Solution Key

Chem 121
Test 2
Version A

You have 50 minutes to complete this 100 point test. Show all work for full credit. You may use a non-graphing, scientific calculator.

1. (5 pts) Identify each compound below as soluble (S) or insoluble (IS). (circle one)

a.	$BaCl_2$	(S)	or	IS
b.	Na_2SO_4	(S)	or	IS
c.	Cu_2CO_3	S	or	(IS)
d.	$Cr(NO_3)_3$	(S)	or	IS
e.	$BaSO_4$	S	or	(IS)

2. (5 pts) Identify each compound below as a strong acid (SA), a weak acid (WA), a strong base (SB) or a weak base (WB). (circle one)

a.	HCl	(SA)	WA	SB	WB
b.	$Ca(OH)_2$	SA	WA	(SB)	WB
c.	NH_3	SA	WA	SB	(WB)
d.	$HC_2H_3O_2$	SA	(WA)	SB	WB
e.	H_3PO_4	SA	(WA)	SB	WB

3. (15 pts) Write the complete, ionic and net ionic balanced equations for the reaction of iron(III) acetate with sodium carbonate. Don't forget to indicate the precipitate.

Complete: $2\,Fe(C_2H_3O_2)_3 + 3\,Na_2CO_3 \rightarrow Fe_2(CO_3)_3(s) + 6\,NaC_2H_3O_2$

Ionic: $2\,Fe^{3+} + 6\,C_2H_3O_2^- + 6\,Na^+ + 3\,CO_3^{2-} \rightarrow Fe_2(CO_3)_3(s) + 6\,Na^+ + 6\,C_2H_3O_2^-$

Net Ionic: $2\,Fe^{3+} + 3\,CO_3^{2-} \rightarrow Fe_2(CO_3)_3(s)$

4. (10 pts) What is the molecular formula of a compound whose molar mass is 90.08 g/mol and whose empirical formula is CH_2O?

CH_2O $\quad MM = 12.01 + 2(1.008) + 16.00 = 30.039\ g/mol$

$$\frac{MM\ of\ MF}{MM\ of\ EF} = \frac{90.08}{30.03} = 3$$

$\boxed{C_3H_6O_3}$

5. (10 pts) Calculate the molar mass of cobalt(II) nitrate hexahydrate.

$Co(NO_3)_2 \cdot 6H_2O$

1 Co = 58.93
2 N = 2(14.01) = 28.02
6 O = 6(16.00) = 96.00
12 H = 12(1.008) = 12.096
6 O = 6(16.00) = 96.00
291.05 g/mol

6. (10 pts) How many atoms of carbon are there in 15.0g C_6H_6? (MM of C_6H_6 = 78.11 g/mol)

$$15.0\,g\,C_6H_6 \times \frac{1\,mol\,C_6H_6}{78.11\,g\,C_6H_6} \times \frac{6\,mol\,C}{1\,mol\,C_6H_6} \times \frac{6.02\times10^{23}\,atoms}{1\,mol\,C} = 6.94\times10^{23}\,atoms\,C$$

7. (10 pts) Calculate the molar concentration of a solution made by dissolving 2.50 g NaCl in 350.0 mL of water. Assume the volume of the final solution is the volume of the water. (MM of NaCl = 58.44 g/mol)

$$\frac{2.50\,g\,NaCl}{350.0\,mL} \times \frac{1\,mol\,NaCl}{58.44\,g\,NaCl} \times \frac{1000\,mL}{1\,L}$$

$= 0.122\,M\,NaCl$

8. (15 pts) It has been found that the depletion of the ozone layer near Antarctica is caused by the reaction of ozone (O_3) with chlorine containing molecules in the presence of stratospheric ice. How many grams of O_3 will be depleted if 15.0L of 1.50M HCl is allowed to react with excess NO_2?(MM of O_3 = 48.00 g/mol)

$$HCl + 2O_3 + NO_2 \xrightarrow{ice} HNO_3 + 2O_2 + ClO$$

15.0L ?? g
1.50 mol/L

$$15.0\,L \times \frac{1.50\,mol\,HCl}{L} \times \frac{2\,mol\,O_3}{1\,mol\,HCl} \times \frac{48.00\,g\,O_3}{1\,mol\,O_3} = 2.16\times10^{3}\,g\,O_3$$

9. (5 pts) What volume (in mL) of 0.125 M K_2SO_4 is needed to make 250.0 mL of 0.0500 M K_2SO_4?

