General Chemistry I Lecture Fall 2017 9/20/17 Monday 9 am class Exam II Dr. Hahn Exam # _____

Name Key (print) Name _____(sign)

Please show work for partial credit and full credit on the Long Answers and in some of the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If you run out of space, continue on the empty back pages but clearly label where the remaining answer can be found. (If I can't find your answer or cannot read it, I obviously cannot grade it). Return your entire exam including the periodic table. (Please count your exam pages and make sure there are real pages + periodic table assembly )

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**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (2 pts each, 18 pts total)**

1) Based on the solubility rules, which one of the following compounds should be *insoluble* in water? 1) A

(A) AgBr B) NaCl C) $MgBr_2$ D) $ZnCl_2$ E) $FeCl_2$

insoluble exception

2) The mass % of H in methane ($CH_4$) is _____. [MW ($CH_4$) = ~~26.02~~ 16.0 g/mol] 2) A

(A) 25.13 B) 7.743 C) 92.26 D) 74.87 E) 4.032

$(4(1.01)/16.00) \times 100 = 25.13$

3) A limiting reagent is 3) D

A) the reactant you run out of last B) the limited product amount

C) none of the above (D) the reactant you run out of first

4) Which of the following will occur when a solution of $Pb(NO_3)_2(aq)$ is mixed with a solution of KI(aq)? 4) A

(A) A precipitate of $PbI_2$ will form; $K^+$ and $NO_3^-$ are spectator ions.

B) A precipitate of $Pb(NO_3)_2$ will form; $K^+$ and $I^-$ are spectator ions.

C) A precipitate of $KNO_3$ will form; $Pb^{2+}$ and $I^-$ are spectator ions.

D) A precipitate of $PbI_2$ will form; $Pb^{2+}$ and $I^-$ are spectator ions.

E) No precipitate will form.

5) In solutions 5) D

A) The solute is always a solid and the solvent is always a liquid.

B) The solute is the solution component which makes up the smallest component of the solution.

C) The solvent is the solution component which makes up the largest component in solution.

(D) ~~(A)~~ and ~~(B)~~ are correct. (B) + (C)

6) Which one of the following will show strong electrical signal when electrodes are placed in an aqueous solution. 6) A

(A) strong electrolyte B) weak electrolyte

C) none of the above D) non electrolyte

7) Which of the following gives the largest number of individual particles in an aqueous solution assuming complete dissociation ? 7) C

A) none of the above
B) Na Cl 2 particles
C) $MgCl_2$ 3 particles
D) Li Cl 2 particles

8) Give the name for $H_2SO_4$. 8) C

A) persulfuric acid
B) hyposulfurous acid
C) sulfuric acid
D) sulfurous acid
E) persulfurous acid

9) The empirical formula of a compound of uranium and fluorine that is composed of 67.6% uranium and 32.4% fluorine is 9) B

A) $UF_4$. B) $UF_6$. C) $U_3F_4$. D) $UF_8$. E) $U_2F$.

**Part II: Short Answers** (53 pts) Show work on all questions for partial and full credit even on questions which do not specify.

1. a. Balance the following reaction by filling in the blank for the missing coefficient. (15 pts, 5 pts per blank )

$2\ NaN_3\ (s) \rightarrow$ 2 Na (s) + 3 $N_2$ (g)

b. Show the number of each of the elements on the reactant and product side of the above reaction which you just balanced. (5 pts)

2 Na, 6 N { 2 Na, 6 N

2. Is $PbSO_4$ [ (soluble) or (insoluble) ] (circle one) in water ? Explain using where the parts of the compound show up in the solubilities rules table. (8 pts)

sulfates soluble but Pb insoluble exception

3. If you dissolve $Na_2SO_4$ in water write out the product. The equation does not need to be balanced. (10 pts, 5 pts per blank)

$Na_2SO_4\ (s) \rightarrow 2Na^{+}\ (aq) + SO_4^{-2}\ (aq)$

4 If you have a compound made up of 40.92 % C, 4.58% H and 54.50 % O by mass, in 100 grams of the compound, (10 pts, 5 pts each letter)

