

**Exam III – Chapters 8, 9, 10, & part of 11**

**Avogadro's Number ( $N_A$ ) =  $6.02 \times 10^{23}$  (atoms, molecules, ions)/mol**

**Molar Volume at STP = 22.4 L/mol**

**1 atm = 760 torr**

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

1. (5 pts) Which of the following metals will react with  $\text{Al}(\text{NO}_3)_3$ ?  
 a. Fe                      b. **Ca**                      c. Ag                      d. **Mg**                      e. (H)

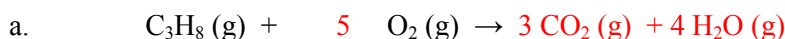
2. (5 pts) What is the molar mass for aluminum nitrate?

$$\text{Al}(\text{NO}_3)_3 = 26.98 \text{ g/mol} + (14.01 \text{ g/mol} \times 3) + (16.00 \text{ g/mol} \times 9) = 213.01 \text{ g/mol}$$

3. (6 pts) How many formula units of aluminum nitrate are in 3.45 g of aluminum nitrate?

$$3.45 \text{ g Al}(\text{NO}_3)_3 (1 \text{ mol Al}(\text{NO}_3)_3 / 213.01 \text{ g})(6.02 \times 10^{23} \text{ formula units/mol}) = 9.75 \times 10^{21} \text{ formula units}$$

4. (9 pts) Predict the products of the reaction of propane gas ( $\text{C}_3\text{H}_8$ ) with oxygen gas as follows (don't forget to include the physical states of all products and balance the reaction):



- b. If 5.00 g of propane reacts according to the above reaction, how many liters of carbon dioxide gas are produced?

$$5.00 \text{ g C}_3\text{H}_8 (1 \text{ mol C}_3\text{H}_8 / 44.11 \text{ g})(3 \text{ mol CO}_2 / 1 \text{ mol C}_3\text{H}_8)(22.4 \text{ L/mol}) = 7.62 \text{ L CO}_2$$

- c. If a student only produced 5.00 L of carbon dioxide gas, what was the student's percent yield?

$$5.00 \text{ L} / 7.62 \text{ L} \times 100\% = 65.6 \% \text{ yield}$$

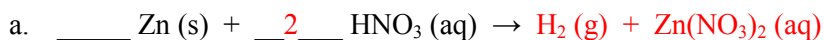
5. (10 pts) Please determine if the following solids are soluble or insoluble in water @ 25°C.

a. $\text{Sr}(\text{OH})_2$	<b>soluble</b>	<b>insoluble</b>
b. $\text{PbBr}_2$	<b>soluble</b>	<b>insoluble</b>
c. $\text{Li}_2\text{CO}_3$	<b>soluble</b>	<b>insoluble</b>
d. $\text{NH}_4\text{NO}_3$	<b>soluble</b>	<b>insoluble</b>
e. $\text{MgS}$	<b>soluble</b>	<b>insoluble</b>

6. (5 pts) According to Boyle's Law, as pressure increases, volume \_\_\_\_\_, assuming temperature remains constant.

- a. increases                      b. **decreases**                      c. remains the same

7. (7 pts) Predict the products for the reaction of solid metal zinc with nitric acid. Please include physical states and balance the final equation.



b. If 2.50 g of zinc reacts with 2.50 g of nitric acid, how many grams of zinc nitrate is produced?  
 $2.50 \text{ g Zn} (1 \text{ mol Zn}/65.30 \text{ g})(1 \text{ mol Zn}(\text{NO}_3)_2 / 1 \text{ mol Zn})(189.41 \text{ g Zn}(\text{NO}_3)_2 / 1 \text{ mol}) = 7.25 \text{ g Zn}(\text{NO}_3)_2$

$2.50 \text{ g HNO}_3 (1 \text{ mol HNO}_3/63.02 \text{ g})(1 \text{ mol Zn}(\text{NO}_3)_2 / 2 \text{ mol HNO}_3)(189.41 \text{ g Zn}(\text{NO}_3)_2 / 1 \text{ mol}) = 3.76 \text{ g Zn}(\text{NO}_3)_2$

The most zinc nitrate produced is 3.76 g Zn(NO<sub>3</sub>)<sub>2</sub>

8. (5 pts) According to Charles' Law, volume and temperature are \_\_\_\_\_ related at constant pressure.

