WORKSHEET 5

EXPERIMENT: DISTILLATION

Syllabus reference 8.5.3

INTRODUCTION

Mixtures of liquids are found in nature, for example petroleum and honey. Liquid mixtures can be separated by a process called distillation. In this process a mixture is boiled, removing the component with the lowest boiling point and leaving behind the other components. The vapour is directed through a condenser where it is condensed and collected. The condensed liquid is called distillate.

The process of distillation is important in the petrochemical industry and also in purifying water. In the following experiment you will distill a solution of water and one volatile substance, ethanol. A volatile substance is one which vaporises easily.

AIM

To distill a mixture of ethanol and water.

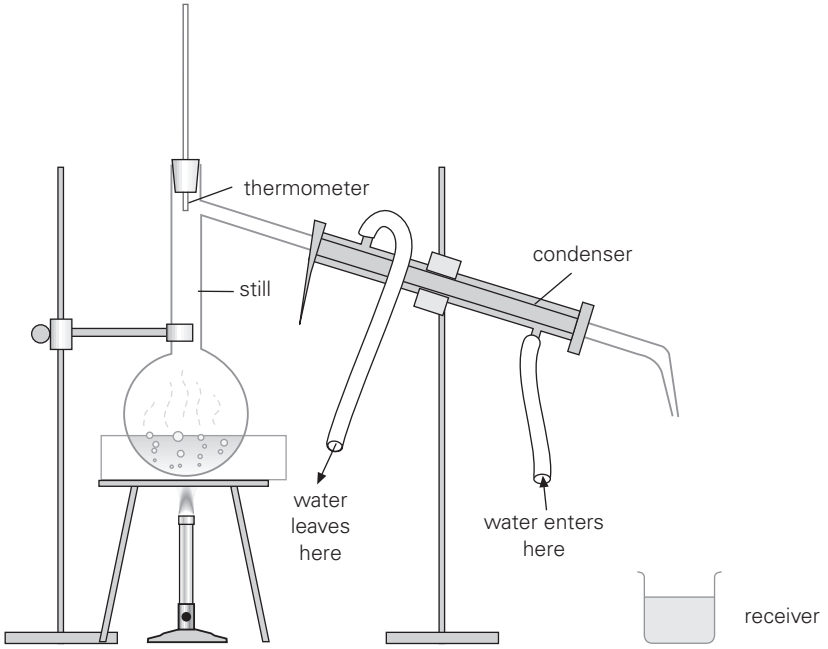
EQUIPMENT

- 250 mL beaker
- distillation flask or round-bottom flask and still head
- condenser and tubing
- thermometer
- beaker for collecting distillate
- 100 mL beakers or test tubes (5)
- electronic balance
- Bunsen burner or hotplate
- tripod
- gauze mat
- retort stand, bosshead and clamp
- 50 mL ethanol, 50 mL water
- measuring cylinder
- boiling chips
- pipette

SAFETY: Safety glasses must be worn. Ethanol is extremely flammable so keep away from naked flame. A hotplate is preferable in this experiment.

PROCEDURE

1 Set up distillation apparatus as shown below. Be sure the thermometer bulb is correctly positioned level with the condenser.



CAUTION: Make certain all connections and clamps are adjusted correctly so there are no leaks.

2 Pour 50 mL ethanol and 50 mL water into the distilling flask and add 3–4 boiling chips.

3 Turn on the cooling water to the outer jacket of the condenser. Position a clean 100 mL beaker or test tube under the condenser to collect the distillate.

4 Using a Bunsen burner or hotplate, gently heat the contents of the distillation flask. Record the temperature at which liquid begins to drip out of the condenser. (Adjust the flame so the solution boils steadily.)

5 Continue to distill the solution until about 15 mL of distillate has been collected in the beaker. Remove the collection beaker from under the condenser and replace it with another clean beaker.

6 Record the mass and volume of the sample.

7 Repeat this procedure until the five samples have been collected. Note the temperature each time the collection beaker is changed.

8 Turn off the Bunsen burner or hotplate and allow the apparatus to cool. Don't boil the flask dry.

9 Compare the density of the different samples by pipetting 5.0 mL of distillate into a weighed beaker and calculating density using:

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

10 Complete the table below in the Results section.

RESULTS

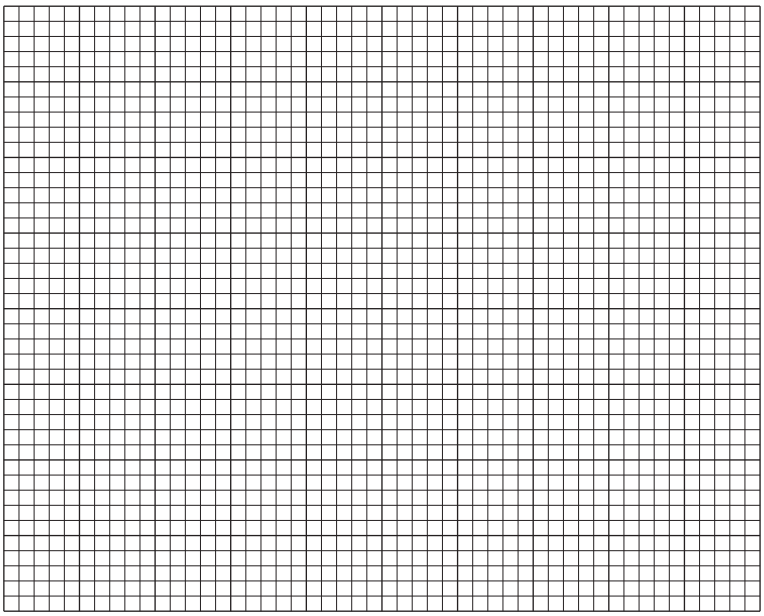
Complete the following table.

SAMPLE	TEMPERATURE	VOLUME (v)	DENSITY (m/v)
1			
2			
3			
4			
5			

The density of pure ethanol is 0.785 g/mL at 25°C and its boiling point is 78.3°C. The density of pure water is 1.00 g/mL and its boiling point is 100°C.

QUESTIONS

1 Plot a graph of density vs temperature



2 Using the results comment on how the density changes as temperature changes (i.e. as distillation proceeds)? Offer an explanation for this. What pattern is evident?

3 Based on the density, which sample had the
- ❍ greatest amount of ethanol?
- ❍ least amount of ethanol?

4 Identify any problems you had with this investigation.

CONCLUSION