KEY

Chemistry 121
Test 2
Spring 2007

You have 75 minutes to complete this 100 point test. Please mark each answer clearly and show all work. You may use a simple scientific calculator. NO GAPHING CALCULATORS.

I. (10 pts) Multiple Choice: Circle the best answer

1. How many moles of aluminum atoms are there in 1.0 mol of aluminum oxide?
   a. 1.0 mol Al
   B (b.) 2.0 mol Al
   c. 3.0 mol Al
   d. 4.0 mol Al

   Al_2O_3

2. What is the empirical formula of ethylene glycol, $HOCH_2CH_2OH$?
   a. CHO
   b. $C_2H_6O_2$
   C (c.) CH_3O
   d. None of the above

   $C_2H_6O_2$

   CH_3O

3. What precipitate will be formed by the reaction of barium nitrate with sodium sulfate?
   a. Na_2SO_4
   b. $NaNO_3$
   D c. $Ba(NO_3)_2$
   (d.) $BaSO_4$

4. Which one of the following is the correct dissociation equation for ammonium carbonate in water?
   a. $(NH_4)_2CO_3 \rightarrow 6\ N + 8\ H + C + 3\ O$
   b. $(NH_4)_2CO_3 \rightarrow NH_4^+ + 2\ CO_3^{2-}$
   C (c.) $(NH_4)_2CO_3 \rightarrow 2\ NH_4^+ + CO_3^{2-}$
   d. $(NH_4)_2CO_3 \rightarrow (NH_4^+)_2 + CO_3^{2-}$

5. Which of the following statements is correct?
   a. In a balanced equation, molecules are balanced.
   B (b.) In a supersaturated solution, the solute is dissolved at high temperature and then cooled.
   c. Weak acids are strong electrolytes.
   d. None of the above

II. Short Answer and Balanced Equations: Clearly show all work for full credit.

1. (10 pts) Balance the following equations
   a. $1\ Ag_2SO_4 + 1\ ZnCl_2 \rightarrow 1\ ZnSO_4 + 2\ AgCl$
   b. $2\ KI + 1\ Pb(NO_3)_2 \rightarrow 2\ KNO_3 + 1\ PbI_2$
   c. $3\ TiCl_4 + 4\ Na_3PO_4 \rightarrow 1\ Ti_3(PO_4)_4 + 12\ NaCl$
   d. $1\ Cu + 2\ HCl \rightarrow 1\ CuCl_2 + 1\ H_2$
   e. $1\ Cr(NO_3)_6 + 3\ K_2CO_3 \rightarrow 1\ Cr(CO_3)_3 + 6\ KNO_3$

2. (10 pts) Indicate whether the following ionic compounds are soluble (S) or insoluble (IS) in water.
   a. $NaNO_3$ S
   b. $CaSO_4$ IS
   c. $PbBr_2$ IS
   d. $Ti(OH)_2$ IS
   e. K_2CO_3 S

3. (15 pts) Write the complete, ionic and net ionic equations for the reaction of sodium oxalate with iron(III) chloride. Make sure that you indicate the precipitate with the correct symbol.

Total: $3Na_2C_2O_4 + 2FeCl_3 \rightarrow Fe_2(C_2O_4)_3(s) + 6NaCl$

Ionic: $6Na^+ + 3C_2O_4^{2-} + 2Fe^{3+} + 6Cl^- \rightarrow Fe_2(C_2O_4)_3(s) + 6Na^+ + 6Cl^-$

Net Ionic: $3C_2O_4^{2-} + 2Fe^{3+} \rightarrow Fe_2(C_2O_4)_3(s)$

4. (5 pts) Write the complete balanced equation (just the complete) for the reaction of HNO_3 with $Ba(OH)_2$.

$$2HNO_3 + Ba(OH)_2 \rightarrow 2H_2O + Ba(NO_3)_2$$

III. Calculations: Make sure you show all work for full credit.

1. (10 pts) Calculate the molar mass of manganese (II) nitrate tetrahydrate.

