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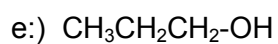
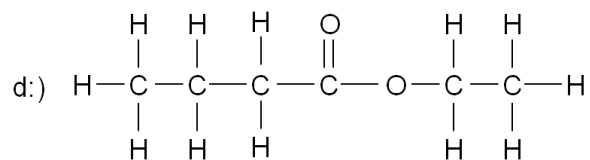
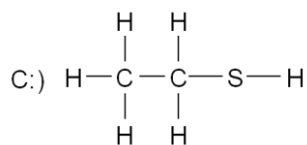
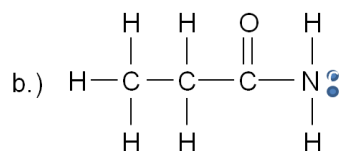
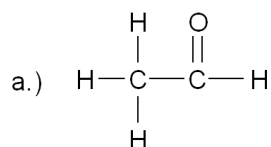
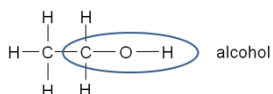
Section: \_\_\_\_\_

## Pre-lab 3: Functional Groups: Smells and Structures

Read the background information and answer the following question before lab.

1) Circle and label the functional groups on the following compounds:

Ex:



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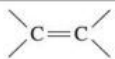

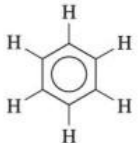


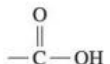
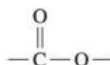
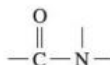
## Lab 3: Functional Groups: Smells and Structures

**Objective:** The objectives of this experiment are to use smells to identify with the different functional groups and to draw and label the functional groups. You will perform an esterification reaction and identify the different smells as the reaction occurs.

### Background Information:

#### Identifying Different Functional Groups:

The different functional groups found in organic chemistry are shown in Figure 1.

TABLE 11.9 Classification of Organic Compounds		
Class	Functional Group	Example
Alkene		$\text{H}_2\text{C}=\text{CH}_2$
Alkyne	$-\text{C}\equiv\text{C}-$	$\text{HC}\equiv\text{CH}$
Aromatic		
Alcohol	$-\text{OH}$	$\text{CH}_3-\text{CH}_2-\text{OH}$
Thiol	$-\text{SH}$	$\text{CH}_3-\text{SH}$
Ether	$-\text{O}-$	$\text{CH}_3-\text{O}-\text{CH}_3$
Aldehyde		$\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$
Ketone		$\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$
Carboxylic acid		$\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$
Ester		$\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{CH}_3$
Amine	$-\text{N}-$	$\text{CH}_3-\text{NH}_2$
Amide		$\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{NH}_2$

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The functional groups should be memorized, so use this chart only if you need it. In lab, you will be given several compounds with different functional groups and be asked to identify the smell.

### Reactions with Functional Groups:

The functional groups are special in that they give the otherwise nonreactive alkanes functionality. This functionality allows organic compounds to react with other compounds to make new compounds. In lab, you will perform an esterification reaction, in which an alcohol will react with a carboxylic acid to form an ester and water.

The reaction between methanoic acid and octanol is shown in Equation 1.

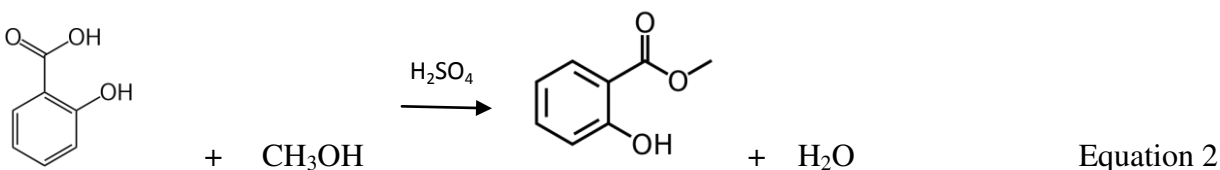


The  $\text{H}_2\text{SO}_4$  that is above the arrow, is the strong acid sulfuric acid. Sulfuric acid acts as a catalyst in the reaction in order to help the reaction occur faster than it would have naturally. The sulfuric acid does not react with anything in this reaction so it is in the same form before and after the reaction.

