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LAB 15
EXPERIMENT

IDENTIFYING UNKNOWN SUBSTANCES

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Goal

Identify unknown substances with the help of different tests.

1. What is the independent variable in this lab?

_____

_____

2. What is the dependent variable in this lab?

_____

_____

Hypothesis

I think that _____

because _____

Materials

- 4 samples of unknown substances (solid insoluble in water, solid soluble in water, liquid and gas)
- balance (accurate to 0.01 g)
- small rubber stopper
- 100-mL graduated cylinder
- wash bottle of distilled water
- electrical conductivity detector
- test-tube rack
- 3 test tubes (18 mm × 150 mm) and stoppers (No. 1)
- 10-mL graduated cylinder
- spatula
- wire loop
- Bunsen burner
- cobalt chloride paper strips
- 100-mL beaker
- hot plate
- thermometer clamp *or* universal clamp and perforated cork stopper
- ring stand
- thermometer
- 140-mL syringe with perforated plunger and stopper
- 4-in nail
- container of limewater
- wood splints
- matches *or* lighter

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Procedure

Solid insoluble in water

1. Note the colour and the odour of the solid.

2. Weigh and record the mass of the solid.

3. Measure the volume of the solid.

a) Place the stopper at the bottom of the 100-mL graduated cylinder.

b) Pour 25 mL of distilled water into the graduated cylinder. Record the volume.

c) Add solid to the graduated cylinder so it is submerged completely in water.

d) Measure and record the volume.

4. Calculate the density of the solid.

5. Test electrical conductivity of the solid.

a) Touch the electrodes of the conductivity detector to the solid.

b) Observe if the detector lights up. Note the result.

6. Clean up.

Solid soluble in water

1. Note the colour and the odour of the solid.

2. Determine the solubility of the solid in water.

a) Weigh the empty test tube and the stopper. Record the mass.

b) Measure into the 10-mL graduated cylinder exactly 5 mL of distilled water.

c) Pour the water into the test tube and close it with the stopper. Weigh and record the mass.

d) Calculate the mass of the water.

e) Add a small quantity of soluble solid into the test tube.

f) Stopper the test tube and shake until dissolution is complete.

g) Repeat steps e) and f) until solute does not dissolve.

h) Weigh the empty graduated cylinder. Record the mass.

i) Decant the solution into the graduated cylinder. Measure and record the volume.

j) Measure and record the mass of the graduated cylinder and the solution.

k) Calculate the mass of the dissolved solute.

l) Calculate the solubility of the solid.

3. Conduct flame test on solid.

a) Dip the wire loop into distilled water, then into the solid.

b) Pass the wire over the flame of the Bunsen burner. Record the colour of the flame.

4. Clean up.

Liquid

1. Note the colour and the odour of the liquid.

2. Determine the density of the liquid.

a) Weigh and record the mass of the 10-mL graduated cylinder.

b) Pour exactly 10 mL of liquid into the graduated cylinder.

c) Weigh the graduated cylinder (with liquid). Record the result.

d) Calculate the density of the liquid.

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3. Test the liquid with a cobalt chloride paper strip.
- *a)* Dip a cobalt chloride paper strip into the liquid.
- *b)* Record the colour of the paper.

4. Determine the boiling point of the liquid.
- *a)* Pour 20 mL of liquid into the 100-mL beaker.
- *b)* Place the beaker on the hot plate.
- *c)* Insert the thermometer into the beaker and clamp it so the bulb is submerged completely and not touching the beaker.
- *d)* Heat the beaker and record the temperature at which bubbles form.

5. Clean up.

Gas

1. Note the colour and the odour of gas.

2. Determine the density of the gas.
- *a)* Stopper the syringe. Set the plunger at the mark of 140 mL and insert the nail into the hole.
- *b)* Weigh the syringe (with plunger, stopper and nail). Record the result.
- *c)* Remove the stopper and the nail from the syringe.
- *d)* Push the plunger down fully into the syringe.
- *e)* Connect the rubber tip of the gas cylinder to the tip of the syringe.
- *f)* Carefully open the valve of the gas cylinder.
- *g)* Quickly close the valve of the gas cylinder when the plunger reaches the mark of 140 mL.
- *h)* Disconnect and quickly close the syringe.
- *i)* Insert the nail into the hole of the plunger. Record the volume of gas in the syringe as exactly as possible.
- *j)* Weigh the syringe (with gas). Record the result.
- *k)* Calculate the density of the gas.

3. Test the gas with limewater.
- *a)* Fill the test the tube with gas and quickly close it with the stopper.
- *b)* Remove the stopper and quickly pour limewater into the test tube, then stopper the test tube and shake. Record the result.

4. Test the gas with a flaming wood splint.
- *a)* Fill the test tube with gas and quickly close it with the stopper.
- *b)* Remove the stopper and quickly insert the flaming wood splint into the test tube. Record the result.

5. Test the gas with a hot ember.
- *a)* Fill the test tube with gas and quickly close it with the stopper.
- *b)* Remove the stopper and quickly insert the hot ember into the test tube. Record the result.

6. Clean up and put away materials.

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Results

Record your results in the table below. Give the table a title.

Title:

Substance	Colour	Odour	Mass (mL)	Volume (mL)	Density (g/mL)	Other observations and results
Solid insoluble in water						
Solid soluble in water						
Liquid						
Gas						

Analysis of the results

1. What characteristic properties have you identified? Specify if each one is a physical charateristic property or a chemical characteristic property.

Physical characteristic properties	Chemical characteristic properties

2. What are the unknown substances? Explain your answers.

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3. What are the possible sources of error in this lab?

_____

4. How could you improve the protocol for this lab?

_____

Conclusion

1. Complete the following sentence:

To identify an unknown substance, it is necessary to determine some of its _____ and compare results obtained with data from _____

2. Was your hypothesis confirmed or not? Explain your answer.

_____

Application

While looking through the refrigerator, Max discovers a liquid substance in a plastic container. The container is not marked and he no longer remembers its contents. How would he be able to identify the substance without having to taste it?

_____

_____

_____

_____

_____

_____

_____