

Name: KEY

Chem 121
Test 2, Spring 2009
Version A

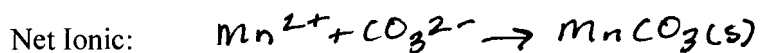
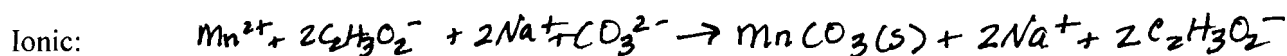
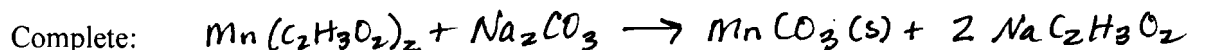
You have 75 minutes to complete this 100 point test. You may use a scientific calculator.

Part 1: Fill-in the Blank (10 pts) Fill-in the blank with the best answer.

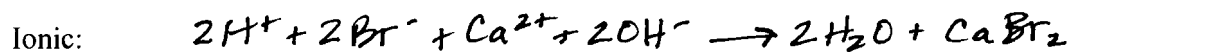
1. Stoichiometry is the study of mass relationships in a chemical compound and also the study of the mass of reactants and products in a balanced chemical reaction.
2. If the theoretical yield of a reaction is 29.3g and the actual yield is 18.5g, the percent yield is 63.1%. $\frac{18.5g}{29.3g} \times 100 =$
3. The numbers used to balance a chemical reaction are referred to as coefficients.
4. The limiting reactant determines the amount of product formed in a reaction.
5. A precipitate is a solid that separates from solution or forms during a reaction.

Part 2: Reactions and Calculations (100 pts) Clearly show all work for credit.

1. (15 pts) Write the complete, ionic and net ionic equations for the reaction of $Mn(C_2H_3O_2)_2$ with Na_2CO_3



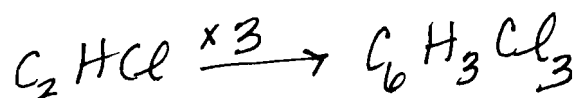
2. (15 pts) Write the complete, ionic and net ionic equations for the reaction of HBr with $Ca(OH)_2$.



3. (5 pts) Trichlorobenzene is an organic solvent. It has an empirical formula of C_2HCl . What is the molecular formula of trichlorobenzene if its molar mass is 181.44 g/mol?

$$\begin{aligned} 2C &= 2(12.01g/mol) \\ 1H &= 1(1.008g/mol) \\ 1Cl &= 1(35.45g/mol) \\ \hline &60.48g/mol \end{aligned}$$

$$\frac{181.44g/mol}{60.48g/mol} = 3$$



4. (15 pts) Nicotine, found in tobacco, is 74.03% C, 8.70% H and 17.27% N. What is the empirical formula of nicotine?

Assume 100. g

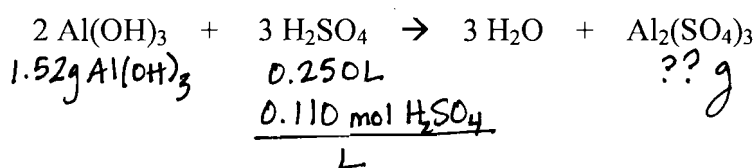
$$74.03 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} = 6.164 \text{ mol C}$$

$$8.70 \text{ g H} \times \frac{1 \text{ mol H}}{1.008 \text{ g H}} = 8.63 \text{ mol H}$$

$$17.27 \text{ g N} \times \frac{1 \text{ mol N}}{14.01 \text{ g N}} = 1.233 \text{ mol N}$$

$$\text{C}_{\frac{6.164}{1.233}} \text{H}_{\frac{8.63}{1.233}} \text{N}_{\frac{1.233}{1.233}} = \boxed{\text{C}_5 \text{H}_7 \text{N}}$$

