Which Colorless Liquid Is This?

Topic

Test for water

Introduction

Water often plays a part at a crime scene. For example, someone may have drowned and been found in a freshwater lake or river – a tragic accident, perhaps. However, a forensic scientist discovers that the water in the body's lungs is salty, i.e., it is seawater. This suggests something more sinister than an accident; the body has been moved after death for some reason – maybe to cover up a crime. Seawater from different places can differ in its saltiness, giving forensic scientists clues as to the source of the water. In this experiment, you will make salty water of different strengths and then measure the melting and boiling points of the solutions. You will then deduce which is fresh water, which is a strong solution of salt, and which is a weak solution of salt.

Time required

Part A: 20 minutes (but samples are left overnight)
Part B: 30 minutes for each liquid

Materials

For Part A:
tap water
4 × 500 ml beakers
250 ml graduated cylinder
weighing scales
120 g salt
4 adhesive labels
waterproof pen
glass rod
4 plastic ice trays
access to a freezer

*For Part B:**
plastic ice trays prepared in Part A
thermometer (range –20°C to 150°C)
400 ml beaker
tripod and wire gauze
Bunsen burner
support stand and clamp
rubber gloves
safety glasses

*Four sets of equipment are required if different students test the various liquids simultaneously in Part B.

Safety note

Wear rubber gloves when handling the ice cubes because the frozen solutions are very cold. Be careful when using the Bunsen burner. Pull back long hair and wear safety glasses.

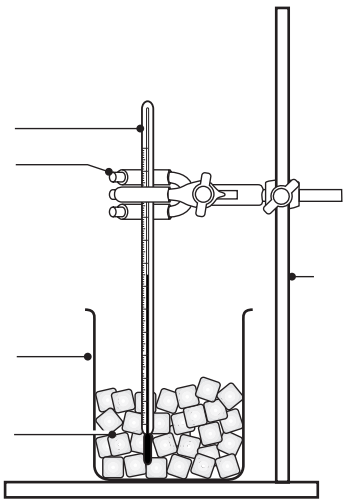
Procedure

Part A: Making the solutions

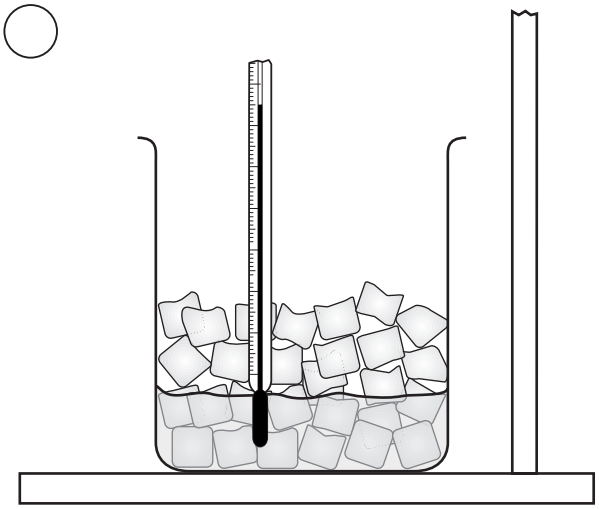
1. Label the four 500 ml beakers and the ice trays A, B, C, and D.
2. Pour 200 ml of water into beaker A.
3. Place 20 g salt into beaker B. Add 200 ml of water to beaker B.
4. Place 40 g salt into beaker C. Add 200 ml of water to beaker C.
5. Place 60 g salt into beaker D. Add 200 ml of water to beaker D.
6. Stir each beaker until the salt dissolves. (The salt may not all dissolve in beaker D.)
7. Fill an ice tray with water from the appropriate beaker (keep the remaining water/solutions in the beakers) and place in a freezer. Leave overnight.

Part B: Measuring melting and boiling points

1. Remove ice tray A from the freezer.
2. Twist out the ice cubes and place them in the 400 ml beaker.
3. Support a thermometer in a clamp and place it in the beaker of ice, so that the base of the thermometer is held about 0.5 cm from the base of the beaker as in diagram 1 below.
4. Allow the ice to melt. When sufficient ice has melted so that the bulb of the thermometer is immersed in liquid (see diagram 2 below), take the reading on the thermometer. This is the melting point for liquid A. Record this value in the data table on the next page.
5. Place the beaker on a wire gauze on a tripod (see diagram 3 on the next page). Use a clamp and support stand to position the thermometer in the beaker so that the end of the thermometer is about 0.5 cm from the bottom of the beaker.
6. Heat the beaker gently using a Bunsen burner as shown in diagram 3.
7. Watch the reading on the thermometer and record the temperature at which liquid A boils in the data table.
8. Repeat steps 1 to 7 for liquids B, C, and D.

