Chemistry 112
Second Hour Exam

Name:_____

Please show all work for partial credit

1. (13 points) What is the % composition of phosphorous in diphosphorous pentaoxide? (If you are uncertain of the proper molecular formula, just write a formula down and solve the problem anyway.)

P_2O_5

Mass of phosphorous =2(30.97) = 61.94
Mass of Oxygen =5(16.00) = 80
Total Mass =141.94

% Phosphorous = (Mass P/ Total) x100%
= 61.94/141.91 x100%
= 43.64%

2. (12 points) Balance the following equations:

$Cr(s) + S_8(s) \rightarrow Cr_2S_3$

$16\ Cr(s) + 3S_8(s) \rightarrow 8\ Cr_2S_3$

Iron reacts with oxygen to form iron(III)oxide (rust)

$4\ Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3\ (s)$

Solid potassium metal reacts with water to form aqueous potassium hydroxide and hydrogen (H_2) gas

$2K(s) + 2\ H_2O(l) \rightarrow 2KOH(aq) + H_2(g)$

3. (13 points) Given the balanced reaction equation: 2 Na(s) + I_2 (g) →2NaI (s)
If I start my reaction with 10 g of Na and 10g of I_2 gas, and get 10 g of product, what was the % yield of my reaction.

If Na is limiting

$$10g\ Na \times \frac{1mole\ Na}{22.99g\ Na} \times \frac{2mole\ NaI}{2mole\ Na} \times \frac{149.8g\ NaI}{1mole\ NaI} = 65.41g\ NaI$$

If I_2 is limiting

$$10g\ I_2 \times \frac{1mole\ I_2}{253.8g\ I_2} \times \frac{2mole\ NaI}{1mole\ I_2} \times \frac{149.8g\ NaI}{1mole\ NaI} = 11.80g\ NaI$$

I_2 is smaller, so it is limiting so my theoretical yield is 11.8 g NaI
So my % yield = (actual/theoretical) x 100%
=(10.00/11.80) x100% = 84.7%

4. (12 points) Classify the following compounds as strong electrolytes (SE), weak electrolytes (WE) or non electrolytes (NE)

HNO_3 __SE (it's a strong acid)_____

$C_{12}H_{24}O_{11}$ (sucrose) _NE (it's not ionic so it can't make ions)_____

Ammonia (a weak base) __WE (weak base)_____

AgCl _WE (an insoluble salt)_____

$AgNO_3$ _SE (a soluble salt)_____

KOH __SE (Strong base)_____

5. (12 points) I am going to dissolve 5 g of iron(III) chloride in a flask to make 500mls of solution.

A. What is the molarity of iron(III) chloride in this solution?

$FeCl_3$

Molar mass = 55.85 + 3(35.45) = 162.2g

Moles = 5 g / 162.2 g/mole = .03083 mole

Molarity = moles/liters = .03083 moles/.5l = .0617M $FeCl_3$

B. What is the molarity of the iron(III) ion in this solution?

When $FeCl_3$ dissolves you have the reaction

$FeCl_3 \rightarrow Fe^{3+} + 3\ Cl^-$

$$.0617M\ FeCl_3 = \frac{.0617 moles\ FeCl_3}{l} \times \frac{1 mole\ Fe^{3+}}{1 mole\ FeCl_3} = .\frac{.0617 mole\ Fe^{3+}}{l} = .0617M\ Fe^{3+}$$

C. What is the molarity of the chloride ion in this solution?

$$.0617M\ FeCl_3 = \frac{.0617 moles\ FeCl_3}{l} \times \frac{3 mole\ Cl^-}{1 mole\ FeCl_3} = .\frac{.185 mole\ Cl^-}{l} = .185M\ Cl^-$$

6. (12 points) Predict correct products (both soluble and insoluble) for the following precipitation reactions. Make sure you give the proper physical form for each product. If there is no solid product, mark the equation with an N.R. for no reaction.

$AgNO_3 + CaCl_2 \rightarrow$ __AgCl(s)___ + __$Ca(NO_3)_2$(aq)

$CaCl_2 + H_2SO_4 \rightarrow$ __$CaSO_4$(s)__ + __HCl(aq)___

$H_2SO_4 + MgBr_2 \rightarrow$ __$Mg(SO_4)$(aq) + __HBr(aq)___N.R.

$MgBr_2 + NH_4NO_3 \rightarrow$ __$Mg(NO_3)_2$(aq) + __NH_4Br(aq)_N.R.

$NH_4OH + AlCl_3 \rightarrow$ __$Al(OH)_3$(s) + _NH_4Cl(aq)__

$CaCl_2 + Ag_2SO_4 \rightarrow$ __AgCl(s)___ + __$CaSO_4$(s)__

Note: I just asked for the chemical formulas of the products, not balanced equations

7. (13 points) Aqueous cobalt(III) nitrate reacts with potassium hydroxide to form solid cobalt (III) hydroxide and potassium nitrate Write this chemical reaction as a balanced equation in each of the following forms:

Molecular equation

$Co(NO_3)_3(aq) + 3KOH(aq) \rightarrow Co(OH)_3(s) + 3KNO_3(aq)$

Complete ionic equation

$Co^{3+}(aq) + 3\ NO_3^-(aq) + 3K^+(aq) + 3OH^-(aq) \rightarrow Co(OH)_3(s) + 3K^+(aq) + 3NO_3^-(aq)$

Net ionic equation

$Co^{3+}(aq) + 3OH^-(aq) \rightarrow Co(OH)_3(s)$

8. (13 points) I have 250 mls of 0.025M $Hg_2(NO_3)_2$ left over from a chemistry lab. I don't want to pour this mercury down the drain, so I am going to react it with NaCl to form a Hg_2Cl_2 precipitate that I can recover and dispose of by other means. How many mls of a 0.95M NaCl solution will I need to precipitate all of the mercury out of the solution?

Balanced Equation for reaction:

$Hg_2(NO_3)_2\ (aq) + 2NaCl(aq) \rightarrow Hg_2Cl_2(s) + 2NaNO_3(aq)$

Moles $Hg_2(NO_3)_2$ = M×V = .025M ×.25L = .00625 moles

Moles of NaCl = .00625moles $Hg_2(NO_3)_2$ x (2 moles NaCl/1 mole $Hg_2(NO_3)_2$)
=.0125 moles NaCl

M = moles/V; V = moles/M
= .0125moles/.95M = .0132 l=13.2mL