(a) how many grams of oxygen (O) do you have ? 54.50 grams oxygen (O) in 100 grams of compound

(b) how many moles of oxygen (O) do you have ? (show work) — O atomic mass = 16.00

$$54.50\ g\ O \times \frac{1\ mol\ O}{16.00\ g\ O} = 3.40\ moles\ O$$

5 If you do a reaction given below and then do a calculation and find that: (9 pts)

$4\ NH_3\ (g) + 5\ O_2\ (g) \rightarrow 4\ NO\ (g) + 6\ H_2O\ (g)$

89.2 moles of NO is generated from the amount of $NH_3$
40.8 moles of NO is generated from the amount of $O_2$

Which is the limiting reagent ? [ ($NH_3$) or ($O_2$) ] (circle one).

lower quantity is limiting reagent

**Part III: Long Answers** (30 pts) Show work on all questions for partial and full credit even on questions which do not specify.

1. Given the following reaction, if you want to make 5.23 grams of NO (g), how many grams of water will be generated. (MW of NO = 30.01 g/mol ) ( MW of $H_2O$ = 18.02 g/mol ) (show work) (15 pts)

$4\ NH_3\ (g) + 5\ O_2\ (g) \rightarrow 4\ NO\ (g) + 6\ H_2O\ (g)$

$5.23\ g\ NO \times \frac{1\ mol\ NO}{30.01\ g\ NO} \times \frac{6\ mol\ H_2O}{4\ mol\ NO} \times \frac{18.02\ g\ H_2O}{1\ mol\ H_2O}$

$= 4.71\ g\ H_2O$ generated

2. Given the following balanced molecular reaction: (15 pts total, 5 pts each)

$3\ NaOH\ (aq) + AlCl_3\ (aq) \rightarrow Al(OH)_3\ (s) + 3\ NaCl\ (aq)$

(a) Write the complete ionic reaction.

$3Na^+ + 3OH^- + Al^{+3} + 3Cl^- \longrightarrow$

$Al(OH)_3\ (s) + 3Na^+ + 3Cl^-$

(b) Write the net ionic reaction.

$3OH^- + Al^{+3} \longrightarrow Al(OH)_3\ (s)$

(c) What are the spectator ions ? List the spectator ions.

$Na^+,\ Cl^-$

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**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (2 pts each, 32 pts total)**

1) A limiting reagent is 1) A
(A) the reactant you run out of first
B) none of the above
C) the reactant you run out of last
D) the limited product amount

2) Which one of the following will show strong electrical signal when electrodes are placed in an aqueous solution. 2) B

A) non electrolyte
(B) strong electrolyte
C) weak electrolyte
D) none of the above

3) In solutions (±990) 3) B
A) The solute is always a solid and the solvent is always a liquid.
(B) ~~(A)~~ and ~~(B)~~ are correct. (C) + (D) are correct
C) The solute is the solution component which makes up the smallest component of the solution.
D) The solvent is the solution component which makes up the largest component in solution.

4) The empirical formula of a compound of uranium and fluorine that is composed of 67.6% uranium and 32.4% fluorine is 4) B
A) $UF_4$. (B) $UF_6$. C) $U_3F_4$. D) $U_2F$. E) $UF_8$.

5) Based on the solubility rules, which one of the following compounds should be *insoluble* in water? 5) A
(A) AgBr B) $FeCl_2$ C) $ZnCl_2$ D) NaCl E) $MgBr_2$

6) Give the name for $HNO_3$. 6) A
(A) nitric acid
B) hydrogen nitride
C) hydrogen nitrate
D) hydrogen nitrite
E) nitrous acid

7) What percent by mass of oxygen is present in carbon monoxide, CO? [MW (CO)=28.01 g/mol] 7) A

(A) 57%
B) 60. %
C) None of the above
D) 59 %
E) 58%

8) Which of the following gives the largest number of individual particles in an aqueous solution assuming complete dissociation ? 8) D

A) none of the above
B) Na Cl – 2 particles
C) Li Cl – 2 particles
(D) $MgCl_2$ – 3 particles

9) Which of the following will occur when a solution of $Pb(NO_3)_2(aq)$ is mixed with a solution of KI(aq)? 9) B

A) A precipitate of $KNO_3$ will form; $Pb^{2+}$ and $I^-$ are spectator ions.
(B) A precipitate of $PbI_2$ will form; $K^+$ and $NO_3^-$ are spectator ions.
C) A precipitate of $PbI_2$ will form; $Pb^{2+}$ and $I^-$ are spectator ions.
D) No precipitate will form.
E) A precipitate of $Pb(NO_3)_2$ will form; $K^+$ and $I^-$ are spectator ions.