5. (15 pts) Aluminum hydroxide reacts with sulfuric acid to form water and aluminum sulfate. What mass of aluminum sulfate is formed if 1.52 g of $\text{Al}(\text{OH})_3$ is allowed to react with 0.250 L of 0.110 M H_2SO_4 ? (MM of $\text{Al}(\text{OH})_3 = 78.00 \text{ g/mol}$, MM of $\text{Al}_2(\text{SO}_4)_3 = 342.14 \text{ g/mol}$)



$$1.52 \text{ g Al}(\text{OH})_3 \times \frac{1 \text{ mol Al}(\text{OH})_3}{78.00 \text{ g Al}(\text{OH})_3} \times \frac{1 \text{ mol Al}_2(\text{SO}_4)_3}{2 \text{ mol Al}(\text{OH})_3} \times \frac{342.14 \text{ g Al}_2(\text{SO}_4)_3}{1 \text{ mol Al}_2(\text{SO}_4)_3} = 3.33 \text{ g Al}_2(\text{SO}_4)_3$$

$$0.250 \text{ L} \times \frac{0.110 \text{ mol H}_2\text{SO}_4}{\text{L}} \times \frac{1 \text{ mol Al}_2(\text{SO}_4)_3}{3 \text{ mol H}_2\text{SO}_4} \times \frac{342.14 \text{ g Al}_2(\text{SO}_4)_3}{1 \text{ mol Al}_2(\text{SO}_4)_3}$$

$$= \boxed{3.14 \text{ g Al}_2(\text{SO}_4)_3}$$

6. (20 pts) One of the newest sweeteners on the market is Splenda. This sweetener contains sucralose, $C_{12}H_{19}Cl_3O_8$.

a. What is the molar mass of sucralose?

$$\begin{array}{r}
 12 \text{ C} \quad 12(12.01 \text{ g/mol}) = 144.1 \text{ g/mol} \\
 19 \text{ H} \quad 19(1.008 \text{ g/mol}) = 19.15 \text{ g/mol} \\
 3 \text{ Cl} \quad 3(35.45 \text{ g/mol}) = 106.4 \text{ g/mol} \\
 8 \text{ O} \quad 8(16.00 \text{ g/mol}) = 128.0 \text{ g/mol} \\
 \hline
 397.7 \text{ g/mol}
 \end{array}$$

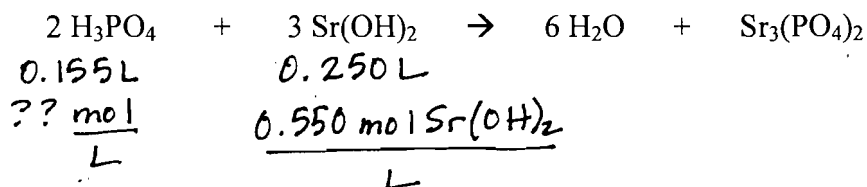
b. What mass of sucralose must be dissolved in 250. mL of water to make a 0.100 M sucralose solution?

$$250. \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{0.100 \text{ mol}}{\text{L}} \times \frac{397.7 \text{ g}}{\text{mol}} = 9.94 \text{ g}$$

c. How many molecules of sucralose are there in the mass calculated in 1b?

$$9.94 \text{ g} \times \frac{1 \text{ mol}}{397.7 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} = 1.50 \times 10^{22} \text{ molecules}$$

7. (10 pts) The titration of a 0.155 L sample of a H_3PO_4 solution of unknown concentration requires 0.250 L of 0.550 M $Sr(OH)_2$ solution to reach the end point. What is the concentration of the unknown H_3PO_4 ?



$$0.250 \text{ L} \times \frac{0.550 \text{ mol Sr(OH)}_2}{\text{L}} \times \frac{2 \text{ mol H}_3\text{PO}_4}{3 \text{ mol Sr(OH)}_2} = 0.0917 \text{ mol H}_3\text{PO}_4$$

$$\frac{0.0917 \text{ mol H}_3\text{PO}_4}{0.155 \text{ L}} = 0.592 \text{ M H}_3\text{PO}_4$$

8. (5pts) What volume of 0.400 M MgSO₄ is needed to make 250.0 mL of 0.125 M MgSO₄?

