

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 I cannot read your work, I obviously cannot grade it. (2 pts print and sign exam) If you run out of space, please continue on the back page of the exam and clearly tell me where the remaining answer can be found.  $N_A = 6.022 \times 10^{23}$

$$PV = nRT \quad R = 0.08206 \text{ (L atm)/(mol K)} \quad (P_2 V_2) / (P_1 V_1) = T_2 / T_1 \quad 1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr}$$

Part I MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. No partial credit for MC. (2 pts per question, 20 pts total)

- 1) Give the name for  $\text{H}_2\text{SO}_4$ . 1) B  
 A) sulfurous acid  
 B) sulfuric acid  
 C) persulfuric acid  
 D) persulfurous acid  
 E) hyposulfurous acid
- 2) The compound,  $\text{NO}_2$ , is named 2) D  
 A) nitrite.  
 B) nitrogen (IV) oxide.  
 D) nitrogen dioxide.  
 C) nitrate.
- 3) Which of the following is an acid-base reaction? 3) D  
 A)  $\text{Fe(s)} + 2 \text{AgNO}_3\text{(aq)} \rightarrow 2 \text{Ag(s)} + \text{Fe(NO}_3)_2\text{(aq)}$   
 B)  $\text{C(s)} + \text{O}_2\text{(g)} \rightarrow \text{CO}_2\text{(g)}$   
 C)  $\text{MgSO}_4\text{(aq)} + \text{Ba(NO}_3)_2\text{(aq)} \rightarrow \text{Mg(NO}_3)_2\text{(aq)} + \text{BaSO}_4\text{(s)}$   
 D)  $2 \text{HCl(aq)} + \text{Ca(OH)}_2\text{(aq)} \rightarrow 2 \text{H}_2\text{O(l)} + \text{CaCl}_2\text{(aq)}$   
 E) None of the above are acid base reactions.
- 4) How many  $\text{H}^+$  ions can the acid,  $\text{H}_2\text{SO}_4$ , donate per molecule? 4) D  
 A) 1  
 B) 0  
 C) 3  
 D) 2
- 5) Determine the name for aqueous  $\text{HF}$ . 5) D  
 A) hydrofluorous acid  
 B) fluorous acid  
 C) fluoric acid  
 D) hydrofluoric acid  
 E) hydrogen fluorate
- 6) When dissolved in water,  $\text{KOH}$  behaves as 6) B  
 A) a base that forms  $\text{KO}^-$  and  $\text{H}^+$  ions.  
 B) a base that forms  $\text{K}^+$  and  $\text{OH}^-$  ions.  
 C) an acid that forms  $\text{K}^+$  and  $\text{OH}^-$  ions.  
 D) an acid that forms  $\text{KO}^-$  and  $\text{H}^+$  ions.
- 7) What is the empirical formula for  $\text{C}_{12}\text{H}_{24}\text{O}_6$ ? 7) D  
 A)  $\text{CHO}$   
 B)  $\text{CHO}_2$   
 C)  $\text{CH}_2\text{O}$   
 D)  $\text{C}_2\text{H}_4\text{O}$   
 E)  $\text{C}_2\text{H}_5\text{O}$
- $12 - 24 - 6 \div 6 = 2 : 4 : 1$

8) Convert 1.50 atm to mm Hg. (1 atm = 760 mm Hg)

- A) 1520 mm Hg
- B) 1000 mm Hg
- C) 760 mm Hg
- D) 875 mm Hg
- E) 1140 mm Hg

$$1.50 \text{ atm} \times \frac{760 \text{ mmHg}}{1 \text{ atm}} = 1140$$

8) E

9) Identify acetic acid. ( $\text{CH}_3\text{COOH}$ )

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

acid

10) Which of the compounds  $\text{HNO}_3$ ,  $\text{Ca}(\text{OH})_2$ ,  $\text{KOH}$ , and  $\text{HI}$  behave as bases when they are dissolved in water?

- A) only  $\text{KOH}$
- C)  $\text{HNO}_3$  and  $\text{HI}$

- B)  $\text{Ca}(\text{OH})_2$  and  $\text{KOH}$
- D) only  $\text{HI}$

10) B

**Part II Short Answer:** Write the word or phrase or circle the choice that best completes each statement or answers the question. Some questions may require that you show work. If you do not show work, you may lose points. Even on questions which do not require work, if you legibly show work, you may get some partial credit.

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work. (43 pts)

1. For the molecule  $\text{Al}_2(\text{SO}_4)_3$  what is the molar mass 342.17 grams  
(show work)

what is the formula mass 342.17 amu (6 pts total)

$$2 \underset{\text{Al}}{(26.98)} + 3 \underset{\text{S}}{(32.07)} + 12(16.00) = 342.17$$

2. For the compound with the formula shown complete the following:

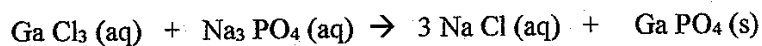
In one mole of  $\text{Ca}(\text{NO}_3)_2$

you have 2 moles (4 pts) of the polyatomic ion  $\text{NO}_3^-$  — 2  $\text{NO}_3$  per molecule  
and 6 moles (4 pts) of the element **O**

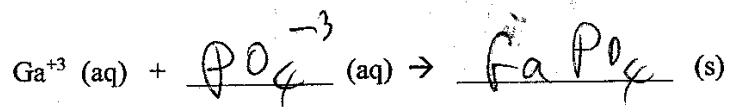
$$3 \underline{\underline{\text{O}}} \times 2 = 6 \underline{\underline{\text{O}}}$$

3. For the following precipitation reaction written as the molecular equation, fill in the blanks to write the net ionic equation (8 pts, 4 pts each)

Molecular equation

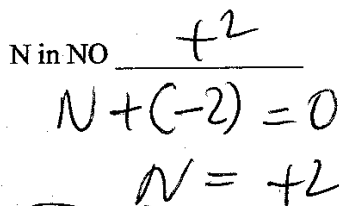


Net ionic equation:



4. Give the oxidation state of the following atom. Either show work or explain where you got the oxidation state. (6 pts, 3 pts each, show work)

Fe zero  
element



5. Is the molecule  $\text{Hg}_2\text{I}_2$  [(soluble) or (insoluble)] (circle one) in water? (5 pts)

I soluble - exception  $\text{Hg}_2^{2+}$

6. Circle all of the following which are strong acids. You may circle one, all or none of the choices. (10 pts total, 2 pt each)



**Part III. Long Answer** Please show work for full credit and to receive partial credit. (35 pts)

\*\*\*\* Please attempt every problem for partial credit. You will get no partial credit if you just rewrite the question with no change in anything.\*\*\*\*

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work otherwise, I obviously cannot grade work I cannot find.

