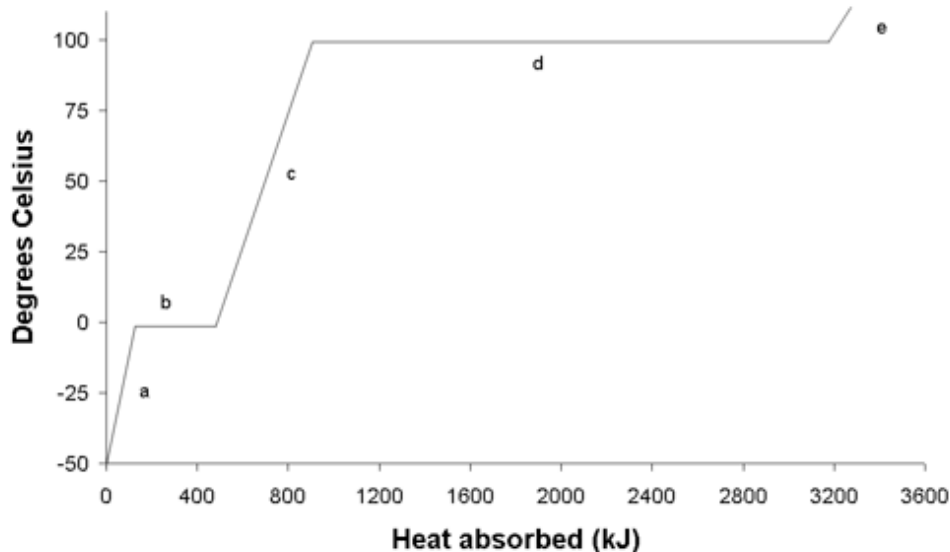
Measuring a ΔH value is done using a calorimeter. This is a device that measures the energy change in a sample of water.

10. If a *reaction* is endothermic it needs to **(absorb or release)** heat while it happens.
11. If the reaction is happening in water, then the water is part of the 'surroundings'. In this case, heat will **(leave or enter)** the water and as a result, the thermometer will show an **(increase or decrease)** in temperature.
12. Find the reaction for dissolving solid state **potassium nitrate**
- (a) Does it dissolve endo- or exothermically? _____
 - (b) What is the sign on ΔH ? _____
 - (c) Is heat being 'released to' or 'absorbed from' the water in order to dissolve the solid? _____
 - (d) Will the water the solution is made from get warmer or colder? _____
 - (e) Write the reaction as written in Table I, but write the HEAT of REACTION into the reaction as either a product or a reactant.

Name: _____

Date: _____

Adding Energy to Water What Happens?



13. The diagram above represents a heating curve for water. Label segments a – e with the appropriate equation ($q = mC\Delta T$, $q = mH_f$, or $q = mH_v$).
14. How much heat is required to raise the temperature of 200g of water from 25°C to 48°C?
1. Which segment on the diagram would this temperature change occur? _____
 2. Which heat equation would you use in order to solve this problem? _____
 3. Solve for the amount of heat required to raise the temperature of water from 25°C to 48°C.
15. How much heat is required to boil 200g of water?
1. Which segment on the diagram does boiling occur? _____
 2. Which heat equation would you use in order to solve this problem? _____
 3. Solve for the amount of heat required to boil 200g of water.
16. How much heat is released when freezing 200g of water?
1. Which segment on the diagram does freezing occur? _____
 2. Which heat equation would you use in order to solve this problem? _____
 3. Solve for the amount of heat released when freezing 200g of water.