Distillation

Why?

Gasoline comes from under the ground as part of a mixture that is referred to as crude oil. Crude oil contains many different organic compounds, only some of which can be used to fuel our cars. It is necessary to separate gasoline from crude oil in order for it to be used by engines that are part of our everyday lives. The purpose of this activity is to investigate the type of physical separation that is used to isolate gasoline from crude oil.

Success Criteria

- Describe the effect of temperature on the vapor pressure of a liquid.
- Describe the effect of intermolecular attractions on vapor pressure of a liquid.
- Relate vapor pressure to boiling point of a liquid.
- Arrange different liquids in order of increasing boiling points and increasing intermolecular attractions based on data presented on a graph.

Prerequisites

- Mixtures
- Physical properties
- Physical separation
- Pressure
- Vapor pressure

Information

- The **boiling point** of a liquid is the temperature at which the vapor pressure above the liquid equals atmospheric pressure.
- The **normal boiling point** of a liquid is the temperature at which a liquid boils when the pressure is equal to one atmosphere (101.3 kPa).

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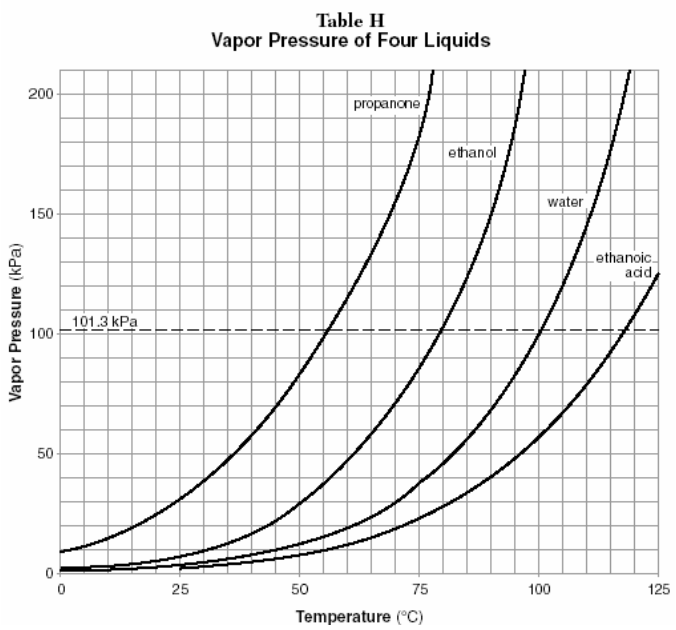
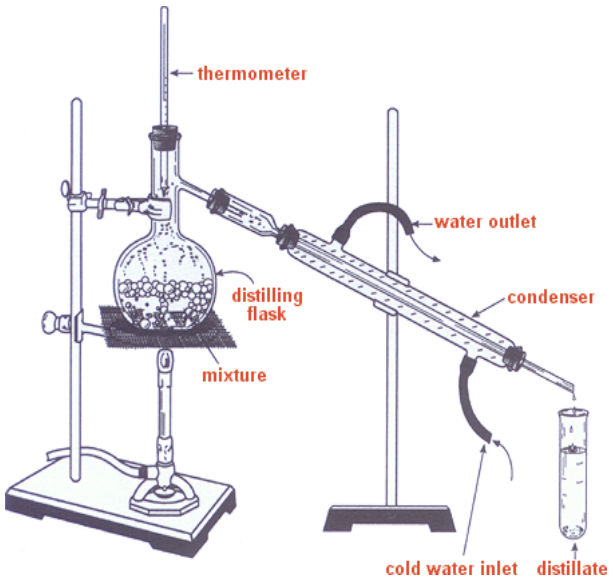
Model



(http://nysedregents.org/testing/reftable/archreftable/ChemRef1-7.pdf)



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Key Questions

1. Do the vapor pressures of the four liquids on Table H increase or decrease as temperature rises?

2. What is the normal boiling point of water?

3. What is the boiling point of water if the atmospheric pressure is 40 kPa?

4. Liquids with stronger intermolecular attractions tend to boil at higher temperatures. Based upon the boiling points shown on Table H, which liquid has the greatest intermolecular attractions?

