Lesson 5: Could any chemical reaction be used to fuel a car? Do all chemical reactions “release” energy?

Unit Question: What fuel should we use for our cars?

NAME: _____

PERIOD: _____ DATE: _____

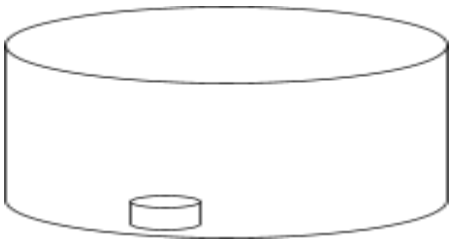
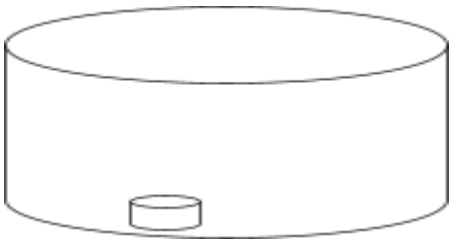
Lesson 3.5: Could any chemical reaction be used to fuel a car? Do all chemical reactions ”release” energy?

PROCESSING LESSON 4 EXPERIMENT- EVAPORATION VS COMBUSTION OF ETHANOL:

1. Which process resulted in the greatest mass loss?

2. How does mass loss relate to the movement of particles?

3. Complete the table for the evaporation vs combustion of ethanol.

	EVAPORATION	**COMBUSTION**
Data ***including mass loss*** and key observations		
Chemical equation with states		
Particle model of ethanol in chamber-(BTB and $CoCl_2$ strip are NOT included)		
Where is the **energy** in the process?		

4. Briefly summarize **three** ways the combustion of ethanol is different than the process of evaporation. Be sure to address energy as one of the ways.
   1.

   2.

   3.

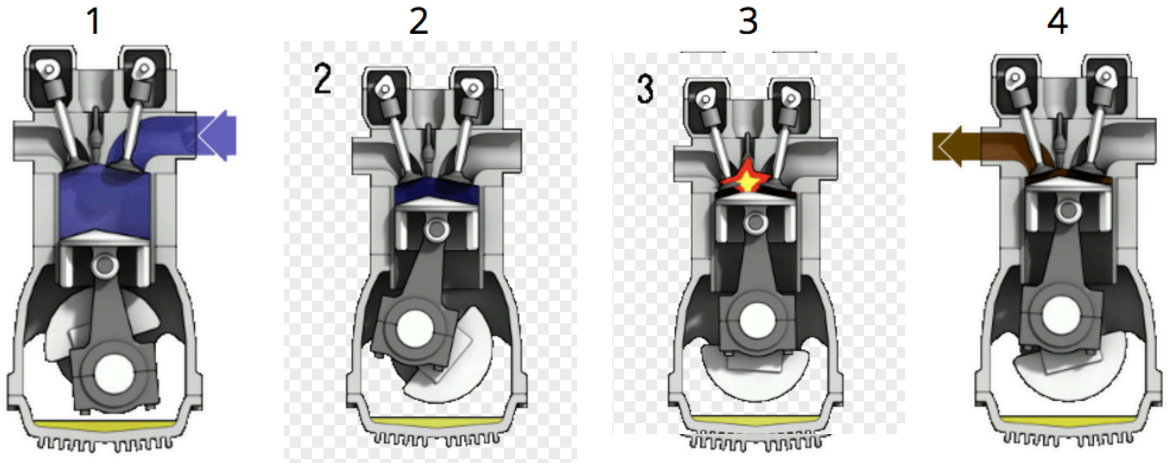
APPLYING RESULTS TO ENGINE MODEL

5. How would you use this information to revise our working model to explain how fuel makes an engine work (and therefore a car move)? Keep in mind that ethanol is added to gasoline. Consider…
    a. Which stroke(s) involve the process of evaporation?

    b. State evidence from your everyday experiences that gasoline evaporates as well as the ethanol additives.

    c. Which stroke(s) involve combustion?

    d. In our model so far, how does fuel make an engine work (and therefore a car move)?



6. Today's question is 'Can any chemical reaction fuel a car?' List experiences with chemical reactions in your day to day activities and think about whether a reaction like you describe could power a car.

