

Chemistry 105 Exam 2

Name Key

Useful information: $N_A = 6.022 \times 10^{23}$, percent yield = actual/theoretical \times 100%

(1)(4 pts) Are the following compounds electrolytes or nonelectrolytes?

(a) $V(NO_3)_3$ *electrolyte (ionic)*

(b) ClF_3 *nonelectrolyte (molecular)*

(c) N_2O_5 *nonelectrolyte (molecular)*

(d) S_2Cl_2 *nonelectrolyte (molecular)*

(2) (4pts) Write the formulas for the following compounds

(a) diiodine pentoxide I_2O_5

(b) barium phosphate $Ba_3(PO_4)_2$

(c) copper(II)chlorate $Cu(ClO_3)_2$

(d) silicon dioxide SiO_2

(3) (4pts) Write the names of the following compounds

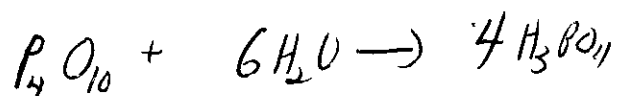
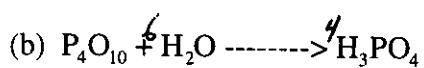
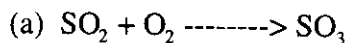
(a) $PbSO_4$ *lead (II) sulfate*

(b) LiF *lithium fluoride*

(c) HNO_2 *nitrous acid*

(d) $AsCl_5$ *arsenic pentachloride*

(3) (4pts) Balance the following equations



(4) (4pts) Calculate the masses of the following compounds state the units.



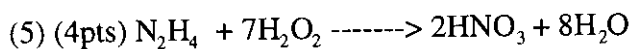
$$234.3 \frac{\text{g}}{\text{mole}}$$

Fe	55.85 $\frac{\text{g}}{\text{mole}}$
3Cl	3(35.45 $\frac{\text{g}}{\text{mole}}$)
8H	8(1.01 $\frac{\text{g}}{\text{mole}}$)
4O	4(16.00 $\frac{\text{g}}{\text{mole}}$)
	<hr/>
	234.3 $\frac{\text{g}}{\text{mole}}$



$$146.20 \frac{\text{g}}{\text{mole}}$$

10C	10(12.01 $\frac{\text{g}}{\text{mole}}$)
10H	10(1.01 $\frac{\text{g}}{\text{mole}}$)
O	+ 16.00 $\frac{\text{g}}{\text{mole}}$
	<hr/>
	146.20 $\frac{\text{g}}{\text{mole}}$



Using the balanced equation above, answer the following questions.

(a) How many moles of hydrogen peroxide (H_2O_2) are needed to react with 0.35 moles of hydrazine (N_2H_4)?

$$0.35 \text{ moles } \text{N}_2\text{H}_4 \times \frac{7 \text{ moles } \text{H}_2\text{O}_2}{1 \text{ mole } \text{N}_2\text{H}_4} = \boxed{2.45 \text{ moles } \text{H}_2\text{O}_2}$$

(b) If 0.35 moles of N_2H_4 is reacted with excess H_2O_2 , how many grams of water would be formed ideally?

$$0.35 \text{ moles } \text{N}_2\text{H}_4 \times \frac{8 \text{ moles } \text{H}_2\text{O}}{1 \text{ mole } \text{N}_2\text{H}_4} = 2.80 \text{ moles } \text{H}_2\text{O}$$

$$\text{H}_2\text{O MW} = 18.02 \frac{\text{g}}{\text{mole}}$$

$$2.80 \text{ moles} \times \frac{18.02 \text{ g}}{\text{mole}} = 50.45 \text{ g } \text{H}_2\text{O} = 51 \text{ g}$$

(6) (4pts) If you know that there are 4.39×10^{25} ClO_2^- ions in a sample of $\text{Al}(\text{ClO}_2)_3$, how many moles of $\text{Al}(\text{ClO}_2)_3$ are there in the sample?

$$4.39 \times 10^{25} \text{ ions} \div \frac{6.022 \times 10^{23} \text{ ions}}{\text{mole}} = 72.9 \text{ moles } \text{ClO}_2^- \text{ ions}$$

$$72.9 \text{ moles } \text{ClO}_2^- \text{ ions} \times \frac{1 \text{ mole } \text{Al}(\text{ClO}_2)_3}{3 \text{ moles } \text{ClO}_2^-} = \boxed{24.3 \text{ moles } \text{Al}(\text{ClO}_2)_3}$$

(7) (4 pts) Do you think that an element will ever be discovered between Magnesium and Aluminum on the periodic table? Why or why not?

No, Mg is element #12 which means it has 12 protons in its nucleus. Al is element #13 and has 13 protons in its nucleus. An element would have to have between 12 & 13 protons in its nucleus to fall between Mg & Al on the periodic table and the number of protons has to be an integer.

