General Chemistry I Lecture Fall 2016 10/17/16 M Exam II form Green 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. Multip choice questions have no partial credit. Please write anything you want graded legibly. If you run out of space, please 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 7 real pages + periodic table+ solubility chart .)

1 mole = molar mass = 6.022×10^{23} PV=nRT R = 0.08206 (L atm)/(molK) K = °C + 273.15

$\frac{P_1V_1}{P_2V_2} = \frac{T_1}{T_2}$ 760 torr = 760 mm Hg = 1.00 atmosphere

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (2 pts each, 26 pts total)

1) Which one of the following compounds is **soluble** in water? 1) B
A) FeS B) $Cu(NO_3)_2$ C) $Cu_3(PO_4)_2$ D) $SrCO_3$

2) What is the concentration of nitrate ions in a 0.225 M $Sr(NO_3)_2$ solution? 2) B
A) 0.225 M B) 0.450 M C) 0.112 M D) 0.675 M E) 0.725 M
$0.225 \times 2 = 0.45$

3) Identify ammonia. 3) D
A) weak electrolyte, strong base
B) strong electrolyte, strong base
C) strong electrolyte, weak base
D) weak electrolyte, weak base
E) nonelectrolyte

BA = bad attempt
NA = not attempted
NW = no work
BBA = bad bad attempt

4) Identify acetic acid. 4) B
A) strong electrolyte, strong acid
B) weak electrolyte, weak acid
C) strong electrolyte, weak acid
D) weak electrolyte, strong acid
E) nonelectrolyte

5) Write the name for $Mg_3(PO_4)_2$. — ionic - no # prefix 5) C
A) trimagnesium phosphorustetraoxide
B) magnesium(III) phosphite
C) magnesium phosphate
D) magnesium phosphite
E) magnesium(II) phosphite

6) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 6) B
A) 760 torr B) 715 torr C) 29.5 torr D) 13.5 torr E) 28.1 torr

7) When dissolved in water, KOH behaves as 7) B

A) an acid that forms KO^- and H^+ ions.
B) a base that forms K^+ and OH^- ions.
C) a base that forms KO^- and H^+ ions.
D) an acid that forms K^+ and OH^- ions.

8) Determine the number of moles of sodium in 3.20 moles of sodium hydrogen phosphate. 8) E

A) 1.60 moles of sodium
B) 3.20 moles of sodium
C) 12.80 moles of sodium
D) 9.60 moles of sodium
E) 6.40 moles of sodium

$2 \times 3.20 = 6.40$ Na_2HPO_4 → 3

9) Give the name for HNO_3. 9) A

A) nitric acid
B) hydrogen nitride
C) hydrogen nitrite
D) nitrous acid
E) hydrogen nitrate

10) Identify the spectator ions in the following molecular equation. 10) B

$KCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + KNO_3(aq)$

non reactly

not Ag + Cl

A) Ag^+ and NO_3^-
B) K^+ and NO_3^-
C) Ag^+ and Cl^-
D) K^+ and Cl^-
E) There are no spectator ions in this reaction.

so $K^+ + NO_3^-$

11) In a container containing Ne, H_2, and CO_2, what is the mole fraction of Ne if the H_2 mole fraction is 0.22 and the CO_2 mole fraction is 0.58? 11) B

$1 - 0.58 - 0.22 =$

$1.0 = 0.22 (X_{H_2}) + ? (X_{Ne}) + 0.58 (X_{CO_2})$

A) 0.30 B) 0.20 C) 0.50 D) 0.10

12) Three identical flasks contain three different gases at standard temperature and pressure. Flask A contains CH_4, flask B contains O_3, and flask C contains N_2. Which flask contains the **largest** number of molecules? 12) D

STP molar volume same

A) flask A
B) flask B
C) flask C
D) All contain same number of molecules.

13) Which of the following is a precipitation reaction? 13) C

A) $HCl(aq) + KOH(aq) \rightarrow KCl(aq) + H_2O(l)$
B) $KCl(aq) + LiI(aq) \rightarrow KI(aq) + LiCl(aq)$
C) $2\ NaI(aq) + Hg_2(NO_3)_2(aq) \rightarrow Hg_2I_2(s) + 2\ NaNO_3(aq)$
D) $Zn(s) + 2\ AgNO_3(aq) \rightarrow 2\ Ag(s) + Zn(NO_3)_2(aq)$
E) None of the above is a precipitation reaction.

right side has insoluble

this is a redox Rxn

II. Short Answers (48 pts)

1. Given the following molecule, show your calculation of the molecular formula mass (molar mass of the molecule). (5 pts)

