CHE111 - Exam 4 - Ch 6,7 - F20 - Ver 1 Score: _____/100

Name: _____ Class: _____ Date: _____

Instructions: Answer the following questions. Show ALL work for problems to receive full credit. Make sure to include proper units and significant figures for all answers.

Complete and balance the following reactions. Indicate the state (solid, liquid or gas) of the products when known. If heat is produced as a product include it. If no reaction occurs write NR in the answer blank.

[3 pt] 1. 1 $C_3H_8(l)$ + 5 $O_2(g)$ ⟶ 3 $CO_2(g)$ + 4 $H_2O(g)$ + heat 1. _____

[3 pt] 2. 2 $HF(aq)$ + 1 $Ca(OH)_2(aq)$ ⟶ 1 $CaF_2(aq)$ + 2 $H_2O(l)$ + heat 2. _____

[3 pt] 3. 1 $Cl_2(g)$ + 1 $CaF_2(aq)$ ⟶ NR 3. **NR**

[3 pt] 4. 1 $K_2SO_3(aq)$ + 2 $HBr(aq)$ ⟶ 2 $KBr(aq)$ + 1 $H_2O(l)$ + 1 $SO_2(g)$ 4. _____

[3 pt] 5. 2 $NaOH(aq)$ + 1 $H_2SO_4(aq)$ ⟶ 1 $Na_2SO_4(aq)$ + 2 $H_2O(l)$ + heat 5. _____

[3 pt] 6. 2 $K(s)$ + 1 $Na_2CO_3(aq)$ ⟶ 1 $K_2CO_3(aq)$ + 2 $Na(s)$ 6. _____

[3 pt] 7. 1 $CaCl_2(aq)$ + 1 $F_2(g)$ ⟶ 1 $CaF_2(s)$ + 1 $Cl_2(g)$ 7. _____

[3 pt] 8. 1 $Al_2(SO_4)_3(aq)$+ 3 $Ca(C_2H_3O_2)_2(aq)$ ⟶ 2 $Al(C_2H_3O_2)_3(aq)$ + 3 $CaSO_4(s)$ 8. _____

[6 pt] 9. Define each of the following terms, list what type of molecules have these properties and give an example compound for each.

	Definition	**Class of Molecules**	**Example**
Strong Electrolyte	Dissociates 100% into ions	Strong Acids Strong Bases Ionic (aq)	H_2SO_4 etc. NaOH etc. NaCl(aq) etc.
Weak Electrolyte	Dissociate < 10% into ions	Weak Acids Weak Acids	$CHC_2H_3O_2$ etc NH_4OH etc.
Non-Electrolyte	Do not dissociate when dissolved in water	Molecular Compounds Ionic (s)	CHO etc. PbI_2 Etc.

[4 pt] 10. Write the total ionic equation and the net ionic equation for the following reaction:

$2\,HF(aq) + Mg(OH)_2(aq) \longrightarrow MgF_2(aq) + 2\,H_2O(l)$

$2HF(aq) + Mg^{+2}(aq) + 2OH^-(aq \longrightarrow Mg_2{}^+(aq) + 2F^-(aq) + 2H_2O(l)$

$2HF(aq) + 2OH^-(aq) \longrightarrow 2\,H_2O(l) + 2F^-(aq)$

[5 pt] 11. What is the oxidation number of each of the atoms in the following compounds or ions.

(a) $KMnO_4$ K ___ Mn ___ O ___

K^+, Mn^{+7}, O^{-2}

(b) $Fe_2(CO_3)_3$ Fe ___ C ___ O ___

Fe^{+3}, C^{+4}, O^{-2}

[5 pt] 12. In the following reaction write the oxidation number of each element below it. Determine which element is oxidized and which element is reduced and write it in the answer blank.

$\_1\_Fe(s) + \_5\_VCl_3(aq) \longrightarrow \_5\_V(s) + \_1\_FeCl_5(aq)$

Oxidized: Fe

☐ ☐☐ ☐ ☐☐

Reduced: V

0 +3, -1 0 +5, -1

[0 pt] 13. Some useful and not so useful Molecular Weights to save you some time:

$PbCl_2$ = 278.11 g/mol	NaCl = 58.44 g/mol	$Pb(NO_3)_2$ = 331.23 g/mol
$Ca(OH)_2$ = 74.10 g/mol	$Al_2(SO_4)_3$ = 342.11 g/mol	C_2H_6 = 30.07 g/mol
CO_2 = 44.01g/mol	H_2O = 18.02 g/mol	O_2 = 16.00 g/mol
H_2SO_4 = 98.09 g/mol	H_3PO_4 = 98.00 g/mol	NaOH = 40.00 g/mol
Na = 22.99 g/mol	Fe_2O_3 = 159.70 g/mol	Al = 26.95 g/mol
Fe = 55.85 g/mol	Al_2O_3 = 101.90 g/mol	

[4 pt] 14. What is the Molarity of a solution made from 25.0 g of $Ca(OH)_2$ added to 350.0 mL of water?

14. **0.964 M $Ca(OH)_2$**

$$\frac{25.0\,\text{g}\,Ca(OH)_2}{350\,\text{mL}} \times \frac{1\,\text{mol}\,Ca(OH)_2}{74.10\,\text{g}\,Ca(OH)_2} \times \frac{1\,\text{mL}}{0.001\,\text{L}} = 0.963948$$

[4 pt] 15. How many O atoms are in 25.0 g of $Al_2(SO_4)_3$?

