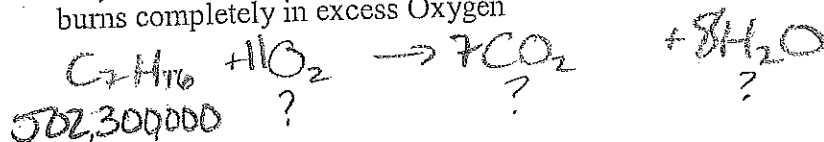


Name
Chemistry
Stoichiometry
Particles #2

- In the following reactions:
 - Complete the reaction (translate and predict products)
 - Determine amount of each reactant and product
 - Use Correct Significant figures (Multiplication/Division: use smallest # of sigfigs)

1. 502,300,000. molecules of Heptane (C₇H₁₆), the basic component of gasoline burns completely in excess Oxygen

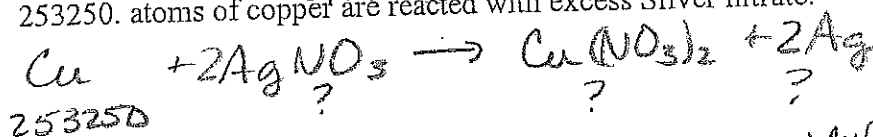


$$5.023 \times 10^8 \text{ C}_7\text{H}_{16} \left| \frac{7 \text{ CO}_2}{1 \text{ C}_7\text{H}_{16}} \right. = 3.516 \times 10^9 \text{ CO}_2$$

$$5.023 \times 10^8 \text{ C}_7\text{H}_{16} \left| \frac{8 \text{ H}_2\text{O}}{1 \text{ C}_7\text{H}_{16}} \right. = 4.018 \times 10^9 \text{ H}_2\text{O}$$

$$5.023 \times 10^8 \text{ C}_7\text{H}_{16} \left| \frac{11 \text{ O}_2}{1 \text{ C}_7\text{H}_{16}} \right. = 5.525 \times 10^9 \text{ O}_2$$

2. 253250. atoms of copper are reacted with excess Silver nitrate.

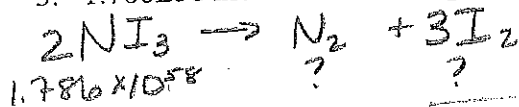


$$253250 \text{ Cu} \left| \frac{2 \text{ Ag}}{1 \text{ Cu}} \right. = 506500 \text{ Ag}$$

$$253250 \text{ Cu} \left| \frac{1 \text{ Cu(NO}_3)_2}{1 \text{ Cu}} \right. = 253250 \text{ Cu(NO}_3)_2$$

$$253250 \text{ Cu} \left| \frac{2 \text{ AgNO}_3}{1 \text{ Cu}} \right. = 506500 \text{ AgNO}_3$$

3. 1.786E58 molecules of nitrogen triiodide decompose to elements.



$$1.786 \times 10^{58} \left| \frac{1 \text{ N}_2}{2 \text{ NI}_3} \right. = 8.930 \times 10^{57} \text{ N}_2$$

$$1.786 \times 10^{58} \left| \frac{3 \text{ I}_2}{2 \text{ NI}_3} \right. = 2.679 \times 10^{58} \text{ I}_2$$

4. 7.8400 x 10²³ molecules of sodium phosphate react with excess molecules of lead (II) nitrate. $2\text{Na}_3\text{PO}_4 + 3\text{Pb(NO}_3)_2 \rightarrow 6\text{NaNO}_3 + \text{Pb}_3(\text{PO}_4)_2$

$$7.8400 \times 10^{23} \text{ Na}_3\text{PO}_4 \left| \frac{3 \text{ Pb(NO}_3)_2}{2 \text{ Na}_3\text{PO}_4} \right. = 1.1760 \times 10^{24} \text{ Pb(NO}_3)_2$$

$$7.8400 \times 10^{23} \text{ Na}_3\text{PO}_4 \left| \frac{6 \text{ NaNO}_3}{2 \text{ Na}_3\text{PO}_4} \right. = 2.3520 \times 10^{24} \text{ NaNO}_3$$

$$7.8400 \times 10^{23} \text{ Na}_3\text{PO}_4 \left| \frac{1 \text{ Pb}_3(\text{PO}_4)_2}{2 \text{ Na}_3\text{PO}_4} \right. = 3.9200 \times 10^{23} \text{ Pb}_3(\text{PO}_4)_2$$

