

Items you may bring: One page, double-sided, of notes and a non-programmable, non-graphing calculator.

## I. KEY VOCABULARY

1 pt 1. What is the name given to the quantitative relationships between the compounds in a chemical reaction?  
Stoichiometry

1 pt each 2. What is the SI unit for mass? kg temperature? K amount quantity? mole electric current? A

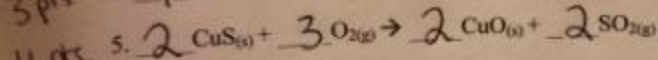
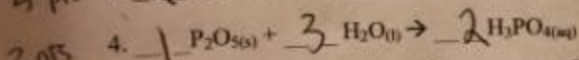
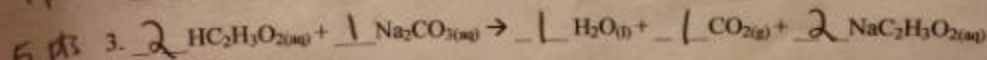
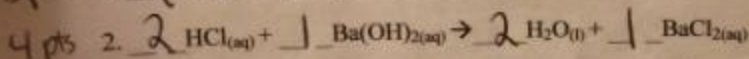
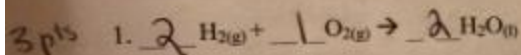
1 pt 3. What is the numerical value of Avogadro's number?  
 $6.02 \times 10^{23}$

2 pts 4. What is the difference between molarity and molality?  
Molarity =  $\frac{\text{moles of solute}}{\text{liters of solution}}$  Molality =  $\frac{\text{moles of solute}}{\text{kg of solvent}}$

1 pt 5. What is the name of a reactant in a chemical equation that is completely consumed and stops the reaction?  
Limiting reactant or limiting reagent

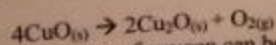
## II. STOICHIOMETRY

i. Balance the following equations:



ii. Solve the following problems:

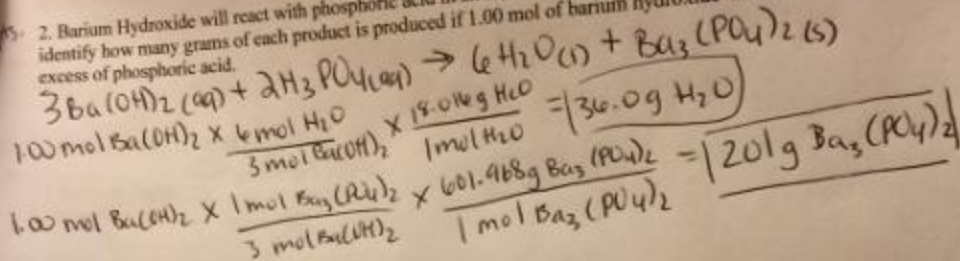
2 pts 1. Copper (II) Oxide will decompose when it is heated strongly.



How many grams of oxygen can be obtained from 2.64 g  $\text{CuO}(\text{s})$ ?

$$9 \text{ CuO} \times \frac{1 \text{ mol CuO}}{79.55 \text{ g CuO}} \times \frac{1 \text{ mol O}_2}{4 \text{ mol CuO}} \times \frac{32 \text{ g}}{1 \text{ mol O}_2}$$

3 pts. 2. Barium Hydroxide will react with phosphoric acid in an acid-base reaction. Predict the products, then identify how many grams of each product is produced if 1.00 mol of barium hydroxide is reacted in an excess of phosphoric acid.



2 pts. 3. How many milliliters of 0.240 M  $\text{MnO}_4^-$  solution will be needed to titrate a 1.56 g sample of pure  $\text{Fe(NO}_3)_2$ ?

$$1.56 \text{ g Fe(NO}_3)_2 \times \frac{1 \text{ mol Fe(NO}_3)_2}{180 \text{ g Fe(NO}_3)_2} \times \frac{1 \text{ mol Fe}^{2+}}{1 \text{ mol Fe(NO}_3)_2} \times \frac{1 \text{ mol MnO}_4^-}{5 \text{ mol Fe}^{2+}} \times \frac{1000 \text{ mL MnO}_4^-}{0.240 \text{ mol MnO}_4^-}$$

$$= \boxed{7.22 \text{ mL MnO}_4^-}$$

4 pts. 4. What is the percentage of Fe, O, H, and  $\text{OH}^-$  polyatomic ion in  $\text{Fe(OH)}_3$ ?