N_2O_4 $2(14.01) + 4(16.00) = 92.02\ g$

NW = -2½

2. Is the following molecule [(soluble) or (insoluble)] (circle one) ? Explain your reasoning in a few words. (5 pts)

Ag_2SO_4 SO_4^{-2} usually soluble but Ag is exception

3. Nomenclature (6 pts total, 3 pts each) -½

a. Name of the molecule diphosphorus pentoxide

P_2O_5 covalent molecule

-½

b. Name of the acid hydrobromic acid

H Br hydro ___ ic acid

-1

4 Given the following acid base reaction, complete & balance the reaction. (6 pts total, 3 pts each) (left side is already balanced & need not be modified)

-1 -3

$3\,KOH + H_3PO_4 \rightarrow K_3PO_4 + 3H_2O$

+ +

gave H_3O^+ -1

10 pts off

5. If I dissolve the following in water, what will be the identity of the blanks ? (6 pts total, 3 pts each)

K_2SO_4 (aq) → $2K^+$ (aq) + SO_4^{-2} (aq) BA -1½

6. a. What is the molarity of the reagent made from 2.54 grams of H Cl (FW HCl = 36.46 g/mol) (5 pts) (M = #moles / liter) by addition of solution up to the 250.0 mL line ? BA -2½

$$\frac{2.54\text{ g HCl}}{250.0\text{ mL}} \times \frac{\text{mol HCl}}{36.46\text{ g HCl}} \times \frac{1000\text{ mL}}{1\text{ L}} = 0.279\text{ M}$$

b. If you dilute that reagent by taking 10.0 mL of the above reagent and adding enough water to make up 100.0 mL, what is the diluted molarity ? (5 pts) ($M_1V_1 = M_2V_2$)

$M_1 = 0.279$ M, $V_1 = 10.0$ mL, $V_2 = 100.0$ mL $M_2 = ?$ (1pt each)

$(0.279\text{ M})(10.0\text{ mL}) = (M_2)(100.0\text{ mL})$ BA = -2½

$M_2 = [(0.279\text{ M})(10.0\text{ mL})/100.0\text{ mL}] = 0.0279\text{ M}$

7. Given the following, **circle all** which are a **strong electrolyte** ? (12 pts, 2 pts each)

NaCl HF HNO_3 NH_3 KOH $HC_2H_3O_2$

HF: weak acid; NH_3: weak base; $HC_2H_3O_2$: weak acid

8. What is the oxidation state of the following ? Either explain or show work. (8 pts, 4 pts per blank)

Fe Zero element in most stable form

N in NO_3^- +5 $N + (-2)3 = -1$

$N - 6 = -1$

$N = -1 + 6 = +5$ BA -2

9 If at STP (0° C and 1 atm) I have 3.5 moles of the gas CH_4, how many liters of CH_4 do I have ? Show work. (STP volume = 22.4 Liters) (5 pts)

78.4 liters of CH_4 BA = -2½

$$3.5\text{ mol} \times \frac{22.4\text{ L}}{1\text{ mol}} = 78.4\text{ L}$$

III. Long Answer (30 pts) Please show work. If you get the final correct number without showing your work, you will earn zero points.

1. Theoretical Yield (20 pts)

2 K_3PO_4 + 3 $CaCl_2$ → 6 K Cl + $Ca_3(PO_4)_2$ (s)

a. What is the theoretical yield in grams for the calcium phosphate from the reaction above if you start with 3.44 grams of $CaCl_2$ reacting to produce the $Ca_3(PO_4)_2$ (s) ? {FW($CaCl_2$) = 110.99 g/mol FW($Ca_3(PO_4)_2$ = 310.21 g/mol} (show work) (10 pts)

Yield in grams _____

$3.44\ g\ CaCl_2 \times \frac{1\ mol\ CaCl_2}{110.99\ g\ CaCl_2} \times \frac{1\ mol\ Ca_3(PO_4)_2}{3\ mol\ CaCl_2} \times \frac{310.21\ g\ Ca_3(PO_4)_2}{1\ mol\ Ca_3(PO_4)_2}$

(2pt) (2pt) (2pt) (2pt)

$= 3.20\ g\ Ca_3(PO_4)_2$

(2pt)

BA = -5 pt missing step -2 extra step -1

b. If the theoretical yield of the product $Ca_3(PO_4)_2$ based on the number of grams of the starting material K_3PO_4 is 6.07 grams $Ca_3(PO_4)_2$, which is the limiting reagent ? Circle one (5 pts) [compare with theoretical yield you calculated in part (a)]