$V_c(0.125\,M\,K_2SO_4) = (250.0\,mL)(0.0500\,M\,K_2SO_4)$

$V_c = 100.\,mL$

10. (15 pts) One of the most important reactions in the body involves glucose. In aerobic metabolism, glucose reacts with oxygen to form carbon dioxide and water. How many moles of carbon dioxide are formed from the reaction of 12.0 g $C_6H_{12}O_6$ with 12.0 g O_2? (MM of $C_6H_{12}O_6$ = 180.16 g/mol, MM of O_2 = 32.00 g/mol)

$$C_6H_{12}O_6 + 6\,O_2 \rightarrow 6\,CO_2 + 6\,H_2O$$

12.0 g 12.0 g ?? mol CO_2

$$12.0\,g\,C_6H_{12}O_6 \times \frac{1\,mol\,C_6H_{12}O_6}{180.16\,g} \times \frac{6\,mol\,CO_2}{1\,mol\,C_6H_{12}O_6} = 0.400\,mol\,CO_2$$

$$12.0\,g\,O_2 \times \frac{1\,mol\,O_2}{32.00\,g\,O_2} \times \frac{6\,mol\,CO_2}{6\,mol\,O_2} = \boxed{0.375\,mol\,CO_2}$$

11. (10 pts) A 10.00 mL sample of phosphoric acid (H_3PO_4) was titrated with 25.86 mL of 0.750 M NaOH. Calculate the concentration of the phosphoric acid.

$$H_3PO_4 + 3\,NaOH \rightarrow 3\,H_2O + Na_3PO_4$$

10.00 mL 25.86 mL $\frac{0.750\,mol\,NaOH}{L}$

$$25.86\,mL \times \frac{1\,L}{1000\,mL} \times \frac{0.750\,mol\,NaOH}{L} \times \frac{1\,mol\,H_3PO_4}{3\,mol\,NaOH} = 6.47 \times 10^{-3}\,mol\,H_3PO_4$$

$$C_{H_3PO_4} = \frac{6.47 \times 10^{-3}\,mol}{10.00\,mL} \times \frac{1000\,mL}{L}$$

$$= \boxed{0.647\,M\,H_3PO_4}$$

Name: Solution Key

Chem 121
Test 2
Version B

You have 50 minutes to complete this 100 point test. Show all work for full credit. You may use a non-graphing, scientific calculator.

1. (5 pts) Identify each compound below as soluble (S) or insoluble (IS). (circle one)

a.	$CaSO_4$	S	or	(IS)
b.	K_3PO_4	(S)	or	IS
c.	$Zn(NO_3)_2$	(S)	or	IS
d.	$NiCO_3$	S	or	(IS)
e.	$MgCl_2$	(S)	or	IS

2. (5 pts) Identify each compound below as a strong acid (SA), a weak acid (WA), a strong base (SB) or a weak base (WB). (circle one)

a.	$Ba(OH)_2$	SA	WA	(SB)	WB
b.	H_2CO_3	SA	(WA)	SB	WB
c.	HNO_3	(SA)	WA	SB	WB
d.	HF	(SA)	WA	SB	WB
e.	NH_3	SA	WA	SB	(WB)

3. (15 pts) Write the complete, ionic and net ionic balanced equations for the reaction of chromium(III) sulfate with barium acetate. Don't forget to indicate the precipitate.

Complete: $Cr_2(SO_4)_3 + 3Ba(C_2H_3O_2)_2 \rightarrow 3BaSO_4(s) + 2Cr(C_2H_3O_2)_3$

Ionic: $2Cr^{3+} + 3SO_4^{2-} + 3Ba^{2+} + 6C_2H_3O_2^- \rightarrow 3BaSO_4(s) + 2Cr^{3+} + 6C_2H_3O_2^-$

Net Ionic: $3Ba^{2+} + 3SO_4^{2-} \rightarrow 3BaSO_4(s)$

OR $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4(s)$

4. (10 pts) What is the molecular formula of a compound whose molar mass is 90.08 g/mol and whose empirical formula is CH_2O?

MM of CH_2O = 12.01 + (2·1.008) + 16.00 = 30.039 g/mol

$$\frac{\text{MM of MF}}{\text{MM of EF}} = \frac{90.08}{30.03} = 3$$

$C_3H_6O_3$

5. (10 pts) Calculate the molar mass of nickel(II) nitrate pentahydrate.

