Energy in Chemical Reactions
PASCO SPARK

Background: All chemical reactions involve the breaking and/or making of chemical bonds.

Bond breaking is endothermic (energy is absorbed from surroundings). Imagine stretching a rubber band until it breaks. You must do work to stretch the rubber band. The energy needed to break the bonds is absorbed from the surroundings.

Bond making is exothermic (energy is released into surroundings). If you have been snapped by a rubber band, you know that when it snaps back it releases energy.

In all chemical reactions, there is a change in energy. Some reactions absorb more energy than they release; endothermic. Some reactions release more energy than they absorb: exothermic. We can use the change in temperature to measure the change in heat energy – the type of energy that most chemical reactions release.

Problem: Which reaction(s) were endothermic? Which reaction(s) were exothermic?

Materials: 3 test tubes and rack, graduated cylinder, water, vinegar, baking soda, magnesium oxide and SPARK system with temperature probe.

Procedure: (If your system goes asleep, press on the buttons on the top sides to continue)
1. Pour 10mL of vinegar into a test tube.
2. Turn on the SPARK by pressing the power button on bottom of the unit (black). Put temperature probe (white wire) into test tube of vinegar – be sure the probe is in the liquid. Wait about 10 seconds for the temperature to be taken.
3. Touch “Temperature” on the SPARK screen and then “Show” on the SPARK screen. A graph with the axis of Temperature vs Time. Find the green play arrow on the bottom left of the screen – this is where you will tell the SPARK to start and stop gathering data. Be sure that you and all of your lab partners are ready.
4. Push the green play button and after 5 seconds, add a small amount magnesium oxide (not much is needed). Let this run for 30 seconds. Push the red play button again to stop gathering data. Did you notice any change in temperature – or does your line appear fairly straight?
5. In order to understand what happened, we need to look at this graph in more detail. Touch the graph icon on lower left of the screen and you will see more options.
6. Choose the autofit icon, the graph in a frame at the top of the far right. This will zoom the graph in so that you can see the data much better. Copy this line onto your graph paper and label it magnesium oxide and vinegar.
7. Put 10mL of water into next test tube. Place the temperature probe in the same way you did in the first test. Push the green play button on the screen and after 5 seconds, add a small amount baking soda (not much is needed). Let this run for 30 seconds. Push the red play button again to stop gathering data. Copy this line onto your graph paper and label it baking soda and water.
8. Put 10mL of vinegar into next test tube. Place the temperature probe in the same way you did in the first test. Push the green play button on the screen and after 5 seconds, add a small amount baking soda (not much is needed). Let this run for 30 seconds. Push the red play button again to stop gathering data. Copy this line onto your graph paper and label it baking soda and vinegar.
Conclusion (use the background information above and your graph):

1. What does every chemical reaction involve?

2. Is chemical bond breaking endothermic or exothermic?

3. Is chemical bond making endothermic or exothermic?

4. What type of energy is released in *most* chemical reactions?

5. Using the data you collect from your graph, determine if the reaction of magnesium oxide and vinegar an exothermic or endothermic reaction?

6. Using the data you collect from your graph, determine if the reaction of baking soda and water an exothermic or endothermic reaction?

7. Using the data you collect from your graph, determine if the reaction of baking soda and vinegar an exothermic or endothermic reaction?