[(K_3PO_4) or ($CaCl_2$)]

$K_3PO_4 \rightarrow 6.07\ g\ Ca_3(PO_4)_2$

$CaCl_2 \rightarrow 3.20\ g\ Ca_3(PO_4)_2$

limiting reagent

BA -2½ no pts off guess

c. If I have 1.78 moles of the calcium phosphate [$Ca_3(PO_4)_2$], how many atoms of oxygen do I have ($N_A = 6.022 \times 10^{23}$) ? (5 pts)

1 mol $Ca_3(PO_4)_2$ = 4 * 2 = 8 moles O =

$$1.78 \text{ mol } Ca_3(PO_4)_2 \times \frac{8 \text{ mol O}}{1 \text{ mol } Ca_3(PO_4)_2} \times \frac{6.022 \times 10^{23} \text{ atoms O}}{1 \text{ mol O}} =$$

1 pt — 1 pt — 2 pt

8.57×10^{24} atoms O =

1 pt

BA −2½

Math −½

2. Gas Law: (10 pts) Given the ideal gas law $PV = n R T$

I have 1.2 moles of a gas in a gas cylinder of 305.1 mL at 753.1 torr, what is the temperature of the gas in Kelvin ? [R = 0.08206 (L atm) / (mol K)]

$n = 1.2\ mol$

$V = 305.1\ ml \times \frac{1\ l}{1000\ ml} = 0.3051\ l$ (1pt)

$P = 753.1\ torr * \frac{1\ atm}{760\ torr} = 0.9909\ atm$ (1pt)

$T = ?$

$R = 0.08206\ \frac{l\ atm}{mol\ K}$

(4pt)

$(0.9909\ atm)(0.3051\ l) = (1.2\ mol)\left(\frac{0.08206\ l\ atm}{mol\ K}\right)(T)$

$\frac{(0.9909\ atm)(0.3051\ l)}{(1.2\ mol)\left(0.08206\ \frac{l\ atm}{mol\ K}\right)} = 3.07\ Kelvin$

BA −5

small algebra −2

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1 mole = molar mass = 6.022×10^{23} $PV=nRT$ $R = 0.08206$ (L atm)/(molK) $K = {}^{o}C + 273.15$

$\frac{P_1V_1}{P_2V_2} = \frac{T_1}{T_2}$ 760 torr = 760 mm Hg = 1.00 atmosphere

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (2 pts each, 26 pts total)

1) Identify the spectator ions in the following molecular equation. 1) D

$KCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + KNO_3(aq)$

A) K^+ and Cl^-
B) Ag^+ and NO_3^-
C) Ag^+ and Cl^-
(D) K^+ and NO_3^-
E) There are no spectator ions in this reaction.

MC same as other form but scrambled

2) What is the concentration of nitrate ions in a 0.225 M $Sr(NO_3)_2$ solution? 2) B

A) 0.675 M (B) 0.450 M C) 0.112 M D) 0.725 M E) 0.225 M

3) Determine the number of moles of sodium in 3.20 moles of sodium hydrogen phosphate. 3) A

(A) 6.40 moles of sodium
B) 1.60 moles of sodium
C) 3.20 moles of sodium
D) 9.60 moles of sodium
E) 12.80 moles of sodium

B A = bad attempt

NA = not attempted

4) Which of the following is a precipitation reaction? 4) B

A) $Zn(s) + 2\ AgNO_3(aq) \rightarrow 2\ Ag(s) + Zn(NO_3)_2(aq)$
(B) $2\ NaI(aq) + Hg_2(NO_3)_2(aq) \rightarrow Hg_2I_2(s) + 2\ NaNO_3(aq)$
C) $HCl(aq) + KOH(aq) \rightarrow KCl(aq) + H_2O(l)$
D) $KCl(aq) + LiI(aq) \rightarrow KI(aq) + LiCl(aq)$
E) None of the above is a precipitation reaction.

NW = no work

BBA = bad bad attempt

5) When dissolved in water, KOH behaves as 5) C

A) a base that forms KO^- and H^+ ions.
(C) a base that forms K^+ and OH^- ions.
B) an acid that forms K^+ and OH^- ions.
D) an acid that forms KO^- and H^+ ions.