$Ni(NO_3)_2 \cdot 5H_2O$

$1\,Ni = 58.71$
$2\,N = 2(14.01) = 28.02$
$6\,O = 6(16.00) = 96.00$
$10\,H = 10(1.008) = 10.08$
$5\,O = 5(16.00) = 80.00$

$272.81\ g/mol$

6. (10 pts) How many atoms of hydrogen are there in 15.0g C_6H_6? (MM of C_6H_6 = 78.11 g/mol)

$$15.0\,g\,C_6H_6 \times \frac{1\,mol\,C_6H_6}{78.11\,g\,C_6H_6} \times \frac{6\,mol\,H}{1\,mol\,C_6H_6} \times \frac{6.02\times10^{23}\,atoms\,H}{1\,mol\,H}$$

$$= 6.94\times10^{23}\,atoms\,H$$

7. (5 pts) What volume (in mL) of 0.125 M K_2SO_4 is needed to make 250.0 mL of 0.0500 M K_2SO_4?

$$V_c(0.125M\,K_2SO_4) = (250.0mL)(0.0500M\,K_2SO_4)$$

$$V_c = 100.mL$$

8. (15 pts) One of the most important reactions in the body involves glucose. In aerobic metabolism, glucose reacts with oxygen to form carbon dioxide and water. How many moles of carbon dioxide are formed from the reaction of 12.0 g $C_6H_{12}O_6$ with 12.0 g O_2? (MM of $C_6H_{12}O_6$ = 180.16 g/mol, MM of O_2 = 32.00 g/mol)

$$\underset{12.0g}{C_6H_{12}O_6} + \underset{12.0g}{6\,O_2} \rightarrow \underset{??mol}{6\,CO_2} + 6\,H_2O$$

$$12.0\,g\,C_6H_{12}O_6 \times \frac{1\,mol\,C_6H_{12}O_6}{180.16\,g} \times \frac{6\,mol\,CO_2}{1\,mol\,C_6H_{12}O_6} = 0.400\,mol\,CO_2$$

$$12.0\,g\,O_2 \times \frac{1\,mol\,O_2}{32.00\,g\,O_2} \times \frac{6\,mol\,CO_2}{6\,mol\,O_2} = \boxed{0.375\,mol\,O_2}$$

9. (15 pts) It has been found that the depletion of the ozone layer near Antarctica is caused by the reaction of ozone (O_3) with chlorine containing molecules in the presence of stratospheric ice. How many grams of O_3 will be depleted if 25.0L of 1.50M HCl is allowed to react with excess NO_2?(MM of O_3 = 48.00 g/mol)

$$\underset{\substack{25.0\,L \\ 1.50\,mol/L}}{HCl} + \underset{??\,g}{2\,O_3} + NO_2 \xrightarrow{ice} HNO_3 + 2\,O_2 + ClO$$

$$25.0\,L \times \frac{1.50\,mol\,HCl}{1\,L} \times \frac{2\,mol\,O_3}{1\,mol\,HCl} \times \frac{48.00\,g\,O_3}{1\,mol\,O_3}$$

$$= 3.60 \times 10^3\,g\,O_3$$

10. (10 pts) Calculate the molar concentration of a solution made by dissolving 2.50 g KCl in 250.0 mL of water. Assume the volume of the final solution is the volume of the water. (MM of KCl = 74.55 g/mol)

$$\frac{2.50\,g\,KCl}{250.0\,mL} \times \frac{1\,mol\,KCl}{74.55\,g\,KCl} \times \frac{1000\,mL}{1\,L}$$

$$= 0.134\,M\,KCl$$

11. (10 pts) A 10.00 mL sample of sulfuric acid (H_2SO_4) was titrated with 25.86 mL of 0.750 M NaOH. Calculate the concentration of the sulfuric acid.

$$\underset{\substack{10.00\,mL \\ ??\,mol/L}}{H_2SO_4} + \underset{\substack{25.86\,mL \\ 0.750\,mol/L}}{2\,NaOH} \rightarrow 2\,H_2O + Na_2SO_4$$

$$25.86\,mL \times \frac{L}{1000\,mL} \times \frac{0.750\,mol\,NaOH}{L} \times \frac{1\,mol\,H_2SO_4}{2\,mol\,NaOH} = 9.70 \times 10^{-3}\,mol\,H_2SO_4$$

$$C_{H_2SO_4} = \frac{9.70 \times 10^{-3}\,mol\,H_2SO_4}{10.00\,mL} \times \frac{1000\,mL}{1\,L} = \boxed{0.970\,M\,H_2SO_4}$$