Name: _____ Block: ___ Date: _____

Functional Groups Activity

Objective: In this activity you will investigate the organic functional groups, what they are called, their structure, their polarity, and how they change the function of the parent molecule.

Functional Group	Lewis Dot Diagram	Ball and Model	Skeletal model with bond angle	Polarity of functional group	Order of increasing polarity
Alcohol					
Ketones					
Aldehydes					
Carboxylic acids					
Carboxylic esters					
Ethers					
Amines					
Thiols					

Procedure 1:

We will be using the letter R to represent the remaining portion of a parent chain when illustrating a functional group. When building the model please use a purple ball to represent the R (parent chain).

1. Diagram the lewis dot structure of each functional group, be sure to use different colored dots for each elements dots so that it is apparent when a bond is formed by the blending of electrons from two different atoms. (recommended coloring: carbon – black, hydrogen – yellow/orange, oxygen – red, nitrogen – blue, sulfur – green)
2. Create ball and stick model for each functional group.
3. Illustrate with colored dots to represent the atoms.
4. Illustrate the functional group with the skeletal model. Please label the resulting bond angles.
5. Examine the bonds, determine the type of bonds that exist and if there will be a region of polarity in the functional group.
6. Rank the functional groups in order of increasing polarity. (1 = low/no polarity, 8 = greatest polarity)

PART 2:

Background:

In this experiment, temperature probes will be placed in various organic liquids. The rate of evaporation is related to the strength of intermolecular forces (IMF) of attraction. Here you will study temperature changes caused by the evaporation of several liquids, and relate the temperature changes to the strength of intermolecular forces of attraction. You will use the results to predict and then measure the temperature change for several other liquids. You will encounter four types of organic compounds in this experiment: alcohols, ketones and acids. The two alcohols are propanol and isopropanol (geometric isomers). You will examine the molecular structure of alkanes, alcohols, ketones, organic acids and ethers to determine the presence and relative strength of two intermolecular forces, hydrogen bonding and dispersion forces.

Safety Note:

The compounds used in this experiment are FLAMMABLE and POISONOUS.
Avoid inhaling their vapors. Allow for good ventilation in the room.
Avoid contact with your skin or clothing.
Be sure there are no open flames in the lab during this experiment.
Notify your teacher immediately if an accident occurs.

Procedure:

1. Set up your device for data collection:
    a. Connect the temperature probes to the interface.
    b. Open the data collection program.
    c. Configure the data collection system to collect readings every second for a total of 4 minutes (240 seconds).

2. Wrap each temperature probe with square pieces of filter paper secured by small rubber bands, as shown in Figure 1. Roll the filter paper around the probe tip in the shape of a cylinder. Hint: First, slip the rubber band on the probe, then wrap the paper around the probe, and finally slip the rubber band over the paper. The paper should be even with the probe end.

3. Place Probe 1 into the propanol container and Probe 2 into the isopropanol container. Make sure the containers do not tip over.

4. Prepare two pieces of masking tape, each about 10 cm long, to tape the probes in position during Step 6.

5. After the probes have been in the liquids for at least 30 seconds, begin data collection. Monitor the temperature for 15 seconds to establish the initial temperature of each liquid. Then simultaneously remove the probes from the liquids and tape them up so the probe tips extend 5 cm over the edge of the table top, as shown in Figure 1.

6. Data collection will stop after 4 minutes unless data collection has been manually stopped before time has elapsed. Examine the graph of temperature vs. time. Based on your data, determine the maximum temperature, t1, and minimum temperature, t2, for both probes. Record t1 and t2 for each probe. For each liquid, subtract the minimum temperature from the maximum temperature to determine Δt, the temperature change during evaporation

7. Repeat Steps 4 through Step 6 using acetone with Probe 1 and acetic acid with Probe 2.

DATA TABLE:

Compound	**Illustrate Compound**	**T_1 (^oC)**	**T_2 (^oC)**	**ΔT**	**Molar mass**
Propanol					
Isopropanol					
Acetone					
Acetic Acid					

Discussion: (answer on a separate sheet of paper)

1. Which functional groups contain a carbonyl group?
2. Why are aldehydes and ketones separated into different functional groups? (please give a detailed answer.)
3. Why do you think it would be important to investigate the polarity of a functional group?
4. Which of the functional groups would you predict that would most easily react as an anion in an acid/base neutralization reaction? Illustrate the anion form of the functional group.
5. Alcohols and amines are classified as 1° (primary), 2° (secondary) and 3° (tertiary) based on the number of carbon attached to the carbon linked to the functional group. a) illustrate a secondary alcohol b) illustrate a tertiary amine
6. Alcohols and carboxylic acids go through a dehydration synthesis reaction to form an ester. Illustrate what you think this reaction would look like, using R for the parent chains, indicating where the water molecule comes from.
7. Butane and methyl ethyl ether, both with molar masses of approx. 60 g/mol, are gases at room temperature. Propose an explanation of why that occurs.