

1. Name the following compounds: (8 pts)



Chromium(III) Chloride



Magnesium Nitride



Bromine Pentafluoride



Bicarbonate

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

Symbol	Protons	Neutrons	Electrons	Charge
$^{32}\text{S}^{2-}$	16	16	18	-2
$^{23}\text{Na}^+$	11	12	10	+1
$^{11}\text{B}^{3+}$	5	10	2	+3
$^{64}\text{Cu}^{n+}$	29	35	28	+1

3. Calculate the molarity and osmolarity of a solution containing 32.6 g of  $\text{LiNO}_3$  dissolved into 450.2 mL of water. (10 pts)Molarity

$$\frac{32.6 \text{ g} \times \frac{1 \text{ mol}}{69 \text{ g}}}{0.4502 \text{ L}} = \frac{0.472 \text{ mol}}{0.4502 \text{ L}} = 1.05 \text{ M}$$

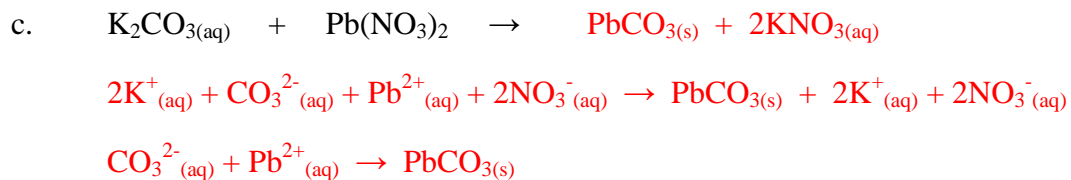
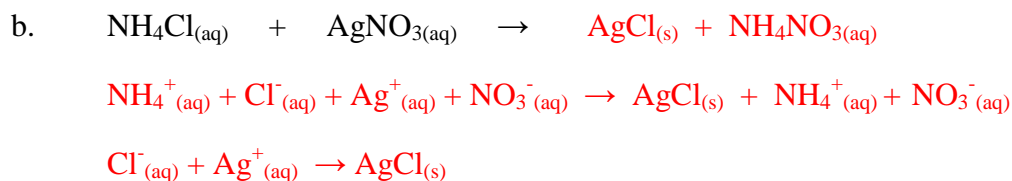
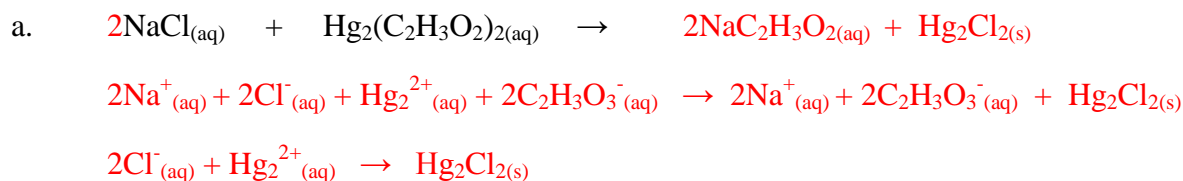
Osmolarity

4. The American Dental Association recommends that an adult female should consume 3.0 mg of fluoride ( $F^-$ ) per day to prevent tooth decay. If the fluoride is consumed as sodium fluoride, how many grams of sodium fluoride must an adult female consume to satisfy the recommended daily dosage of fluoride? (*Hint*: NaF is 45.24 % F by mass) (6 pts)

$$3.0 \times 10^{-3} \text{ g } F \times \frac{1 \text{ g NaF}}{0.4524 \text{ g } F} = 6.6 \times 10^{-3} \text{ g of NaF}$$

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, $NH_4^+$ , $Ca^{2+}$
$SO_4^{2-}$	$Ca^{2+}$ , $Ag^+$ , $Pb^{2+}$ , $Ba^{2+}$	$OH^-$	Group 1A, $NH_4^+$ , $Ca^{2+}$ , $Ba^{2+}$

5. Write the balance molecular equation, complete ionic equation, and net ionic equation for each of the following aqueous double displacement precipitation reactions. Include phase labels to receive full credit. (18 pts)



6. Calculate the empirical formula for a compound with the following mass percent composition: (10 pts)

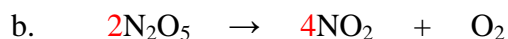
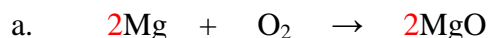
Assume a 100 g sample. 58.80 % C, 9.87 % H, 31.33 % O

$$58.80g C \times \frac{1 \text{ mol}}{12 g} = 4.9 \text{ mol} \div 1.96 \text{ mol} = 2.5 \times 2 = 5$$

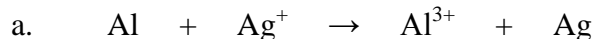
$$9.87g H \times \frac{1 \text{ mol}}{1 g} = 9.87 \text{ mol} \div 1.96 \text{ mol} = 5 \times 2 = 10$$

$$31.33 g O \times \frac{1 \text{ mol}}{16 g} = 1.96 \text{ mol} \div 1.96 \text{ mol} = 1 \times 2 = 2 \quad \text{Empirical Formula} = C_5H_{10}O_2$$

7. Balance the following equations: (10 pts)



8. Balance the following redox reactions using the half-reaction method and clearly label the oxidation and reduction steps. Also, indicate which element is the reducing agent. (6 pts)

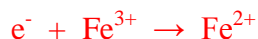


Oxidation

Al is the reducing agent



Reduction



Reduction

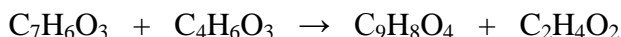


Oxidation

Cu<sup>+</sup> is the reducing agent



9. Aspirin can be synthesized by reacting salicylic acid,  $C_7H_6O_3$ , with acetic anhydride to produce acetyl salicylic acid (aspirin),  $C_9H_8O_4$ , and acetic acid.



If 1.25 g of salicylic acid was mixed with 3.00 mL of acetic anhydride ( $d = 1.08 \text{ g/mL}$ ) to produce 1.22 g of aspirin, calculate the % yield for this reaction. (10 pts)

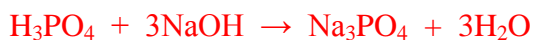
Find the limiting reagent. Limiting Reactant Theoretical Yield

$$1.25g \text{ S.A.} \times \frac{1 \text{ mol}}{138g} \times \frac{1 \text{ mol S.A.}}{1 \text{ mol Aspirin}} = 0.00906 \text{ mol Aspirin} \times \frac{180g}{\text{mol}} = 1.63 \text{ g Aspirin}$$

$$3.00mL \text{ A.A.} \times \frac{1.08g}{mL} \times \frac{1 \text{ mol}}{102g} \times \frac{1 \text{ mol Aspirin}}{1 \text{ mol A.A.}} = 0.0318 \text{ mol Aspirin}$$

$$\% \text{ Yield} = \frac{\text{Experimental Yield}}{\text{Theoretical Yield}} \times 100 = \frac{1.22}{1.63} \times 100 = 74.8\%$$

10. A 20.0 mL sample of phosphoric acid,  $H_3PO_4$ , was neutralized with 18.45 mL of a 0.100 M NaOH solution. What is the molarity of the phosphoric acid solution? Write the balance equation for this acid-base neutralization reaction. (10 pts)



$$M_a = \frac{M_b V_b}{3V_a} = \frac{(0.100 \text{ M})(18.45 \text{ mL})}{3(20.0 \text{ mL})} = 0.031 \text{ M}$$

11. Extra Credit. Complete and balance the following reaction: (5 pts)

