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

Complete: $Mn(C_2H_3O_2)_2 + Na_2CO_3 \rightarrow MnCO_3(s) + 2\,NaC_2H_3O_2$

Ionic: $Mn^{2+} + 2C_2H_3O_2^- + 2Na^+ + CO_3^{2-} \rightarrow MnCO_3(s) + 2Na^+ + 2C_2H_3O_2^-$

Net Ionic: $Mn^{2+} + CO_3^{2-} \rightarrow MnCO_3(s)$

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

Complete: $2HBr + Ca(OH)_2 \rightarrow 2H_2O + CaBr_2$

Ionic: $2H^+ + 2Br^- + Ca^{2+} + 2OH^- \rightarrow 2H_2O + CaBr_2$

Net Ionic: $H^+ + OH^- \rightarrow H_2O$

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?

$2\,C = 2(12.01\,g/mol)$
$1\,H = 1(1.008\,g/mol)$
$1\,Cl = 1(35.45\,g/mol)$
$60.48\,g/mol$

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

$C_2HCl \xrightarrow{\times 3} C_6H_3Cl_3$

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

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

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

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

$$C_{\frac{6.164}{1.233}} H_{\frac{8.63}{1.233}} N_{\frac{1.233}{1.233}} = \boxed{C_5H_7N}$$

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 $Al(OH)_3$ is allowed to react with 0.250 L of 0.110 M H_2SO_4? (MM of $Al(OH)_3$ = 78.00 g/mol, MM of $Al_2(SO_4)_3$ = 342.14 g/mol)

$$\underset{1.52\text{g Al(OH)}_3}{2\,Al(OH)_3} + \underset{\substack{0.250\text{L} \\ 0.110\text{ mol H}_2\text{SO}_4 \\ \text{L}}}{3\,H_2SO_4} \rightarrow 3\,H_2O + \underset{??\text{ g}}{Al_2(SO_4)_3}$$

$$1.52\text{g Al(OH)}_3 \times \frac{1\text{ mol Al(OH)}_3}{78.00\text{g Al(OH)}_3} \times \frac{1\text{mol Al}_2(SO_4)_3}{2\text{ mol Al(OH)}_3} \times \frac{342.14\text{g Al}_2(SO_4)_3}{1\text{ mol Al}_2(SO_4)_3}$$

$$= 3.33\text{ g Al}_2(SO_4)_3$$

$$0.250\text{L} \times \frac{0.110\text{ mol H}_2SO_4}{\text{L}} \times \frac{1\text{mol Al}_2(SO_4)_3}{3\text{ mol H}_2SO_4} \times \frac{342.14\text{g Al}_2(SO_4)_3}{1\text{ mol Al}_2(SO_4)_3}$$

$$= \boxed{3.14\text{ g Al}_2(SO_4)_3}$$

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?

12 C $12(12.019\ g/mol) = 144.19\ g/mol$
19 H $19(1.0089\ g/mol) = 19.159\ g/mol$
3 Cl $3(35.459\ g/mol) = 106.4\ g/mol$
8 O $8(16.009\ g/mol) = 128.09\ g/mol$

$397.7\ g/mol$

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

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

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

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

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

$$2\ H_3PO_4 + 3\ Sr(OH)_2 \rightarrow 6\ H_2O + Sr_3(PO_4)_2$$

0.155 L 0.250 L
?? mol/L 0.550 mol $Sr(OH)_2$/L

$$0.250\ L \times \frac{0.550\ mol\ Sr(OH)_2}{L} \times \frac{2\ mol\ H_3PO_4}{3\ mol\ Sr(OH)_2} = 0.0917\ mol\ H_3PO_4$$

$$\frac{0.0917\ mol\ H_3PO_4}{0.155\ L} = 0.592\ M\ H_3PO_4$$

8. (5pts) What volume of 0.400 M $MgSO_4$ is needed to make 250.0 mL of 0.125 M $MgSO_4$?

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

$$(250.0\,mL)(0.125\,M) = V_{conc}(0.400\,M)$$

$$V_{conc} = 78.1\,mL$$

	IA												IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1 H 1.008	IIA																2 He 4.00
2	3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.31	IIIB	IVB	VB	VIB	VIIB	VIIIB			IB	IIB	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.71	29 Cu 63.55	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc [98]	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.40	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.60	53 I 126.90	54 Xe 131.30
6	55 Cs 132.9	56 Ba 137.3	71 Lu 175	72 Hf 178.5	73 Ta 181	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197	80 Hg 200.59	81 Tl 204.4	82 Pb 207.2	83 Bi 209	84 Po [209]	85 At [210]	86 Rn [222]
7	87 Fr [223]	88 Ra [226]	103 Lr [262]	104 Rf [267]	105 Db [268]	106 Sg [271]	107 Bh [272]	108 Hs [270]	109 Mt [276]	110 Ds [281]	111 Rg [280]	112 Uub [285]	113 Uut [284]	114 Uuq [289]	115 Uup [288]	116 Uuh [293]		118 Uuo [294]

57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm [145]	62 Sm 150.4	63 Eu 152	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.93	68 Er 167.3	69 Tm 168.9	70 Yb 173
89 Ac [227]	90 Th 232	91 Pa [231]	92 U 238	93 Np [237]	94 Pu [244]	95 Am [243]	96 Cm [247]	97 Bk [247]	98 Cf [251]	99 Es [252]	100 Fm [257]	101 Md [258]	102 No [259]