Chem Unit 11 Gases
Avogadro's Law Notes

Avogadro's Law: Volume and moles relationships in gases

Review:

- There are four variables related to gases: P, V, T, and n (moles)
- Boyle's Law deals with P & V $P_1V_1 = P_2V_2$
- Charles' Law covers T & V $V_1 / T_1 = V_2 / T_2$
- Combined Gas Law covers P, V, T $P_1T_1/T_1 = P_2T_2/T_2$

Notes:

- The next gas law is very simple. It is called Avogadro's Law and deals with the relationship between V and n (number of moles)
- If P and T are kept constant, then increasing the number of moles of a gas will increase it volume proportionally. (diagram p. 413)
- Mathematically: $V_1 / n_1 = V_2 / n_2$

Cautions:

1. Always watch your units … use the same P, V on both sides.
2. Use common sense … think about your answer!

Examples:

1. $n_1 = 3.2$ mol, $V_1 = 2.5$ L, $V_2 = ?$, $n_2 = 2.0$ mol

$\frac{V_1}{n_1} = \frac{V_2}{n_2}$ $\quad V_2 = \frac{n_2 V_1}{n_1}$ $\quad 1.5625\ L$

$\frac{2.0\ mol \mid 2.5\ L}{3.2\ mol} = \boxed{1.6\ L}$

2. $V_1 = 3.25$ L at $n_1 = 5.25$ mol, $V_2 = 4.45$ L at $n_2 = ?$ mol

$\frac{V_1}{n_1} = \frac{V_2}{n_2}$ flip $\frac{n_1}{V_1} = \frac{n_2}{V_2}$ $\quad n_2 = \frac{V_2 n_1}{V_1}$ $\quad 7.18846$

$\frac{4.45\ L \mid 5.25\ mol}{3.25\ L} = \boxed{7.19\ mol}$

3. V_1= 475 mL at n_1 = 12.2 g (He), V_2 = ? at n_2 = 4.50 g (He)

$\frac{V_1}{n_1} = \frac{V_2}{n_2}$ moles of He (4.00 g/mol)

$V_2 = \frac{n_2 V_1}{n_1}$

$\frac{4.50\text{ g He} \mid 475\text{ mL}}{12.2\text{ g He}} =$ 175.204918 mL = **175 mL**

4. If 0.214 moles of argon gas occupies a volume of 652 mL at a particular temperature and pressure, what volume would 0.375 moles of argon occupy under the same conditions?

$V_2 = \frac{n_2 V_1}{n_1}$

$\frac{.375\text{ mol Ar} \mid 652\text{ mL}}{.214\text{ mol Ar}} =$ 1142.52336 mL = **1140 mL**

5. If 46.2 g of oxygen gas occupies a volume of 100. L at a particular temperature and pressure, what volume will 5.00 g of oxygen gas occupy under the same conditions?

$V_2 = \frac{n_2 V_1}{n_1}$

$\frac{5.00\text{ g } O_2 \mid 100.\text{ L}}{46.2\text{ g } O_2} =$ 10.822510 82 = **10.8 L**