Thermodynamics Project -- Combustion, Heat Flow, and Energy Content

Name: ______________________________ Pd:_____________ Date: ____________

Purpose: Use ideas from *Collision Theory* and *Thermodynamics* to design an efficient combustion reaction.

Materials:
-- 10 cm by 10 cm Piece of Paper -- 5 cm of clear tape -- one paper clip.

Safety: Igniting your design (i.e. setting it on fire) can only be done in the test area with supervision from Dr. B.

Yes, I understand and agree to this. ______________________________________
(your signature)

Day One: Preliminary Brainstorming, Design, and Test Design

Your Goal: Using all of the materials listed above, design and build a structure that will burn the fastest.

To Turn In (each person): Use **ten** of the terms listed in the *vocabulary list* (end of this packet) to write:
-- A description of your design (include a rough illustration).
-- Why you chose this design (what made you think it would burn the fastest?).
-- Based on your first burn, what would you change and why?

Day Two: Learn about *Collision Theory* in order to improve your design.

Your Goal: Redesign your structure based on what you learn about *Collision Theory* from the class activity.

How to Use a Theory: A theory is really just an explanation of something. In science theories are based observations and experimentation (sometimes called the "scientific method"). Widely accepted theories in science will be backed up by many observations and different investigations all coming to the same conclusion.

Theories are useful because they help us understand, explain, and predict physical phenomena. For example, *Collision Theory* states if there are more surfaces for molecules to collide there will be more chemical reactions. That's useful information for the structures we are currently working on in class. It also helps us predict what will work best and explain why some designs work better than others.

Using a theory involves really thinking about what the theory says and applying it to a problem (e.g. our class designs).

To Turn In (each person):
-- Completed *Collision Theory* activity.
-- On bottom of your *Collision Theory* activity sheet list:
  -- three design principles gained from the *Collision Theory* activity.
  -- new insights and ideas you have on how to improve your design.

Day Three: Redesign and Final Combustion Reaction

Your Goal: Finish your design. We'll test them as a class and collect data for all combustion reactions.

Day Four: Final Burns, Assessment

Your Goal: Finish collecting data and use the data collected to complete the assessment.

Assessment: Based on the data we collected in class you will be asked to complete the following BCR:

* Use *Collision Theory* to describe which two designs are the best.
* Compare and contrast these with your design. What would you change and why (based on *Collision Theory)*?
* Use the following vocabulary in your explanations.

--- exothermic reaction	--- endothermic reaction
--- Fuel + $O_2 \rightarrow CO_2 + H_2O$ + heat	--- reactants and products
--- effective collisions	--- surface area
--- bonds breaking	--- bonds forming
--- thermal energy	--- activation energy
--- rate of reaction	--- concentration

The assessment will also have several ***additional*** *questions to test your understanding of Thermodynamics.*

Thermodynamics Vocabulary You Are Responsible for Understanding and Applying

Thermodynamics	The study of heat changes that occur during chemical reactions and physical changes of state.
Thermal energy	The sum of the kinetic energy (motion of molecules) and latent energy (don't worry about it now).
Activation Energy	The minimum energy needed to start a chemical reaction.
Exothermic reaction	Energy is released - products are lower in energy than reactants
Endothermic reaction	Energy is absorbed - reactants are lower in energy than products
Collision Theory	Molecules must collide (bump into each other) in order for a reaction to occur. Further, they must collide with enough energy and the correct orientation (or angle).
Chemical reaction	In chemical reactions bonds break and reform new compounds. Breaking bonds takes energy. Forming bonds releases energy.
Rate of Reaction	How quickly a chemical reaction takes place. Factors influencing the rate are below.
- Catalysts	Speed up chemical reactions but do not change (they aren't part of the new compounds made).
- Concentration	The amount of substance in a given volume. For solutions we called this Molarity.
- Surface Area	The amount of area on the exposed on the surface of an object.
- Temperature	Describes the average kinetic energy (amount of motion) of particles.
Heat	Describes how much energy is transferred from one object to another. You can think of heat as the total amount of energy.
Kinetic Energy	The energy of an object in motion. Atoms in motion have KE.