Purpose Use proportional reasoning to solve gas problems.

Warmup:

Check your HW answers.

I. Pressure conversions

Std Pressure = 1.00 atm = 101 kPa = 760 mmHg

II. The formulas in this chapter work perfectly for an "ideal gas"

Definition: An ideal gas...

(1) widely seperated (2) extremely hot (3) has zero stickiness

Conclusion: In real life, the gas formulas work 'pretty well but not perfectly.'

III. If volume is held constant, What happens to pressure if you double the temperature?

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\frac{P_1}{T_1} = \frac{P_2}{T_2} = 2$

$\frac{(1)}{(1)} = \frac{P_2}{(2)}$

Technique:

(1) Write an equation.
(2) Circle the unknown
(3) Replace the numbers that changed.
(4) Write "ONE" for everything else.

IV. What happens to pressure if you make the new volume ¼ of the original and the new temperature 1/3 of the original?

SOLUTION ONE

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \quad V_2 \leftarrow \frac{1}{4} \quad T_2 \leftarrow \frac{1}{3}$$

$$\frac{1 \cdot 1}{1} = \frac{P_2\left(\frac{1}{4}\right)}{\left(\frac{1}{3}\right)}$$

$$1 = P_2\left(\frac{1}{4}\right)\left(\frac{3}{1}\right)$$

$$\frac{1}{\frac{3}{4}} = \frac{P_2\frac{3}{4}}{\frac{3}{4}}$$

$$\frac{4}{3} = P_2$$

IV. What happens to pressure if you make the new volume ¼ of the original and the new temperature 1/3 of the original?

Alternative Solution

$$\frac{T_2}{V_2}\cdot\frac{P_1V_1}{T_1}=\frac{P_2V_2}{T_2}\cdot\frac{T_2}{V_2}$$