DEMO - TWO SALTS IN A ZIPLOC BAG

$$Ba(OH)_2.8H_2O(s) + NH_4Cl(s) \rightarrow BaCl_2.2H_2O(s) + 2NH_3(aq) + 8H_2O(l)$$

1. Look at the following balanced equation. What information does this equation give you?

2. After observing this reaction, what information can you add?

3. In which direction did heat move in this reaction?

INVESTIGATING ENERGY IN OTHER PROCESSES

Materials

- 3-Thermometers
- 3-150 mL beakers
- 100 mL graduated cylinder
- 250 mL beaker for distilled water
- Ammonium chloride, NH_4Cl
- Calcium chloride, $CaCl_2$
- 3-Stirring rods
- Scale, spatula, 2-weighing boats
- Stop watch/timer

Safety

- Wear safety glasses at all times to protect your eyes from chemical spills or splashes.
- Handle substances with care. Do not ingest any of the substances.

Procedure

1. Obtain approximately 200 mL of water from the white carboy container at the sink, if your instructor has not done this for you.
2. Label your beakers: #1 ,#2, #3, if not done so for you.
3. Fill 3-150 mL beakers with 50 mL of water each using a graduated cylinder. Record the exact volume of water used for each in the data table.
4. Use the thermometer so that it is immersed in the water but not touching the bottom or the sides of the beakers.
5. Record the initial temperature of the water in each of the beakers in the data table.
6. Using the scale and a weighing boat, measure approximately 4.0 g of ammonium chloride. Record your exact mass in the data table.
7. Using the scale and a weighing boat, measure approximately 4.0 g of calcium chloride. Record your exact mass in the data table.

8. **Simultaneously**, add the 4.0 g of ammonium chloride to one beaker, and add 4.0 g of calcium chloride to the second beaker, and leave the third beaker without any chemical added.
9. **Immediately start the stop watches** and stir the beakers with a stirring rod continuously.
10. Record the temperature every minute for a total of 6 minutes in the data table.
11. Clean by emptying the solutions into the waste beakers in the fume hood. Rinse the beakers, stirring rods, and thermometers with water.
12. Return everything as it was before beginning the experiment including placing the chemicals back up front.

Data

Mass and Volume Measurements			
Beaker Number	**Substance**	**Volume of H_2O (mL)**	**Mass (g) of solute**
1	**Ammonium chloride**		
2	**Calcium chloride**		
3	**Water only**		

Solution Temperature Measurements					
Ammonium chloride		**Calcium chloride**		**Water Alone**	
Time (min)	**Temp (ºC)**	**Time (min)**	**Temp (ºC)**	**Time (min)**	**Temp (ºC)**
0		**0**		**0**	
1		**1**		**1**	
2		**2**		**2**	
3		**3**		**3**	
4		**4**		**4**	
5		**5**		**5**	
6		**6**		**6**	

RESULTS/ANALYSIS

7. For each substance, look at the data table and record the highest temperature and lowest temperature.

Substances	Highest temperature (ºC)	Lowest temperature(ºC)
Ammonium chloride		
Calcium chloride		
Water		

8. a) An **exothermic** process or reaction releases energy. Which solution released heat or was "exothermic"?

   b) An **endothermic** process or reaction requires energy. Which solution required heat or was "endothermic"?

9. Aqueous (aq) is used by scientists to indicate that a solid is dissolved in water. Equations can be used to describe the process of dissolving each of these compounds. Modify the equations so that heat is shown as part of the equation. Do this by adding heat (+ heat) to either the reactant or product side of the equation.

   Dissolving NH_4Cl in H_2O: $NH_4Cl\ (s) \rightarrow NH_4Cl\ (aq)$

   Dissolving $CaCl_2$ in H_2O: $CaCl_2\ (s) \rightarrow CaCl_2\ (aq)$

10. These processes are used in our lives as hot packs and cold packs.
    a. Which chemical would you use in a cold pack? Why?

    b. Which chemical would you use in a hot pack? Why?

11. This investigation helped us define the flow of energy of a system. Do you think either of these processes could be used as <u>energy</u> for moving a car? Explain your answer.

12. If we are looking to find alternative fuel sources, what are some criteria they should meet to power the engines we currently use?

NEXT STEPS:

1. Reflect on today's question: Could any chemical reaction be used to fuel a car? Do all chemical reactions "release" energy?
2. Open up the IMT for this unit, complete all boxes for lesson 5
3. Make sure all parts of the L3.5 student sheet are complete
4. Check for understanding next class.

REVIEW & REINFORCE:

Use the following sections of the textbook to help you review materials that were covered in this lesson

- Section 11.6 - Combustion reactions
- Section 13.7 - Evaporation
- Section 13.17 - Changes in state
- Section 17.2 - Heat
- Section 17.3 - Exothermic
- Section 17.4 - Endothermic
- Section 17.5 - Exothermic and Endothermic Processes