6) Identify acetic acid. 6) B

A) strong electrolyte, strong acid
B) weak electrolyte, weak acid
C) weak electrolyte, strong acid
D) strong electrolyte, weak acid
E) nonelectrolyte

7) Give the name for HNO_3. 7) D

A) hydrogen nitrite
B) nitrous acid
C) hydrogen nitride
D) nitric acid
E) hydrogen nitrate

8) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 8) E

A) 29.5 torr B) 13.5 torr C) 28.1 torr D) 760 torr E) 715 torr

9) Identify ammonia. 9) C

A) weak electrolyte, strong base
B) strong electrolyte, strong base
C) weak electrolyte, weak base
D) strong electrolyte, weak base
E) nonelectrolyte

10) Which one of the following compounds is **soluble** in water? 10) B

A) $Cu_3(PO_4)_2$ B) $Cu(NO_3)_2$ C) $SrCO_3$ D) FeS

11) Write the name for $Mg_3(PO_4)_2$. 11) D

A) magnesium phosphite
B) trimagnesium phosphorustetraoxide
C) magnesium(III) phosphite
D) magnesium phosphate
E) magnesium(II) phosphite

12) Three identical flasks contain three different gases at standard temperature and pressure. Flask A contains CH_4, flask B contains O_3, and flask C contains N_2. Which flask contains the **largest** number of molecules? 12) D

A) flask A
B) flask B
C) flask C
D) All contain same number of molecules.

13) In a container containing Ne, H_2, and CO_2, what is the mole fraction of Ne if the H_2 mole fraction is 0.22 and the CO_2 mole fraction is 0.58? 13) B

A) 0.10 B) 0.20 C) 0.30 D) 0.50

II. Short Answers (48 pts)

1. Given the following molecule, show your calculation of the molecular formula mass (molar mass of the molecule). (5 pts)

NW = -2½

P_2O_5 $2(30.97) + 5(16.00) = 141.94\ g/mol$

P O

2. Is the following molecule [(soluble) or (insoluble)] (circle one) ? Explain your reasoning in a few words. (5 pts)

$(NH_4)_2S$ S^{-2} is usually insoluble NE -2½

but NH_4 is an exception so soluble

3. Nomenclature (6 pts total, 3 pts each) -½

a. Name of the molecule -½ attempt -1½

N_2O_4 dinitrogen tetroxide

covalent molecule - use # prefix

b. Name of the acid nitric acid

HNO_3

attempt -1½

4 Given the following acid base reaction, complete & balance the reaction. (6 pts total, 3 pts each) (left side is already balanced & need not be modified)

H_3O^+ -1

(-1) -2

$2\ LiOH + H_2SO_4 \rightarrow Li_2SO_4 + 2H_2O$

(+) (+)

no pts off leave out 2

5. If I dissolve the following in water, what will be the identity of the blanks ? (6 pts total, 3 pts each)

$Ba(NO_3)_2$ (aq) → Ba^{+2} (aq) + $2NO_3^{-1}$ (aq)

-2½ BA

0,0976M

6. a. What is the molarity of the reagent made ~~from 1.78~~ grams of H Cl (FW HCl = 36.46 g/mol) (5 pts) (M = #moles / liter) by addition of solution up to the 500.0 mL line ?

$1.78\,g\,HCl \times \frac{1\,mol\,HCl}{36.46\,g\,HCl} = 0.04882\,mol\,HCl$ $\quad M = \frac{0.04882}{0.5000\,l}$ -1

$500.0\,ml \times \frac{1\,l}{1000\,ml} = 0.5000\,l$

b. If you dilute that reagent by taking 25.0 mL of the above reagent and adding enough water to make up 250.0 mL, what is the diluted molarity ? (5 pts) ($M_1V_1 = M_2V_2$)

BA-2½

$V_1 = 25.0\,ml \quad M_1 = 0.0976M \quad V_2 = 250.0\,ml$

$(0.0976M)(25.0\,ml) = (M_2)(250.0\,ml)$ (1pt each)

$M_2 = (0.0976M)(25.0\,ml)/(250.0\,ml) = 9.76 \times 10^{-3} M$ (1pt)

7. Given the following, **circle all** which are a **weak electrolyte** ? (12 pts, 2 pts each)

NaCl (HF) HNO_3 (NH_3) KOH ($HC_2H_3O_2$)

Weak acid Weak base weak acid

8. What is the oxidation state of the following ? Either explain or show work. (8 pts, 4 pts per blank)

N_2 zero element in most stable form

BA-2

P in PO_4^{-3} +5 $\quad P + 4(-2) = -3$ $\quad P = -3 + 8 = +5$

algebra + rule -1

BA-2

9 If at STP (0° C and 1 atm) I have 1.35 moles of the gas CH_4, how many liters of CH_4 do I have ? Show work. (STP volume = 22.4 Liters) (5 pts)

30.24 liters of CH_4 $\quad 1.35\,mol \times \frac{22.4\,l}{1\,mol} = 30.24\,l$

BA -2½

III. Long Answer (30 pts) Please show work. If you get the final correct number without showing your work, you will earn zero points.

