

AP LAB 03D: Determination of R (the universal gas constant)

Aim To calculate the Universal Gas Constant, R

Apparatus Gas buret, clamp and stand, 400 mL beaker, large bucket, stopper with one hole, graduated cylinder

Chemicals Magnesium ribbon, 3.00 M HCl, copper wire, water, steel wool

Method

1. Weigh out approx. 0.0300 g of Magnesium ribbon. Use the steel wool to clean the ribbon, wipe it with a paper towel and then re-weigh the metal. Record the mass (the mass must NOT exceed 0.0350 g).
2. Lightly wrap the copper wire around the magnesium, creating a cage, leaving about 3 cm of the copper wire to act as a handle. The copper cage must be tight enough to keep the magnesium inside, but must also allow the solution to easily flow around the magnesium.
3. Using a funnel add 10.0 mL of 3.00 M HCl to the gas buret. Then very carefully add water to fill the gas buret to the brim.
4. Hang the copper cage with the magnesium inside it, in the gas buret. Then insert the stopper and quickly invert the gas buret into a 400 mL beaker two-thirds filled with water. Clamp the upside down gas buret in place.
5. Allow the reaction to proceed until no magnesium is left and no more gas is produced. This should take approx. five to ten minutes.
6. In order to equalize the pressure (that is to get the pressure of hydrogen and water vapor in the gas buret equal to atmospheric pressure) the level of the water inside the gas buret needs to be the same as the level of water outside the gas buret. To enable that assumption to be made, transfer the buret and beaker into the large bucket of water in the sink. Then raise or lower the tube until the internal and external water levels are equal.
7. **After** equalizing the pressure, record the following measurements;
 - The volume of hydrogen gas collected
 - The temperature of the hydrogen gas collected, in °C. This can be measured by removing the stopper and placing the thermometer directly in the gas buret. (Assume that the temperature of the hydrogen gas is the same as the temperature of the water)
 - The atmospheric pressure

Results

Mass of magnesium ribbon in g	
Volume of hydrogen gas collected in mL	
Temperature in °C	
Atmospheric pressure in mmHg	

Water Vapor Pressure	
Temperature in °C	Pressure in mmHg
17	14.5
18	15.5
19	16.5
20	17.5
21	18.7
22	19.8
23	21.1
24	22.4
25	23.8
26	25.2
27	26.7
28	28.3
29	30.0
30	31.8
31	33.7

Conclusion/Calculation

1. Write an equation with state symbols to summarize the reaction that takes place.
2. Why is copper a suitable metal to use as the cage?
3. Use the data to calculate a value for R. Include units.