5. 2500000000. molecules of Nitric acid react with excess molecules of aluminum hydroxide. $3\text{HNO}_3 + \text{Al(OH)}_3 \rightarrow 3\text{HOH} + \text{Al(NO}_3)_3$

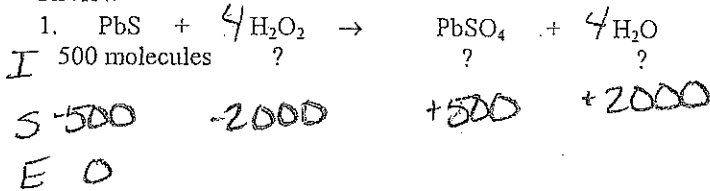
$$2.5 \times 10^9 \text{ HNO}_3 \left| \frac{1 \text{ Al(OH)}_3}{3 \text{ HNO}_3} \right. = 8.3 \times 10^8 \text{ Al(OH)}_3$$

$$2.5 \times 10^9 \text{ HNO}_3 \left| \frac{3 \text{ HOH}}{3 \text{ HNO}_3} \right. = 2.5 \times 10^9 \text{ HOH}$$

$$2.5 \times 10^9 \text{ HNO}_3 \left| \frac{1 \text{ Al(NO}_3)_3}{3 \text{ HNO}_3} \right. = 8.3 \times 10^8 \text{ Al(NO}_3)_3$$

Name
Chemistry
Stoichiometry
Particles, Limiting and Excess #1

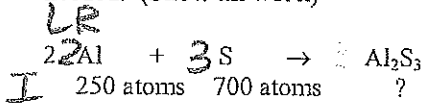
Review



$$500 \text{ PbS} \left| \frac{4 \text{ H}_2\text{O}_2}{1 \text{ PbS}} \right. = 2000 \text{ H}_2\text{O}_2$$

$$500 \text{ PbS} \left| \frac{1 \text{ PbSO}_4}{1 \text{ PbS}} \right. = 500 \text{ PbSO}_4$$

For the following problems determine the "?", limiting and excess. Balance and determine products as needed. (Show all work)

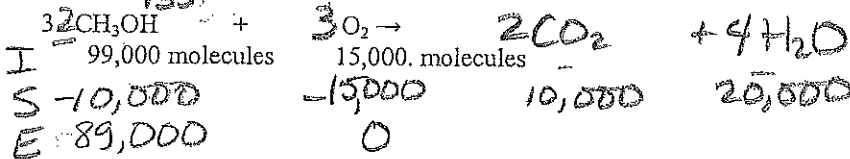


S -250 -375 +125

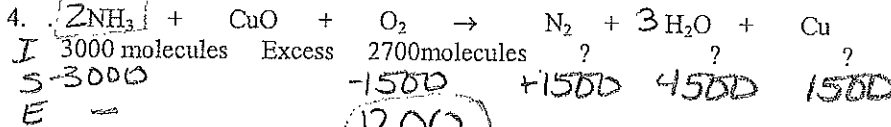
E 0

LR $250 \text{ Al} \left| \frac{3 \text{ S}}{2 \text{ Al}} \right. = 375 \text{ S}$ $250 \text{ Al} \left| \frac{3 \text{ S}}{2 \text{ Al}} \right. = 375 \text{ S}$

$700 \text{ S} \left| \frac{1 \text{ Al}_2\text{S}_3}{3 \text{ S}} \right. = 233 \text{ Al}_2\text{S}_3$

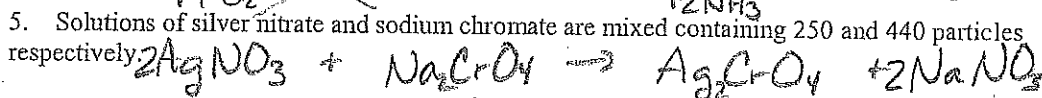


$99000 \text{ CH}_3\text{OH} \left| \frac{2 \text{ CO}_2}{3 \text{ CH}_3\text{OH}} \right. = 99000 \text{ CO}_2$ $15000 \text{ O}_2 \left| \frac{2 \text{ CO}_2}{3 \text{ O}_2} \right. = 10000 \text{ CO}_2$