$$\frac{T_2P_1V_1}{V_2T_1}=P_2$$

$$\frac{\left(\frac{1}{3}\right)(1)(1)}{\left(\frac{1}{4}\right)(1)}=P_2$$

$$\frac{\frac{1}{3}}{\frac{1}{4}}=P_2$$

$$\frac{1}{3}\cdot\frac{4}{1}=P_2$$

$$\frac{4}{3}=P_2$$

IV. If pressure is held constant, What happens to volume if you make the new temperature ¼ of the original?

$\frac{PV}{T} = \frac{PV}{T}$

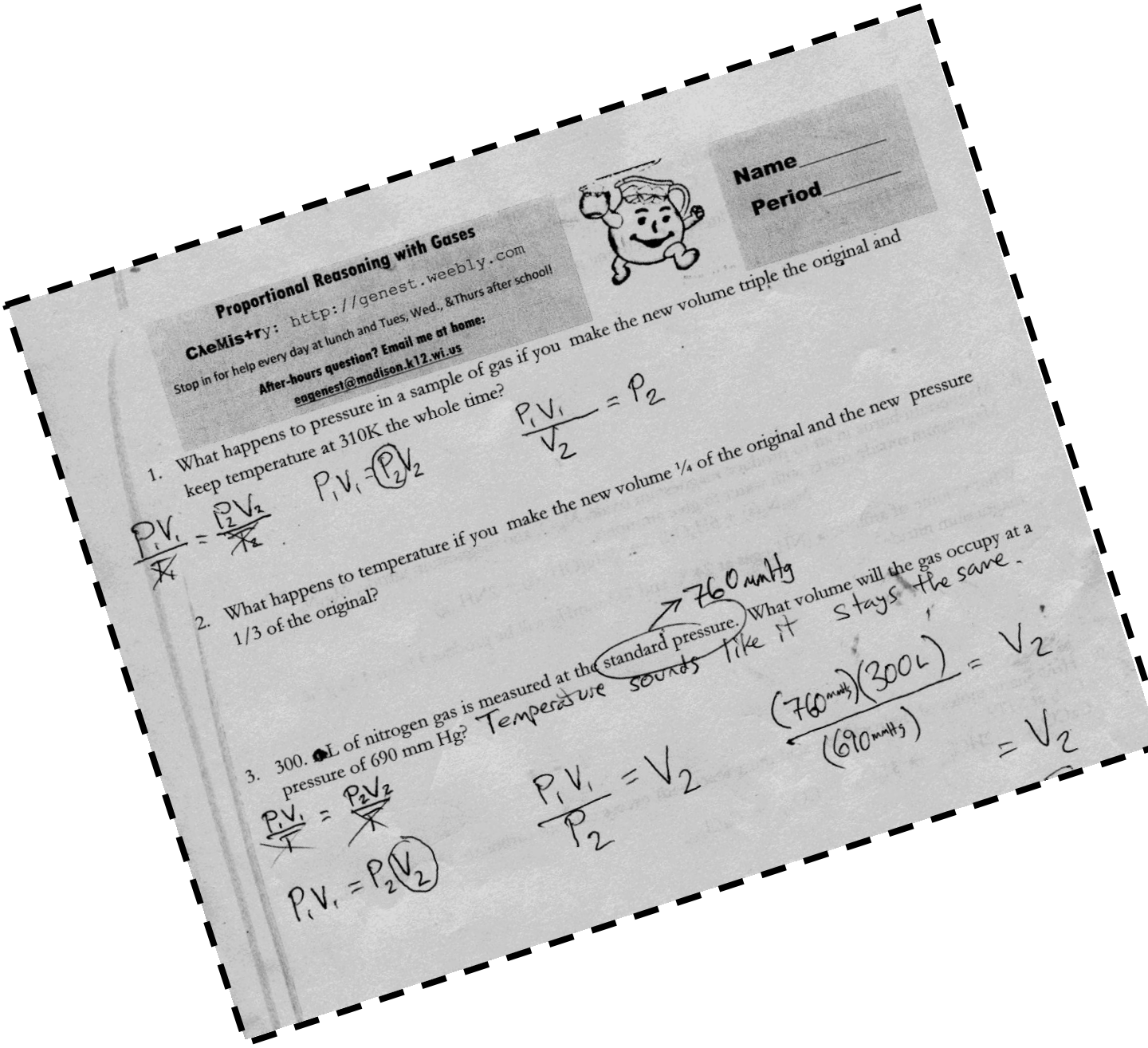
$\frac{1}{4} \cdot \frac{1}{1} = V$

$\frac{1}{4} = V$

$\frac{1}{4} \cdot \frac{1}{1} = \frac{V}{\frac{1}{4}} \cdot \frac{1}{4}$

[illegible]

Here are a couple hints to help you start the Kool Aid Man homework tonight:



Proportional Reasoning with Gases

CHeMis+ry: http://genest.weebly.com

Stop in for help every day at lunch and Tues, Wed., &Thurs after school!

After-hours question? Email me at home: eggenest@madison.k12.wi.us

Name_____

Period_____

1. What happens to pressure in a sample of gas if you make the new volume triple the original and keep temperature at 310K the whole time?

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $P_1V_1 = P_2V_2$ $\frac{P_1V_1}{V_2} = P_2$

