DATE: NAME: CLASS:

CHAPTER 15	Investigation 15.A: Preparing Esters	BLM 15.1.3
HANDOUT		

You now know that chemists use esterification reactions to synthesize artificial esters. In this investigation, you will synthesize three esters. Make careful observations and see if you can recognize the aromas of these esters.

Question

What observable properties do esters have?

Safety Precautions

- Be sure that there is no open flame in the laboratory. Organic compounds are very flammable. Use a hot plate, not a Bunsen burner.
- Use a fume hood for all steps involving acids. Carry out all procedures in a well-ventilated area.
- Sulfuric acid, ethanoic acid, and butanoic acid are all extremely corrosive. Wear goggles, an apron, and gloves.
- Treat the acids with extreme care. If you spill any acid on your skin, immediately wash it with plenty of cold water and notify your teacher. If you spill the acids on the lab bench or floor, inform your teacher right away.
- Avoid touching the hot plate and the hot-water bath when it has been heated.
- Wash your hands when you have completed the investigation.

Materials

- ice
- distilled water
- ethanoic acid
- ethanol
- propan-1-ol
- butanoic acid
- 6 mol/L sulfuric acid
- 250 mL beakers (2)
- 50 mL small beakers (2)
- 100 mL beaker
- 10 mL graduated pipettes (2)
- watch glass
- hot plate
- thermometer (alcohol or digital)
- retort stand
- 2 clamps
- 4 plastic micropipettes
- medicine dropper
- stopper or paper towel

Procedure

1. Label three pipettes as shown. Use the appropriate pipette for each of the three reactions.
- ethanoic acid + ethanol
- ethanoic acid + propan-1-ol
- butanoic acid + ethanol

2. Prepare your equipment as follows:

(a) Be sure that all the glassware is clean, dry, and free of chips or cracks.

(b) Prepare a hot-water bath. Heat about 125 mL of tap water in a 250 mL beaker on the hot plate to 60 °C. Adjust the hot plate so the temperature remains between 50 °C and 60 °C. Avoid touching the hot plate or beaker.

(c) Prepare a cold-water bath. Place about 125 mL of a mixture of water and ice chips in the second 250 mL beaker. The temperature of the cold-water bath will remain around 0 °C.

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(d) Place about 5 mL of distilled water in a 50 mL beaker. You will use this in Procedure Step 9.

(e) Set up the retort stand beside the hot-water bath. Use one clamp to hold the thermometer in the hot-water bath. You will use the other clamp to steady the micropipettes when you place them in the hot-water bath.

(f) Cut off the bulb of the unlabelled micropipette, halfway along the wide part of the bulb. You will use this bulb as a cap to prevent vapours from escaping during the reactions.

3. **Note:** In this step, do not inhale any alcohol vapour directly. Use the graduated pipette to measure 1.0 mL of ethanol into the 50 mL beaker. As you do so, you will get a whiff of the odour of the alcohol. Record your observations.

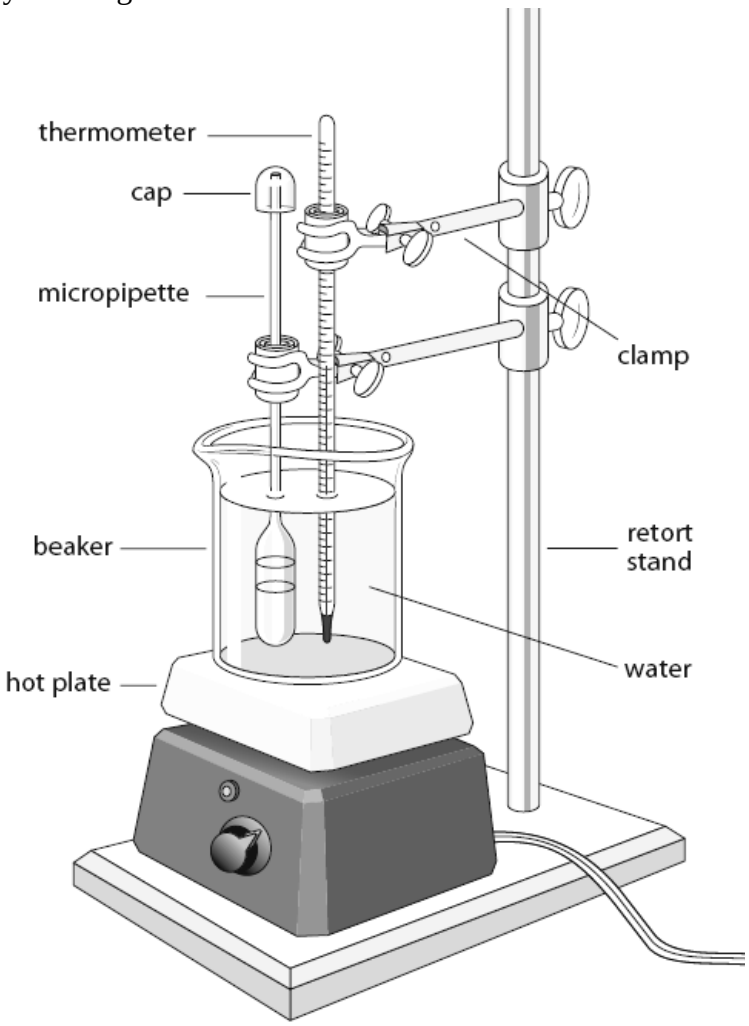
4. **Note:** In this step, do not inhale any acid directly. Use the graduated pipette to add 1.0 mL of ethanoic acid to the ethanol. As you do so, you will get a whiff of the odour of the acid. Record your observations.

5. Your teacher will carefully add four drops of sulfuric acid to the alcohol/acid mixture.

6. Suction the mixture into the appropriately labeled micropipette. Invert the micropipette. Place it, bulb down, in the hot-water bath. (See the diagram.) Place the cap over the tip of the pipette. Use a clamp to hold the pipette in place.

7. Leave the pipette in the hot water for about 10 min to 15 min. Use the thermometer to monitor the temperature of the hot water. The temperature should stay between 50 °C and 60 °C.

8. After 10 to 15 min in the hot-water bath, place the pipette in the cold-water bath. Allow it to cool for about 5 min.



9. Carefully squeeze a few drops of the product onto a watch glass. Mix it with a few drops of distilled water. To smell the odour of the compound, use your hand to wave the aroma toward your nose. Do not inhale. Record your observations of the aroma.

10. Repeat Procedure Steps 2 through 8 for the other two reactions. (Butanoic acid has an offensive odour. Do not attempt to smell it.) **Note:** While the first reaction mixture is being heated, you may want to prepare the other mixtures and put them in the hot-water bath. Working carefully, you should be able to stabilize more than one micropipette with the clamp. If you choose to do this, make sure that your materials are clearly labelled. Also, remember to keep a record of the time at which each micropipette is placed in the hot-water bath.

11. Dispose of all materials as your teacher directs. Clean all glassware thoroughly with soap and water.

Analysis

1. Make a table to organize your data. What physical property did you observe?

2. How do you know that a new product was formed in each reaction? Explain.

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Conclusion

3. Describe the odour of each product that was formed. Compare the odours with familiar odours (such as the odours of plants, flowers, fruits, and animals) to help you describe them.

Application

4. Research the organic compounds that are responsible for the smell and taste of oranges, pineapples, pears, oil of wintergreen, and apples. Find and record the chemical structure of each compound.