$3000 \text{ NH}_3 \left| \frac{1 \text{ N}_2}{2 \text{ NH}_3} \right. = 1500 \text{ N}_2$ $3000 \text{ NH}_3 \left| \frac{1 \text{ O}_2}{2 \text{ NH}_3} \right. = 1500 \text{ O}_2$

$2700 \text{ O}_2 \left| \frac{1 \text{ N}_2}{3 \text{ O}_2} \right. = 2700 \text{ N}_2$ $3000 \text{ NH}_3 \left| \frac{3 \text{ H}_2\text{O}}{2 \text{ NH}_3} \right. = 4500 \text{ H}_2\text{O}$



S -250 -125 +125 +250
 E 0 315 125 250

LR $250 \text{ AgNO}_3 \left| \frac{2 \text{ NaNO}_3}{2 \text{ AgNO}_3} \right. = 250 \text{ NaNO}_3$

$440 \text{ Na}_2\text{CrO}_4 \left| \frac{2 \text{ NaNO}_3}{1 \text{ Na}_2\text{CrO}_4} \right. = 880 \text{ NaNO}_3$

NAME _____
 CHEMISTRY
 Moles Limiting and Excess #1

What are the two factors that affect which substance will be the limiting reactant?

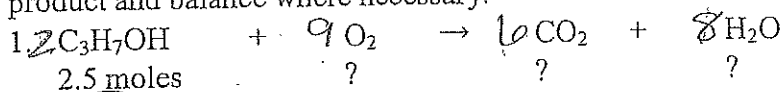
1. rate consumed

2. quantity

If needed, what is the general method one uses to solve for the limiting reactant?

Compare initial quantity of each reactant to see which will make less product.

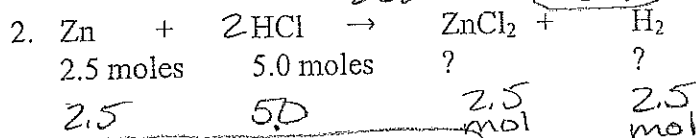
Determine the "?", Limiting and excess for the following reactions. Complete the product and balance where necessary.



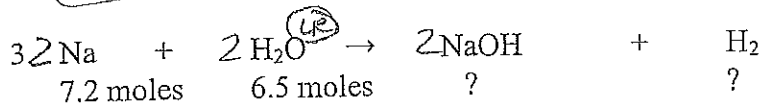
$2.5 \text{ mol } C_3H_7OH \left| \frac{9O_2}{2C_3H_7OH} = 11.25 \text{ mol } O_2 \right.$

$2.5 \text{ mol } C_3H_7OH \left| \frac{8H_2O}{2C_3H_7OH} = 10 \text{ mol } H_2O \right.$

$2.5 \text{ mol } C_3H_7OH \left| \frac{6CO_2}{2C_3H_7OH} = 7.5 \text{ mol } CO_2 \right.$

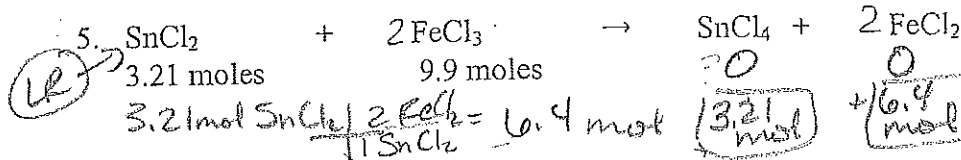
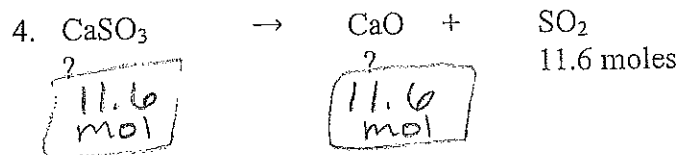


Both LR, no excess

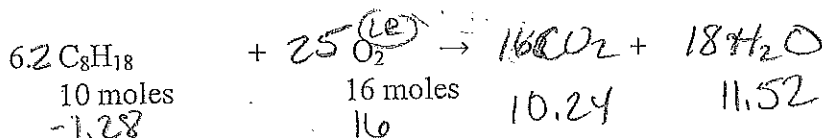


$-6.5 \quad -6.5 \quad +6.5 \quad +3.25$
 $0.7 \quad \quad \quad 6.5 \text{ mol} \quad \quad 3.25 \text{ mol}$