$Pb(NO_3)_2 + KI \rightarrow PbI_2(s) + KNO_3$ soluble

**Part II: Short Answers** (53 pts) Show work on all questions for partial and full credit even on questions which do not specify.

1. a. Balance the following reaction by filling in the blank for the missing coefficient. (15 pts, 5 pts per blank )

$2\ KClO_3\ (s) \rightarrow \underline{2}\ KCl\ (s) + \underline{3}\ O_2\ (g)$

b. Show the number of each of the elements on the reactant and product side of the above reaction which you just balanced. (5 pts)

2K, 2Cl, 6O = 2K, 2Cl, 6O

2. Is $Na_3PO_4$ [ (soluble) or (insoluble) ] (circle one) in water ? Explain using the where the parts of the compound show up in the solubilities rules table. (8 pts)

phosphates are insoluble except for alkali metals, Na is an alkali metal

3. If you dissolve $Al(NO_3)_3$ in water write out the product The equation does not need to be balanced. (10 pts, 5 pts per blank.)

$Al(NO_3)_3\ (s) \rightarrow \underline{Al^{+3}}\ (aq) + \underline{3NO_3^{-1}}\ (aq)$

4 If you have a compound made up of 40.92 % C, 4.58% H and 54.50 % O by mass, in 100 grams of the compound, (10 pts, 5 pts each letter)

(a) how many grams of C do you have ? 40.92 grams C in 100 grams of compound

(b) how many moles of C do you have ? (show work) atom mass C = 12.01 g/mol

$$40.92\text{ g C} \times \frac{1\text{ mol C}}{12.01\text{ g C}} = 3.41\text{ mol C}$$

5 If you do a reaction given below and then do a calculation and find that: (9 pts)

$$8\ H_2S\ (g) + 4\ O_2\ (g) \rightarrow S_8\ (l) + 8\ H_2O\ (g)$$

40.8 moles of $S_8$ is generated from the amount of $H_2S$

89.2 moles of $S_8$ is generated from the amount of $O_2$

Which is the limiting reagent ? [ ($H_2S$) or ($O_2$) ] (circle one)

run out of S before run out of $O_2$

**Part III: Long Answers** (30 pts) Show work on all questions for partial and full credit even on questions which do not specify.

1. Given the following reaction, if you want to make 12.7 grams of $S_8$, how many grams of $H_2S$ do you need ? (MW of $S_8$ = 256.56 g / mol ) (MW of $H_2S$ = 34.09 g / mol ) (show work) (15 pts)

$$8\,H_2S\,(g) + 4\,O_2\,(g) \rightarrow S_8\,(l) + 8\,H_2O\,(g)$$

$$12.7\,g\,S_8 \times \frac{1\,mol\,S_8}{256.56\,g\,S_8} \times \frac{8\,mol\,H_2S}{1\,mol\,S_8} \times \frac{34.09\,g\,H_2S}{1\,mol\,H_2S} =$$

13.5 g $H_2S$ needed

2. Given the following balanced molecular reaction: (15 pts total, 5 pts each)

$Mg\ Cl_2\ (aq) + Na_2\ CO_3\ (aq) \rightarrow Mg\ CO_3\ (s) + 2\ Na\ Cl\ (aq)$

(a) Write the complete ionic reaction.

$Mg^{+2} + 2Cl^- + 2Na^+ + CO_3^{-2} \longrightarrow$

$MgCO_3(s) + 2Na^+ + 2Cl^-$

(b) Write the net ionic reaction.

