

Chemistry 112  
Second Hour Exam

Name: \_\_\_\_\_

**Please show all work for partial credit**

1. (10 points) I am going to mix the following solutions. Identify the mixtures that will not react with **N.R.** and those that will form a precipitate with a **P**. In the mixtures that form a precipitate, give the molecular formula of the final solid product.

NaCl and  $\text{Fe}(\text{NO}_3)_3$  **N.R.**

Copper(II) Chloride and Sodium sulfide **P**  $\text{CuS}(\text{s})$

NaOH and  $\text{MnSO}_4$  **P**  $\text{Mn}(\text{OH})_2(\text{s})$

Nickel(II) chloride and Potassium nitrate **N.R.**

$\text{Pb}(\text{NO}_3)_2$  and NaCl **P**  $\text{PbCl}_2$

2. (10 points) How many milliliters of 0.125M  $\text{HNO}_3$  will be required to neutralize 500 mls of 0.1M  $\text{Mg}(\text{OH})_2$ ?

Neutralization: Mole acid = moles base

Moles base = Moles  $\text{OH}^-$  but moles  $\text{OH}^- \neq$  Mole  $\text{Mg}(\text{OH})_2$ !

Moles  $\text{Mg}(\text{OH})_2 = \text{Molarity} \times \text{Volume} = .1\text{M} \times .5\text{l} = .05 \text{ moles } \text{Mg}(\text{OH})_2$

$\text{Mg}(\text{OH})_2 \rightarrow \text{Mg}^{+2} + 2 \text{OH}^-$ ; so:

$.05 \text{ moles } \text{Mg}(\text{OH})_2 \times [2 \text{ moles } \text{OH}^- / 1 \text{ mole } \text{Mg}(\text{OH})_2] = .1 \text{ mol } \text{OH}^-$

$.1 \text{ mol } \text{OH}^- = .1 \text{ mol } \text{H}^+$ ;  $M = \text{mole/volume}$ ,  $.125 = .1/X$ ;  $X = .1/.125 = .8\text{l} = 800\text{ml}$

3. Assign the oxidation state **for chlorine only** in each of the following anions

$\text{OCl}^-$   
 $-1 = -2 + \text{Cl}$   
 $\text{Cl} = +1$

$\text{ClO}_2^-$   
 $-1 = -2(2) + \text{Cl}$   
 $\text{Cl} = +3$

$\text{ClO}_3^-$   
 $-1 = -2(3) + \text{Cl}$   
 $\text{Cl} = +5$

$\text{ClO}_4^-$   
 $-1 = -2(4) + \text{Cl}$   
 $\text{Cl} = +7$

4. (10 points) Gold metal will not dissolve in either concentrated nitric acid or concentrated hydrochloric acid. It will dissolve, however, in aqua regia, a mixture of the two acids. The products of the reaction are:  $\text{AuCl}_4^-$ (aq) and  $\text{NO}$ (g). Write a balanced equation for this reaction. Nitric Acid =  $\text{HNO}_3$ , Hydrochloric Acid =  $\text{HCl}$



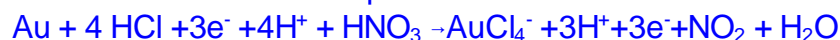
Redox reaction!



x1

x1

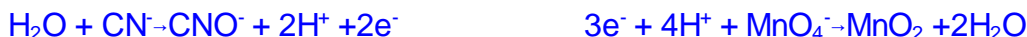
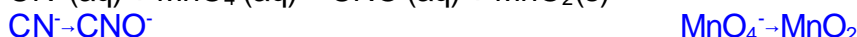
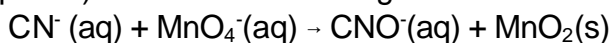
Combine equations



Remove common terms

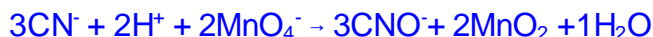


5. (10 points) Balance the following reaction under **Basic conditions**:

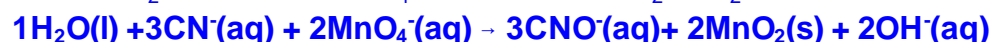
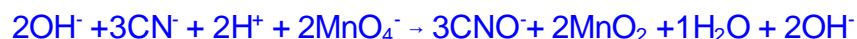


x3

x2



Now add  $\text{OH}^-$  to **both** side to remove the  $\text{H}^+$



6. (10 points) When I use my pressure canner at home I can adjust it so that the pressure inside the canner is at 10 psi above the atmospheric pressure of 14.7 psi. When I do this, what is the pressure inside the canner **in ATM**?

$$\text{Total pressure} = 10 + 14.7 = 24.7 \text{ psi}$$

$$24.7 \text{ psi} \times [1 \text{ atm}/14.7 \text{ psi}] = 1.68 \text{ atm}$$

7. (10 points) For chemistry experiments I occasionally use a very small gas cylinder called a 'lecture' bottle. My CO<sub>2</sub> lecture bottle has a volume of 0.5 l and contains 227g of CO<sub>2</sub>. What is the pressure in this bottle at 25°C?

$$PV=nRT;$$

$$V = .5\ell$$

$$n=227 \text{ g} \times (1 \text{ mole}/44\text{g}) = 5.159 \text{ mol}$$

$$R = .08206 \ell \cdot \text{atm}/\text{K} \cdot \text{mol}$$

$$T = 25 + 273 = 298\text{K}$$

$$P = nRT/V$$

$$= (5.159\text{mol} \times .08206\ell \cdot \text{atm}/\text{K} \cdot \text{mol} \times 298\text{K})/.5\ell$$

$$= 252 \text{ atm}$$

8. (10 points) I have two gas cylinders, one with a volume of 0.50 liters contains He gas at a pressure of 3 atm. The second cylinder has a volume of 3 liters and contains N<sub>2</sub> gas at a pressure of 4 atm. If I open a valve between these cylinders and allow the two gases to mix.

A. What is the final pressure in the system?

$$\text{Pressure of one gas expanding } P_1V_1 = P_2V_2; V_2 = \text{total volume} = 3 + .5 = 3.5\ell$$

$$P_{\text{He}} : .5(3) = X(3.5); X = .5(3)/3.5 = .4286 \text{ atm}$$

$$P_{\text{N}_2} : 4(3) = X(3.5); X=4(3)/3.5 = 3.4286 \text{ atm}$$

$$P_{\text{tot}} = P_{\text{He}} + P_{\text{N}_2} = .4286 + 3.4286 = 3.857 \text{ atm}$$

B. What is the mole fraction of He in the system?

$$\text{Mole fraction} = \chi = n_1/n_{\text{tot}} = P_1/P_{\text{tot}}$$

$$= .4286/3.857 = .111 \text{ for He}$$

9. (10 points) At what temperatures and pressure do deviations from the ideal gas law occur? What physical properties of a gas cause it to deviate from the ideal?

Deviations from the ideal gas law occur at high pressures and low temperatures. The physical properties of a gas that cause it to be non-ideal are the volume of the gas particle and attractive or repulsive forces between the particles

10. (10 points) What is the Kinetic Molecular Theory of Gases? In your explanation be sure to give at least four of the major postulates of the theory.

The Kinetic Molecular Theory of gases is the theory that gases are made up of small, moving particles, and it is the properties of these particles that account for the properties of the gas as a whole. The major postulates of the theory are:

1. Gas is composed of tiny particles.
2. Particles are so small that their volume can be ignored.
3. Particles are in motion.
4. Particles exert no force on each other.
5. The Kinetic Energy of the particles is proportional to their temperature.
6. Pressure comes from the particles bouncing off the surface.