- a. **directly**                      b. inversely                      c. not

9. (12 pts) Determine if the following are strong electrolytes (SE), weak electrolytes (WE), or nonelectrolytes (NE):

- |   |           |           |           |
|---|-----------|-----------|-----------|
| a. NaCl (aq)  | <b>SE</b> | <b>WE</b> | <b>NE</b> |
| b. K <sub>3</sub> PO <sub>4</sub> (aq)                | <b>SE</b> | <b>WE</b> | <b>NE</b> |
| c. Al <sub>2</sub> S <sub>3</sub> (aq)                | <b>SE</b> | <b>WE</b> | <b>NE</b> |
| d. C <sub>6</sub> H <sub>12</sub> O <sub>6</sub> (aq) | <b>SE</b> | <b>WE</b> | <b>NE</b> |
| e. LiCl (s)   | <b>SE</b> | <b>WE</b> | <b>NE</b> |
| f. BaSO <sub>4</sub> (aq)                             | <b>SE</b> | <b>WE</b> | <b>NE</b> |

10. (6 pts) A 4.50 L container of helium gas at 28°C and 2.56 atm is compressed to 2.50 L and the temperature is increased to 50.0°C. What is the final pressure of the gas?

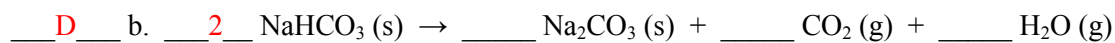
$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \quad P_1 = 2.56 \text{ atm}, T_1 = 28 + 273 = 301 \text{ K}, V_1 = 4.50 \text{ L}$$

$$P_2 = ? \quad T_2 = 323 \text{ K} \quad V_2 = 2.50 \text{ L}$$

$$P_2 = \frac{P_1 V_1 T_2}{T_1 V_2} = \frac{(2.56 \text{ atm})(4.50 \text{ L})(323 \text{ K})}{(301 \text{ K})(2.50 \text{ L})} = \mathbf{4.94 \text{ atm}}$$

11. (9 pts) Identify the reaction type and balance the following equations:

- |                    |                         |                         |
|--------------------|-------------------------|-------------------------|
| Combination (C)    | Decomposition (D)       | Combustion (B)          |
| Neutralization (N) | Single Replacement (SR) | Double Replacement (DR) |



12. (5 pts) Solid aluminum metal is placed in water at 25°C.

- a. What type of reaction occurs? **NR – Al is not one of the six active metals so it does not react with water at room temp.**
- b. What are the products of this reaction?



13. (10 pts) Please circle true (T) or false (F) for the following statements:

- a. Gases take the shape and volume of their container. **T or F**
- b. One product of a neutralization reaction is always hydrogen gas. **T or F**
- c. When the pressure of a gas is doubled, temperature also doubles if volume is held constant. **T or F**
- d. Standard temperature and pressure is 760 torr and 273 K. **T or F**
- e. When an ionic solid dissolves in water the physical state is (s) for solid. **T or F**

14. (6 pts) What is the percent composition for each atom in lithium sulfate? (Show all work!)

$$\text{Li}_2\text{SO}_4 \quad \text{Li: } \frac{2 \times 6.94 \text{ g/mol}}{109.95 \text{ g/mol}} \times 100\% = 12.6\% \quad \text{S: } \frac{32.07 \text{ g/mol}}{109.95 \text{ g/mol}} \times 100\% = 29.17\%$$

$$\text{O: } = \frac{4 \times 16.00 \text{ g/mol}}{109.95 \text{ g/mol}} \times 100\% = 58.21\%$$

$$\% \text{ Li: } \underline{\hspace{1cm}} 12.6\% \underline{\hspace{1cm}} \quad \% \text{ S: } \underline{\hspace{1cm}} 29.17\% \underline{\hspace{1cm}} \quad \% \text{ O: } \underline{\hspace{1cm}} 58.21\% \underline{\hspace{1cm}}$$

**Extra Credit: (5 pts)**

What is the density, in g/L, of propane (C<sub>3</sub>H<sub>8</sub>) gas at 0°C and 1 atm?