1. Concentration Problem: (20 pts)

- a. If you do the following reaction, using 825.2 grams of  $MgCl_2$  (FW  $MgCl_2 = 95.21$  g/mol), how many mL of a 0.25 M concentration solution of NaOH will you need? (10 pts)



$$825.2g \frac{mol MgCl_2}{95.21g MgCl_2} \times \frac{2 mol NaOH}{1 mol MgCl_2} \times \frac{1000ml NaOH}{0.25 mol NaOH}$$

$$= 69337.2 - 4 \text{ sig fig}$$

$$6.933 \times 10^4 \text{ ml}$$

- b. If you then dilute the concentration of the solution of the NaOH from 0.25 M to 0.15 M how many mL of the new more dilute solution will you then need to complete the reaction? (HINT: treat this as a dilution problem instead of going back to the stoichiometry of the reaction for easiest solution. However you can answer it any way you want) ( $M_1V_1 = M_2V_2$ ) (10 pts)

$$M_1 = 0.25 M, V_1 = 6.933 \times 10^4 \text{ ml}, V_2 = \frac{(0.25)(6.933 \times 10^4)}{(0.15)}$$

$$M_2 = 0.15 M, V_2 = ? \rightarrow$$

$$V_2 = 115550 \text{ ml} \rightarrow 1.2 \times 10^5 \text{ ml on}$$

$$825.2g \frac{mol MgCl_2}{95.21g MgCl_2} \times \frac{2 mol NaOH}{1 mol MgCl_2} \times \frac{1000 ml NaOH}{0.15 mol NaOH} =$$

$$115562 \text{ ml}$$

$$1.2 \times 10^5 \text{ ml}$$

2. Gas Law Problem: Answer the following by filling in the blanks (you may use a ? or the word unknown or the letter symbol (P, V, n or T) for an unknown variable. You need to come up with the final correct answer with the correct units for the answer. (15 pts)  
 (Kelvin = °C + 273.15, 1 atm = 760 torr = 760 mm Hg)

Use the Ideal Gas Law to answer the following. [ P V = n R T, R = 0.08206 (Liter Atm) / (Mol K)]

If you have a gas at 1.1 atm and 25°C which occupies 255 mL volume, how many moles of the gas do you have?

$$P = \frac{1.1}{\text{atm}} \quad V = \frac{255}{\text{ml}} \quad n = \text{?} \quad T = 25^\circ\text{C} \quad (4 \text{ pts, 1 pt each})$$

Final Answer showing all work:

$$T = 25^\circ\text{C} + 273.15 = 298.15 \text{ K}$$

$$V = 255 \text{ ml} \times \frac{1}{1000 \text{ ml}} = 0.255 \text{ L}$$

$$(1.1 \text{ atm}) (0.255 \text{ L}) = n (0.08206 \frac{\text{L atm}}{\text{mol K}}) (298.15 \text{ K})$$

$$n = \frac{(1.1 \text{ atm}) (0.255 \text{ L})}{(0.08206 \frac{\text{L atm}}{\text{mol K}}) (298.15 \text{ K})} =$$

$$n = 0.011 \text{ mol}$$

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 I cannot read your work, I obviously cannot grade it. (2 pts print and sign exam) If you run out of space, please continue on the back page of the exam and clearly tell me where the remaining answer can be found.  $N_A = 6.022 \times 10^{23}$

$$PV = nRT \quad R = 0.08206(\text{L atm})/(\text{mol K}) \quad (P_2 V_2) / (P_1 V_1) = T_2 / T_1 \quad 1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr}$$

**Part I MULTIPLE CHOICE.** Choose the one alternative that best completes the statement or answers the question. No partial credit for MC. (2 pts per question, 20 pts total)

1) Which of the following is an acid-base reaction?

- A)  $\text{Fe(s)} + 2 \text{AgNO}_3(\text{aq}) \rightarrow 2 \text{Ag(s)} + \text{Fe(NO}_3)_2(\text{aq})$   
 B)  $\text{C(s)} + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$   
 C)  $2 \text{HCl(aq)} + \text{Ca(OH)}_2(\text{aq}) \rightarrow 2 \text{H}_2\text{O(l)} + \text{CaCl}_2(\text{aq})$   
 D)  $\text{MgSO}_4(\text{aq}) + \text{Ba(NO}_3)_2(\text{aq}) \rightarrow \text{Mg(NO}_3)_2(\text{aq}) + \text{BaSO}_4(\text{s})$   
 E) None of the above are acid base reactions.

1) C2) Give the name for  $\text{H}_2\text{SO}_4$ .

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

2) B3) The compound,  $\text{NO}_2$ , is named

- A) nitrogen (IV) oxide.  
 C) nitrogen dioxide.  
 B) nitrate.  
 D) nitrite.

3) C

4) Convert 1.50 atm to mm Hg. (1 atm = 760 mm Hg)

- A) 1000 mm Hg  
 B) 760 mm Hg  
 C) 875 mm Hg  
 D) 1140 mm Hg  
 E) 1520 mm Hg

$$1.50 \times 760 = 1140$$

4) D

5) When dissolved in water, KOH behaves as

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

5) B6) Identify acetic acid. ( $\text{CH}_3\text{COOH}$ )