$$V_{dil} M_{dil} = V_{con} M_{con}$$

$$(250.0 \text{ mL})(0.125 \text{ M}) = V_{con} (0.400 \text{ M})$$

$$V_{con} = 78.1 \text{ mL}$$

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|--------|-------|-------|-------|--------|--------|--------|--|--|--|--|--|--|--|--|--------|--|
| | IA | | | | | | | | | | | | | | | | | | | | | | | | | | VIII A | |
| 1 | 1 | | | | | | | | | | | | | | | 2 | | | | | | | | | | | 2 | |
| | H | | | | | | | | | | | | | | | He | | | | | | | | | | | | |
| | 1.008 | | | | | | | | | | | | | | | 4.00 | | | | | | | | | | | | |
| 2 | 3 | 4 | | | | | | | | | | | 5 | 6 | 7 | 8 | 9 | 10 | | | | | | | | | | |
| | Li | Be | | | | | | | | | | | B | C | N | O | F | Ne | | | | | | | | | | |
| | 6.94 | 9.01 | | | | | | | | | | | 10.81 | 12.01 | 14.01 | 16.00 | 19.00 | 20.18 | | | | | | | | | | |
| 3 | 11 | 12 | | | | | | | | | | | 13 | 14 | 15 | 16 | 17 | 18 | | | | | | | | | | |
| | Na | Mg | | | | | | | | | | | Al | Si | P | S | Cl | Ar | | | | | | | | | | |
| | 22.99 | 24.31 | | | | | | | | | | | 26.98 | 28.09 | 30.97 | 32.06 | 35.45 | 39.95 | | | | | | | | | | |
| 4 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | | | | | | | | | | |
| | K | Ca | Sc | Ti | V | Cr | Mn | Fe | Co | Ni | Cu | Zn | Ga | Ge | As | Se | Br | Kr | | | | | | | | | | |
| | 39.10 | 40.08 | 44.96 | 47.90 | 50.94 | 52.00 | 54.94 | 55.85 | 58.93 | 58.71 | 63.55 | 65.37 | 69.72 | 72.59 | 74.92 | 78.96 | 79.90 | 83.80 | | | | | | | | | | |
| 5 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | | | | | | | | | | |
| | Rb | Sr | Y | Zr | Nb | Mo | Tc | Ru | Rh | Pd | Ag | Cd | In | Sn | Sb | Te | I | Xe | | | | | | | | | | |
| | 85.47 | 87.62 | 88.91 | 91.22 | 92.91 | 95.94 | [98] | 101.1 | 102.9 | 106.4 | 107.9 | 112.40 | 114.8 | 118.7 | 121.8 | 127.60 | 126.90 | 131.30 | | | | | | | | | | |
| 6 | 55 | 56 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | | | | | | | | | | |
| | Cs | Ba | Lu | Hf | Ta | W | Re | Os | Ir | Pt | Au | Hg | Tl | Pb | Bi | Po | At | Rn | | | | | | | | | | |
| | 132.9 | 137.3 | 175 | 178.5 | 181 | 183.9 | 186.2 | 190.2 | 192.2 | 195.1 | 197 | 200.59 | 204.4 | 207.2 | 209 | [209] | [210] | [222] | | | | | | | | | | |
| 7 | 87 | 88 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | | 118 | | | | | | | | | | |
| | Fr | Ra | Lr | Rf | Db | Sg | Bh | Hs | Mt | Ds | Rg | Uub | Uut | Uuq | Uup | Uuh | | Uuo | | | | | | | | | | |
| | [223] | [226] | [262] | [267] | [268] | [271] | [272] | [270] | [276] | [281] | [280] | [285] | [284] | [289] | [288] | [293] | | [294] | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | | | | | | | | | | | | | | |
| | La | Ce | Pr | Nd | Pm | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | | | | | | | | | | | | | | |
| | 138.9 | 140.1 | 140.9 | 144.2 | [145] | 150.4 | 152 | 157.3 | 158.9 | 162.5 | 164.93 | 167.3 | 168.9 | 173 | | | | | | | | | | | | | | |
| | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | | | | | | | | | | | | | | |
| | Ac | Th | Pa | U | Np | Pu | Am | Cm | Bk | Cf | Es | Fm | Md | No | | | | | | | | | | | | | | |
| | [227] | 232 | [231] | 238 | [237] | [244] | [243] | [247] | [247] | [251] | [252] | [257] | [258] | [259] | | | | | | | | | | | | | | |