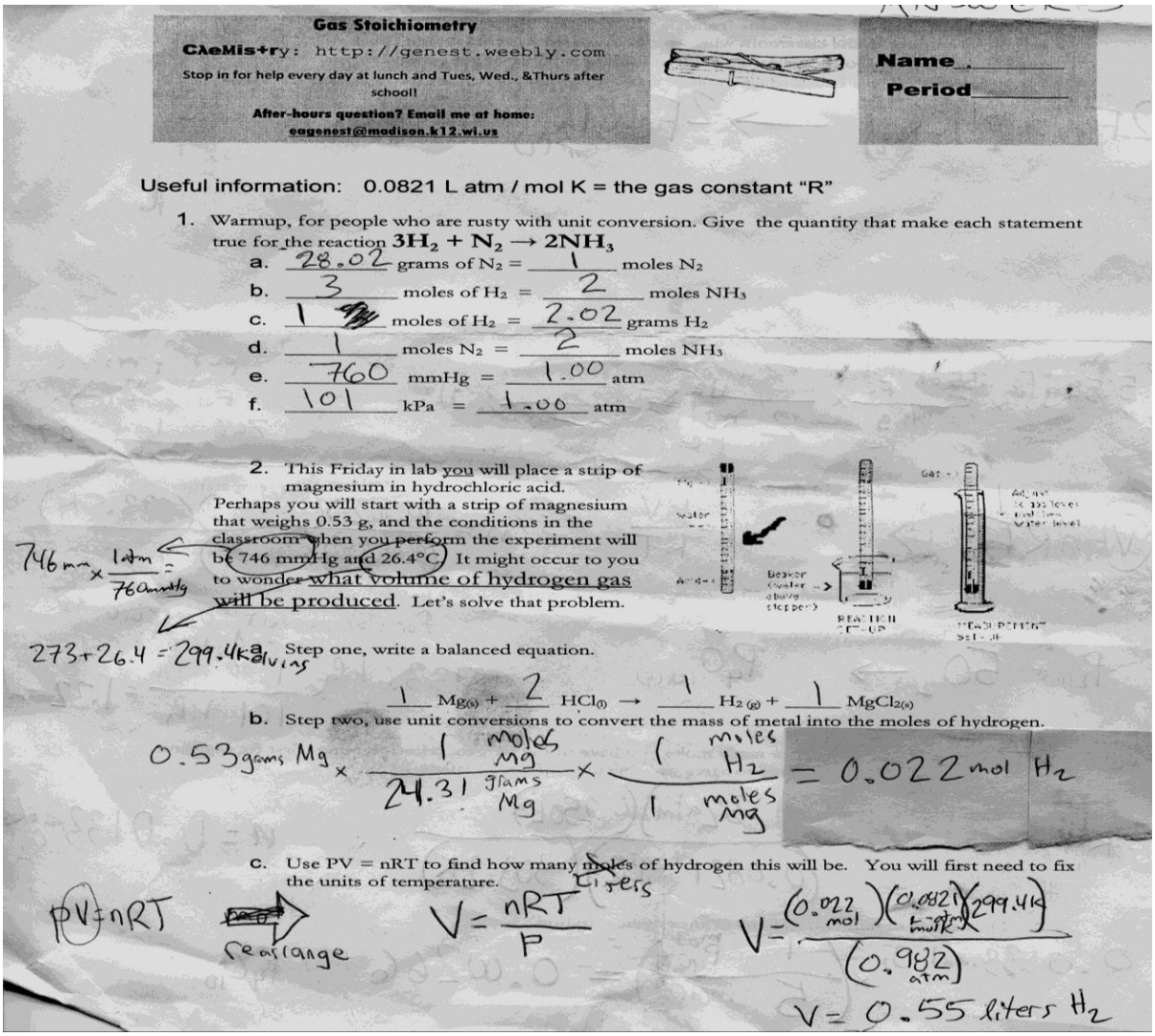
2. What happens to temperature if you make the new volume ¼ of the original and the new pressure 1/3 of the original?

3. 300. mL of nitrogen gas is measured at the standard pressure. What volume will the gas occupy at a pressure of 690 mm Hg? Temperature sounds like it stays the same.

760 mmHg

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $P_1V_1 = P_2V_2$ $\frac{P_1V_1}{P_2} = V_2$ $\frac{(760\text{mmHg})(300\text{L})}{(690\text{mmHg})} = V_2$ $= V_2$

Here are the answers to the homework that was due today:



Gas Stoichiometry

CλeMis+ry: http://genest.weebly.com

Stop in for help every day at lunch and Tues, Wed., &Thurs after school!

After-hours question? Email me at home: eagenest@madison.k12.wi.us

Name _____

Period _____

Useful information: 0.0821 L atm / mol K = the gas constant "R"

1. Warmup, for people who are rusty with unit conversion. Give the quantity that make each statement true for the reaction $3H_2 + N_2 \rightarrow 2NH_3$

   a. 28.02 grams of N_2 = 1 moles N_2

   b. 3 moles of H_2 = 2 moles NH_3

   c. 1 moles of H_2 = 2.02 grams H_2

   d. 1 moles N_2 = 2 moles NH_3

   e. 760 mmHg = 1.00 atm

   f. 101 kPa = 1.00 atm

2. This Friday in lab you will place a strip of magnesium in hydrochloric acid. Perhaps you will start with a strip of magnesium that weighs 0.53 g, and the conditions in the classroom when you perform the experiment will be 746 mmHg and 26.4°C. It might occur to you to wonder what volume of hydrogen gas will be produced. Let's solve that problem.