$Mn(NO_3)_2 \cdot 4H_2O$

1 Mn	54.94	
2 N	2(14.01) = 28.02	+ = 251.0 g/mol
10 O	10(16.00) = 160.0	
8 H	8(1.008) = 8.064	

2. (5pts) What is the mass (in grams) of 2.54×10^{23} molecules of chloroform, $CHCl_3$? (MM of $CHCl_3$ = 119.37 g/mol)

$$2.54 \times 10^{23}\ \text{molecules}\ CHCl_3 \times \frac{1\ \text{mol}\ CHCl_3}{6.02 \times 10^{23}\ \text{molecules}} \times \frac{119.37\ \text{g}\ CHCl_3}{1\ \text{mol}\ CHCl_3} = 50.4\ \text{g}\ CHCl_3$$

3. (5 pts) How many grams of solute are needed to make 25.0 mL of 0.525 M NaOH? (MM of NaOH = 40.00 g/mol)

$$25.0\ \text{mL} \times \frac{1\ \text{L}}{1000\ \text{mL}} \times \frac{0.525\ \text{mol}\ NaOH}{1\ \text{L}} \times \frac{40.00\ \text{g}\ NaOH}{1\ \text{mol}\ NaOH} = 0.525\ \text{g}\ NaOH$$

4. (15 pts) Indigo, the dye for blue jeans is composed of carbon, hydrogen, nitrogen and oxygen. It has percent composition by mass of 73.27% C, 3.84% H, 10.68% N and the remainder is oxygen. The molar mass of indigo is 262.3 g/mol. What are the empirical formula and the molecular formula of indigo?

Assume 100 g - 73.27 - 3.84 - 10.68 = 12.21 g O

$73.27\text{ g C} \times \frac{1\text{ mol C}}{12.01\text{ g C}} = 6.101\text{ mol C}$

$10.68\text{ g N} \times \frac{1\text{ mol N}}{14.01\text{ g N}} = 0.7623\text{ mol N}$

$3.84\text{ g H} \times \frac{1\text{ mol H}}{1.008\text{ g H}} = 3.810\text{ mol H}$

$12.21\text{ g O} \times \frac{1\text{ mol O}}{16.00\text{ g O}} = 0.7631\text{ mol O}$

$\frac{C_{6.101}}{0.7623}\frac{H_{3.810}}{0.7623}\frac{N_{0.7623}}{0.7623}\frac{O_{0.7631}}{0.7623} =$ **C_8H_5NO Empirical Formula**

$8(12.01) + 5(1.008) + 14.01 + 16.00 = 131.13\text{ g/mol}$

$\frac{\text{MM of MF}}{\text{MM of EF}} = \frac{262.3}{131.13} = 2$

$C_{16}H_{10}N_2O_2$ Molecular Formula

5. (15 pts) Below is a side reaction in the manufacture of rayon. How many grams of Na_2CS_3 are produced in the reaction of 121 g of CS_2 and 1.50 L of 1.85 M NaOH? (MM of CS_2 = 76.13 g/mol, MM of Na_2CS_3 = 154.17 g/mol)

$$3\ CS_2 + 6\ NaOH \rightarrow 2\ Na_2CS_3 + Na_2CO_3 + 3\ H_2O$$

121 g | 1.50 L, 1.85 mol/L | ?? g

$121\text{ g } CS_2 \times \frac{1\text{ mol } CS_2}{76.13\text{ g } CS_2} \times \frac{2\text{ mol } Na_2CS_3}{3\text{ mol } CS_2} \times \frac{154.17\text{ g } Na_2CS_3}{1\text{ mol } Na_2CS_3} = 163\text{ g } Na_2CS_3$

$1.50\text{ L} \times \frac{1.85\text{ mol NaOH}}{1\text{ L}} \times \frac{2\text{ mol } Na_2CS_3}{6\text{ mol NaOH}} \times \frac{154.17\text{ g } Na_2CS_3}{1\text{ mol } Na_2CS_3} =$ **$143\text{ g } Na_2CS_3$**

6. (10 pts) How many milliliters of 2.155 M KOH are required to titrate 25.00 mL of 0.3057 M H_2SO_4?

$$2\,KOH + H_2SO_4 \rightarrow K_2SO_4 + 2\,H_2O$$

?? mL 25.00 mL

$\frac{0.2155\ mol}{L}$ $\frac{0.3057\ mol}{L}$

$$25.00\ mL \times \frac{1\ L}{1000\ mL} \times \frac{0.3057\ mol\ H_2SO_4}{1\ L} \times \frac{2\ mol\ KOH}{1\ mol\ H_2SO_4} \times \frac{1\ L}{0.2155\ mol\ KOH} \times \frac{1000\ mL}{1\ L}$$

$$= 70.93\ mL\ KOH$$

	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 [261]	105 [262]	106 [263]												

	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]