All same rate



excess $FeCl_3$
 9.9 mol
 6.4
 3.5 mol excess $FeCl_3$



$16 \text{ mol } O_2 \left| \frac{2 \text{ mol } C_8H_{18}}{25 \text{ mol } O_2} \right.$ $16 \text{ mol } O_2 \left| \frac{16 \text{ mol } CO_2}{25 \text{ mol } O_2} \right.$ $16 \text{ mol } O_2 \left| \frac{18 \text{ mol } H_2O}{25 \text{ mol } O_2} \right.$

Name
Chemistry
Stoichiometry
Molar Mass #1

- Mass is a means to measure number of particles.
- The only mathematical operation that can be performed on mass is to convert to moles.
- Mass is deceiving
- $207\text{g Pb} = 2\text{g H}_2$ This have the same number of particles, 1 mole.

1. Molar mass is the mass of one mole of any chemical substance.
2. In order to calculate the mass of one mole of a compound one should add up the atomic mass units of each of the elements present in the compound.

Compute the molar mass of the following.

- | | |
|---|---|
| 3. N_2 $2 \times 14 = 28\text{ g/mol}$ | 9. Potassium Chloride KCl 74.5 g/mol |
| 4. I_2 $2 \times 127 = 254\text{ g/mol}$ | 10. Sulfate SO_4^{2-} 96 g/mol |
| 5. $\text{C}_6\text{H}_{12}\text{O}_6$ $(6 \times 12) + (12 \times 1) + (6 \times 16) = 180\text{ g/mol}$ | 11. Magnesium phosphate $\text{Mg}_3(\text{PO}_4)_2$ 136 g/mol |
| 6. Na^+ 23 g/mole | 12. Sulfuric Acid H_2SO_4 98 g/mol |
| 7. CO_3^{2-} $12 + (3 \times 16) = 60\text{ g/mol}$ | 13. Carbon Tetrachloride CCl_4 154 g/mol |
| 8. $\text{Al}(\text{HCO}_3)_3$ $27 + (1+12+16) \times 3 = 114\text{ g/mol}$ | 14. H_2O 18 g/mol |

Using the factor label method determine the number of moles in the following.

15. $64.0\text{ g O}_2 \rightarrow 32\text{ g/mol} \rightarrow 64\text{ g O}_2 \times \frac{1\text{ mol}}{32\text{ g}} = 2\text{ mol}$
16. 58.9 g NH_3 17 g/mol
17. $.205\text{ g Cl}$ 35.5 g/mol
18. $.205\text{ g Cl}_2$ 71 g/mol
19. $12.0\text{ g sodium chloride}$ $58.5\text{ g/mol} \rightarrow 12\text{ g NaCl} \times \frac{1\text{ mol}}{58.5\text{ g}} = 0.205\text{ mol NaCl}$

Using the factor label method determine the number of grams in the following.

20. $1.5\text{ moles H}_2\text{O}$ $1.5\text{ mol H}_2\text{O} \times \frac{18\text{ g}}{1\text{ mol}} = 27\text{ g H}_2\text{O}$
21. $.52\text{ moles AgNO}_3$
22. 1.98 moles PbCl_2 $349\text{ g/mol} \rightarrow 0.52\text{ mol AgNO}_3 \times \frac{170\text{ g}}{1\text{ mol}} = 88\text{ g AgNO}_3$
23. $26.5\text{ moles SO}_4^{2-}$ $96\text{ g/mol} = 2500\text{ g SO}_4^{2-}$
24. $1.5\text{E-}4\text{ moles Ammonium sulfite}$ $1.5 \times 10^{-4}\text{ mol} (\text{NH}_4)_2\text{SO}_3 \times \frac{116\text{ g}}{1\text{ mol}} = 0.017\text{ g } (\text{NH}_4)_2\text{SO}_3$

Using the factor label method determine the number of particles for the following.