Word autocorrected

1. Theoretical Yield (20 pts)

2 NH_4OH + $Al(NO_3)_3$ → $Al(OH)_3$ (s) + 3 NH_4NO_3

Typo — 3

a. If 2.54 grams of NH_4OH reacts by the above reaction, what is the theoretical yield in grams of the $Al(OH)_3$? { $FW(NH_4OH) = 35.06$ g/mol $FW(Al(OH)_3) = 78.03$ g/mol } (10 pts)

Theoretical yield _____ g $Al(OH)_3$

$$2.54\text{ g } NH_4OH \times \frac{1\text{ mol } NH_4OH}{35.06\text{ g } NH_4OH} \times \frac{1\text{ mol } Al(OH)_3}{2\text{ mol } NH_4OH} \times \frac{78.03\text{ g } Al(OH)_3}{1\text{ mol } Al(OH)_3} =$$

2pt 2pt 2pt 2pt

2.83 g $Al(OH)_3$ 2pt

BA -5 — missing step -2 — extra step -1

$Al(NO_3)_3$ → 1.02 g $Al(OH)_3$ (limiting reagent)

NH_4OH → 2.83 g $Al(OH)_3$

graded consistent to above

b. If the theoretical yield of the product $Al(OH)_3$ based on the number of grams of the starting material $Al(NO_3)_3$ is 1.02 grams $Al(OH)_3$, which is the limiting reagent ? Circle one (5 pts) [compare with theoretical yield you calculated in part (a)]

[(NH_4OH) or ($Al(NO_3)_3$)]

BA = -2½ — no pts off for guess

c. If I have 2.72 moles of the aluminum nitrate , how many atoms of oxygen do I have (N_A = 6.022×10^{23}) ? (5 pts)

$$2.72 \text{ mol } Al(NO_3)_3 \times \frac{9 \text{ mol O}}{1 \text{ mol } Al(NO_3)_3} \times \frac{6.022 \times 10^{23} \text{ atoms O}}{1 \text{ mol O}} = 1.47 \times 10^{25} \text{ atom O}$$

1 mol $Al(NO_3)_3$ = (3 * 3) mol O

(1 pt) (1 pt) (2 pt)

BA − 2½

math − ½

2. Gas Law: (10 pts)

Given the combined gas law $\frac{P_2V_2}{P_1V_1} = \frac{T_2}{T_1}$

BA = -5

math -1

algebra -2

I have a mixed gas system at 0° C at 1.01 atmosphere occupying 258.1 mL. If I heat the system to 25° C at the same time that I increase the pressure to 2.3 atmosphere, what volume will the gas occupy ? (K = ° C + 273.15)

$T_1 = 0°C + 273.15 = 273.15K$

$P_1 = 1.01 atm$

$V_1 = 258.1 mL * \frac{1L}{1000mL} = 0.2581 L$

$T_2 = 25°C + 273.15 = 298.15 K$

$P_2 = 2.3 atm$

$V_2 = ?$

1pt 4pt 1pt

$$\frac{(2.3 atm)(V_2)}{(1.01 atm)(0.2581 L)} = \frac{(298.15 K)}{(273.15 K)}$$

1pt

$$V_2 = \frac{(298.15 K)(1.01 atm)(0.2581 L)}{(273.15 K)(2.3 atm)}$$

$V_2 = 0.12 L$

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$\frac{P_1V_1}{P_2V_2} = \frac{T_1}{T_2}$ 760 torr = 760 mm Hg = 1.00 atmosphere

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (2 pts each, 26 pts total)

1) Which one of the following compounds is **soluble** in water? 1) _____
A) FeS B) $Cu(NO_3)_2$ C) $Cu_3(PO_4)_2$ D) $SrCO_3$

2) What is the concentration of nitrate ions in a 0.225 M $Sr(NO_3)_2$ solution? 2) _____
A) 0.225 M B) 0.450 M C) 0.112 M D) 0.675 M E) 0.725 M

3) Identify ammonia. 3) _____
A) weak electrolyte, strong base
B) strong electrolyte, strong base
C) strong electrolyte, weak base
D) weak electrolyte, weak base
E) nonelectrolyte

