Name ____Mr. Perfect_____ Date ____F 11_____

1. Calculate the percent composition of oxygen in the following compound. (4pts)

$BaCrO_4$
Ba = 137 g/mol
Cr = 52 g/mol
O = 16 g/mol x 14 = 64 g/mol
253 g/mol

$$\%\, O = \frac{64}{253} \times 100 = \mathbf{25}\ \%\ \boldsymbol{O}$$

2. Fill in the missing information in the following table: (12 pts)

Symbol	Protons	Neutrons	Electrons	Charge
$^{88}Sr^{2+}$	38	50	36	+2
$^{32}P^{3-}$	15	17	18	-3
$^{131}I^{-}$	53	78	54	-1
$^{59}Co^{n+}$	27	32	24	+3

3. Name the following compounds: (8 pts)

a. $Cu(NO_3)_2$
Type (II)
Copper(II) Nitrate

b. LiF
Type (I)
Lithium Fluoride

c. N_2O_4
Type (III)
dinitrogen tetraoxide

d. NH_4ClO_3
Type (I)
Ammonium Chlorate

4. An element has four naturally occurring isotopes with the following masses and abundances:

Isotopic Mass (amu)	Fractional Abundance
49.946	0.0435
51.940	0.8379
52.941	0.0950
53.939	0.0236

What is the atomic weight of this element? (6pts)

$$Atomic\ Weight = 49.946(0.0435) + 51.940(0.8379) + 52.941(0.095) + 53.939(0.0236) = \mathbf{51.996}\ \boldsymbol{Amu}$$

Name ____Mr. Perfect_____ Date ____F 11_____

5. For each of the following pairs of ions, write the formula of the corresponding compound. (12pts)

a. Na^+ and CO_3^{2-} — Na_2CO_3

b. Ag^+ and OH^- — $AgOH$

c. Fe^{3+} and SO_4^{2-} — $Fe_2(SO_4)_3$

d. Ca^{2+} and HCO_3^- — $Ca(HCO_3)_2$

e. Na^+ and CO_3^{2-} — Na_2CO_3

d. Al^{3+} and PO_4^{3-} — $AlPO_4$

Soluble	Except	Insoluble	Except
Na^+, K^+, Li^+, NH_4^+	None	CO_3^{2-}	Group 1A, NH_4^+
NO_3^-	None	PO_4^{3-}	Group 1A, NH_4^+
Cl^-, Br^-, I^-	Ag^+, Pb^{2+}, Hg_2^{2+}	S^{2-}	Group 1A, NH_4^+
SO_4^{2-}	Ca^{2+}, Ag^+, Pb^{2+}, Ba^{2+}	OH^-	Group 1A, Ca^{2+}, Ba^{2+}

6. Write the balance molecular equation, complete ionic equation, and net ionic equation for each of the following aqueous reactions including phase labels. If no reaction occurs (*no precipitate*), just write NR after the arrow: (18 pts)

a. $2K_3PO_{4(aq)} + 3Ca(NO_3)_{2(aq)} \rightarrow 6KNO_{3(aq)} + Ca_3(PO_4)_{2(s)}$

$6K^+_{(aq)} + 2PO_4^{3-}{}_{(aq)} + 3Ca^{2+}_{(aq)} + 6NO_3^-{}_{(aq)} \rightarrow 6K^+_{(aq)} + 6NO_3^-{}_{(aq)} + Ca_3(PO_4)_{2(s)}$

$3Ca^{2+}_{(aq)} + 2PO_4^{3-}{}_{(aq)} \rightarrow Ca_3(PO_4)_{2(s)}$

b. $Al(NO_3)_{3(aq)} + 3NaOH_{(aq)} \rightarrow Al(OH)_{3(s)} + 3NaNO_{3(aq)}$

$Al^{3+}_{(aq)} + 3NO_3^-{}_{(aq)} + 3Na^+_{(aq)} + 3OH^-_{(aq)} \rightarrow Al(OH)_{3(s)} + 3Na^+_{(aq)} + 3NO_3^-{}_{(aq)}$

$Al^{3+}_{(aq)} + 3OH^-_{(aq)} \rightarrow Al(OH)_{3(s)}$

c. $Na_2S_{(aq)} + ZnCl_{2(aq)} \rightarrow ZnS_{(s)} + 2NaCl_{(aq)}$

$2Na^+_{(aq)} + S^{2-}_{(aq)} + Zn^{2+}_{(aq)} + 2Cl^-_{(aq)} \rightarrow ZnS_{(s)} + 2Na^+_{(aq)} + 2Cl^-_{(aq)}$