$Mg^{+2} + CO_3^{-2} \longrightarrow MgCO_3(s)$

(c) What are the spectator ions ? List the spectator ions.

$Na^+, Cl^-$

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A) $AgBr$ B) $NaCl$ C) $MgBr_2$ D) $ZnCl_2$ E) $FeCl_2$

2) The mass % of H in methane ($CH_4$) is _____. [MW ($CH_4$) = ~~26.02~~ 16.04 g/mol] 2) _____

A) 25.13 B) 7.743 C) 92.26 D) 74.87 E) 4.032

3) A limiting reagent is 3) _____

A) the reactant you run out of last B) the limited product amount
C) none of the above D) the reactant you run out of first

4) Which of the following will occur when a solution of $Pb(NO_3)_2(aq)$ is mixed with a solution of $KI(aq)$? 4) _____

A) A precipitate of $PbI_2$ will form; $K^+$ and $NO_3^-$ are spectator ions.
B) A precipitate of $Pb(NO_3)_2$ will form; $K^+$ and $I^-$ are spectator ions.
C) A precipitate of $KNO_3$ will form; $Pb^{2+}$ and $I^-$ are spectator ions.
D) A precipitate of $PbI_2$ will form; $Pb^{2+}$ and $I^-$ are spectator ions.
E) No precipitate will form.

5) In solutions 5) _____

A) The solute is always a solid and the solvent is always a liquid.
B) The solute is the solution component which makes up the smallest component of the solution.
C) The solvent is the solution component which makes up the largest component in solution.
D) (A) and (B) are correct.

6) Which one of the following will show strong electrical signal when electrodes are placed in an aqueous solution. 6) _____

A) strong electrolyte B) weak electrolyte
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7) Which of the following gives the largest number of individual particles in an aqueous solution assuming complete dissociation ? 7) _____

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B) Na Cl
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8) Give the name for $H_2SO_4$. 8) _____

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**Part II: Short Answers** (53 pts) Show work on all questions for partial and full credit even on questions which do not specify.

1. a. Balance the following reaction by filling in the blank for the missing coefficient. (15 pts, 5 pts per blank )

$2\ Na\ N_3\ (s) \rightarrow$ ___ $Na\ (s)$ + ___ $N_2\ (g)$

b. Show the number of each of the elements on the reactant and product side of the above reaction which you just balanced. (5 pts)

2. Is $Pb\ SO_4$ [ (soluble) or (insoluble) ] (circle one) in water ? Explain using where the parts of the compound show up in the solubilities rules table. (8 pts)

3. If you dissolve $Na_2\ SO_4$ in water write out the product. The equation does not need to be balanced. (10 pts, 5 pts per blank)

$Na_2\ SO_4\ (s) \rightarrow$ _____ (aq) + _____ (aq)

4 If you have a compound made up of 40.92 % C, 4.58% H and 54.50 % O by mass, in 100 grams of the compound, (10 pts, 5 pts each letter)

(a) how many grams of oxygen (O) do you have ? _____ grams oxygen (O) in 100 grams of compound

(b) how many moles of oxygen (O) do you have ? (show work)

5 If you do a reaction given below and then do a calculation and find that: (9 pts)

$4\ NH_3\ (g) + 5\ O_2\ (g) \rightarrow 4\ NO\ (g) + 6\ H_2O\ (g)$

89.2 moles of NO is generated from the amount of $NH_3$
40.8 moles of NO is generated from the amount of $O_2$

Which is the limiting reagent ? [ ($NH_3$) or ($O_2$) ] (circle one).

**Part III: Long Answers** (30 pts) Show work on all questions for partial and full credit even on questions which do not specify.

1. Given the following reaction, if you want to make 5.23 grams of NO (g), how many grams of water will be generated. (MW of NO = 30.01 g/mol ) ( MW of $H_2O$ = 18.02 g/mol ) (show work) (15 pts)

$4\ NH_3\ (g)\ +\ 5\ O_2\ (g) \rightarrow\ 4\ NO\ (g)\ +6\ H_2\ O\ (g)$

2. Given the following balanced molecular reaction: (15 pts total, 5 pts each)

$$3\ Na\ OH\ (aq) + Al\ Cl_3\ (aq) \rightarrow Al\ (OH)_3\ (s) + 3\ Na\ Cl\ (aq)$$

(a) Write the complete ionic reaction.