$\text{CH}_3\text{COOH}$  is a carboxylic acid. The IUPAC name for this carboxylic acid is methanoic acid. The common name for methanoic acid is acetic acid. When the chemical is bottled it is given its common name so the bottle will read acetic acid. Methanoic acid has a familiar scent so make sure that when you put the acetic acid in the vial you smell it and try to guess what it smells like.

$\text{CH}_3(\text{CH}_2)_7\text{OH}$  is an alcohol. The IUPAC name for this alcohol is octanol. The common name for octanol is n-octyl alcohol. The bottle of the chemical will have the common name n-octyl alcohol on it. The alcohol does not have a strong smell.

The reaction between 2-hydroxybenzoic acid and methanol is shown in Equation 2.



The first structure in the reaction is a carboxylic acid with a hydroxyl group as a branch. The IUPAC name is 2-hydroxybenzoic acid. The common name is salicylic acid.

$\text{CH}_3\text{OH}$  is an alcohol. The IUPAC name for this alcohol is methanol. The common name for methanol is methyl alcohol. The bottle of the chemical will have the common name methyl alcohol on it

The two esters formed from these reactions will have a strong sweet smell. In lab try to describe each smell and when you can recognize the smell, name the commonly used product with that smell.

**Procedure:**

**Data:**

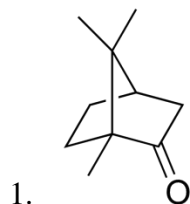
*Identifying Different Functional Groups:*

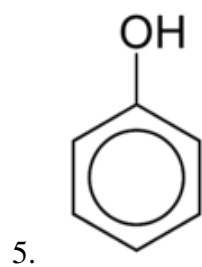
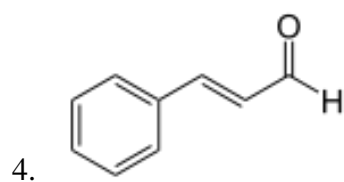
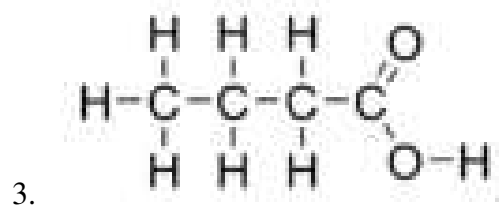
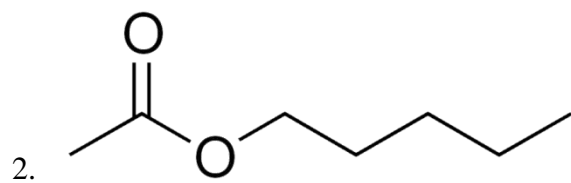
By scent: The front bench has several bottles with chemicals with distinct scents in them. Open each lid separately and try to describe each scent on the chart provided below. To smell the contents of the bottles, waft the air above the bottle toward your nose. (Wafting is waving your hand over the opening of the bottle toward your face.)

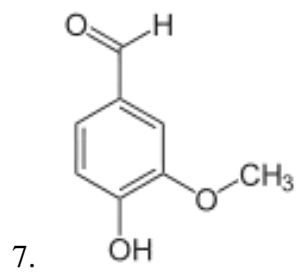
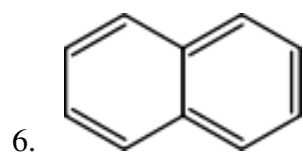
#	Description of Scent (Product Name)	#	Description of Scent (Product Name)
1		6	
2		7	
3		8	
4		9	
5		10	

Fill in the identical chart on your report sheet.

By Structure: The structures for the chemical each bottle are shown below. Circle and label the functional group(s) in each structure.







