

The Universal Gas Constant Lab: Chemistry 20

Name _____ Partner _____ Score _____

Purpose: To find a value for the universal gas constant (R) and compare it to the accepted value of $8.314 \frac{\text{LkPa}}{\text{Kmol}}$

Prelab

- using the accepted value, calculate a new "R" value if
 - Pressure is in atmospheres _____
 - Pressure is in torr _____
 - Pressure is in mm (Hg) _____
- Write the non, total and net ionic reaction for the addition of magnesium metal to hydrochloric acid.
 - NON _____
 - TOTAL _____
 - NET _____
- Calculate the theoretical volume (L) of gas produced per gram of magnesium used in this reaction at conditions of SATP.

Materials: magnesium ribbon
Copper wire
Hydrochloric acid (6.0 mol/L)
Graduated Cylinder – 100 mL
Distilled water
Beaker(s)
Rubber stopper (must have at least one hole in it)
Electronic scale

Procedure:

- Obtain a sample of magnesium ribbon that is between 0.050 and 0.070 g.
- Measure and record the mass of magnesium. _____ g
- Measure and record the ambient temperature of the lab. _____ °C
- Measure and record the ambient pressure of the lab. _____

5. Fold the magnesium ribbon to make a small compact bundle about the size of a pencil eraser
6. Wrap a fine copper wire around the magnesium making a cage to hold it, but leaving about 4 – 6 cm of copper wire free to act as a handle.
7. Carefully pour about 15 mL of 6.0 mol/L $\text{HCl}_{(\text{aq})}$ into a graduated cylinder
8. Slowly fill the graduated cylinder to the brim with water from a beaker. As you fill the cylinder, pour down the side of the cylinder **to minimize mixing** the water with the acid at the bottom.
9. Half fill a large beaker (600 mL or larger) with water.
10. Bend the copper wire handle through the holes of a stopper so that the magnesium can hang about 1 cm below the bottom of the stopper.
11. Using the stopper, insert the magnesium bundle into the cylinder. The liquid in the cylinder will overflow a little. Be sure to wipe up the liquid.
12. Tightly cover the holes in the stopper with your fingers. Working quickly, invert the cylinder and immediately lower it so that the stopper is below the surface of the water in the large beaker. Remove your fingers.
13. Record your observations. Wait until the reaction has stopped. (This may take 5 minutes or more – so be patient)
14. While the reaction is happening, raise or lower the graduated cylinder so that the level of liquid inside the beaker is the same as the level of liquid in the graduated cylinder.
15. Measure and record the volume of gas that collects in the graduated cylinder.
16. All the liquids can be poured down the sink.
17. Clean up glassware and put away.

Observations:

Mass of magnesium metal	
Ambient temperature of the lab	
Ambient pressure of the lab	
Volume of gas collected in the graduated cylinder	

Analysis:

1. Compare the value of mL of gas per gram of magnesium that you calculated to what happened in the pre- lab to what actually happened in the lab. Explain either the similarity or the difference in the values.
2. Use the Ideal Gas laws and the data collected to find the value of “R” for your data.

3. Compare this lab value to the accepted value of $8.314 \frac{LkPa}{Kmol}$ and find the percentage error
4. Give reasons that will help to explain (justify) your error.
5. Give at least two applications of the gas laws that pertain to a vehicle. (Hint: one might be the air in your tires.) Try and connect the application to Boyle's Law, Charles' Law, Dalton and / or Lussac's Law.