Skills Challenges – CH1020
Ideal Gas Constant – Post Lab Submission

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Equipment/device(s) used:
250 mL beaker filled about 2/3s way full. Upside down graduated cylinder filled with HCl used as makeshift eudiometer.

Reason for using each measuring device:
The graduated cylinder serves to measure the exact volume of gas produced by the reaction The beaker filled with water ensures that that HCl in the graduated cylinder does not escape and thus the gas remains in the graduated cylinder

Limitations of each measuring device used:

The gas can still escape if it is ejected at too great a pressure by going into the graduated cylinder and also escaping out of the small hole in the rubber stopper. If the Mg strips get too small, they can also fall through the hole in the rubber stopper and stop the reaction and/or prevent the gas from being measured.

Procedure (*Be concise and comprehensive, use grammatically correct complete sentences):*

1. Obtain a large beaker (250 mL- 500 mL) and fill with water about ⅔ full
2. Mass magnesium ribbon. Make sure magnesium strip is no more than 1 gram
3. Attach Mg strip to a string and direct string through a single hole rubber stopper so the Mg strip is on the inside end of the stopper
4. Add about 15 mL of HCl (a relative excess to the Mg strip) to the graduated cylinder
5. Very slowly fill the rest of the eudiometer with water through the hold in the rubber stopper until there is only liquid and no gas in the graduated cylinder
6. When completely filled with liquid, place rubber stopper onto graduated cylinder while making sure to pull on the string so the Mg strip does not touch the HCl. Plug hole at top of rubber stopper with gloved finger and place upside down at an angle inside beaker, make sure there are no bubbles inside the graduated cylinder
7. Remove finger as the graduated cylinder's open end is in the water. Make sure there is a slight angle and the graduated cylinder leans on the beaker wall
8. Wait until bubbles stop forming and the Mg strip is no longer visible and tap the sides of the graduated cylinder to dislodge bubbles

9. Record final volume of gas in graduated cylinder
10. Record temperature of the water inside the beaker
11. Using moles of Mg consumed, current atmospheric pressure, volume of gas produced, and temperature of gas, estimate the ideal gas constant

Results (multiple trials if requested):

Trial	m_{Mg}(g)	n_{Mg} = n_{H2}(mol)	V_{H2}(L)	T_{H2} = T_{H2O}(K)	P_{H2O} at this T(atm)	P_{H2}(atm)	R [=] L-atm/ (mol K)
1	.0119	$4.90*10^{-4}$	.0068	295.4	.0261	.9421	.04426
2	.0127	$5.22*10^{-4}$	.0070	295.4	.0261	.9421	.0427
3	.0100	$4.11*10^{-4}$	.0066	297.4	.0295	.9467	.0512
4							
5							

% Relative standard deviation	9.81%

<u>Discussion:</u> What sources of error are present in your experiment? If your experimental value of R differs significantly from the accepted value, what contributed to this?

Any given part of the equation could have contributed to error.

The most easily measured was “n” or our molar quantity of magnesium. Although this is the easiest to measure given the molar mass of magnesium and the measured mass of the

strips, it is possible that we did not completely accurately measure the mass of the magnesium via systematic or human error.

We measured the temperature to be that of the water in the beaker, however, the reaction between magnesium and HCl is measurably exothermic, but the high specific heat of water may have made it so the water in the beaker did not heat up as much as the gas inside, creating a difference in the measured and actual temperature in the graduated cylinder.

The pressure of the atmosphere may have been different than the pressure inside the graduated cylinder due to the pressure of the water compressing or decompressing the gas inside. Although it could have acted as a relatively accurate proxy, there could have been a pressure difference between the two systems which caused the error between the true and measured values.

The volume of the gas is most likely the greatest cause for error. Catching all the gas proved to be very difficult as the rate of reaction affected how many bubbles we were able to catch. At some points, too much Mg created too much gas to measure in the small graduated cylinder, and at others, the concentration of HCl was so high that the reaction proceeded too quickly and ejected gas out of the graduated cylinder. A combination of unmeasured gas volume, as well as possible pressure differences between the inside of the graduated cylinder and the atmosphere could have affected the data.