8. Diphenyl ether

9. dodecanethiol

10. dodecanamine

Redraw 8, 9, and 10 on your report sheet.

*Reactions with Functional Groups: esterification*

Equipment list:

- 2 Reaction vials with lids
- 2- 100 mL beakers

Label the lids of the two reaction vials and the beakers with your group number followed by an A on one and a B on the other. You can do both reactions at the same time to save time, be sure that the vials are labeled to avoid confusion.

Reaction of methanoic acid and octanol:

1. Using the 1 mL syringe next to the bottle, place 2 mL of methanoic acid in one of the reaction vial.
2. Waft the air above the reaction vial toward your nose.
3. Describe the smell and record this observation on the blank line. \_\_\_\_\_
4. Record this observation on your report sheet also.
5. Using the 1 mL syringe next to the bottle, add 2 mL of octanol to the reaction vial.
6. Using the dropper next to the bottle, add 2 to 3 drops of sulfuric acid to the reaction vial.
7. Put the lid on.
8. Mix the contents of the reaction vial by gently swirling it.
9. Loosen the lid by turning it until it is loose. Do not put the vial on the heat with the lid tight or it will explode.
10. Place the reaction vial on the stirring hot plate.
11. Wait for the mixture in the vial to start to reflux.
12. After it is refluxing allow the mixture to continue to heat and stir for 20 minutes.
13. Remove the vial from the heat plate and allow it to cool.
14. Waft the air above the reaction vial toward your nose.
15. Describe the smell and record this observation on the blank line. \_\_\_\_\_
16. Fill the 100 mL beaker with about 50 mL of water.
17. Pour the contents of the reaction vial into the 100 mL beaker with the water.
18. Waft the air above the beaker toward your nose.
19. Describe the smell and record this observation on the blank line. \_\_\_\_\_
20. Record this observation on your report sheet also.
21. Place the beaker to the side for later use.



Reaction of salicylic acid and methanol:

1. Using weigh paper, weigh out about 1 g of salicylic acid.
2. Record the exact mass on the blank line. \_\_\_\_\_
3. Record this value on your report sheet also.
4. Place the 1 g of powder in the second reaction vial.
5. Using the 1 mL syringe next to the bottle, add 2 mL of methanol  
In the reaction vial.
6. Using the dropper next to the bottle, add 2 to 3 drops of sulfuric  
Acid to the reaction vial.
7. Put the lid on.
8. Mix the contents of the reaction vial by gently swirling it.
9. Remember to loosen the lid.
10. Place the reaction vial on the stirring hot plate.
11. Wait for the mixture in the vial to start to reflux.
12. After it is refluxing allow the mixture to continue to heat and  
stir for 20 minutes.
13. Remove the vial from the heat plate and allow it to cool.
14. Pour the contents of the reaction vial into a 100 mL beaker  
filled with 50 mL of water.
15. Waft the air above the beaker toward your nose.
16. Describe the smell and record your observations on the blank line. \_\_\_\_\_
17. Record this observation on your report sheet also.
18. Compare the smell from the two beakers.
19. Flush both esters down the sink with the faucet running.

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Name: \_\_\_\_\_

Partner(s): \_\_\_\_\_

Section: \_\_\_\_\_

## Functional Groups: Smells and Structures

*Identifying different Functional Groups:*

Fill in the table the same as you did in the procedure/data.

#	Description of Scent (Product Name)	#	Description of Scent (Product Name)
1		6	
2		7	
3		8	
4		9	
5		10	

Redraw 8, 9, and 10 from the procedure/data and circle and label the functional groups.

8. Diphenyl ether

9. dodecanethiol

10. dodecanamine

*Reactions with Functional Groups: esterification*

Reaction of methanoic acid and octanol:

3. \_\_\_\_\_

19. \_\_\_\_\_

Reaction of salicylic acid and methanol:

2. \_\_\_\_\_

16. \_\_\_\_\_