Experiment 1: Layering Liquids

(DO NOT FORGET TO WRITE DOWN THE LETTER OF YOUR SET ON YOUR ANSWER SHEET)

OBJECTIVE: To layer 4 liquids properly

MATERIALS:

- 1 bottle of red water
- 3 small plastic containers
  (70% ethyl alcohol, kerosene, and oil)
- Tall glass
- 4 pcs plastic syringes

You may have come across the term density. Density is calculated as mass of the object divided by its volume. When comparing the density of two objects, you know that the denser object sinks while the less dense object floats.

Another concept that is important in this experiment is miscibility. Two liquids are miscible if they form one phase when mixed, i.e., they do not form two separate layers. So, if liquid X is not miscible with liquid Y, and liquid X is less dense than liquid Y, then liquid X will sit or float on top of liquid Y forming two layers.

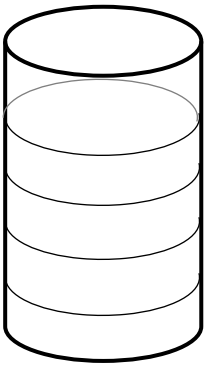
Given four different liquids, your task is to layer one liquid on top of another liquid in the glass.

TIPS:

- Do not smell the liquids directly.
- Layer the liquids according to the miscibility and density tests.
- Use the plastic syringes provided and slowly transfer the liquids to the glass.
- Record all the results of your experiment. Then, immediately pour out all the liquids from the glass to the plastic containers.

QUESTIONS:

1. Indicate the color of the layered liquids in the figure below. Write **colorless** if there is no color.



2. What causes two liquids to be miscible with each other?
3. Observe carefully the first and second layers. Take note the formation of a thin layer. Explain why this thin layer was formed.
4. If only 3 mL of each liquid is provided, will the sequence of the layers be the same? Explain.
5. Is there a need to check the miscibility of all liquids? If no, suggest an alternative.
6. How many layers will form if you swirl the glass? Explain.

Experiment 2: Chromatography

(DO NOT FORGET TO WRITE DOWN THE LETTER OF YOUR SET ON YOUR ANSWER SHEET)

OBJECTIVE: To determine the identity of Pen X

MATERIALS:

- 6 pcs filter paper with the mark of the unknown Pen X
- Rubbing alcohol
- Water
- Plastic cup
- Tape and scissors
- 3 different kinds of pens

You have probably learned in art class that by mixing together various paint colors, completely new colors can be made. For example, by mixing yellow and blue paints, a green color can be obtained and to get an orange colored paint, red and yellow paints can be mixed together. Similarly, various colors of ink can also be mixed together to form new colors of ink. This is often used to obtain a specific color for calligraphy pens and felt tipped pens.

Chromatography (from Greek χρῶμα *chroma* "color" and γράφειν *graphein* "to write") is the collective term for a set of laboratory techniques for the separating mixtures. Simple paper chromatography is used in analytical chemistry to separate and identify mixtures that are or can be colored, especially pigments. Chromatography is used extensively in forensics, from analyzing body fluids for the presence of illegal drugs, to fiber analysis, blood analysis from a crime scene, and at airports to detect residue from explosives.

In the following experiment, you are tasked to identify the pen used in a crime. You are provided three (3) different pens, which you will use in your investigation. The unknown Pen X has been marked already for you in the filter paper. You can use your pencil to label the **pen marks** to guide you in order to avoid confusion.

PROCEDURE:

1. Obtain a piece of filter paper.
2. Draw a small line near the bottom of the paper as indicated by the arrow. Write the brand name of the pens below their corresponding marks as shown in Figure 1. “Panda” is one of the brands of the pens. You can look for the other two brand names.

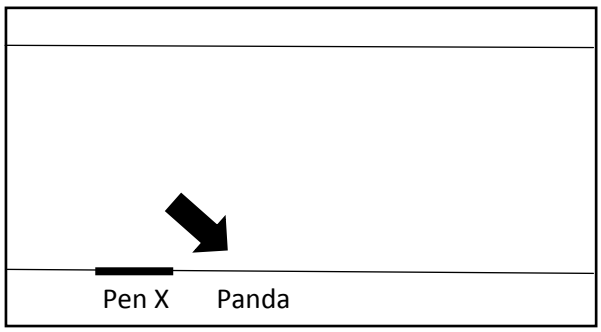


Figure 1. Layout of filter paper

3. Roll the filter paper in the form of a cylinder and tape the ends as indicated by the arrow in Figure 2. Make sure that the ends of the paper **do not** overlap.