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

6) B

- 7) Which of the compounds  $\text{HNO}_3$ ,  $\text{Ca(OH)}_2$ ,  $\text{KOH}$ , and  $\text{HI}$ , behave as bases when they are dissolved in water? 7) C  
 A) only  $\text{HI}$  B) only  $\text{KOH}$   
 C)  $\text{Ca(OH)}_2$  and  $\text{KOH}$  D)  $\text{HNO}_3$  and  $\text{HI}$
- 8) What is the empirical formula for  $\text{C}_{12}\text{H}_{24}\text{O}_6$ ? 8) D  
 A)  $\text{CHO}$  B)  $\text{CHO}_2$  C)  $\text{C}_2\text{H}_5\text{O}$   D)  $\text{C}_2\text{H}_4\text{O}$  E)  $\text{CH}_2\text{O}$
- 9) Determine the name for aqueous  $\text{HF}$ . 9) E  
 A) hydrogen fluoride  
 B) fluorous acid  
 C) hydrofluorous acid  
 D) fluoric acid  
 E) hydrofluoric acid
- 10) How many  $\text{H}^+$  ions can the acid,  $\text{H}_2\text{SO}_4$ , donate per molecule? 10) B  
 A) 0  B) 2 C) 3 D) 1



**Part II Short Answer:** Write the word or phrase or circle the choice that best completes each statement or answers the question. Some questions may require that you show work. If you do not show work, you may lose points. Even on questions which do not require work, if you legibly show work, you may get some partial credit.

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work. (43 pts)

1. For the molecule  $(\text{NH}_4)_3\text{N}$  what is the molar mass 68.16 grams (show work)

what is the formula mass 68.16 amu (6 pts total)

$$\begin{array}{c} 4(14.01) + 12(1.01) = 68.16 \\ \text{N} \qquad \qquad \text{H} \end{array}$$

2. For the compound with the formula shown complete the following:

In one mole of  $\text{Ga}_2(\text{SO}_4)_3$

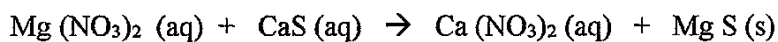
you have 3 moles (4 pts) of the polyatomic ion  $\text{SO}_4^{2-}$

and 12 moles (4 pts) of the element O

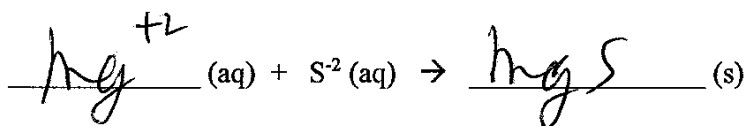
$$3 \times 4 = 12$$

3. For the following precipitation reaction written as the molecular equation, fill in the blanks to write the net ionic equation (8 pts, 4 pts each)

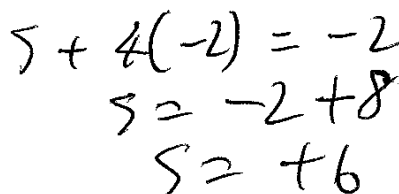
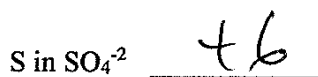
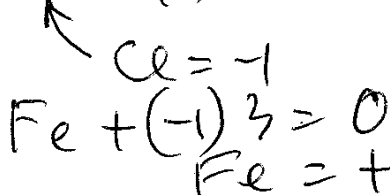
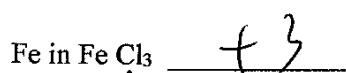
Molecular equation



Net ionic equation:



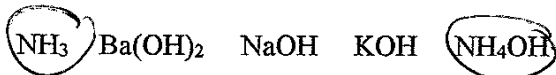
4. Give the oxidation state of the following atom. Either show work or explain where you got the oxidation state. (6 pts, 3 pts each, show work)



5. Is the molecule  $\text{CaS}$  (soluble) or (insoluble] (circle one) in water? (5 pts)

$\text{S}^{2-}$  insoluble except  $\text{CaS}$  - soluble

6. Circle all of the following which are weak bases. You may circle one, all or none of the choices. (10 pts total, 2 pt each)



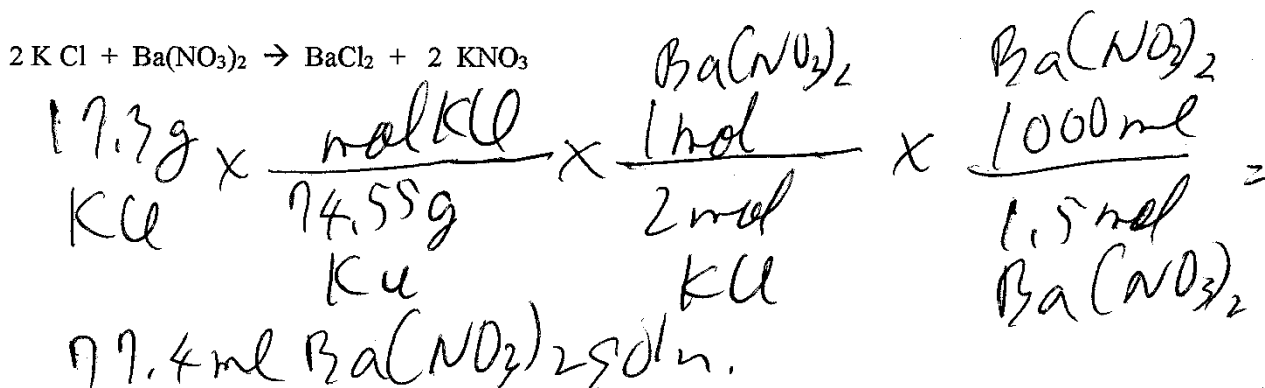
**Part III. Long Answer** Please show work for full credit and to receive partial credit. (35 pts)

\*\*\*\* Please attempt every problem for partial credit. You will get no partial credit if you just rewrite the question with no change in anything.\*\*\*\*

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work otherwise, I obviously cannot grade work I cannot find.

