Fractional Distillation Worksheet

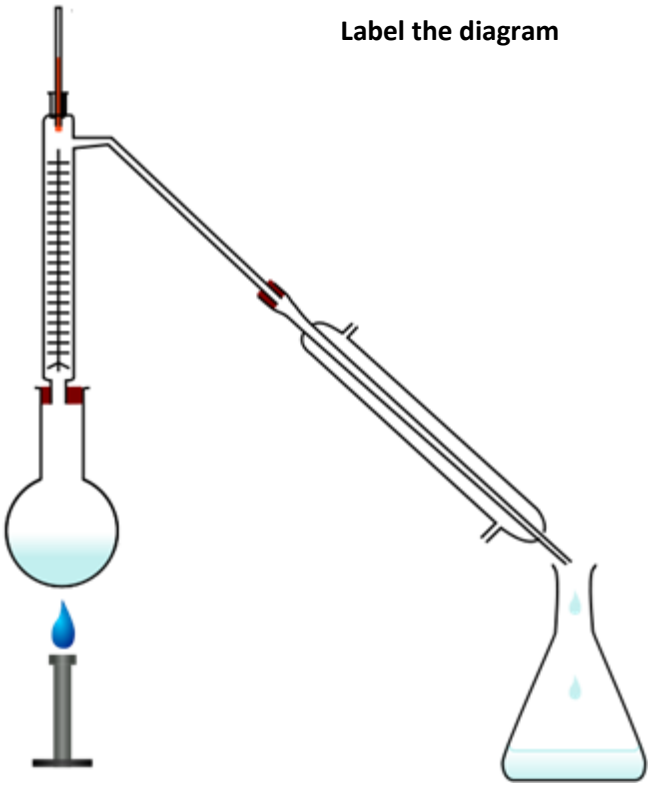
What is fractional distillation?

Fractional distillation is the process used to separate two _____ liquids based upon differences in boiling point.

Example: Ethanol has a boiling point of _____**.** Water has a boiling point of _____**.** Both water and ethanol are infinitely miscible in one another. This means the resulting mixture looks like a _____liquid no matter how much ethanol or water is added. Water and ethanol can be separated by the process of fractional distillation.*

How does fractional distillation work?

Label the diagram



When a mixture of soluble liquids is heated all liquids are evaporated. The liquid with the _____boiling point however, forms the greatest percentage of vapour.

A _____ column is needed to further separate the mixture.

As the vapour moves up the fractionating column it becomes progressively _____ with the component that has the lowest boiling point.

This is due to the vapour mixture continually condensing and _____ as it moves up the column.

A thermometer is used to measure temperature of the gaseous fractions before they _____

The liquid with the lowest boiling point will be the first 'fraction' or portion of the _____

** In reality an azeotropic mixture is produced when the mixture reaches 95% ethanol and 5% water. This prevents further purification by fractional distillation. An _____ is a mixture of two miscible liquids that has a constant boiling point and composition.*

Questions

1. Fractional distillation is used to separate

    i) what type of mixtures?

    ii) on the basis of what physical property?

2. What additional piece of glassware is needed for fractional distillation compared to distillation?

3. What is the maximum purity of ethanol that obtained by the fractional distillation of ethanol and water?

4. Why can't 100% ethanol be obtained by the fractional distillation of a mixture of ethanol and water?

5. **Research:** How is fractional distillation used in the petroleum industry?

Fractional Distillation Worksheet - ANSWERS

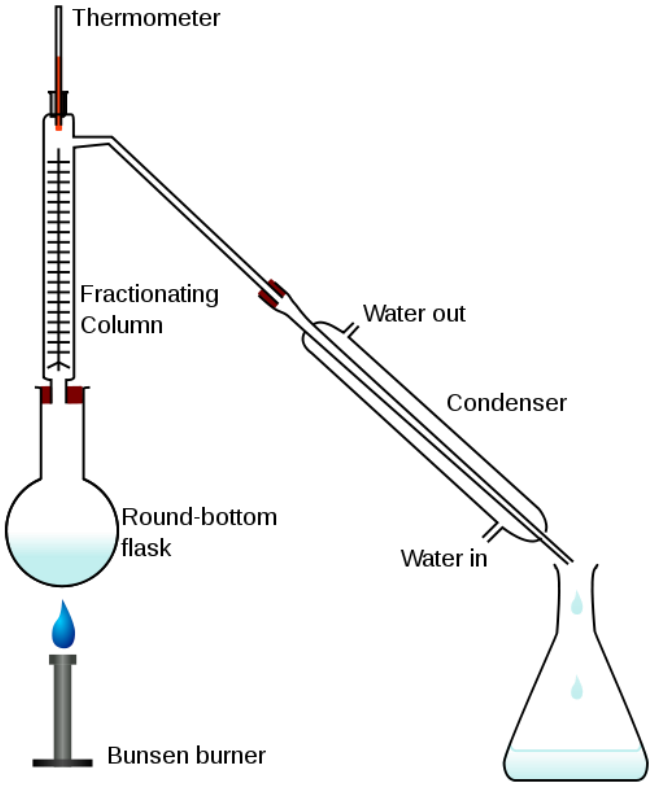
What is fractional distillation?

Fractional distillation is the process used to separate two **miscible** liquids based upon differences in boiling point.

Example: Ethanol has a boiling point of 172 ºF or 78 °C. Water has a boiling point of 212 ºF or 100 °C.

Both water and ethanol are infinitely miscible in one another. This means the resulting mixture looks like a **single** liquid no matter how much ethanol or water is added. Water and ethanol can be separated by the process of fractional distillation.*

How does fractional distillation work?



When a mixture of soluble liquids is heated all liquids are evaporated. The liquid with the **lowest** boiling point however, forms the greatest percentage of vapour.

A **fractionating** column is needed to further separate the mixture.

As the vapour moves up the fractionating column it becomes progressively **richer** with the component that has the lowest boiling point.

This is due to the vapour mixture continually condensing and **evaporating** as it moves up the column.

A thermometer is used to measure temperature of the gaseous fractions before they **condense.**

The liquid with the lowest boiling point will be the first 'fraction' or portion of the **distillate.**

** In reality an azeotropic mixture is produced when the mixture reaches 95% ethanol and 5% water. This prevents further purification by fractional distillation. An **azeotrope** is a mixture of two miscible liquids that has a constant boiling point and composition.*

Questions

1. Fractional distillation is used to separate
   i) what type of mixtures? *Miscible liquids*
   ii) on the basis of what physical property? *Differences in boiling points*
2. What additional piece of glassware is needed for fractional distillation compared to distillation?

A fractionating column

3. What is the maximum purity of ethanol that obtained by the fractional distillation of ethanol and water? *95%*
4. Why can't 100% ethanol be obtained by the fractional distillation of a mixture of ethanol and water?

Water and ethanol form an azeotropic mixture at 95% ethanol. This mixture has a constant boiling point and cannot be further separated.

5. **Research:** How is fractional distillation used in the petroleum industry? *Own student research*