15. 5.28×10^{23} **atoms $Al_2(S$**

$$\frac{25.0\,\text{g}\,Al_2(SO_4)_3}{} \times \frac{1\,\text{mol}\,Al_2(SO_4)_3}{342.11\,\text{g}\,Al_2(SO_4)_3} \times \frac{6.02 \times 10^{23}\,\text{molec.}}{1\,\text{mol}\,Al_2(SO_4)_3} \frac{12\,\text{atoms O}}{1\,\text{molecule}\,Al_2(SO_4)_3} = 5.2790 \times 1023$$

[4 pt] 16. How many grams of H_2O can be produced by burning 28.75 grams of C_2H_6?

16. **51.69 g H_2O**

$\_2\_\,C_2H_6(g) + \_7\_\,O_2(g) \longrightarrow \_4\_\,CO_2(g) + \_6\_\,H_2O(g)$

$$\frac{28.75\,\text{g}\,C_2H_6}{} \times \frac{1\,\text{mol}\,C_2H_6}{30.07\,\text{g}\,C_2H_6} \times \frac{6\,\text{mol}\,H_2O}{2\,\text{mol}\,C_2H_6} \times \frac{18.02\,\text{g}\,H_2O}{1\,\text{mol}\,H_2O} = 51.686897$$

[5 pt] 17. In a titration, it took 115.0 mL of 0.38 M H_3PO_4 to neutralize 45.0 mL of an unknown concentration of $Ca(OH)_2$. What is the concentration of the $Ca(OH)_2$ solution?

17. **1.5 M $Ca(OH)_2$**

$\_2\_\,H_3PO_4(aq) + \_3\_\,Ca(OH)_2(aq) \longrightarrow \_1\_\,Ca_3(PO_4)_2(aq) + \_6\_\,H_2O$

$$\frac{115.0\,\text{mL}\,H_3PO_4}{45.0\,\text{mL}\,Ca(OH)_2} \times \frac{0.001\,\text{L}}{1\,\text{mL}} \times \frac{0.38\,\text{mol}\,H_3PO_4}{1\,\text{L}\,H_3PO_4} \times \frac{3\,\text{mol}\,Ca(OH)_2}{2\,\text{mol}\,H_3PO_4} \times \frac{1\,\text{mL}}{0.001\,\text{L}} = 1.456666$$

[5 pt] 18. Relax, take a break. Imagine yourself on you dream vacation doing something amazing. Tell me where you are and what you are doing? (Then get back to work you slackers!)

[5 pt] 19. Your 3.00 g "sample" of cocaine is cut with NaCl. To determine the percentage impurity you react your "sample" with $Pb(NO_3)_2$ to produce 5.30 g of $PbCl_2$ precipitate. What is the percentage of NaCl in your cocaine?

19. **74.3 %**

[8 pt] 20. An unknown hydrocarbon (CxHy) was combusted to produce 22.72 g CO_2 and 11.62 g of H_2O. The molecular weight of the original compound is 58.119 g/mol.

(a) What is the percentage of Carbon? 20(a) **82.67%**

(b) What is the percentage of Hydroen? 20(b) **17.33%**

(c) What is the Empirical Formula of the compound? 20(c) **C_2H_5**

(d) What is the Molecular Formula of the compound? 20(d) **C_4H_{10}**

[21 pt] 21. You perform a reaction in lab starting with 50.0 g of Fe_2O_3 and 75.0 g Al. Show all calculations in the space provided.

$$\_1\_ Fe_2O_3(s) + \_2\_ Al(s) \longrightarrow \_2\_ Fe(l) + \_1\_ Al_2O_3(l) + 250kJ$$

(a) What is the limiting reactant? 21(a) **Fe_2O_3**

$$\frac{50.0\,g\,Fe_2O_3}{} \times \frac{1\,mol\,Fe_2O_3}{159.7\,g\,Fe_2O_3} \times \frac{2\,mol\,Fe}{1\,mol\,Fe_2O_3} \times \frac{55.845\,g\,Fe}{1\,mol\,Fe} = 34.9686$$

$$\frac{75.0\,g\,Al}{} \times \frac{1\,mol\,Al}{26.982\,g\,Al} \times \frac{1\,mol\,Fe}{2\,mol\,Al} \times \frac{55.845\,g\,Fe}{1\,mol\,Fe} = 77.7006$$

(b) How many grams of the excess reagent will be left over? 21(b) **58.1 g Al**

$$\frac{50.0\,g\,Fe_2O_3}{} \times \frac{1\,mol\,Fe_2O_3}{159.7\,g\,Fe_2O_3} \times \frac{2\,mol\,Al}{1\,mol\,Fe_2O_3} \times \frac{26.982\,g\,Al}{1\,mol\,Al} = 16.895$$

Start - End = Left Over

75.0 - 16.9 = 58.1

(c) What is the theoretical yield in grams of Fe in grams? 21(c) **35.0 g Fe_2O_3**

See part (a)

(d) What is the theoretical yield in grams of Al_2O_3 in grams? 21(d) **31.9 g Al_2O_3**

See part (a)

(e) What is the percent yield if you performed the reaction and produced 23.0 grams of Fe? 21(e) **65.7 %**

$$\text{Percent Yield} = \frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100$$

$$\frac{23.0}{35.0} \times 100 = 65.71$$

(f) How many Joules of heat will be released? 21(f) **78,300 J**

$$\frac{50.0\,g\,Fe_2O_3}{} \times \frac{1\,mol\,Fe_2O_3}{159.7\,g\,Fe_2O_3} \times \frac{250\,kJ}{1\,mol\,Fe_2O_3} \times \frac{1000J}{1\,kJ} = 78,271.76$$

(g) Does the reaction obey Lavoisier Law? Explain. 21(g) **78,300 J**