1. Concentration Problem: (20 pts)

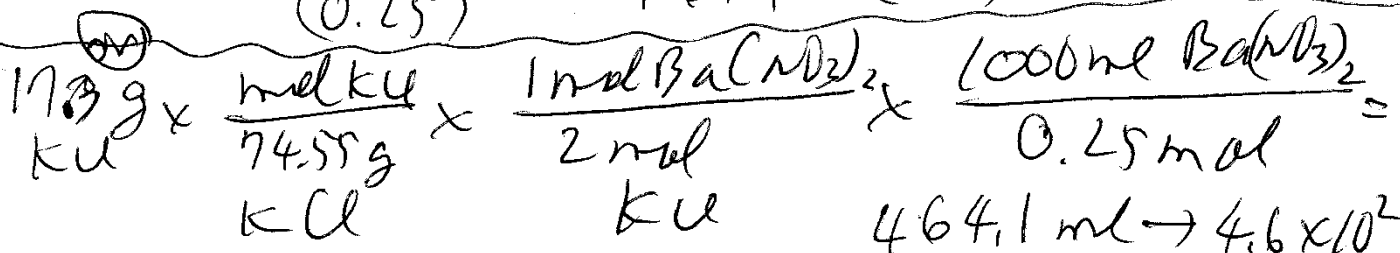
- a. If you do the following reaction, using 17.3 grams of KCl (FW KCl = 74.55 g/mol), how many mL of a 1.5 M concentration solution of  $\text{Ba}(\text{NO}_3)_2$  will you need ? (10 pts)



- b. If you then dilute the concentration of the solution of the  $\text{Ba}(\text{NO}_3)_2$  from 1.5 M to 0.25 M how many mL of the new more dilute solution will you then need to complete the reaction ? (HINT: treat this as a dilution problem instead of going back to the stoichiometry of the reaction for easiest solution. However you can answer it any way you want) ( $M_1V_1 = M_2V_2$ ) (10 pts)

$$M_1 = 1.5 \text{ M} \quad V_1 = 77.4 \text{ mL} \quad M_2 = 0.25 \text{ M} \quad V_2 = ?$$

$$V_2 = \frac{(1.5)(77.4)}{(0.25)} = 464.4 \text{ mL} \rightarrow 4.6 \times 10^2 \text{ mL}$$



2. Gas Law Problem: Answer the following by filling in the blanks (you may use a ? or the word **unknown or the letter symbol (P, V, n or T)** for an unknown variable. You need to come up with the final correct answer with the correct units for the answer. (15 pts)  
 (Kelvin = °C + 273.15, 1 atm = 760 torr = 760 mm Hg)

Use the Combined Gas Law to answer the following.  $\frac{P_2 V_2}{P_1 V_1} = \frac{T_2}{T_1}$

A gas at 730 torr and 298 K occupies a 7.5 liter cylinder. If you change the pressure of the gas to 770 torr and adjust the volume to 91.2 Liters, what is the new temperature ?

$$P_1 = \frac{730 \text{ torr}}{760} V_1 = 7.5 \text{ L} \quad T_1 = 298 \text{ K} \quad P_2 = \frac{770}{760} \text{ torr} \quad V_2 = 91.2 \text{ L} \quad T_2 = ? \quad (3 \text{ pts, } 1/2 \text{ pt each})$$

Final Answer showing all work:

$$P_1 = 730 \text{ torr} \times \frac{1 \text{ atm}}{760 \text{ torr}} = 0.961 \text{ atm}$$

$$P_2 = 770 \text{ torr} \times \frac{1 \text{ atm}}{760 \text{ torr}} = 1.01 \text{ atm}$$

$$\frac{(1.01 \text{ atm})(91.2 \text{ L})}{(0.961 \text{ atm})(7.5 \text{ L})} = \frac{T_2}{298 \text{ K}}$$

$$\frac{(1.01)(91.2)(298 \text{ K})}{(0.961)(7.5)} = 3808.4 \text{ K}$$

$$3.81 \times 10^3 \text{ K}$$

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 I cannot read your work, I obviously cannot grade it. (2 pts print and sign exam) If you run out of space, please continue on the back page of the exam and clearly tell me where the remaining answer can be found.  $N_A = 6.022 \times 10^{23}$

$PV = nRT$   $R = 0.08206(\text{L atm})/(\text{mol K})$   $(P_2 V_2) / (P_1 V_1) = T_2 / T_1$   $1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr}$

Part I MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. No partial credit for MC. (2 pts per question, 20 pts total)

- 1) How many  $\text{H}^+$  ions can the acid,  $\text{H}_3\text{PO}_4$ , donate per molecule? 1) D  
 A) 1 B) 2 C) 0 D) 3
- 2) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 2) C  
 A) 760 torr B) 13.8 torr C) 715 torr D) 31.8 torr E) 28.1 torr
- 3) What is the empirical formula for  $\text{C}_8\text{H}_{16}\text{O}_4$ ? C  $\text{C}_8\text{H}_{16}\text{O}_4 \div 4$  3) B  
 A)  $\text{C}_2\text{H}_5\text{O}$  B)  $\text{C}_2\text{H}_4\text{O}$  C)  $\text{CHO}_2$  D)  $\text{CHO}$  E)  $\text{CH}_2\text{O}$
- 4) Which of the compounds  $\text{HNO}_3$ ,  $\text{Ca}(\text{OH})_2$ ,  $\text{KOH}$ , and  $\text{HI}$ , behave as bases when they are dissolved in water? 4) A  
A)  $\text{Ca}(\text{OH})_2$  and  $\text{KOH}$  B)  $\text{HNO}_3$  and  $\text{HI}$   
 C) only  $\text{HI}$  D) only  $\text{KOH}$
- 5) Give the name for  $\text{HNO}_3$ . 5) A  
 A) nitric acid  
 B) nitrous acid  
 C) hydrogen nitride  
 D) hydrogen nitrate  
 E) hydrogen nitrite
- 6) Determine the name for aqueous  $\text{HBr}$ . 6) D  
 A) hydrobromous acid  
 B) hydrogen bromate  
 C) bromic acid  
D) hydrobromic acid  
 E) bromous acid  
*hydro-ic acid*
- 7) Identify  $\text{HCl}$ . 7) C  
 A) nonelectrolyte  
 B) strong electrolyte, weak acid  
C) strong electrolyte, strong acid  
 D) weak electrolyte, weak acid  
 E) weak electrolyte, strong acid

8) When dissolved in water, KOH behaves as

- A) a base that forms  $\text{KO}^-$  and  $\text{H}^+$  ions.
- C) an acid that forms  $\text{K}^+$  and  $\text{OH}^-$  ions.

- B) an acid that forms  $\text{KO}^-$  and  $\text{H}^+$  ions.
- D) a base that forms  $\text{K}^+$  and  $\text{OH}^-$  ions.

8) D

9) Which of the following is an acid-base reaction?