Fe:  $100 \text{ g Fe(OH)}_3 \times \frac{1 \text{ mol Fe(OH)}_3}{106.8 \text{ g Fe(OH)}_3} \times \frac{1 \text{ mol Fe}}{1 \text{ mol Fe(OH)}_3} \times \frac{55.8 \text{ g Fe}}{1 \text{ mol Fe}} = 52.2 \text{ g Fe}$   
 $\frac{52.2 \text{ g Fe}}{100 \text{ g Fe(OH)}_3} \times 100 = \boxed{52.2\% \text{ Fe}}$

O:  $100 \text{ g Fe(OH)}_3 \times \frac{1 \text{ mol Fe(OH)}_3}{106.8 \text{ g Fe(OH)}_3} \times \frac{3 \text{ mol O}}{1 \text{ mol Fe(OH)}_3} \times \frac{16 \text{ g O}}{1 \text{ mol O}} = 44.9 \text{ g O}$   
 $\frac{44.9 \text{ g O}}{100 \text{ g Fe(OH)}_3} \times 100 = \boxed{44.9\% \text{ O}}$

H:  $100 \text{ g Fe(OH)}_3 \times \frac{1 \text{ mol Fe(OH)}_3}{106.8 \text{ g Fe(OH)}_3} \times \frac{3 \text{ mol H}}{1 \text{ mol Fe(OH)}_3} \times \frac{1 \text{ g H}}{1 \text{ mol H}} = 2.8 \text{ g H}$   
 $\frac{2.8 \text{ g H}}{100 \text{ g Fe(OH)}_3} \times 100 = \boxed{2.8\% \text{ H}}$

$\text{OH}^-$ :  $100 \text{ g Fe(OH)}_3 \times \frac{1 \text{ mol Fe(OH)}_3}{106.8 \text{ g Fe(OH)}_3} \times \frac{3 \text{ mol OH}^-}{1 \text{ mol Fe(OH)}_3} \times \frac{17.0 \text{ g OH}^-}{1 \text{ mol OH}^-} = 47.8 \text{ g OH}^-$   
 $\frac{47.8 \text{ g OH}^-}{100 \text{ g Fe(OH)}_3} \times 100 = \boxed{47.8\% \text{ OH}^-}$

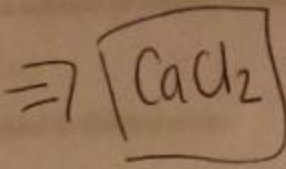
5 pts. 5. What is the empirical formula of a compound that contains 4.0 g of calcium and 7.1 g of chlorine?

$$1 \text{ Ca} \times \frac{1 \text{ mol Ca}}{40.08 \text{ g Ca}} = 0.10 \text{ mol Ca}$$

$$1.1 \text{ g Cl} \times \frac{1 \text{ mol Cl}}{35.45 \text{ g Cl}} = 0.20 \text{ mol Cl}$$

