Gas volume and limiting reagent

CheMistry: http://genest.weebly.com

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

Name KEY

Period

1. What does STP stand for? standard temperature and pressure
2. At STP what is the pressure? 1.00 atmospheres
3. At STP what is the temperature? 0° celsius
4. Suppose 8.61 g of zinc was allowed to react with 8.61 liters of HCl gas to produce zinc chloride and hydrogen gas.
   a. What is the balanced equation?

$$1\,Zn + 2\,HCl \rightarrow 1\,ZnCl_2 + 1\,H_2$$

   b. Which reactant is limiting? (Show both calculations.)

$$8.61 \text{ liters } HCl \times \left(\frac{1 \text{ mol } HCl}{22.4 \text{ L } HCl}\right) \times \left(\frac{1 \text{ mol } H_2}{2 \text{ mol } HCl}\right) = 0.192 \text{ mol } H_2$$

$$8.61 \text{ grams } Zn \times \left(\frac{1 \text{ mol } Zn}{65.38 \text{ g } Zn}\right) \times \left(\frac{1 \text{ mol } H_2}{1 \text{ mol } Zn}\right) = 0.132 \text{ mol } H_2$$

★Answer: Zinc is limiting

   c. Using the limiting reactant, solve for how many liters of hydrogen gas will form at Standard Temperature and Pressure.

We just found that the limiting reactant is Zinc. It formed 0.132 moles of H_2 above.

$$0.132 \text{ mol } H_2 \times \left(\frac{22.4 \text{ Liters } H_2}{1 \text{ mol } H_2}\right) = 2.96 \text{ liters } H_2$$

5. Determine the volume in liters of carbon dioxide that should be produced in the reaction between 100. g of carbon and 100. liters of O_2. (Use the same three steps as in the previous problem above).

$$C + O_2 \rightarrow CO_2$$

$$100 \text{ g } C \left(\frac{1 \text{ moles } C}{12.01 \text{ grams } C}\right)\left(\frac{1 \text{ moles } CO_2}{1 \text{ moles } C}\right) = 8.32 \text{ moles } CO_2$$

$$100 \text{ L } O_2 \left(\frac{1 \text{ moles } O_2}{22.4 \text{ Liters } O_2}\right)\left(\frac{1 \text{ moles } CO_2}{1 \text{ moles } O_2}\right) = 4.46 \text{ moles } CO_2$$

then convert the CO_2 from the true result (from the limiting reactant)

$$4.46 \text{ moles } CO_2 \times \left(\frac{22.4 \text{ L } CO_2}{1 \text{ mole } CO_2}\right) = 99.9 \text{ liters}$$

Answer: 99.9 liters CO_2

$$4.46 \text{ mol } CO_2 \times \left(\frac{22.4 \text{ Liters } CO_2}{1 \text{ moles } CO_2}\right) = 99.9 \text{ liters } CO_2$$

s

KEY

6. Suppose 2.00 L of nitrogen gas and 5.00 L of hydrogen gas are mixed and reacted to form ammonia (NH_3). Calculate the volume in liters of ammonia produced when this reaction runs to completion.

Step 1: balanced equation:

$$1\,N_2 + 3H_2 \rightarrow 2NH_3$$

use 22.4 & one — use the balanced eqn — use 22.4 and 1

Step 2:

$$2.00\ \text{Liters}\ N_2 \times \left(\frac{1\ \text{mol}\ N_2}{22.4\ L\ N_2}\right) \times \left(\frac{2\ \text{mol}\ NH_3}{1\ \text{mol}\ N_2}\right)\left(\frac{22.4\ L\ NH_3}{1\ \text{mol}\ NH_3}\right) = 4.00\ \text{Liters}\ NH_3$$

$$5.00\ L\ H_2 \times \left(\frac{1\ \text{mol}\ H_2}{22.4\ \text{liters}\ H_2}\right) \times \left(\frac{2\ \text{mol}\ NH_3}{3\ \text{mol}\ H_2}\right)\left(\frac{22.4\ L\ NH_3}{1\ \text{mol}\ NH_3}\right) = 3.33\ \text{liters}\ NH_3$$

therefore multiple ways to solve. Since the answer is supposed to be in liters of NH_3 gas, we can save time by putting that as the goal in Step 2.

Step 3. We sort of already combined step 3 into step 2. That's why we went into liters instead of stopping at moles.

Answer: 3.33 liters of NH_3 gas

7. Uranium (III) sulfide can react with fluorine to form uranium hexafluoride gas and S_8. Write a balanced reaction and then find how many liters at STP of UF6 will form if you have 333.3 grams uranium (III) sulfide and 0.9 liters fluorine.