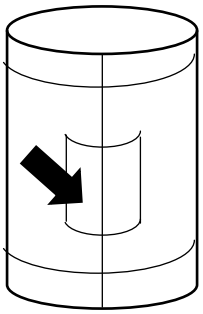


Figure 2. Rolling the filter paper to a cylinder

4. Pour a small amount of **water** (solvent) into the cup. Make sure that the ink marks do not touch the liquid.
5. Put the rolled filter paper into the cup. You may cover the cup with a piece of paper for faster development. Make sure that the cover is not too heavy to prevent the cup from crushing.
6. Wait until the liquid reaches the top pencil mark. Do not disturb the cup until you remove the filter paper.

7. Air dry the filter paper.
8. Repeat steps 1-7 of the experiment using **alcohol** as the solvent.
9. You are provided with 6 pieces of filter paper.
   OPTIONAL: You can use the remaining filter papers to repeat the experiment if necessary.
10. Using your tape, select only one filter paper for each solvent used (water and alcohol) and attach it on your answer sheet.

QUESTIONS:

1. What is the identity of Pen X? Write down the BRAND NAME of the pen.
2. Explain the difference in the results you obtained from using two different solvents.
3. Why does the pencil mark not rise with the liquid?
4. What will happen if the ink marks touched the liquid when you drop the filter paper into the cup?
5. Why should you not disturb the cup while the liquid rises on the filter paper?

Experiment 3: Density of a Solid

(DO NOT FORGET TO WRITE DOWN THE LETTER OF YOUR SET ON YOUR ANSWER SHEET)

OBJECTIVE: To determine the density of an unknown solid

MATERIALS:

- Metre rule
- Strings
- A pair of scissors
- Washers/Nuts (small - 4 g ; big - 10 g)
- Iron bolt (unknown solid)
- Water
- 30 cm ruler
- Tissue paper

The density of an object expresses a relationship of mass to volume. The formula is:

$$Density = \frac{Mass}{Volume}$$

To find the density of a solid, we need to measure its mass and its volume.

Stage 1: Determine the mass of a solid.

If a mass balance is not available, it is possible to determine the mass of an object by using the Principle of Moment (this is the principle of how most balances worked in the olden days) which involves the idea of balancing.

If a uniform beam is suspended by a string at its mid-point as shown in **Figure 1** and another mass of known value is used, the beam will balance if the product of the mass and the distance from the point of suspension are equal on both sides. The formula is:

$$m \times d = M \times D$$

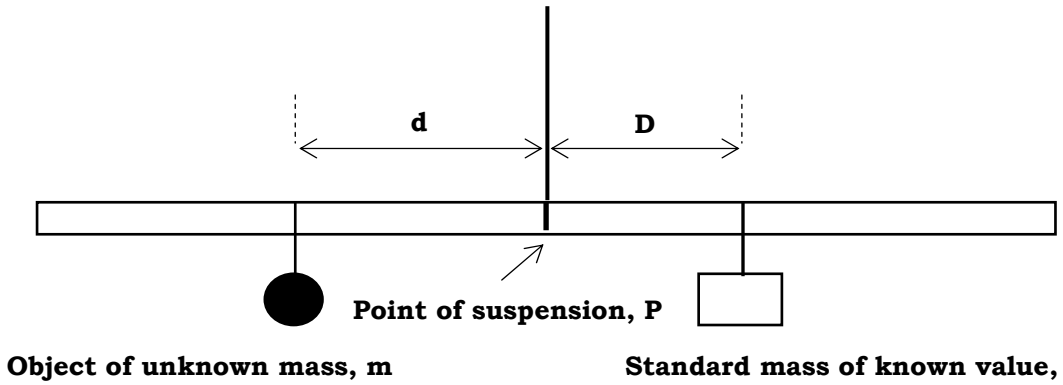


Figure 1. Illustration showing the Principle of Moment

PROCEDURE:

1. Tie the metre rule using a string such that the metre rule is suspended as shown in **Figure 1**. Adjust the point of suspension **P** until the metre rule is horizontally balanced. The position **P** shall be kept constant throughout.
2. Tie a known mass, ***M*** of a chosen value on one side of **P** at a chosen distance **D** from **P**.
3. Tie the iron bolt on the other side of **P** of the metre rule.
4. Adjust the position of the iron bolt until the metre rule balances.
5. Measure **d**, the distance of the iron bolt from **P**.
6. Calculate the mass of the iron bolt, ***m*** using the formula:

$$m = \frac{D}{d} \times M$$

where ***M*** is the mass of the standard mass.

7. Repeat the experiment for another two (2) values of known mass and calculate the average mass of the iron bolt.

Stage 2: Determine the density of the iron bolt.

Design an experiment using the available materials to determine the density of the iron bolt.

(a) Write your procedure as detailed as possible.

(b) Record the data you obtained.

(c) Show your calculation to determine the density of the iron bolt.