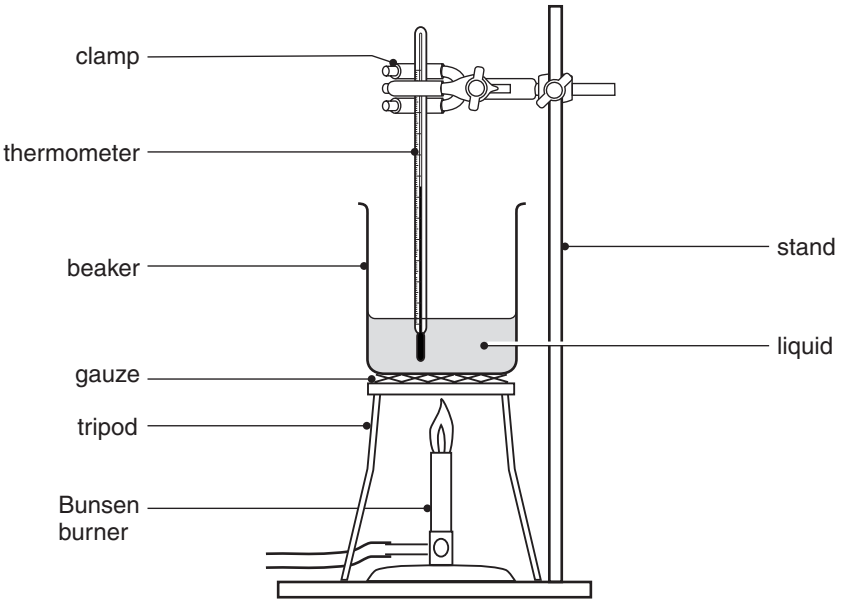


Position of thermometer in beaker of ice



Bulb of thermometer immersed in liquid

3



Heating the liquid in the beaker to its boiling point

DATA TABLE

Solution	Melting point (°C)	Boiling point (°C)
A (water)		
B		
C		
D		

Analysis

1. How would you decide which liquid was fresh water?
2. Why is the reading for the melting point taken only when the ice has melted sufficiently to immerse the thermometer bulb?
3. What did you find out about the melting points of the different solutions?
4. What did you find out about the boiling points of the different solutions?

Want to know more?

1. Pure water (at normal atmospheric pressure) boils at 100°C and ice made with pure water melts at 0°C.
2. A substance reaches it melting point when both liquid and solid are present.
3. The melting point was lower for the solutions containing more salt. This phenomenon is called freezing point depression.
4. The boiling point was higher for the solutions containing more salt. This phenomenon is called boiling point elevation.

Special Safety Note To Experimenters

Each experiment includes any special safety precautions that are relevant to that particular project. These do not include all of the basic safety precautions that are necessary whenever you are working on a scientific experiment. For this reason, it is absolutely essential that you read, copy, and remain mindful of the General Safety Precautions that follow this note. Experimental science can be dangerous, and good laboratory procedure always includes carefully following basic safety rules. Things can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. There will be no time after the fact to protect yourself. Be prepared for unexpected dangers by following basic safety guidelines the entire time you are performing the experiment, whether or not something seems dangerous to you at a given moment.

We have been quite sparing in prescribing safety precautions for the individual experiments. We made this choice for one reason: We want you to take very seriously every safety precaution that is printed in this book. If you see it written here, you can be sure that it is here because it is absolutely critical to your safety.

One further note: The book assumes that you will read the safety precautions that follow, as well as those in the box within each experiment you are preparing to perform, and that you will remember them. Except in rare instances, the general precautions listed below will not be repeated in the procedure itself. It is up to you to use your good judgment and pay attention when performing potentially dangerous parts of the procedure. Just because the book does not say **BE CAREFUL WITH HOT LIQUIDS or DON'T CUT YOURSELF WITH THE KNIFE** does not mean that you should be careless when boiling water or cutting a section of a stem for microscope work. It does mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, wait to perform it until you find out from a qualified adult that it is safe.