25. 90.5 g Mg^{2+} $90.5\text{ g Mg}^{2+} \times \frac{1\text{ mol}}{24\text{ g}} \times \frac{6.02 \times 10^{23}}{1\text{ mol}} = 2.27 \times 10^{22}\text{ Mg}^{2+}$
26. 125 g Nitric Acid $125\text{ g HNO}_3 \times \frac{1\text{ mol}}{63\text{ g}} \times \frac{6.02 \times 10^{23}}{1\text{ mol}} = 1.2 \times 10^{21}\text{ HNO}_3$
27. $1.5\text{ moles Copper (II) Hydroxide}$ $1.5\text{ mol Cu(OH)}_2 \times \frac{6.02 \times 10^{23}}{1\text{ mol}} = 9.03 \times 10^{23}\text{ Cu(OH)}_2$
28. 2.5 kg of SO_2 (careful) $2.5\text{ kg SO}_2 \times \frac{1000\text{ g}}{1\text{ kg}} \times \frac{1\text{ mol}}{64\text{ g}} \times \frac{6.02 \times 10^{23}}{1\text{ mol}} = 2.35 \times 10^{25}\text{ SO}_2$
29. 2.5 mL Mercury (Density: $1\text{g} = 13.2\text{ mL}$) $2.5\text{ mL Hg} \times \frac{1\text{ g}}{13.2\text{ mL}} \times \frac{1\text{ mol}}{200\text{ g}} \times \frac{6.02 \times 10^{23}}{1\text{ mol}} = 1.1 \times 10^{21}\text{ atoms Hg}$

NAME
CHEMISTRY
MOLES AND MOLAR MASS
MOLAR MASS #2

1. A mole = 6.02×10^{23}
2. The molar mass is the mass of one mole.
3. The molar mass of an element is equal to its atomic mass unit (average atomic mass)
4. The molar mass of a compound is the mass of all the atomic masses of each element present.

Moles:

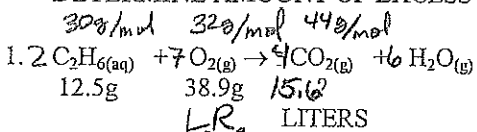
5. What is the mass of one mole of sulfur?
 $32. \text{ g/mol}$
6. If I have 64 g of sulfur do I have more or less than 1 mole? more
7. How many moles of sulfur do I have? $64 \text{ g} / \frac{1 \text{ mol}}{32 \text{ g}} = 2 \text{ mol S}$
8. If I have 25g Sulfur how many moles do I have?
 $25 \text{ g S} / \frac{1 \text{ mol}}{32 \text{ g}} = 0.78 \text{ mol S}$
9. What is the molar mass of Water?
 $\left. \begin{array}{l} \text{H } 2 \times 1 = 2 \\ \text{O } 1 \times 16 = 16 \end{array} \right\} 18 \text{ g/mol}$
10. If I have 15 grams of water how many moles do I have?
 $15 \text{ g} / \frac{1 \text{ mol}}{18 \text{ g}} = 5.6 \text{ mol H}_2\text{O}$
11. If I have 100 grams of water how many moles do I have?
 $100 \text{ g H}_2\text{O} / \frac{1 \text{ mol}}{18 \text{ g}} =$
12. What is the molar mass of Hydrochloric acid?
 $\left. \begin{array}{l} \text{H} \\ \text{Cl } 35.5 \end{array} \right\} 36.5 \text{ g/mol}$
13. What is the molar mass of Hypochlorous acid?
 $\left. \begin{array}{l} \text{H} \\ \text{Cl } 35.5 \\ \text{O} \end{array} \right\}$
14. How many atoms are present in 1 mole of gold? 6.02×10^{23} atoms
15. How many atoms are present in 1 mole of Sodium Chloride? 6.02×10^{23} atoms
16. How many atoms are present in $\frac{1}{2}$ a mole of Aluminum?
 $0.5 \text{ mol Al} / \frac{1 \text{ mol}}{6.02 \times 10^{23}} = 3.01 \times 10^{23}$ atoms
17. How many atoms are present in .3 moles of He?
 $0.3 \text{ mol He} / \frac{1 \text{ mol}}{6.02 \times 10^{23}} = 1.806 \times 10^{23}$ atoms
18. How many atoms are present in 1.5 moles of Zinc?
 $1.5 \text{ mol Zn} / \frac{1 \text{ mol}}{6.02 \times 10^{23}} = 9.03 \times 10^{23}$ atoms

