

WHICH WILL EVAPORATE FIRST?

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MATERIALS NEEDED:

Chalkboard
Water, H₂O, 25 mL
Methanol, CH₃OH, 25 mL
Ethanol, C₂H₅OH, 25 mL
Iso-propyl alcohol (2-propanol), CH₃CHOHCH₃, 25 mL
Acetone, CH₃COCH₃, 25 mL
Hexane, C₆H₁₄, 25 mL
Watch glasses (6)
Cotton balls (6)

SAFETY PRECAUTIONS:

Wear safety goggles while performing this experiment.

Liquids used in this experiment are flammable. Avoid flames or sparks.

DISPOSAL:

Only small amounts of liquids should be used in this experiment. No specialized disposal methods should be necessary.

PROCEDURE:

Place 6 watch glasses on a table or desk in front of the classroom. Place one or two cotton balls on each watch glass.

Write the words water, methanol, ethanol, and 2-propanol across the top of the chalkboard. (Common names can be used if preferred.) Leave space, as the liquids will be placed on the chalkboard under each compound name.

Wet the cotton on the first watch glass with approximately 5 mL of water.

Wet the cotton on the second watch glass with approximately 5 mL of methanol.

Wet the cotton on the third watch glass with approximately 5 mL of ethanol.

Wet the cotton on the fourth watch glass with approximately 5 mL of 2-propanol.

Have four volunteers simultaneously wipe the wet cotton balls on the chalkboard under the corresponding name of the compounds.

Ask the class to predict which liquid will evaporate first. Ask why. (Have the class consider both structure and molecular weight.)

EXPLANATION:

The four compounds used are all polar liquids containing an –OH group. The amount of hydrogen bonding differs as the molecular weight of the compound increases. Evaporation for the alcohols will occur according to molecular weight, with the lowest molecular weight compound evaporating first. So, Methanol (MW = 32) will evaporate first; ethanol (MW = 46) will evaporate second; generally, 2-propanol (MW = 60) will evaporate third; and the water (MW = 18) will usually evaporate last. (Note: Occasionally, conditions may favor the evaporation of the water over the 2-propanol.) The fact that the water usually evaporates last demonstrates that the strong hydrogen bonding between water molecules affects evaporation (and boiling point) more than molecular weight.

Repeat the demonstration using hexane (MW = 86) and acetone (MW = 58). Discuss the effect of molecular weight and polarity between these two molecules.