Step 1

$$8\,U_2S_3 + 48\,F_2 \rightarrow 16\,UF_6 + 3\,S_8$$

balance this!

use the periodic table

Step 2+3

$$333.3\ \text{grams}\ U_2S_3 \times \left(\frac{1\ \text{moles}\ U_2S_3}{572.24\ \text{grams}\ U_2S_3}\right) \times \left(\frac{16\ \text{moles}\ UF_6}{8\ \text{moles}\ U_2S_3}\right) \times \left(\frac{22.4\ \text{liters}\ UF_6}{1\ \text{moles}\ UF_6}\right) = 26.1\ L\ UF_6$$

$$0.9\ \text{liters}\ F_2 \times \left(\frac{1\ \text{moles}\ F_2}{22.4\ \text{liters}\ F_2}\right) \times \left(\frac{16\ \text{moles}\ UF_6}{48\ \text{moles}\ F_2}\right) \times \left(\frac{22.4\ \text{liters}\ UF_6}{1\ \text{moles}\ UF_6}\right) = 0.3\ L\ UF_6$$

use one mole = 22.4 L — use the coefficients from the balanced equation — use one mole = 22.4 L gas at STP

Answer: F_2 is limiting. 0.3 liters of UF_6 will form.

class

notes begin here

PURPOSE WHAT MATH CAN WE DO WITH CONCENTRATION?

WARMUP
Do the slip by 10:12

Warmup Slip

Directions: Turn the following into balanced equations by filling in the blanks with the correct coefficients, formulas of ions or solids, and names.

Cation		Anion		Formula	Name
A. ___ Cu^{+}	+	___ SO_4^{2-}	→	______	______________
B. ___ Pb^{2+}	+	___ Cl^{-}	→	______	______________
C. ______	+	______	→	$AlCl_3$	______________
D. ______	+	______	→	$Mg(NO_3)_2$	______________
E. ______	+	______	→	______	iron (III) sulfide
F. ______	+	______	→	______	copper (II) nitrate
G. ___ Cu^{2+}	+	___ OH^{-}	→	______	______________

Warmup Slip

Directions: Turn the following into balanced equations by filling in the blanks with the correct coefficients, formulas of ions or solids, and names.

	Cation		Anion		Formula	Name
A.	2 Cu^+	+	1 SO_4^{2-}	→	Cu_2SO_4	Copper (I) sulfate
B.	1 Pb^{2+}	+	2 Cl^-	→	$PbCl_2$	Lead (II) chloride
C.	Al^{3+}	+	$3Cl^-$	→	$AlCl_3$	Aluminum Chloride
D.	Mg^{2+}	+	$2NO_3^-$	→	$Mg(NO_3)_2$	magnesium nitrate
E.	Fe^{3+}	+	S^{2-}	→	Fe_2S_3	iron (III) sulfide
F.	Cu^{2+}	+	$2NO_3^-$	→	$Cu(NO_3)_2$	copper (II) nitrate
G.	1 Cu^{2+}	+	2 OH^-	→	$Cu(OH)_2$	Copper (II) hydroxide

Copy this formula. In the second box rearrange the formula to isolate ***moles***. In the third box rearrange to isolate ***volume***:

$$molarity = \frac{moles}{volume}$$

$$molarity = \frac{moles}{volume}$$

$$molarity \times volume = moles$$

$$volume = \frac{moles}{molarity}$$

Molarity is number of things per volume. (It is also called concentration.)

Units: molarity is $\frac{mol}{L}$ (abbreviated [illegible])

$1cm^3$ = 1 mL for all things

(#1) Compute the number of moles needed to make a 900 mL solution that has a concentration of 1.40M.

remember 1.40 M is 1.40 $\frac{moles}{liter}$

~~moles = ?~~

moles = volume × molarity

moles = (0.9L) × (1.40 $\frac{mol}{L}$)

moles = 1.26 moles

(#2) Compute the molarity of 40.6 g of $Al_3(NO_3)_3$ dissolved in enough water to make 400 mL of solution.

take inventory

volume	0.4 liters
molarity	??
moles	0.152

We can get moles, using the grams

$40.6g \times \left(\frac{1 \text{ moles } Al(NO_3)_3}{266.97 \text{ grams}}\right) = 0.152 \text{ moles } Al(NO_3)_3$

molarity = $\frac{moles}{volume}$

Molarity = $\frac{0.152 \text{ moles}}{0.4 L}$

molarity = 0.38 $\frac{moles}{L}$