(8) (4pts) Who is credited with inventing the periodic table and what nationality was he?

Dimitri Mendeleev, Russian

(9) (8 pts) $2 \text{MnI}_2 + 13\text{F}_2 \rightarrow 2\text{MnF}_3 + 4\text{IF}_5$

Using the balanced equation above, if 0.451 moles of MnI_2 is reacted with 2.98 moles of F_2 ...

(a) what is the limiting reagent (show work)

$$0.451 \text{ mole } \text{MnI}_2 \times \frac{13 \text{ mole } \text{F}_2}{2 \text{ mole } \text{MnI}_2} = 2.93 \text{ mole } \text{F}_2 \therefore 0.451 \text{ moles}$$

MnI_2 could react with 2.93 moles of F_2 . There are 2.98 moles of F_2 \therefore MnI_2 is the limiting reagent.

(b) What is the theoretical yield of MnF_3 ?

MnI_2 is the limiting reagent \therefore

$$0.451 \text{ mole } \text{MnI}_2 \times \frac{2 \text{ mole } \text{MnF}_3}{2 \text{ mole } \text{MnI}_2} = 0.451 \text{ mole } \text{MnF}_3$$

$$\text{MnF}_3 \text{ MW} = 111.94 \frac{\text{g}}{\text{mole}}$$

$$0.451 \text{ mole } \text{MnF}_3 \times 111.94 \frac{\text{g}}{\text{mole}} = 50.48 \text{ g}$$
$$\text{MnF}_3$$
$$\boxed{= 50.5 \text{ g}}$$

(c) If the actual yield of MnF_3 is 42.0 g, what is the percent yield for the reaction?

$$\% \text{ yield} = \frac{\text{actual}}{\text{theoretical}} \times 100\% \quad \begin{array}{l} \text{actual} = 42.0 \text{ g} \\ \text{theoretical (part d)} = 50.5 \text{ g} \end{array}$$

$$\frac{42.0 \text{ g}}{50.5 \text{ g}} \times 100\% = 83.2\%$$

(10) A compound is found to have a composition that is 40.05% S and 59.95% O by mass. What is the empirical formula for the compound?

Assume a 100g sample. \therefore 40.05g S and 59.95g O
S AW = 32.05 $\frac{\text{g}}{\text{mole}}$ O AW = 16.00 $\frac{\text{g}}{\text{mole}}$

$$\text{S } 40.05 \text{ g} \div 32.05 \frac{\text{g}}{\text{mole}} = 1.250 \text{ moles}$$

$$\text{O } 59.95 \text{ g} \div 16.00 \frac{\text{g}}{\text{mole}} = 3.747 \text{ moles}$$

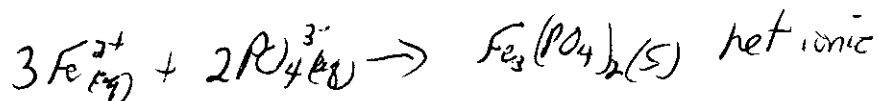
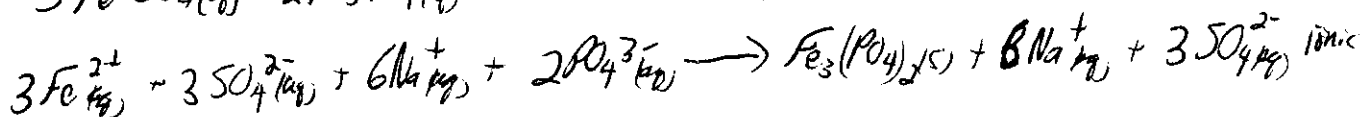
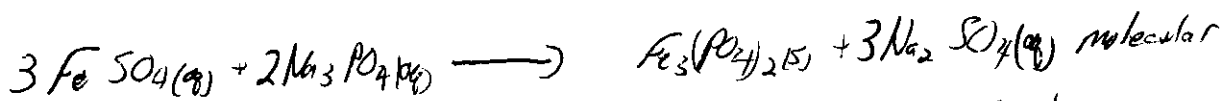
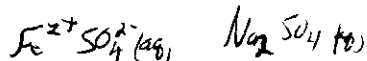
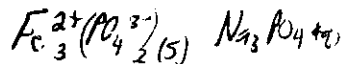
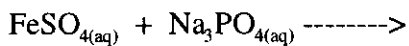
divide by the smallest # moles to get whole # ratios

$$\text{S } 1.250 \text{ mole} \div 1.250 \text{ mole} = 1$$

$$\text{O } 3.747 \text{ moles} \div 1.250 \text{ mole} = 2.998 \approx 3$$

$\therefore \text{SO}_3$ is the empirical formula

(11) Write the balanced molecular, ionic, and net ionic equations for the reaction of the following reagents



(Extra Credit) (4 pts) Predict the products of the following reactions (you only have to give the balanced molecular equation)

