Chromatography

Prelab
Read pages 366 to 375 in your text to answer the following questions.

Classify the following changes as physical or chemical by putting a P or a C on the line next to the description.

Example: Water boils ___ P

1. A baby grows two inches ______
2. Ice melts ______
3. Water boils ______
4. Milk spoils ______
5. Wood burns ______

Classify the following as A, homogeneous mixture; B, heterogeneous mixture; C, element; or D, a compound.

1. Coca Cola ______
2. Milk ______
3. Water ______
4. Copper wire ______
5. Steel ______

Name and give one example of three ways that the components of a mixture can be separated from one another

1. ____________________________
2. ____________________________
3. ____________________________
Read pages 233 to 235 and 263 in your text to answer the following questions.

Mark the following diagram to clearly show the wavelength and amplitude of the wave.

![Diagram of a wave with labeled axes](image)

Light has wavelike properties. What is the relationship between the frequency of light and its color? Express the relationship in words and with an equation.

Circle T for True or F for False.

1. All pure substances are elements. T F
2. All homogeneous mixtures are pure substances T F
3. A pure element is homogeneous T F
Discussion
This is a good experiment for children as well as adults. The technique is simple, but can be varied in a number of ways that will be discussed at the end of the procedure.

Chemists use a many techniques such as filtration, sublimation, or extraction to separate mixtures. You may use filtration at home to separate coffee grounds from coffee. This experiment illustrates another technique commonly used to separate mixtures in the laboratory.

Why is black ink black? Black is not really a color, but the absence of a color. A substance that absorbs all the frequencies (or colors) of light will appear black. A mixture of many different colored inks such as blue, red, and yellow serve to absorb all the frequencies of light. With no light reflected, the mixture of different colors of ink appears black.

In this experiment you will use a chemical technique called “paper chromatography” to separate the black ink into its components. The technique works on the principle of adsorption, the tendency to “stick” to the surface of a solid, in this case paper. A small dot of black ink is placed on a piece of paper, and a solvent is dripped on the dot. Capillary action carries the solvent away from the drop of ink. Because the various components in the black ink have differing affinities for the solvent and paper, they travel with the solvent at different rates. One of the colored inks in the black ink may stick to the paper and not be moved by the solvent passing over it, while another color may not stick to the paper and travel along with the solvent. Bands of color will appear; hence the name chromatography, meaning, “graph of color.”

Paper chromatography and related chromatography techniques were developed about 50 years ago. If you are ever tested for drugs chromatography will be used to separate the drugs, if any, from the other components of your urine. DNA testing also makes use of chromatography.
**Procedure**

You can work in groups of three or four. Take one of the black pens and place a small dot of the ink at the center of a piece of filter paper. Add more ink to the dot in the center by touching the center of the paper with the pen. Try to keep the dot small. Prop the marked paper on a small beaker as shown below.

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Filter paper
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Beaker
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Carefully and slowly add a small drop of water on top of the ink dot. Watch the ink spread in a circle as the water is absorbed by the paper. Just before your drop of water is completely absorbed, add a second drop, then a third, and so on until the components have separated to your satisfaction. You may not be successful with water. You may have to try another solvent such as white vinegar, rubbing alcohol or a mixture of solvents to obtain the best separation. Show your separated ink colors to the instructor. The best separation will receive a one bonus point for every member of the group. How the components separate depends on several factors, including your choice of solvent and your technique.

Complete this experiment at home. See the data sheet for instructions.
Data Sheet for Chromatography

Try this experiment at home with another pen. Non-permanent black felt-tip pens that use water soluble inks seem to work best, but experiment at home with a variety of different types of pens, food coloring, soft drinks, colored liquids from flowers or vegetables. Coffee filters or any other porous paper can be used in place of the filter paper we used in class. Bring one example of a good separation to class. You may work as a group.

Have you noticed that all “blue” inks aren’t the same color blue? How might this be explained?

You wax your car to protect the finish, but after rain dries you still find water spots. What are those spots are composed of? Your choices are (a) water, (b) dirt, (c) wax, (d) autopaint, (e) all of these. Explain.