$Zn^{2+}_{(aq)} + S^{2-}_{(aq)} \rightarrow ZnS_{(s)}$

Name ____Mr. Perfect_____ Date ____F 11_____

7. Balance the following Redox reactions using the half-reaction method and clearly label the oxidation and reduction steps. (10 pts)

a) $Ce^{4+}_{(aq)} + Sn^{2+}_{(aq)} \rightarrow Ce^{3+}_{(aq)} + Sn^{4+}_{(aq)}$

$2 \times (e^- + Ce^{4+} \rightarrow Ce^{3+})$ reduction

$Sn^{2+} \rightarrow Sn^{4+} + 2e^-$ oxidation

$2Ce^{4+} + Sn^{2+} \rightarrow 2Ce^{3+} + Sn^{4+}$

b) $Sn^{2+}_{(aq)} + I_{2(aq)} \rightarrow I^-_{(aq)} + Sn^{4+}_{(aq)}$

$Sn^{2+} \rightarrow Sn^{4+} + 2e^-$ oxidation

$2e^- + I_2 \rightarrow 2I^-$ reduction

$Sn^{2+} + I_2 \rightarrow 2I^- + Sn^{4+}$

8. One of the most commonly used white pigments in paint is a compound of titanium and oxygen that contains 59.9% Ti by mass and has a molecular mass of 80 g/mol. Determine the empirical formula and molecular formula of this compound. (10 pts)

Assume a 100 g sample:

$$59.9\ g\ Ti \times \frac{mol}{48\ g} = 1.25\ mol \div 1.25\ mol = 1$$

100% - 59.9% = 40.1% O

$$40.1\ g\ O \times \frac{mol}{16\ g} = 2.51\ mol \div 1.25\ mol = 2$$

Empirical Formula
TiO_2 Empirical Mass = 80 g/mol

$$\frac{Molecular\ mass}{Empirical\ Mass} = \frac{80}{80} = 1$$

Molecular Formula
TiO_2

Name ____Mr. Perfect_____ Date ____F 11_____

9. Combustion of a 1.00 g sample of an organic compound containing only carbon, hydrogen, and oxygen produces 2.360 g of CO_2 and 0.640 g of H_2O. Calculate the % composition for C, H, and O. (10 pts)

1.00 g sample

$$2.360\ g\ CO_2 \times \frac{mol}{44\ g} \times \frac{1\ mol\ C}{1\ mol\ CO_2} \times \frac{12\ g}{mol} = 0.644\ g\ C\ or\ \mathbf{64.4\%\ C}$$

$$0.640\ g\ H_2O \times \frac{mol}{18\ g} \times \frac{2\ mol\ H}{1\ mol\ H_2O} \times \frac{1\ g}{mol} = 0.071\ g\ H\ or\ \mathbf{7.1\%\ H}$$

100% - (64.4% + 7.1%) = **28.5 % O**

10. Aluminum burns in bromine, producing aluminum bromide:

$$2Al_{(s)} + 3Br_{2(l)} \rightarrow 2AlBr_{3(s)}$$

When 10.0g of aluminum was reacted with an excess of bromine, 79.8 g of aluminum bromide was isolated. Calculate the theoretical yield and the percent yield of this reaction. (10pts)

Theoretical Yield

$$10.0\ gAl \times \frac{mol}{27\ g} \times \frac{2\ mol\ AlBr_3}{2\ mol\ Al} \times \frac{267\ g}{mol} = 98.9\ g\ AlBr_3$$

$$\%\ Yield = \frac{actual\ yield}{theoretical\ yield} \times 100 = \frac{79.8}{98.9} \times 100 = \mathbf{80.7}\ \%$$

11. Extra Credit. Hydrogen has two stable isotopes, ^{1}H and ^{2}H, and sulfur has four stable isotopes, ^{32}S, ^{33}S, ^{34}S, and ^{36}S. How many peaks would you observe in the mass spectrum of the positive ion of hydrogen sulfide, H_2S^+? *Assume no decomposition of the ion into smaller fragments*. (5 pts) 4 isotopes of sulfur

Possible Masses

H combinations

$^{1}H^{1}H$ 34 35 36 __ 38

$^{2}H^{2}H$ 36 37 38 __ 40 — 7 peaks

$^{1}H^{2}H$ 35 36 37 __ 39

1 2 3 4 5 6 7