CHAPTER 3	Investigation 3.B: The Relationship between Temperature and Volume of a Gas	BLM 3.3.1
HANDOUT		

In this investigation, you will examine the effect of temperature changes on the volume of a gas.

Question
What is the relationship between the temperature and volume of a fixed amount of gas at a constant external pressure?

Prediction
Predict what the relationship between temperature and volume of a gas will be.
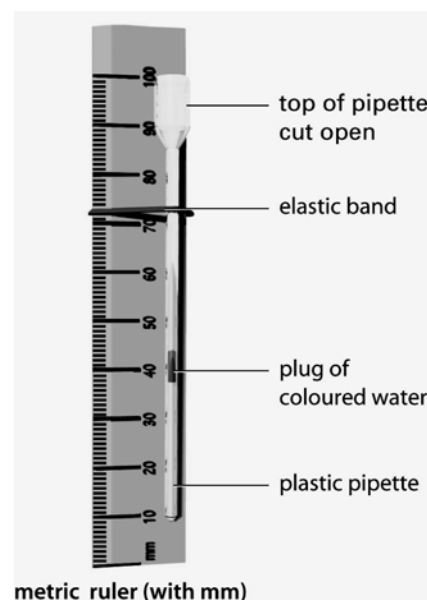
Safety Precautions
- Use care when sealing the end of the plastic pipette with a flame. The plastic will melt and may begin to burn. Hot, molten plastic can burn your skin.
- Do not inhale any of the fumes from the plastic. If a hood is available, seal the pipette in the hood.
- Before lighting the Bunsen burner, check that there are no flammable solvents in the laboratory.

Materials
- coloured water
- tap water
- ice
- thin stem plastic pipette
- match or Bunsen burner
- scissors
- metric ruler (with mm calibrations)
- 2 rubber bands
- 400 mL beaker
- Celsius thermometer
- hot plate
- marker

Procedure
1. Squeeze the pipette bulb and draw enough water into the pipette to form a small plug that is about 0.5 cm long. The rest of the pipette should contain air.

2. Using the flame from a match or a small flame from a Bunsen burner, carefully seal the open end of the pipette completely. Allow the pipette to cool for at least three minutes before proceeding to Step 3.

3. Using scissors, cut off a small section at the top of the bulb of the pipette.

4. Carefully attach the pipette to the ruler, using a rubber band, so that the bottom of the tube is even with the 10 mm (1.0 cm) mark of the ruler, as shown in the diagram.

5. Fill a 400 mL beaker about two thirds full of tap water and add three or four ice cubes. Place the thermometer in the water. Then put the ruler with the attached pipette into the water. Allow the ruler and pipette to sit for five minutes.

top of pipette cut open

elastic band

plug of coloured water

plastic pipette

metric ruler (with mm)

Investigation 3.B: The Relationship between Temperature and Volume of a Gas (continued)

6. After five minutes, measure the length of the trapped gas in mm. (Recall that the length is proportional to the volume because $V = A \times L$.) Remember that the bottom of the pipette stem is set at the 10 mm (1.0 cm) mark. Record these values in the following data table.

T (ºC)	V(mm × A)

7. Place the beaker on the hot plate and **slowly** heat the water in the beaker. Measure the length and temperature of the trapped gas at every 10 °C to 15 °C. Measure the length of the column of air and temperature of the water to a maximum of 60 °C.

8. Clean the apparatus and dispose of the pipette as directed.

Analysis
1. What is the manipulated (independent) variable? What is the responding (dependent) variable? Name two controlled variables.

2. Plot a graph of volume, in terms of length times constant area (mm × *A)* versus temperature. Choose your scale so that the temperature axis extends from −300 °C to 100 °C.

3. Draw a line of best fit through your data points. Extrapolate this line until it reaches the *x*-axis (temperature axis).

4. What relationship between volume and temperature does your graph suggest?

5. Speculate about the significance of the temperature where the line reaches the temperature axis, which indicates zero volume.

6. Put a copy of your data table and graph into your notebook because you will use the data again in another investigation.

Conclusion

7. Write a paragraph summarizing your conclusions about the relationship between temperature and the volume of a gas.