

CHAPTER 4	Investigation 4.B: Finding the Value of the Universal Gas Constant, R	BLM 4.2.9
HANDOUT		

In this investigation, you will work in groups to design an investigation to determine the value of the universal gas constant. After you have agreed on a procedure and safety precautions, you will present your plans to your teacher. When your procedure is approved, you will carry out your experiment.

Question

How can you obtain experimental data that will enable you to calculate the value of the universal gas constant?

Safety Precautions

After you have designed your experiment, list the safety precautions you must take while you are performing the experiment.

Materials

With your group, discuss possible types of gas that you could use. Remember that you must have a method for determining the amount of gas in your sample. In Investigation 4.A, you used a butane lighter as a source of gas. What other sources of specific gases are available? Be sure that the gas you choose to use has the properties that are necessary for the experiment. For example, carbon dioxide gas is relatively soluble in water and if you used water displacement to determine a volume, you would not be able to get an accurate value for carbon dioxide. Make a list of materials that you will need for your experiment. Consider all the materials and equipment that you have used in other investigations. If you believe that you need types of equipment that you have not yet used, find out whether this equipment will be available.

Experimental Plan

With your group, discuss the type of data that you will need to calculate R . Discuss the methods you will need to use to obtain the data. When you have agreed on the general methods, write a detailed, step-by-step procedure for obtaining the data. Remember to include safety precautions. Present your plan to your teacher. When you have received permission, carry out your procedure.

Data and Observations

Based on your experimental plan, decide exactly what type of data you will need to obtain in your investigation. Determine the type of calculations that you will need to make and ensure that you will have the necessary data to make these calculations. Before you start your investigation, prepare data tables in which you will record your data. Each member of the group should record all the data in his or her notebook. Be sure to include units in your recorded data. Convert your data to kPa for pressure, K for temperature, and L for volume. Use your data to calculate the universal gas constant, R . Record your calculations below.

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Analysis

1. Compare your results with the accepted value of R , $8.314 \frac{\text{kPa}\cdot\text{L}}{\text{mol}\cdot\text{K}}$.
2. Calculate your percentage error.
3. Now that you have carried out your procedure, discuss with your group some possible ways to improve the methods of data collection.

Conclusions

4. Evaluate your experimental method. List the parts of your procedure that worked well and those that need improvement.
5. What do you think were the most significant sources of error in your procedure? How could they be avoided or modified?