NAME
STOICHIOMETRY
Mass, Limiting and Excess #1

Note: 1 mole of any gas = 22.4 L of Volume at STP

IN THE FOLLOWING PROBLEMS DETERMINE THE FOLLOWING:

- BALANCE REACTION
- ANSWER ? IN CORRECT UNITS
- DETERMINE LIMITING REAGENTS
- DETERMINE AMOUNT OF EXCESS



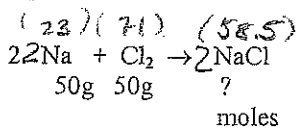
$$38.9 \text{ g O}_2 \left| \frac{1 \text{ mol O}_2}{32 \text{ g O}_2} \right| \frac{2 \text{ mol C}_2\text{H}_6}{7 \text{ mol O}_2} \left| \frac{30 \text{ g C}_2\text{H}_6}{1 \text{ mol C}_2\text{H}_6} \right| = 10.4 \text{ g C}_2\text{H}_6$$

determine L.R.

$$12.5 \text{ g C}_2\text{H}_6 \left| \frac{1 \text{ mol C}_2\text{H}_6}{30 \text{ g C}_2\text{H}_6} \right| \frac{4 \text{ mol CO}_2}{2 \text{ mol C}_2\text{H}_6} \left| \frac{22.4 \text{ L CO}_2}{1 \text{ mol CO}_2} \right| = 18.4 \text{ L CO}_2$$

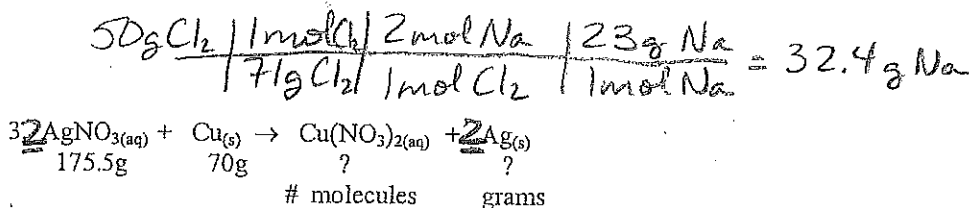
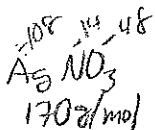
$$\text{L.R. } 38.9 \text{ g O}_2 \left| \frac{1 \text{ mol O}_2}{32 \text{ g O}_2} \right| \frac{4 \text{ mol CO}_2}{7 \text{ mol O}_2} \left| \frac{22.4 \text{ L CO}_2}{1 \text{ mol CO}_2} \right| = 15.6 \text{ L CO}_2$$

$$12.5 - 10.4 = 2.1 \text{ g C}_2\text{H}_6 \text{ excess}$$



$$50 \text{ g Na} \left| \frac{1 \text{ mol Na}}{23 \text{ g Na}} \right| \frac{2 \text{ mol NaCl}}{1 \text{ mol Na}} = 4.35 \text{ mol NaCl}$$

$$\text{L.R. } 50 \text{ g Cl}_2 \left| \frac{1 \text{ mol Cl}_2}{71 \text{ g Cl}_2} \right| \frac{2 \text{ mol NaCl}}{1 \text{ mol Cl}_2} = 1.41 \text{ mol NaCl}$$



$$50 \text{ g Cl}_2 \left| \frac{1 \text{ mol Cl}_2}{71 \text{ g Cl}_2} \right| \frac{2 \text{ mol Na}}{1 \text{ mol Cl}_2} \left| \frac{23 \text{ g Na}}{1 \text{ mol Na}} \right| = 32.4 \text{ g Na}$$

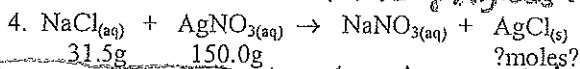
$$50 \text{ g} - 32.4 \text{ g} = 17.6 \text{ g Na excess}$$

$$\text{L.R. } 175.5 \text{ g AgNO}_3 \left| \frac{1 \text{ mol AgNO}_3}{170 \text{ g AgNO}_3} \right| \frac{2 \text{ mol Ag}}{2 \text{ mol AgNO}_3} \left| \frac{108 \text{ g Ag}}{1 \text{ mol Ag}} \right| = 111.5 \text{ g Ag}$$

