COMBINED GAS LAW LAB replacement activity (spring 2020)

WHAT TO TURN IN (upload answers to Focus-Portal): KWL chart; Questions 1-6, 2 Calculations (Data Table n and o)

OBJECTIVES

To learn about collection of gases in the absence of an in-person lab.
To review the combined gas law equation.
To review the concept of STP.
To solve the combines gas equation for V_2 at STP conditions.

BACKGROUND INFORMATION

It is difficult to find the mass of a gas produced in an experiment. You can trap the gas and measure its volume in a eudiometer or gas measuring tube. The volume occupied by one mole of any gas at standard temperature and pressure (STP) equals 22.4 L. We will use this conversion factor in the experiment.

In this experiment you will determine the volume of gas evolved in a reaction between magnesium metal and hydrochloric acid, and from your results determine how many liters of gas would be produced under STP conditions. You will need to convert room temperature and pressure to standard conditions (STP) in order to compare your results.

$$\frac{P_1 V_1}{T_1} = \frac{P_2 \boxed{V_2}}{T_2}$$

at STP: P_2 = 760 mm Hg, T_2 = 273.15 K

PROCEDURE

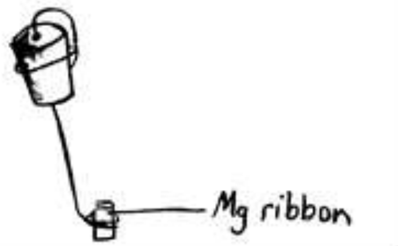
1) Set up one KWL chart. Fill in the K part first. Leave the other columns blank for now.

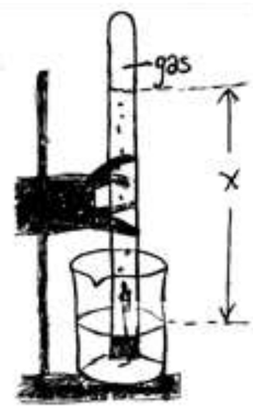
K = What do you KNOW already about gas collection and the combined gas law W = What do you WANT (or need) to know about gas collection and the combined gas law L = What did you LEARN about gas collection and the combined gas law

2) Watch the following short videos:
   https://www.youtube.com/watch?v=6dmtLj2dLi0 to 2:00
   https://www.youtube.com/watch?v=g-05H4y6lGc to 2:51
   https://www.youtube.com/watch?v=BBWXMQJDx3E to 7:30
3) Fill in the rest of the KWL chart.
4) Look at the data table on the next page before answering the questions.

QUESTIONS

1) Write the balanced chemical equation for the reaction of magnesium metal with hydrochloric acid.
2) When the tube is inverted, why doesn't the reaction occur immediately?
3) Why is copper wire a good substance to use to hold the ribbon?
4) Why should the tube be filled completely with water before inversion?
5) How could you test if the gas was actually hydrogen? (HINT: go back to the chapter 8 chemical reactions lab, single replacement section).
6) When the gas is collected, why do we assume it is "wet"?





DATA TABLE from period 3 3/7/2020

a)	length of magnesium ribbon	measured with ruler	4.5 cm
b)	mass of magnesium ribbon	from electronic balance	0.07 g
c)	moles of magnesium used	molar mass conversion	0.003 mol
d)	room temperature, Celsius	from classroom thermometer	21.5 ºC
e)	room temperature, K (T_1)	converted from classroom thermometer	294.7 K
f)	barometric pressure ($P_{atrmosphere}$)	from classroom digital barometer	769.62 mm Hg
g)	volume of gas collected (V_1)	read from gas measuring tube	77.0 mL
h)	"x"	distance btw water levels when finished… measure with ruler	120. mm H_2O
i)	x / 13.6	convert mm H_2O to mm Hg… Hg is 13.6 x denser than water	8.82 mm Hg
j)	water vapor pressure (P_{H2O})	for the temp; from reference table	19.231mm Hg
k)	corrected pressure of dry gas (P_1)	P_1 = [P_{atmos}- P_{H2O} - (x/13.6)] or Data (f - j – i)	741.6 mm Hg
l)	standard temperature (T_2)	standard	273.15 K
m)	standard pressure (P_2)	standard	760 mm Hg
n)	volume of hydrogen gas at STP (V_2)	see hint below	________ mL
o)	volume of hydrogen from 1 mol Mg at STP	see hint below	________ mL

(n) Use the combined gas law to calculate the volume that would be occupied by the gas under STP conditions.

(o) From your calculations, a fractional part of a mole of Mg was determined (step c), since the pieces of Mg used in lab were very small. Use this information to calculate the volume of hydrogen gas produced if *one mole* of magnesium reacted with excess hydrochloric acid at STP:

$$\frac{\text{your } V_2\text{, in mL}}{\text{your \# of moles}} = \frac{?\text{ mL}}{1\text{ mole}} \quad \text{or} \quad \frac{\text{(step n)}}{\text{(step c)}} = \frac{?\text{ mL}}{1\text{ mole}}$$

At STP, 1 mol of gas = 22.4 L. Since we used mL in lab, 1 mol of gas = 22,400 mL. Unfortunately, because of the equipment limitations – especially with the electronic balance – the final answer is limited to only one sigfig.

How close were you to 22,400 mL?