POPPY SCHOLARS · CHEMISTRY IN THE EARTH SYSTEM

Home lab 8 · Unit 8 · about 50 minutes

How does the volume of a gas change with temperature, and what does that tell us about absolute zero?

Name _____ Date _____

MATERIALS

You supply everything. Tick each item as you gather it.

- ☐ A 60 mL plastic syringe with a luer tip (from a pharmacy) and a tight cap, or a small rubber stopper that seals the tip
- ☐ 3 containers of water at different temperatures: ice water, room temperature, and hot tap water (no hotter than 60 °C)
- ☐ A thermometer, a timer, paper and a calculator
- ☐ A ruler is optional

SAFETY

Hot tap water only, never boiling. An adult should handle hot water. Never point a syringe at a person or put it in your mouth, and keep the cap on so that the syringe cannot shoot out a plug. Wash your hands after. Keep small caps away from young children.

PROCEDURE

1. Pull the plunger to 50 mL at room temperature, cap the tip tightly, and measure the air temperature (about 21 °C). Check the seal by pushing the plunger a little and letting go: it should spring back.
2. Put the syringe, tip and barrel, in the ice water for 3 minutes. Hold the plunger lightly and read the volume at the line, with the temperature of the bath.
3. Move it to the room-temperature bath, wait 3 minutes, and read the volume and temperature.
4. Move it to a warm bath of about 40 °C, wait 3 minutes, and record. Then repeat with a bath of about 60 °C.
5. Convert each temperature to kelvins: K = °C + 273.15.
6. Graph volume (vertical) against temperature in °C (horizontal), draw the best straight line, and extend it to the left until it reaches zero volume. Read the temperature where it crosses.

RECORD YOUR DATA

Bath	Temperature (°C)	Temperature (K)	Volume (mL)
Ice water			
Room			
Warm			
Hot			

LAB REPORT

Write a report that gives your table and graph, shows the line fit and the temperature at which it predicts zero volume, and compares that temperature with absolute zero (−273.15 °C). Explain Charles's law at the particle

level, and say what assumptions the gas law makes that real gases break near condensation.

Report the numbers you actually got, even when they disagree with the lesson. Write on the lines, or type your report on the website and send it to a teacher there.

Question and hypothesis *State the question in your own words, what you expect to happen, and why you expect it.*

Method *What you changed, what you measured, what you kept the same, and how many trials you ran.*

Observations *Describe what you saw, including anything unexpected. Your data tables are added to the report automatically.*

Calculations *Show each calculation step by step, with units.*

Claim and reasoning *Answer the question using your numbers, then explain why, using the science from the unit.*

Limits and next step *What could have affected your results, and one change you would make next time.*