Gas Pressure and Volume Relationships
Exp. A

Name_____ Lab Section_____

Lab Partner_____

Problem Statement: How are the pressure and volume of a gas sample related?

I. Data Collection:

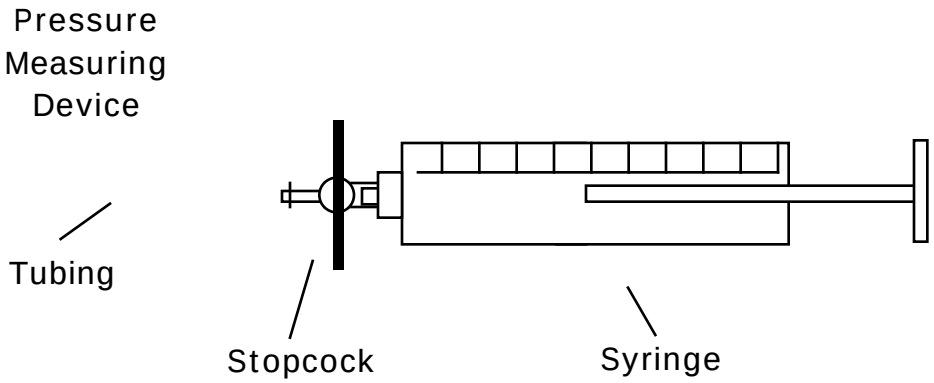

Figure A

A. Obtain a pressure measuring device as indicated by your lab instructor. Obtain a 60 mL syringe, fill it with air, and connect the syringe to the gas measuring device as indicated in figure A. Test your apparatus for gas leaks. If you can't eliminate all leaks, see your lab instructor.

B. If necessary, calibrate your gas measuring device as indicated by your lab instructor. Fill your syringe to the largest volume mark on the syringe and reconnect it to the gas measuring device. What is the pressure of the trapped air in the syringe? Explain.

C. Depress the plunger of the syringe and describe the system. Is the pressure of the trapped air greater or less than atmospheric pressure? Explain.

D. Release the plunger of the syringe. Adjust the plunger to the 60 mL mark. Record the pressure reading of the trapped air in the following table. Compress the trapped air by pushing on the plunger. Note the volume of the trapped air, close the stopcock to trap the pressure, and then note the pressure reading on the pressure device. Record these data in the following table. Take volume and pressure readings for a total of ten compressions down to as small a syringe volume as is practical. Obtain atmospheric pressure. Record these values in the following table.

Atmospheric pressure =_____torr at_____(time),_____(date)

Pressure Reading	Syringe Volume
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

II. Data Analysis:

A. If necessary, calculate the total pressure of the trapped air for each reading and record it in the following table. Show how you calculate this pressure for your first reading in the space below.

B. Calculate the total volume of the trapped air for each reading and record it in the following table. Show how you calculated this volume for your first reading. (Hint: treat the volume in the tubing and the pressure measuring device as a cylinder, $V = \pi r^2 l$.)

Data Table

Pressure	Total Volume
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

C. What patterns are shown in these data? It might be helpful to graph the data. Try to come up with an algebraic equation that expresses the pattern you found.

III. Interpretation and Conclusions:

A. How are the pressure and volume of a gas sample related?

B. Mental Model - Draw a picture(s) that explains how the pressure and volume of a gas sample are related at the level of atoms and molecules and that illustrates the observations you made in the experiment. In words, explain how your picture(s) illustrate(s) this relationship.

Gas Pressure and Temperature Relationships
Exp. B

Name_____ Lab Section_____

Lab Partner_____

Problem Statement: How are the pressure and temperature of a gas sample related?

I. Data Collection:

A. Obtain a pressure measuring device as indicated by your lab instructor. Assemble a 125 mL Erlenmeyer flask with thermometer, tubing, and a 1000 mL beaker as shown in figure A. Connect this via a three way stopcock to the pressure measuring device and test for gas leaks.

If you can't eliminate all leaks, see your lab instructor.

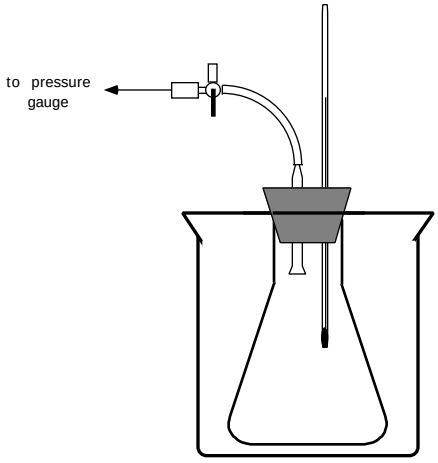

Figure A

B. If necessary, calibrate your gas measuring device as indicated by your lab instructor. Using a ring and wire gauze, support the 1000 mL beaker so that a gas burner can be used to heat the beaker. Using a clamp, suspend the flask in the beaker so that only its neck is above the beaker rim and does not touch the sides or bottom of the beaker.

Fill the beaker with tap water to about 1 1/2 cm from the rim. Be careful to **not** get any water into the flask.

Adjust the stopcock so that the flask is vented to the outside. Using a gas burner, heat the water to a temperature of 80-85˚ C using a second thermometer dipped directly into the water. The water should be constantly stirred during the heating process. The thermometer can be used, but care must be taken to not break the fragile thermometer.

When the temperature reaches 80-85˚ C, remove the heat. When the thermometer measuring the air temperature inside the flask reaches a maximum, adjust the stopcock to connect the flask to the pressure measuring device while closing the vent to the outside. While continuing to gently stir the water, allow the temperature to drop about 5˚ C.

C. Record the temperature and pressure reading in the following table. Allow the temperature to cool approximately another 5˚ C while continuing to stir the water. Record the temperature of the gas sample and the pressure reading in the following table. Using the procedure outlined above continue to record readings at approximately 5˚ C intervals until a temperature of about 15˚ C is reached.

Notes:

1. If the system leaks at any time, the experiment must be restarted
2. Cooling can be hastened by adding small amounts of ice to the water. However, to insure the temperature of the gas sample has been equalized, stir for at least 3 minutes after the ice has disappeared before taking readings.
3. Excess water can be removed from the beaker. However, the water level should be at most 3 cm from the rim.

II. Data Analysis:

A. If necessary, calculate the total pressure of the trapped air for each reading and record it in the following table. Show how you calculated this pressure for your first reading in the space below. Obtain atmospheric pressure. Record these values in the following table.

Atmospheric pressure =_____torr at_____(time),_____(date)

Data Table

Pressure Reading	Temperature (˚ C)	Pressure of Trapped Gas
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

B. What patterns are shown in these data? It might be helpful to graph the data. Try to come up with an algebraic equation that expresses the pattern you found.

C. (Optional) Estimate the temperature of a gas when the pressure is reduced to zero. Discuss the significance of this temperature.

III. Interpretation and Conclusions:

A. How are the pressure and temperature of a gas sample related?

B. Mental Model - Draw a picture(s) that explains how the pressure and temperature of a gas sample are related at the level of atoms and molecules and that illustrates the observations you made in the experiment. In words, explain how your picture(s) illustrate(s) this relationship.

Appendix B

Laboratory instructions for the Gas Law computer simulation.