746 mm × 1 atm / 760 mm = 0.982 atm

273 + 26.4 = 299.4 Kelvins

Step one, write a balanced equation.

1 $Mg_{(s)}$ + 2 $HCl_{(l)}$ → 1 $H_{2\,(g)}$ + 1 $MgCl_{2(s)}$

b. Step two, use unit conversions to convert the mass of metal into the moles of hydrogen.

$$0.53\text{ grams Mg} \times \frac{1\text{ mole Mg}}{24.31\text{ grams Mg}} \times \frac{1\text{ moles } H_2}{1\text{ moles Mg}} = 0.022\text{ mol } H_2$$

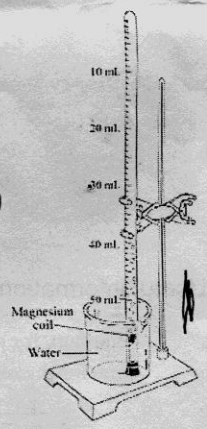
c. Use PV = nRT to find how many moles of hydrogen this will be. You will first need to fix the units of temperature.

PV = nRT → rearrange → $V = \frac{nRT}{P}$

$$V = \frac{(0.022\text{ mol})(0.0821\text{ L atm / mol K})(299.4\text{ K})}{(0.982\text{ atm})}$$

V = 0.55 liters H_2

3. If you try a reaction where you put a chunk of iron that weighs 5.58 g, into aqueous hydrochloride and it forms Iron(III) Chloride and hydrogen gas, and and the conditions in the classroom when you perform the experiment are 746 mmHg and 20.5°C. Do the following steps to find the volume of gas produced.



a. Step one, write a balanced equation.

$2Fe_{(s)} + 6HCl_{(aq)} \longrightarrow 2FeCl_{3(aq)} + 3H_{2(g)}$

b. Using your balanced equation from (a), do a unit conversion calculation to convert grams of iron used in reaction into moles of hydrogen gas produced.

$5.58\text{ g Fe} \times \frac{1\text{ mol Fe}}{55.845\text{ g Fe}} \times \frac{3\text{ mol H}_2}{2\text{ mol Fe}} = 0.150\text{ mol H}_2$

put pressure into atmos For part (C)

$746 \times \frac{1\text{ atm}}{760\text{ mm}} =$

c. Use PV = nRT to find the volume of the moles you found in (b). Watch out for the temperature

$PV = nRT$ $\quad V = \frac{nRT}{P}$ $\quad V = \frac{(0.150\text{ mol H}_2)(0.0821)(293.5\text{ K})}{(0.982\text{ atm})}$ ANSW 3.68

Red phosphorus, P4, reacts with 0.250 L oxygen at 30.2°C and 133.6 kPa to produce how many moles of P_4O_{10}?

a. Write a balanced equation.

$P_{4(s)} + 5O_{2(g)} \longrightarrow P_4O_{10(s)}$

for (B) convert pressure to an allowed unit:

$133.6\text{ kPa} \times \frac{1.00\text{ atm}}{101\text{ kPa}} = 1.3$

b. Use PV = nRT to find how many moles you have of the oxygen. [Hint: you must first fix your units for pressure and temperature to agree with the units of our constant, R]

$n = \frac{PV}{RT}$ $\quad n = \frac{(1.32\text{ atm})(0.250\text{ L})}{(0.0821\frac{\text{L·atm}}{\text{mol·K}})(303.2\text{ K})}$ $\quad n = 0.0133$

c. Do a series of unit conversions to answer the question.

$0.0133\text{ mol O}_2 \times \left(\frac{1\text{ mol P}_4O_{10}}{5\text{ mol O}_2}\right) = 0.00266\text{ mol P}_4O_{10}$