5. What is the lowest normal boiling point for a liquid shown on Table H?

6. The figure below Table H represents a distillation apparatus. Where is the purified distillate collected?

7. The condenser is a closed glass tube immersed in cool running water. Why is cool water used in the condenser?

8. Assume that a mixture containing the four liquids from Table H is being heated in the distilling flask within the illustration. List the four liquids in the order that you would expect them to be collected?

   (First) _____ (2) _____ (3) _____ (Last) _____

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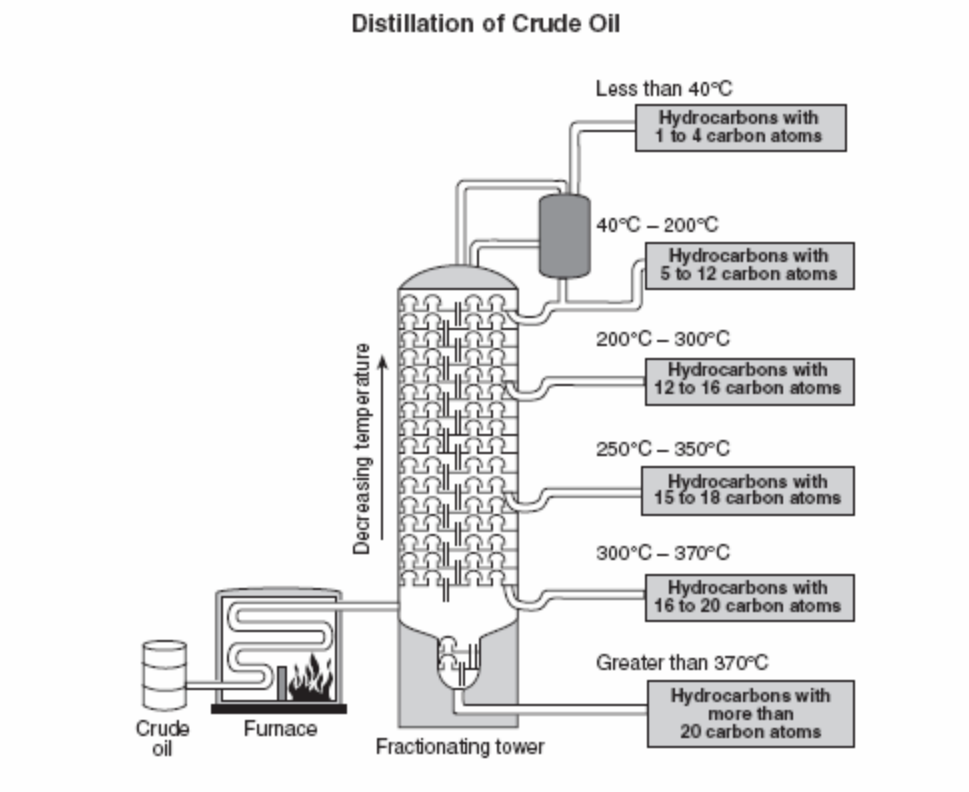
Applications

Crude oil is a mixture of many hydrocarbons, each containing different numbers of carbon atoms. The use of a fractionating tower allows the separation of this mixture based upon the boiling points of the hydrocarbons.



(http://nysedregents.org/testing/scire/chem605.pdf)

1. State the trend between the number of carbon atoms in a hydrocarbon and the boiling point of the compound.

2. Describe the relationship between the number of carbon atoms in a hydrocarbon and the strength of the intermolecular forces of attraction.

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3. Gasoline has a strong odor at low temperatures and has a low boiling point. Explain the presence of these properties in terms of the strength of intermolecular attractions between hydrocarbon molecules.

4. Liquids that readily form vapors are referred to as volatile. Some examples of volatile substances are perfumes, acetone (commonly found in nail polish remover), and rubbing alcohol. Explain in terms of intermolecular forces why these substances are said to be volatile.

Research

Using resources available (textbook, internet), determine the names and uses of some compounds that fractionate in each of the different temperature zones shown in the illustration of the distillation of crude oil.

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