

## Experiment 12, A Study of Chemical Reactions

Name \_\_\_\_\_ Per \_\_\_\_\_

**Purpose:** To investigate chemical reactions, their energies, and what factors influence the rates of reactions. **We shall be making notes of all observations.**

**Evidences for a chemical reaction. Watch for them and make note of them.**

### 1. Gas Produced

- .... a. bubbles-- effervescence
- .... b. odor
- .... c. explosion-- fast gas
- .... d. decrepitation-- crystals explode as water changes to steam.

### 2. Color Change.

### 3. Temperature change-- heat added or absorbed.

- .... a. exothermic-- gives off heat, feels warm.
- .... b. endothermic-- absorbs heat, feels cold.

### 4. Water formed. It uses up ions. Acids neutralizing bases.

### 5. Precipitation-- Solid formed. New substance formed

### 6. Electrical change-- Electricity added or absorbed. Battery charging and discharging. Electrolysis.

### 7. Light added or absorbed. Photosynthesis, bioluminescence.

## Terms:

**Effervescence--** Bubbles liberated. i.e. soda water.

**Efflorescence--** Water lost from a crystal.

**Decrepitation--** Crystals explode from vaporizing water.

**Deliquescent--** Absorb water and get wet. NaOH pellets.

**Exothermic--** Gives off heat (will feel warm).

**Endothermic --** Absorbs heat (will feel cold).

**Catalyst --** Changes the rate of a reaction without being used up.

## Teacher Demos:

1. Heat 1 ml of  $\text{PbO}_2(s)$  in a test tube. Note changes \_\_\_\_\_. Insert a glowing splint.  
Observations and What's happening?

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2. Heat 1 ml of  $\text{Pb}(\text{NO}_3)_2(s)$  in a test tube. Insert glowing splint. Observations and What's happening?

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3. Ignite on the brick, 5 ml of  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7(s) \rightarrow \text{Cr}_2\text{O}_3(s) + \text{N}_2(g) + 4\text{H}_2\text{O}(g)$

**Observations:**

**\*\* GOGS ON!! WARNING!! NEVER carry a chemical bottle by its stopper, cap, or dropper!!!**

### Part 1 Heat of Reactions:

a. Place a thermometer into 5 ml of tap water in a test tube. Note the temp: \_\_\_\_ °C. Add 15 drops, one at a time, of 18M H<sub>2</sub>SO<sub>4</sub> (**Danger! GOGS ON**, It's in the hood. *If you get any on you wash with plenty of water and tell the Boom*). Note the temp \_\_\_\_ °C.

Note if the reaction is exothermic or endothermic: \_\_\_\_\_.

**Save this diluted acid (about 2M) to use in parts IIb and IIIa.**

b. Place a thermometer into 5 ml of tap water in a test tube. Note the temp: \_\_\_\_ °C. Using a spatula, add 3 pellets of NaOH<sub>(s)</sub>. Do not touch the pellets or your finger will be changed into soap. *If you get any on you wash with plenty of water and tell the Boom*). Gently mix the pellets with the thermometer until they are dissolved. Note the temp: \_\_\_\_ °C.

Note if the reaction is exothermic or endothermic: \_\_\_\_\_.

**Save this solution for Part IIa.**

c. Place one ml (20 drops) of tap water into a test tube. Note how full it is. Into a **dry** test tube, use a spatula to add the same depth of solid NH<sub>4</sub>Cl crystals. Carefully place a thermometer onto the crystals. Note the temp: \_\_\_\_ °C. Now add 5 ml of tap water, carefully stir until the crystals have dissolved and note the temp: \_\_\_\_ °C. Note if the reaction is exothermic or endothermic: \_\_\_\_\_.

d. Repeat step c using the same amount of Sodium Acetate, NaCH<sub>3</sub>COO<sub>(s)</sub>. First Temp: \_\_\_\_ °C, Second Temp: \_\_\_\_ °C, Is it exo or endothermic? \_\_\_\_\_.

### Part II Reactions and their evidences:

a. Add 1 ml (20 drops) of the NaOH solution from Part Ib to 5 ml of tap water. Add three drops of phenolphthalein indicator. Note the result:

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b. Add 1 ml (20 drops) of the H<sub>2</sub>SO<sub>4</sub> solution from Part Ia to 5 ml of tap water. Add three drops of phenolphthalein indicator. Note the result:

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c. Using a spatula, place 0.5 ml of solid Na<sub>2</sub>SO<sub>3</sub> into a dry test tube. Carefully add 3 ml of 6M HCl (**Warning!** Deadly hydrochloric acid). Observations:

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d. Place 5 ml of 0.1 M  $\text{FeSO}_4$  into a test tube. Add 10 drops of 0.1 M  $\text{KMnO}_4$  one drop at a time shaking the tube after each drop. **WARNING: Try not to touch  $\text{KMnO}_4$ , it stains the skin for several days.** Wash it off with plenty of water. Observations:

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e. Add 1 ml of 0.1 M  $\text{NaCl}$  to 1 ml of 0.1 M  $\text{KBr}$ . Observation:

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### Part III Temperature and Reaction Rates:

a. Set up four test tubes, each containing 5 ml of 0.1 M  $\text{Na}_2\text{C}_2\text{O}_4$  (sodium oxalate). Acidify each by adding 1 ml (20 drops) of the 2M  $\text{H}_2\text{SO}_4$  prepared in Part Ia.

(1) Place two of the test tubes in a hot water bath (40-50°C) so that both will be at the same temperature. To one of these tubes, add 5 drops of 0.1M  $\text{MnSO}_4$ . Next add 2 drops of 0.1 M  $\text{KMnO}_4$  to each of the two tubes. Shake each tube to mix and note how long it takes for each to reach the same end products:

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(2) To *one* of the other two test tubes at room temperature, add 5 drops of 0.1 M  $\text{MnSO}_4$ . Then to each of these two tubes, add 2 drops of 0.1 M  $\text{KMnO}_4$ . Shake each tube to mix and note how long it takes for each to reach the same end products:

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(3) Compare the times of reactions for each:

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(4) What conclusion can you make about temperature and rate of reaction?

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b. Label five test tubes 1, 2, 3, 4, 5. In 1 put 5 ml of 6M  $\text{HCl}$  (hydrochloric acid), in 2 put 5 ml of 6M  $\text{CH}_3\text{COOH}$  (acetic acid), in 3 put 5 ml of 1M  $\text{HCl}$ , in 4 put 5 ml of 0.1 M  $\text{HCl}$ , in 5 put 5 ml of 1M  $\text{CH}_3\text{COOH}$ . To each tube, using a spatula, add a chip of  $\text{CaCO}_3$  (s). Record the relative rates of reactions:

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c. What can you conclude about the rate of reactions and concentrations of reactants?

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**Questions:**

1. In which of the experiments was there no evidence of a chemical reactions?  
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2. Which reactions produced a new phase (solid, liquid, gas)?  
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3. Which reactions were exothermic?  
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4. Which were endothermic?  
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5. In which reactions did concentration affect the rate?  
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6. In which reactions did temperature affect the rate?  
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7. In Part IIIa what effect on the rate of reactions did adding  $\text{MnSO}_4$  have?  
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8. What evidence did you observe to indicate that in some of the reactions part of the reactants was not used up?  
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**Write a Critique for this lab:**