(b) Write the net ionic reaction.

(c) What are the spectator ions ? List the spectator ions.

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C) weak electrolyte
D) none of the above

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5) Based on the solubility rules, which one of the following compounds should be *insoluble* in water? 5) _____
A) AgBr B) $FeCl_2$ C) $ZnCl_2$ D) NaCl E) $MgBr_2$

6) Give the name for $HNO_3$. 6) _____
A) nitric acid
B) hydrogen nitride
C) hydrogen nitrate
D) hydrogen nitrite
E) nitrous acid

7) What percent by mass of oxygen is present in carbon monoxide, CO? [MW (CO)=28.01 g/mol] 7) _____

A) 57%
B) 60. %
C) None of the above
D) 59 %
E) 58%

8) Which of the following gives the largest number of individual particles in an aqueous solution assuming complete dissociation ? 8) _____

A) none of the above
B) Na Cl
C) Li Cl
D) $Mg\ Cl_2$

9) Which of the following will occur when a solution of $Pb(NO_3)_2(aq)$ is mixed with a solution of KI(aq)? 9) _____

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C) A precipitate of $PbI_2$ will form; $Pb^{2+}$ and $I^-$ are spectator ions.
D) No precipitate will form.
E) A precipitate of $Pb(NO_3)_2$ will form; $K^+$ and $I^-$ are spectator ions.

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1. a. Balance the following reaction by filling in the blank for the missing coefficient. (15 pts, 5 pts per blank )

$2\ KClO_3\ (s) \rightarrow$ ___ $KCl\ (s)$ + ___ $O_2\ (g)$

b. Show the number of each of the elements on the reactant and product side of the above reaction which you just balanced. (5 pts)

2. Is $Na_3PO_4$ [ (soluble) or (insoluble) ] (circle one) in water ? Explain using the where the parts of the compound show up in the solubilities rules table. (8 pts)

3. If you dissolve $Al(NO_3)_3$ in water write out the product The equation does not need to be balanced. (10 pts, 5 pts per blank.)

$Al(NO_3)_3\ (s) \rightarrow$ _____ (aq) + _____ (aq)

4 If you have a compound made up of 40.92 % C, 4.58% H and 54.50 % O by mass, in 100 grams of the compound, (10 pts, 5 pts each letter)

(a) how many grams of C do you have ? _____ grams C in 100 grams of compound

(b) how many moles of C do you have ? (show work)

5 If you do a reaction given below and then do a calculation and find that: (9 pts)

$$8\ H_2S\ (g)\ +\ 4\ O_2\ (g)\ \rightarrow\ S_8\ (l)\ +\ 8\ H_2O\ (g)$$

40.8 moles of $S_8$ is generated from the amount of $H_2S$

89.2 moles of $S_8$ is generated from the amount of $O_2$

Which is the limiting reagent ? [ ( $H_2S$ ) or ($O_2$ ) ] (circle one)

**Part III: Long Answers** (30 pts) Show work on all questions for partial and full credit even on questions which do not specify.

1. Given the following reaction, if you want to make 12.7 grams of $S_8$, how many grams of $H_2S$ do you need ? (MW of $S_8$ = 256.56 g / mol ) (MW of $H_2S$ = 34.09 g / mol ) (show work) (15 pts)

$$8\ H_2S\ (g) + 4\ O_2\ (g) \rightarrow S_8\ (l) + 8\ H_2O\ (g)$$

2. Given the following balanced molecular reaction: (15 pts total, 5 pts each)

$$Mg\ Cl_2\ (aq) + Na_2\ CO_3\ (aq) \rightarrow Mg\ CO_3\ (s) + 2\ Na\ Cl\ (aq)$$

(a) Write the complete ionic reaction.

(b) Write the net ionic reaction.

(c) What are the spectator ions ? List the spectator ions.