4) Identify acetic acid. 4) _____
A) strong electrolyte, strong acid
B) weak electrolyte, weak acid
C) strong electrolyte, weak acid
D) weak electrolyte, strong acid
E) nonelectrolyte

5) Write the name for $Mg_3(PO_4)_2$. 5) _____
A) trimagnesium phosphorustetraoxide
B) magnesium(III) phosphite
C) magnesium phosphate
D) magnesium phosphite
E) magnesium(II) phosphite

6) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 6) _____
A) 760 torr B) 715 torr C) 29.5 torr D) 13.5 torr E) 28.1 torr

7) When dissolved in water, KOH behaves as 7) _____

A) an acid that forms KO^- and H^+ ions.
B) a base that forms K^+ and OH^- ions.
C) a base that forms KO^- and H^+ ions.
D) an acid that forms K^+ and OH^- ions.

8) Determine the number of moles of sodium in 3.20 moles of sodium hydrogen phosphate. 8) _____

A) 1.60 moles of sodium
B) 3.20 moles of sodium
C) 12.80 moles of sodium
D) 9.60 moles of sodium
E) 6.40 moles of sodium

9) Give the name for HNO_3. 9) _____

A) nitric acid
B) hydrogen nitride
C) hydrogen nitrite
D) nitrous acid
E) hydrogen nitrate

10) Identify the spectator ions in the following molecular equation. 10) _____

$$KCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + KNO_3(aq)$$

A) Ag^+ and NO_3^-
B) K^+ and NO_3^-
C) Ag^+ and Cl^-
D) K^+ and Cl^-
E) There are no spectator ions in this reaction.

11) In a container containing Ne, H_2, and CO_2, what is the mole fraction of Ne if the H_2 mole fraction is 0.22 and the CO_2 mole fraction is 0.58? 11) _____

A) 0.30 B) 0.20 C) 0.50 D) 0.10

12) Three identical flasks contain three different gases at standard temperature and pressure. Flask A contains CH_4, flask B contains O_3, and flask C contains N_2. Which flask contains the **largest** number of molecules? 12) _____

A) flask A
B) flask B
C) flask C
D) All contain same number of molecules.

13) Which of the following is a precipitation reaction? 13) _____

A) $HCl(aq) + KOH(aq) \rightarrow KCl(aq) + H_2O(l)$
B) $KCl(aq) + LiI(aq) \rightarrow KI(aq) + LiCl(aq)$
C) $2\ NaI(aq) + Hg_2(NO_3)_2(aq) \rightarrow Hg_2I_2(s) + 2\ NaNO_3(aq)$
D) $Zn(s) + 2\ AgNO_3(aq) \rightarrow 2\ Ag(s) + Zn(NO_3)_2(aq)$
E) None of the above is a precipitation reaction.

II. Short Answers (48 pts)

1. Given the following molecule, show your calculation of the molecular formula mass (molar mass of the molecule). (5 pts)

N_2O_4

2. Is the following molecule [(soluble) or (insoluble)] (circle one) ? Explain your reasoning in a few words. (5 pts)

$Ag_2\,SO_4$

3. Nomenclature (6 pts total, 3 pts each)

a. Name of the molecule _____

P_2O_5

b. Name of the acid _____

H Br

4 Given the following acid base reaction, complete & balance the reaction. (6 pts total, 3 pts each) (left side is already balanced & need not be modified)

3 K OH + $H_3\,PO_4$ → _____ + _____

5. If I dissolve the following in water, what will be the identity of the blanks ? (6 pts total, 3 pts each)

K_2SO_4 (aq) → _____ (aq) + _____ (aq)

6. a. What is the molarity of the reagent made from 2.54 grams of H Cl (FW HCl = 36.46 g/mol) (5 pts) (M = #moles / liter) by addition of solution up to the 250.0 mL line ?

b. If you dilute that reagent by taking 10.0 mL of the above reagent and adding enough water to make up 100.0 mL, what is the diluted molarity ? (5 pts) ($M_1V_1 = M_2V_2$)

7. Given the following, **circle all** which are a **strong electrolyte** ? (12 pts, 2 pts each)

NaCl HF HNO_3 NH_3 KOH H $C_2H_3O_2$

8. What is the oxidation state of the following ? Either explain or show work. (8 pts, 4 pts per blank)

Fe _____

N in NO_3 _____

9 If at STP (0° C and 1 atm) I have 3.5 moles of the gas CH_4, how many liters of CH_4 do I have ? Show work. (STP volume = 22.4 Liters) (5 pts)

_____ liters of CH_4

III. Long Answer (30 pts) Please show work. If you get the final correct number without showing your work, you will earn zero points.