- A)  $\text{Fe(s)} + 2 \text{AgNO}_3(\text{aq}) \rightarrow 2 \text{Ag(s)} + \text{Fe(NO}_3)_2(\text{aq})$
- B)  $2 \text{HCl(aq)} + \text{Ca(OH)}_2(\text{aq}) \rightarrow 2 \text{H}_2\text{O(l)} + \text{CaCl}_2(\text{aq})$
- C)  $\text{MgSO}_4(\text{aq}) + \text{Ba(NO}_3)_2(\text{aq}) \rightarrow \text{Mg(NO}_3)_2(\text{aq}) + \text{BaSO}_4(\text{s})$
- D)  $\text{C(s)} + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$
- E) None of the above are acid base reactions.

9) B

10) Give the name for  $\text{PBr}_3$ .

- A) phosphorus (II) bromide
- B) potassium tribromide
- C) phosphorus tribromide
- D) phosphorus bromide
- E) phosphorus (III) bromide

- covalent  
# prefix

10) C

**Part II Short Answer:** Write the word or phrase or circle the choice that best completes each statement or answers the question. Some questions may require that you show work. If you do not show work, you may lose points. Even on questions which do not require work, if you legibly show work, you may get some partial credit.

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work. (43 pts)

1. For the molecule  $\text{Ga}(\text{NO}_3)_3$  what is the molar mass 255.75 grams (show work)

what is the formula mass 255, 75 amu (6 pts total)

$$\begin{array}{c} \text{Ga} \\ (69.72) \end{array} + 3 \begin{array}{c} \text{N} \\ (14.01) \end{array} + 9(16.00) = 255.75$$

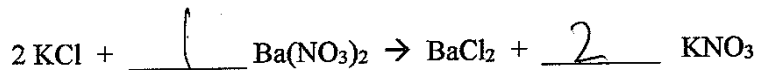
2. If you have 73.2 grams of  $\text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2$ , how many moles is that? 0.287 moles  
(molar mass of  $\text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2$  is 255.43 g/mol) (8 pts) (show work)

$$\begin{array}{c} 73.2 \\ \text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2 \end{array} \times \frac{\text{mol Ba}(\text{C}_2\text{H}_3\text{O}_2)_2}{255.43 \text{ g/mol Ba}(\text{C}_2\text{H}_3\text{O}_2)_2} = 0.287 \text{ mol Ba}(\text{C}_2\text{H}_3\text{O}_2)_2$$

3. Balancing Chemical Reactions: (8 pts total, 4 pts each blank)

- (a) Given the following unbalanced reaction, balance the reaction by filling in the blanks in the equation
- (b) After balancing the reaction give the number of each type of atom (or polyatomic ion) on each side of the reaction by filling in the blanks. Show work for partial credit.

(NOTE: in a balanced chemical reaction, if no coefficient is found before a molecular formula, it means that there is ONE of the molecule formula. A missing coefficient does not mean that there are ZERO of the molecular formula.)



# of  $\text{Ba}^{+2}$  (reactant) 1

2K, 2Cl, 1Ba,  
2NO<sub>3</sub>

# of  $\text{NO}_3^{-1}$  (product) 2

1Ba<sup>+2</sup>, 2Cl<sup>-1</sup>, 2K<sup>+</sup>, 2NO<sub>3</sub><sup>-1</sup>

4. Give the oxidation state of the following atom. Either show work or explain where you got the oxidation state. (6 pts, 3 pts each, show work)

H<sub>2</sub> zero  
most stable  
form element

P in  $\text{PO}_4^{-3}$  +5

$$P + 4(-2) = -3$$

$$P = -3 + 8 = +5$$

5. Is the molecule  $\text{Al}(\text{OH})_3$  [(soluble) or (insoluble)] (circle one) in water? (5 pts)

OH<sup>-</sup> are insoluble Al<sup>+3</sup> not exception.

6. Circle all of the following which are strong bases. You may circle one, all or none of the choices. (10 pts total, 2 pt each)

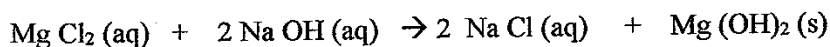
$\text{NH}_3$  Ba(OH)<sub>2</sub> NaOH KOH  $\text{NH}_4\text{OH}$



**Part III. Long Answer** Please show work for full credit and to receive partial credit. (35 pts)  
 \*\*\*\* Please attempt every problem for partial credit. You will get no partial credit if you just rewrite the question with no change in anything. \*\*\*\*

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work otherwise, I obviously cannot grade work I cannot find.

1. Stoichiometry: In the following reaction if I have 792.3 grams of NaOH (FW= 40.00 g/mol ), how many grams of Mg(OH)<sub>2</sub> (FW = 58.52 g/mol ) will I produce? To solve this problem, complete the following. (20 pts)



- a. Give 3 conversion factors below. HINT: 2 of the conversion factors use the definition of the mole and the third uses the balanced chemical reaction. (9 pts)

Conversion Factor #1:  $1 \text{ mol NaOH} = 40.00 \text{ g NaOH}$

Conversion Factor #2:  $2 \text{ mol NaOH} \rightarrow 1 \text{ mol Mg(OH)}_2$

Conversion Factor #3:  $1 \text{ mol Mg(OH)}_2 = 58.52 \text{ g Mg(OH)}_2$

- b. Complete the problem by using dimensional analysis and the 3 conversion factors above to answer the question. (11 pts)

$$792.3 \text{ g NaOH} \times \frac{1 \text{ mol NaOH}}{40.00 \text{ g NaOH}} \times \frac{1 \text{ mol Mg(OH)}_2}{2 \text{ mol NaOH}} \times \frac{58.52 \text{ g Mg(OH)}_2}{1 \text{ mol Mg(OH)}_2} = 579.56 \text{ g Mg(OH)}_2$$

4 sig fig  
579.6 g

2. Gas Law Problem: Answer the following by filling in the blanks (you may use a ? or the word **unknown** or the letter symbol (P, V, n or T) for an unknown variable. You need to come up with the final correct answer with the correct units for the answer. (15 pts)

(Kelvin = °C + 273.15, 1 atm = 760 torr = 760 mm Hg)

Use the Combined Gas Law to answer the following.  $\frac{P_2 V_2}{P_1 V_1} = \frac{T_2}{T_1}$

A gas at 763.2 mm Hg occupies 1.5 Liters at 298 K. At 2.0 Liters and 305 Kelvin, what is the pressure exerted by the same gas ?