GENERAL SAFETY PRECAUTIONS

Accidents caused by carelessness, haste, insufficient knowledge, or taking unnecessary risks can be avoided by practicing safety procedures and being alert while conducting experiments. Be sure to check the individual experiments in this book for additional safety regulations and adult supervision requirements. If you will be working in a lab, do not work alone.

PREPARING:

—Clear all surfaces before beginning experiments
—Read the instructions before you start
—Know the hazards of the experiments and anticipate dangers

PROTECTING YOURSELF:

—Follow the directions step-by-step; only do one experiment at a time
—Locate exits, fire blanket and extinguisher, gas and electricity shut-offs, eyewash, and first-aid kit
—Make sure there is adequate ventilation
—Act sensibly at all times
—Wear an apron and safety glasses
—Do not wear open shoes, loose clothing, or loose hair
—Keep floor and workspace neat, clean, and dry
—Clean up spills immediately, being careful to follow the recommended procedure for dealing with the spilt substance
—Never eat, drink, or smoke in the laboratory or workspace
—Do not eat or drink any substances tested unless expressly permitted to do so by a knowledgeable adult

USING EQUIPMENT WITH CARE:

—Set up apparatus far from the edge of the desk
—Use knives and other sharp or pointed instruments with caution
—Pull plugs, not cords, when removing electrical plugs

—Don't use your mouth to pipette liquids; use a suction bulb
—Check glassware is clean and dry before use
—Check glassware for scratches, cracks, and sharp edges
—Report broken glassware immediately so that it can be cleaned up by a responsible person
—Do not use reflected sunlight to illuminate your microscope
—Use only low voltage and current materials such as lantern batteries
—Be careful when using stepstools, chairs, and ladders

USING CHEMICALS AND BIOLOGICAL MATERIALS:
—Never taste or inhale chemicals
—Label all bottles and apparatus containing chemicals
—Read labels carefully
—Avoid chemical contact with skin and eyes (wear safety glasses, lab apron, and gloves)
—Do not touch chemical solutions
—Wash hands before and after using solutions
—Wipe up spills thoroughly
—Use sterile procedures when handling even common and harmless microorganisms
—Avoid contact with human blood
—Treat all living organisms with appropriate respect

HEATING SUBSTANCES:
—Wear safety glasses, apron, and gloves when boiling water
—Keep your face away from test tubes and beakers
—Use test tubes, beakers, and other glassware made of Pyrex™ or borosilicate glass
—Use alcohol-filled thermometers (do not used mercury-filled thermometers)
—Never leave apparatus unattended
—Use safety tongs and heat-resistant mittens
—If your laboratory does not have heat-proof workbenches, put your Bunsen burner on a heat-proof mat before lighting it
—Take care when lighting your Bunsen burner; use a Bunsen burner lighter in preference to wooden matches
—Turn off hot plates, Bunsen burners, and gas when you are done
—Keep flammable substances away from heat
—Keep sheets of paper and other flammable objects away from your Bunsen burner
—Have a fire extinguisher on hand

FIELDWORK:
—Be aware of environmental dangers (e.g., do not carry out fieldwork near dangerous roads, cliffs, or water)
—Remember that strong sunlight can be dangerous – pack sunscreen and a good supply of drinking water if you will be outside all day
—Never carry out fieldwork in areas where you cannot find your way to safety easily and quickly and never wander off on your own in search of new areas to study

FINISHING UP:
—Clean your work area and glassware (follow any instructions given by a supervising adult)
—Be careful not to return chemicals or contaminated reagents to the wrong containers
—Don't dispose of materials in the sink unless instructed to do so
—Wash your hands
—Clean up all residues and put in proper containers for disposal
—Dispose of all chemicals according to all local, state, and federal laws
—Dispose of all microbiological cultures by treatment with an appropriate disinfectant

BE SAFETY CONSCIOUS AT ALL TIMES

Settings And Warning Signs

Settings and hazard warning signs are used throughout the experiments to indicate where they should take place and where particular care should be taken with the materials involved.

SCHOOL LAB

HOME

TOXIC

SPLASH

WARNING

IRRITANT

NAKED FLAMES

HOT LIQUIDS

CORROSIVE

CUT / STAB HAZARD