$$70 \text{ g Cu} \left| \frac{1 \text{ mol Cu}}{63.5 \text{ g Cu}} \right| \frac{2 \text{ mol Ag}}{1 \text{ mol Cu}} \left| \frac{108 \text{ g Ag}}{1 \text{ mol Ag}} \right| = 238.1 \text{ g Ag}$$

$$175.5 \text{ g AgNO}_3 \left| \frac{1 \text{ mol AgNO}_3}{170 \text{ g AgNO}_3} \right| \frac{1 \text{ mol Cu}}{2 \text{ mol AgNO}_3} \left| \frac{63.5 \text{ g Cu}}{1 \text{ mol Cu}} \right| = 32.7 \text{ g Cu}$$

$$175.5 \text{ g AgNO}_3 \left| \frac{1 \text{ mol AgNO}_3}{170 \text{ g AgNO}_3} \right| \frac{1 \text{ mol Cu}(\text{NO}_3)_2}{2 \text{ mol AgNO}_3} \left| \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol Cu}(\text{NO}_3)_2} \right| = 3.10 \times 10^{23} \text{ Cu}(\text{NO}_3)_2 \text{ molecules}$$



$$\text{L.R. } 31.5 \text{ g NaCl} \left| \frac{1 \text{ mol NaCl}}{58.5 \text{ g NaCl}} \right| \frac{1 \text{ mol AgCl}}{1 \text{ mol NaCl}} = 0.54 \text{ mol AgCl}$$

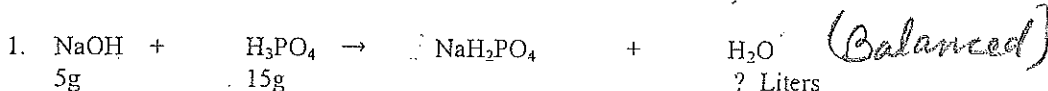
$$150.0 \text{ g AgNO}_3 \left| \frac{1 \text{ mol AgNO}_3}{170 \text{ g AgNO}_3} \right| \frac{1 \text{ mol AgCl}}{1 \text{ mol AgNO}_3} = 0.88 \text{ mol AgCl}$$

$$70 \text{ g Cu} - 32.7 \text{ g} = 37.3 \text{ g Cu excess}$$

NAME
STOICHIOMETRY
Mass, Limiting and Excess #2

IN THE FOLLOWING PROBLEMS DETERMINE THE FOLLOWING:

- BALANCE REACTION
- ANSWER "?" IN CORRECT UNITS
- DETERMINE LIMITING REAGENTS
- DETERMINE AMOUNT OF EXCESS IN GRAMS

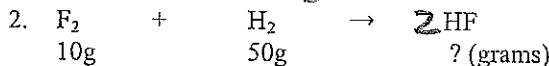


LR. $\frac{5\text{g NaOH}}{40\text{g NaOH}} \times \frac{1\text{mol NaOH}}{1\text{mol NaOH}} \times \frac{1\text{mol H}_2\text{O}}{1\text{mol H}_2\text{O}} \times \frac{22.4\text{L H}_2\text{O}}{1\text{mol H}_2\text{O}} = 2.8\text{L H}_2\text{O}$

$\frac{15\text{g H}_3\text{PO}_4}{98\text{g H}_3\text{PO}_4} \times \frac{1\text{mol H}_3\text{PO}_4}{1\text{mol H}_3\text{PO}_4} \times \frac{1\text{mol H}_2\text{O}}{1\text{mol H}_3\text{PO}_4} \times \frac{22.4\text{L H}_2\text{O}}{1\text{mol H}_2\text{O}} = 3.4\text{L H}_2\text{O}$

$\frac{5\text{g NaOH}}{40\text{g NaOH}} \times \frac{1\text{mol NaOH}}{1\text{mol NaOH}} \times \frac{1\text{mol H}_3\text{PO}_4}{1\text{mol NaOH}} \times \frac{98\text{g H}_3\text{PO}_4}{1\text{mol H}_3\text{PO}_4} = 12.25\text{g H}_3\text{PO}_4$

15g
12.25g
2.75g excess H_3PO_4

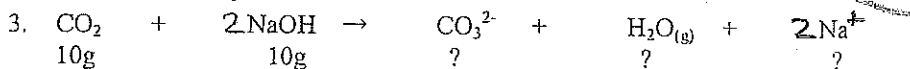


LR. $\frac{10\text{g F}_2}{38\text{g F}_2} \times \frac{1\text{mol F}_2}{1\text{mol F}_2} \times \frac{2\text{mol HF}}{1\text{mol F}_2} \times \frac{20\text{g HF}}{1\text{mol HF}} = 10.5\text{g HF}$