1. Theoretical Yield (20 pts)

2 K_3PO_4 + 3 $CaCl_2$ → 6 K Cl + $Ca_3(PO_4)_2$ (s)

a. What is the theoretical yield in grams for the calcium phosphate from the reaction above if you start with 3.44 grams of $CaCl_2$ reacting to produce the $Ca_3(PO_4)_2$ (s) ? {FW($CaCl_2$) = 110.99 g/mol FW($Ca_3(PO_4)_2$ = 310.21 g/mol} (show work) (10 pts)

Yield in grams _____

b. If the theoretical yield of the product $Ca_3(PO_4)_2$ based on the number of grams of the starting material K_3PO_4 is 6.07 grams $Ca_3(PO_4)_2$, which is the limiting reagent ? Circle one (5 pts) [compare with theoretical yield you calculated in part (a)]

[(K_3PO_4) or ($CaCl_2$)]

c. If I have 1.78 moles of the calcium phosphate [$Ca_3 (PO_4)_2$], how many atoms of oxygen do I have ($N_A = 6.022 \times 10^{23}$) ? (5 pts)

2. Gas Law: (10 pts) Given the ideal gas law $PV = n R T$

I have 1.2 moles of a gas in a gas cylinder of 305.1 mL at 753.1 torr, what is the temperature of the gas in Kelvin ? [$R = 0.08206$ (L atm) / (mol K)]

General Chemistry I Lecture Fall 2016 10/17/16 M Exam II form White Dr. Hahn Exam # 1-4

Name_____ (print) Name _____(sign)

Please show work for partial credit and full credit on the Long Answers and in some of the Short Answer Questions. Multip choice questions have no partial credit. Please write anything you want graded legibly. If you run out of space , please 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 7 real pages + periodic table+ solubility chart .)

1 mole = molar mass = 6.022×10^{23} PV=nRT R = 0.08206 (L atm)/(molK) K = $^oC + 273.15$

$\frac{P_1V_1}{P_2V_2} = \frac{T_1}{T_2}$ 760 torr = 760 mm Hg = 1.00 atmosphere

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (2 pts each, 26 pts total)

1) Identify the spectator ions in the following molecular equation. 1) _____

$KCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + KNO_3(aq)$

A) K^+ and Cl^-
B) Ag^+ and NO_3^-
C) Ag^+ and Cl^-
D) K^+ and NO_3^-
E) There are no spectator ions in this reaction.

2) What is the concentration of nitrate ions in a 0.225 M $Sr(NO_3)_2$ solution? 2) _____
A) 0.675 M B) 0.450 M C) 0.112 M D) 0.725 M E) 0.225 M

3) Determine the number of moles of sodium in 3.20 moles of sodium hydrogen phosphate. 3) _____
A) 6.40 moles of sodium
B) 1.60 moles of sodium
C) 3.20 moles of sodium
D) 9.60 moles of sodium
E) 12.80 moles of sodium

4) Which of the following is a precipitation reaction? 4) _____
A) $Zn(s) + 2\ AgNO_3(aq) \rightarrow 2\ Ag(s) + Zn(NO_3)_2(aq)$
B) $2\ NaI(aq) + Hg_2(NO_3)_2(aq) \rightarrow Hg_2I_2(s) + 2\ NaNO_3(aq)$
C) $HCl(aq) + KOH(aq) \rightarrow KCl(aq) + H_2O(l)$
D) $KCl(aq) + LiI(aq) \rightarrow KI(aq) + LiCl(aq)$
E) None of the above is a precipitation reaction.

5) When dissolved in water, KOH behaves as 5) _____
A) a base that forms KO^- and H^+ ions.
B) an acid that forms K^+ and OH^- ions.
C) a base that forms K^+ and OH^- ions.
D) an acid that forms KO^- and H^+ ions.

6) Identify acetic acid. 6) _____

A) strong electrolyte, strong acid
B) weak electrolyte, weak acid
C) weak electrolyte, strong acid
D) strong electrolyte, weak acid
E) nonelectrolyte

7) Give the name for HNO_3. 7) _____

A) hydrogen nitrite
B) nitrous acid
C) hydrogen nitride
D) nitric acid
E) hydrogen nitrate

8) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 8) _____

A) 29.5 torr B) 13.5 torr C) 28.1 torr D) 760 torr E) 715 torr

9) Identify ammonia. 9) _____

A) weak electrolyte, strong base
B) strong electrolyte, strong base
C) weak electrolyte, weak base
D) strong electrolyte, weak base
E) nonelectrolyte