$P_1 = \underline{763.2}$   $V_1 = \underline{1.5 \text{ L}}$   $T_1 = \underline{298 \text{ K}}$   $P_2 = \underline{?}$   $V_2 = \underline{2.0 \text{ L}}$   $T_2 = \underline{305 \text{ K}}$  (3 pts, 1/2 pt each)

mmHg

Final Answer showing all work:

$$P_1 = 763.2 \text{ mmHg} \times \frac{1 \text{ atm}}{760 \text{ mmHg}} = 1.004 \text{ atm}$$

$$\frac{(P_2)(2.0 \text{ L})}{(1.004 \text{ atm})(1.5 \text{ L})} = \frac{305 \text{ K}}{298 \text{ K}}$$

$$P_2 = \left( \frac{305 \text{ K}}{298 \text{ K}} \right) \left( \frac{1.004 \text{ atm}}{2.0 \text{ L}} \right) (1.5 \text{ L})$$

$$P_2 = 0.7707 \text{ atm}$$

Name Kly (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 I cannot read your work, I obviously cannot grade it. (2 pts print and sign exam) If you run out of space, please continue on the back page of the exam and clearly tell me where the remaining answer can be found.  $N_A = 6.022 \times 10^{23}$

$$PV = nRT \quad R = 0.08206(\text{L atm})/(\text{mol K}) \quad (P_2 V_2) / (P_1 V_1) = T_2 / T_1 \quad 1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr}$$

**Part I MULTIPLE CHOICE.** Choose the one alternative that best completes the statement or answers the question. No partial credit for MC. (2 pts per question, 20 pts total)

1) Identify HCl.

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

1) A

2) Determine the name for aqueous HBr.

- A) bromous acid  
 B) bromic acid  
 C) hydrobromous acid  
 D) hydrogen bromate  
 E) hydrobromic acid

2) E3) Give the name for HNO<sub>3</sub>.

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

3) B

4) When dissolved in water, KOH behaves as

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

4) B

5) Which of the following is an acid-base reaction?

- A)  $2 \text{HCl}(\text{aq}) + \text{Ca}(\text{OH})_2(\text{aq}) \rightarrow 2 \text{H}_2\text{O}(\text{l}) + \text{CaCl}_2(\text{aq})$   
 B)  $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$   
 C)  $\text{MgSO}_4(\text{aq}) + \text{Ba}(\text{NO}_3)_2(\text{aq}) \rightarrow \text{Mg}(\text{NO}_3)_2(\text{aq}) + \text{BaSO}_4(\text{s})$   
 D)  $\text{Fe}(\text{s}) + 2 \text{AgNO}_3(\text{aq}) \rightarrow 2 \text{Ag}(\text{s}) + \text{Fe}(\text{NO}_3)_2(\text{aq})$   
 E) None of the above are acid base reactions.

5) A6) How many H<sup>+</sup> ions can the acid, H<sub>3</sub>PO<sub>4</sub>, donate per molecule?

- A) 1  
 B) 0  
 C) 2  
 D) 3

6) D

- 7) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 7) A  
A) 715 torr      B) 31.8 torr      C) 13.8 torr      D) 760 torr      E) 28.1 torr
- 8) What is the empirical formula for  $C_8H_{16}O_4$ ? 8) C  
A) CHO      B)  $CHO_2$       C)  $C_2H_4O$       D)  $CH_2O$       E)  $C_2H_5O$
- 9) Which of the compounds  $HNO_3$ ,  $Ca(OH)_2$ , KOH, and HI, behave as bases when they are dissolved in water? 9) A  
A)  $Ca(OH)_2$  and KOH      B) only HI  
C)  $HNO_3$  and HI      D) only KOH
- 10) Give the name for  $PBr_3$ . 10) C  
A) potassium tribromide  
B) phosphorus (II) bromide  
C) phosphorus tribromide  
D) phosphorus bromide  
E) phosphorus (III) bromide

**Part II Short Answer:** Write the word or phrase or circle the choice that best completes each statement or answers the question. Some questions may require that you show work. If you do not show work, you may lose points. Even on questions which do not require work, if you legibly show work, you may get some partial credit.

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work. (43 pts)

1. For the molecule  $\text{Be}_3(\text{PO}_4)_2$  what is the molar mass 216.97 grams (show work)

what is the formula mass 216.97 amu (6 pts total)

$$\begin{array}{c} (9.01)(3) \\ \text{Be} \end{array} + \begin{array}{c} (30.97)2 \\ \text{P} \end{array} + \begin{array}{c} (16.00)(8) \\ \text{O} \end{array} = 216.97$$

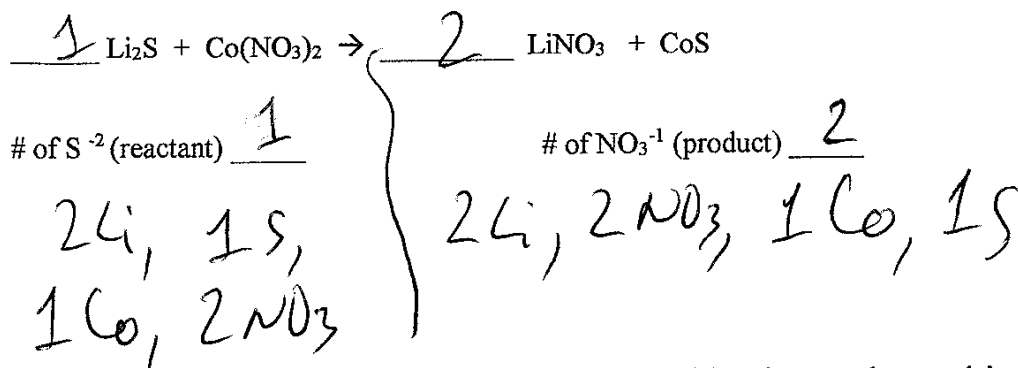
2. If you have 73.2 grams of  $\text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2$ , how many moles is that? 0.287 moles  
(molar mass of  $\text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2$  is 255.43 g/mol) (8 pts) (show work)

$$\begin{array}{c} 73.2 \text{ g} \\ \text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2 \end{array} \times \frac{\text{mol Ba}(\text{C}_2\text{H}_3\text{O}_2)_2}{255.43 \text{ g Ba}(\text{C}_2\text{H}_3\text{O}_2)_2} = 0.287 \text{ mol}$$