$\frac{50\text{g H}_2}{2\text{g H}_2} \times \frac{1\text{mol H}_2}{1\text{mol H}_2} \times \frac{2\text{mol HF}}{1\text{mol H}_2} \times \frac{20\text{g HF}}{1\text{mol HF}} = 1000\text{g HF}$

$\frac{10\text{g F}_2}{38\text{g F}_2} \times \frac{1\text{mol F}_2}{1\text{mol F}_2} \times \frac{1\text{mol H}_2}{1\text{mol F}_2} \times \frac{2\text{g H}_2}{1\text{mol H}_2} = 0.52\text{g H}_2$

50g
- 0.52g
49.5g H_2 excess



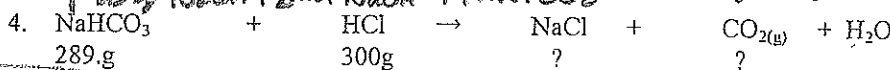
$\frac{10\text{g CO}_2}{44\text{g CO}_2} \times \frac{1\text{mol CO}_2}{1\text{mol CO}_2} \times \frac{1\text{mol H}_2\text{O}}{1\text{mol CO}_2} \times \frac{22.4\text{L}}{1\text{mol H}_2\text{O}} = 5.1\text{L H}_2\text{O}$

LR. $\frac{10\text{g NaOH}}{40\text{g NaOH}} \times \frac{1\text{mol NaOH}}{1\text{mol NaOH}} \times \frac{1\text{mol H}_2\text{O}}{2\text{mol NaOH}} \times \frac{22.4\text{L H}_2\text{O}}{1\text{mol H}_2\text{O}} = 2.8\text{L H}_2\text{O}$

$\frac{10\text{g NaOH}}{40\text{g NaOH}} \times \frac{1\text{mol NaOH}}{1\text{mol NaOH}} \times \frac{2\text{mol Na}^+}{1\text{mol NaOH}} \times \frac{6.02 \times 10^{23} \text{Na}^+}{1\text{mol Na}^+} = 1.51 \times 10^{23} \text{Na}^+$

$\frac{10\text{g NaOH}}{40\text{g NaOH}} \times \frac{1\text{mol NaOH}}{1\text{mol NaOH}} \times \frac{1\text{mol CO}_3^{2-}}{2\text{mol NaOH}} \times \frac{44\text{g CO}_3^{2-}}{1\text{mol CO}_3^{2-}} = 5.5\text{g CO}_3^{2-}$

10g
5.5g
4.5g excess CO_2



LR. $\frac{289\text{g NaHCO}_3}{84\text{g NaHCO}_3} \times \frac{1\text{mol NaHCO}_3}{1\text{mol NaHCO}_3} \times \frac{1\text{mol NaCl}}{1\text{mol NaHCO}_3} \times \frac{58.5\text{g NaCl}}{1\text{mol NaCl}} = 201\text{g NaCl}$

$\frac{300\text{g HCl}}{36.5\text{g HCl}} \times \frac{1\text{mol HCl}}{1\text{mol HCl}} \times \frac{1\text{mol NaCl}}{1\text{mol HCl}} \times \frac{58.5\text{g NaCl}}{1\text{mol NaCl}} = 481\text{g NaCl}$

$\frac{289\text{g NaHCO}_3}{84\text{g NaHCO}_3} \times \frac{1\text{mol NaHCO}_3}{1\text{mol NaHCO}_3} \times \frac{1\text{mol CO}_2}{1\text{mol NaHCO}_3} \times \frac{22.4\text{L CO}_2}{1\text{mol CO}_2} = 77.1\text{L CO}_2$

$\frac{289\text{g NaHCO}_3}{84\text{g NaHCO}_3} \times \frac{1\text{mol NaHCO}_3}{1\text{mol NaHCO}_3} \times \frac{1\text{mol HCl}}{1\text{mol NaHCO}_3} \times \frac{36.5\text{g HCl}}{1\text{mol HCl}} = 126\text{g HCl}$

300g
126g
174g
HCl excess