$$\frac{0.10 \text{ mol Ca}}{0.10} = 1 \text{ mol Ca}$$

$$\frac{0.20 \text{ mol Cl}}{0.10} = 2 \text{ mol Cl}$$



1 pt each

### III. NOMENCLATURE

7/10  
#4

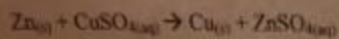
7/10  
#3

Chemical Name	Chemical Formula
Bromate	$\text{BrO}_3^-$
Periodate	$\text{IO}_4^-$
Peroxide	$\text{O}_2^{2-}$
Thiosulfate	$\text{S}_2\text{O}_3^{2-}$
Dichromate	$\text{Cr}_2\text{O}_7^{2-}$
Permanganate	$\text{MnO}_4^-$
Cyanide	$\text{CN}^-$
Chlorate	$\text{ClO}_3^-$
Nitrate	$\text{NO}_3^-$
Bicarbonate	$\text{HCO}_3^-$
Acetate	$\text{CH}_3\text{COO}^-$
Hydroxide	$\text{OH}^-$
Thiocyanate	$\text{SCN}^-$
Phosphite	$\text{PO}_3^{3-}$
Hypiodite	$\text{IO}^-$
Bromous Acid	$\text{HBrO}_2$
Carbonic Acid	$\text{H}_2\text{CO}_3$
Hydrosulfuric Acid	$\text{H}_2\text{S}$
Hydrofluoric Acid	$\text{HF}$
Iodic Acid	$\text{HIO}_3$
Nitric Acid	$\text{HNO}_3$
Copper (II) Oxide	$\text{CuO}$
Tetraphosphorus Decoxide	$\text{P}_4\text{O}_{10}$
Magnesium chloride	$\text{MgCl}_2$

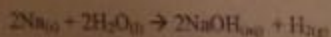
### IV. CHEMICAL REACTIONS

\*Cancel out spectator ions if applicable\*

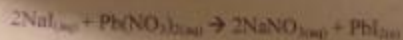
2 pts 1. A bar of zinc metal is immersed in a solution of copper(II) sulfate.



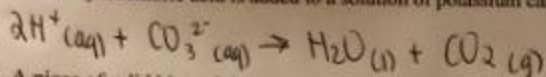
2 pts 2. A small piece of sodium metal is added to distilled water.



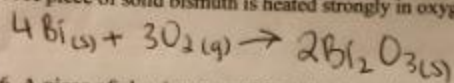
2 pts 3. Solutions of sodium iodide and lead(II) nitrate are combined.



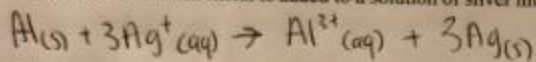
2 pts 4. Dilute hydrochloric acid is added to a solution of potassium carbonate.



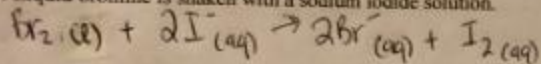
2 pts 5. A piece of solid bismuth is heated strongly in oxygen.



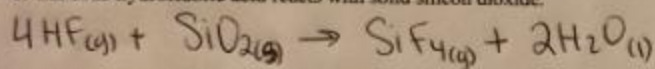
2 pts 6. A piece of aluminum metal is added to a solution of silver nitrate.



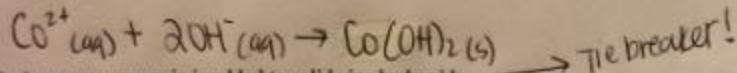
2 pts 7. Liquid bromine is shaken with a sodium iodide solution.



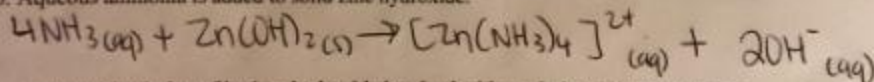
2 pts 8. Gaseous hydrofluoric acid reacts with solid silicon dioxide.



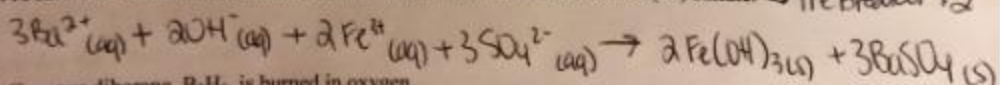
2 pts 9. Solutions of cobalt(II) nitrate and sodium hydroxide are mixed.



2 pts 10. Aqueous ammonia is added to solid zinc hydroxide.



2 pts 11. A saturated solution of barium hydroxide is mixed with a solution of iron(III) sulfate.  $\rightarrow$  Tie Breaker #2



2 pts 12. Gaseous diborane,  $\text{B}_2\text{H}_6$ , is burned in oxygen.