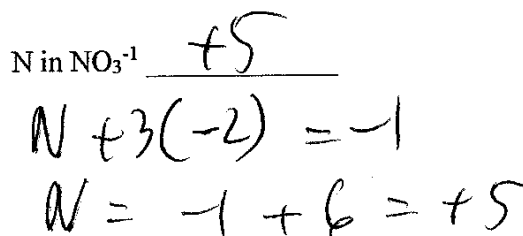
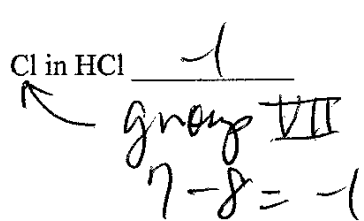
3. Balancing Chemical Reactions: (8 pts total, 4 pts each blank)

- (a) Given the following unbalanced reaction, balance the reaction by filling in the blanks in the equation  
 (b) After balancing the reaction give the number of each type of atom (or polyatomic ion) on each side of the reaction by filling in the blanks. Show work for partial credit.

(NOTE: in a balanced chemical reaction, if no coefficient is found before a molecular formula, it means that there is ONE of the molecule formula. A missing coefficient does not mean that there are ZERO of the molecular formula.)



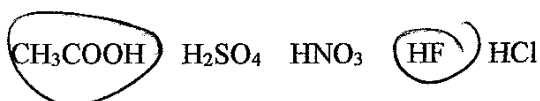
4. Give the oxidation state of the following atom. Either show work or explain where you got the oxidation state. (6 pts, 3 pts each, show work)



5. Is the molecule Na<sub>2</sub>CO<sub>3</sub> [(soluble) or (insoluble)] (circle one) in water? (5 pts)

CO<sub>3</sub><sup>-2</sup> insoluble except alkali metals

6. Circle all of the following which are weak acid. You may circle one, all or none of the choices. (10 pts total, 2 pt each)

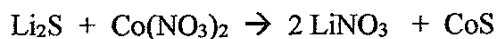


**Part III. Long Answer** Please show work for full credit and to receive partial credit. (35 pts)

\*\*\*\* Please attempt every problem for partial credit. You will get no partial credit if you just rewrite the question with no change in anything.\*\*\*\*

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work otherwise, I obviously cannot grade work I cannot find.

1. Stoichiometry: In the following reaction if I have 792.3 grams of  $\text{Li}_2\text{S}$  (FW = 45.95 g/mol), how many grams of  $\text{LiNO}_3$  (FW = 68.95 g/mol) will I produce? To solve this problem, complete the following. (20 pts)



- a. Give 3 conversion factors below. HINT: 2 of the conversion factors use the definition of the mole and the third uses the balanced chemical reaction. (9 pts)

Conversion Factor #1:  $1 \text{ mol Li}_2\text{S} = 45.95 \text{ g Li}_2\text{S}$

Conversion Factor #2:  $1 \text{ mol LiNO}_3 = 68.95 \text{ g LiNO}_3$

Conversion Factor #3:  $1 \text{ mol Li}_2\text{S} = 2 \text{ mol LiNO}_3$

- b. Complete the problem by using dimensional analysis and the 3 conversion factors above to answer the question. (11 pts)

$$792.3 \text{ g Li}_2\text{S} \times \frac{1 \text{ mol Li}_2\text{S}}{45.95 \text{ g Li}_2\text{S}} \times \frac{2 \text{ mol LiNO}_3}{1 \text{ mol Li}_2\text{S}} \times \frac{68.95 \text{ g LiNO}_3}{1 \text{ mol LiNO}_3}$$

$$= 2377.76 \text{ g LiNO}_3$$

2377 g  $\text{LiNO}_3$   
(4 sig fig)

2. Gas Law Problem: Answer the following by filling in the blanks (you may use a ? or the word **unknown** or the letter symbol **(P, V, n or T)** for an unknown variable. You need to come up with the final correct answer with the correct units for the answer. (15 pts)

(Kelvin = °C + 273.15, 1 atm = 760 torr = 760 mm Hg)

Use the Ideal Gas Law to answer the following. [  $P V = n R T$ ,  $R = 0.08206 \text{ (Liter Atm) / (Mol K)}$  ]

If a 0.25 mole sample of a gas has pressure of 750 mm Hg at a volume of 357 mL, what is the temperature of the gas ?

$$P = \frac{750}{\text{mmHg}} \quad V = \frac{357}{\text{ml}} \quad n = \frac{0.25}{\text{mol}} \quad T = \underline{\quad ? \quad} \quad (4 \text{ pts, 1 pt each})$$

Final Answer showing all work:

$$P = 750 \text{ mmHg} \times \frac{1 \text{ atm}}{760 \text{ mmHg}} = 0.987 \text{ atm}$$

$$V = 357 \text{ ml} \times \frac{1 \text{ l}}{1000 \text{ ml}} = 0.357 \text{ l}$$

$$P V = n R T$$

$$(0.987 \text{ atm})(0.357 \text{ l}) = (0.25 \text{ mol})(0.08206 \frac{\text{l atm}}{\text{mol K}})(T)$$

$$\frac{(0.987 \text{ atm})(0.357 \text{ l})}{(0.25 \text{ mol})(0.08206 \frac{\text{l atm}}{\text{mol K}})} = T$$

$$17.2 \text{ K} = T$$



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. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If I cannot read your work, I obviously cannot grade it. (2 pts print and sign exam) If you run out of space, please continue on the back page of the exam and clearly tell me where the remaining answer can be found.  $N_A = 6.022 \times 10^{23}$

$$PV = nRT \quad R = 0.08206(\text{L atm})/(\text{mol K}) \quad (P_2 V_2) / (P_1 V_1) = T_2 / T_1 \quad 1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr}$$

**Part I MULTIPLE CHOICE.** Choose the one alternative that best completes the statement or answers the question. No partial credit for MC. (2 pts per question, 20 pts total)

- 1) Give the name for  $\text{H}_2\text{SO}_4$ . 1) \_\_\_\_\_
  - A) sulfurous acid
  - B) sulfuric acid
  - C) persulfuric acid
  - D) persulfurous acid
  - E) hyposulfurous acid
  
- 2) The compound,  $\text{NO}_2$ , is named 2) \_\_\_\_\_

A) nitrite.	B) nitrogen (IV) oxide.
C) nitrate.	D) nitrogen dioxide.
  