10) Which one of the following compounds is **soluble** in water? 10) _____

A) $Cu_3(PO_4)_2$ B) $Cu(NO_3)_2$ C) $SrCO_3$ D) FeS

11) Write the name for $Mg_3(PO_4)_2$. 11) _____

A) magnesium phosphite
B) trimagnesium phosphorustetraoxide
C) magnesium(III) phosphite
D) magnesium phosphate
E) magnesium(II) phosphite

12) Three identical flasks contain three different gases at standard temperature and pressure. Flask A contains CH_4, flask B contains O_3, and flask C contains N_2. Which flask contains the **largest** number of molecules? 12) _____

A) flask A
B) flask B
C) flask C
D) All contain same number of molecules.

13) In a container containing Ne, H_2, and CO_2, what is the mole fraction of Ne if the H_2 mole fraction is 0.22 and the CO_2 mole fraction is 0.58? 13) _____

A) 0.10 B) 0.20 C) 0.30 D) 0.50

II. Short Answers (48 pts)

1. Given the following molecule, show your calculation of the molecular formula mass (molar mass of the molecule). (5 pts)

P_2O_5

2. Is the following molecule [(soluble) or (insoluble)] (circle one) ? Explain your reasoning in a few words. (5 pts)

$(NH_4)_2\ S$

3. Nomenclature (6 pts total, 3 pts each)

a. Name of the molecule _____

$N_2\ O_4$

b. Name of the acid _____

$H\ NO_3$

4 Given the following acid base reaction, complete & balance the reaction. (6 pts total, 3 pts each) (left side is already balanced & need not be modified)

$2\ Li\ OH + H_2SO_4 \rightarrow$ _____ + _____

5. If I dissolve the following in water, what will be the identity of the blanks ? (6 pts total, 3 pts each)

$Ba(NO_3)_2$ (aq) → _____ (aq) + _____ (aq)

6. a. What is the molarity of the reagent made from 1.78 grams of H Cl (FW HCl = 36.46 g/mol) (5 pts) (M = #moles / liter) by addition of solution up to the 500.0 mL line ?

b. If you dilute that reagent by taking 25.0 mL of the above reagent and adding enough water to make up 250.0 mL, what is the diluted molarity ? (5 pts) ($M_1V_1 = M_2V_2$)

7. Given the following, **circle all** which are a **weak electrolyte** ? (12 pts, 2 pts each)

NaCl HF HNO_3 NH_3 KOH $H C_2H_3O_2$

8. What is the oxidation state of the following ? Either explain or show work. (8 pts, 4 pts per blank)

N_2 _____

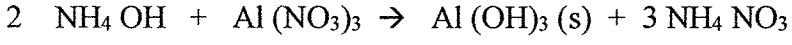
P in PO_4^{-3} _____

9 If at STP (0° C and 1 atm) I have 1.35 moles of the gas CH_4, how many liters of CH_4 do I have ? Show work. (STP volume = 22.4 Liters) (5 pts)

_____ liters of CH_4

III. Long Answer (30 pts) Please show work. If you get the final correct number without showing your work, you will earn zero points.

1. Theoretical Yield (20 pts)



$$2\ NH_4OH + Al(NO_3)_3 \rightarrow Al(OH)_3\ (s) + 3\ NH_4NO_3$$

a. If 2.54 grams of NH_4OH reacts by the above reaction, what is the theoretical yield in grams of the $Al(OH)_3$? { $FW(NH_4OH) = 35.06$ g/mol $FW(Al(OH)_3) = 78.03$ g/mol } (10 pts)

Theoretical yield _____ g $Al(OH)_3$

b. If the theoretical yield of the product $Al(OH)_3$ based on the number of grams of the starting material $Al(NO_3)_3$ is 1.02 grams $Al(OH)_3$, which is the limiting reagent ? Circle one (5 pts) [compare with theoretical yield you calculated in part (a)]

[(NH_4OH) or $(Al(NO_3)_3$]

c. If I have 2.72 moles of the aluminum nitrate , how many atoms of oxygen do I have (N_A = 6.022×10^{23}) ? (5 pts)

2. Gas Law: (10 pts)

Given the combined gas law $\frac{P_2V_2}{P_1V_1} = \frac{T_2}{T_1}$

I have a mixed gas system at 0° C at 1.01 atmosphere occupying 258.1 mL. If I heat the system to 25° C at the same time that I increase the pressure to 2.3 atmosphere, what volume will the gas occupy ? (K = ° C + 273.15)