- 3) Which of the following is an acid-base reaction? 3) \_\_\_\_\_
  - A)  $\text{Fe(s)} + 2 \text{AgNO}_3(\text{aq}) \rightarrow 2 \text{Ag(s)} + \text{Fe(NO}_3)_2(\text{aq})$
  - B)  $\text{C(s)} + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$
  - C)  $\text{MgSO}_4(\text{aq}) + \text{Ba(NO}_3)_2(\text{aq}) \rightarrow \text{Mg(NO}_3)_2(\text{aq}) + \text{BaSO}_4(\text{s})$
  - D)  $2 \text{HCl(aq)} + \text{Ca(OH)}_2(\text{aq}) \rightarrow 2 \text{H}_2\text{O(l)} + \text{CaCl}_2(\text{aq})$
  - E) None of the above are acid base reactions.
  
- 4) How many  $\text{H}^+$  ions can the acid,  $\text{H}_2\text{SO}_4$ , donate per molecule? 4) \_\_\_\_\_

A) 1	B) 0	C) 3	D) 2
------	------	------	------
  
- 5) Determine the name for aqueous  $\text{HF}$ . 5) \_\_\_\_\_
  - A) hydrofluorous acid
  - B) fluorous acid
  - C) fluoric acid
  - D) hydrofluoric acid
  - E) hydrogen fluoride
  
- 6) When dissolved in water,  $\text{KOH}$  behaves as 6) \_\_\_\_\_

A) a base that forms $\text{KO}^-$ and $\text{H}^+$ ions.	B) a base that forms $\text{K}^+$ and $\text{OH}^-$ ions.
C) an acid that forms $\text{K}^+$ and $\text{OH}^-$ ions.	D) an acid that forms $\text{KO}^-$ and $\text{H}^+$ ions.
  
- 7) What is the empirical formula for  $\text{C}_{12}\text{H}_{24}\text{O}_6$ ? 7) \_\_\_\_\_

A) $\text{CHO}$	B) $\text{CHO}_2$	C) $\text{CH}_2\text{O}$	D) $\text{C}_2\text{H}_4\text{O}$	E) $\text{C}_2\text{H}_5\text{O}$
-----------------	-------------------	--------------------------	-----------------------------------	-----------------------------------

- 8) Convert 1.50 atm to mm Hg. (1 atm = 760 mm Hg) 8) \_\_\_\_\_
- A) 1520 mm Hg
  - B) 1000 mm Hg
  - C) 760 mm Hg
  - D) 875 mm Hg
  - E) 1140 mm Hg
- 9) Identify acetic acid. ( $\text{CH}_3\text{COOH}$ ) 9) \_\_\_\_\_
- A) weak electrolyte, strong acid
  - B) strong electrolyte, strong acid
  - C) nonelectrolyte
  - D) strong electrolyte, weak acid
  - E) weak electrolyte, weak acid
- 10) Which of the compounds  $\text{HNO}_3$ ,  $\text{Ca}(\text{OH})_2$ ,  $\text{KOH}$ , and  $\text{HI}$ , behave as bases when they are dissolved in water? 10) \_\_\_\_\_
- A) only  $\text{KOH}$
  - B)  $\text{Ca}(\text{OH})_2$  and  $\text{KOH}$
  - C)  $\text{HNO}_3$  and  $\text{HI}$
  - D) only  $\text{HI}$

**Part II Short Answer:** Write the word or phrase or circle the choice that best completes each statement or answers the question. Some questions may require that you show work. If you do not show work, you may lose points. Even on questions which do not require work, if you legibly show work, you may get some partial credit.

**Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work. (43 pts )**

1. For the molecule  $\text{Al}_2(\text{SO}_4)_3$  what is the molar mass \_\_\_\_\_ grams  
(show work)

what is the formula mass \_\_\_\_\_ amu (6 pts total)

2. For the compound with the formula shown complete the following:

In one mole of  $\text{Ca}(\text{NO}_3)_2$

you have \_\_\_\_\_ moles (4 pts) of the polyatomic ion  $\text{NO}_3^{-1}$

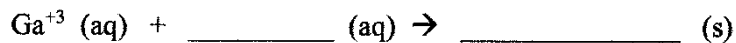
and \_\_\_\_\_ moles (4 pts) of the element **O**

3. For the following precipitation reaction written as the molecular equation, fill in the blanks to write the net ionic equation (8 pts, 4 pts each)

Molecular equation



Net ionic equation:



4. Give the oxidation state of the following atom. Either show work or explain where you got the oxidation state. (6 pts, 3 pts each, show work)

Fe           

N in NO           

5. Is the molecule  $\text{Hg}_2\text{I}_2$  [(soluble) or (insoluble)] (circle one) in water? (5 pts)

6. Circle all of the following which are strong acids. You may circle one, all or none of the choices. (10 pts total, 2 pt each)

$\text{CH}_3\text{COOH}$     $\text{H}_2\text{SO}_4$     $\text{HNO}_3$     $\text{HF}$     $\text{HCl}$

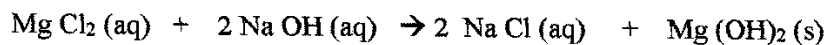
**Part III. Long Answer** Please show work for full credit and to receive partial credit. (35 pts)

\*\*\*\* Please attempt every problem for partial credit. You will get no partial credit if you just rewrite the question with no change in anything.\*\*\*\*

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work otherwise, I obviously cannot grade work I cannot find.

1. Concentration Problem: (20 pts)

- a. If you do the following reaction, using 825.2 grams of  $\text{MgCl}_2$  (FW  $\text{MgCl}_2 = 95.21 \text{ g/mol}$ ), how many mL of a 0.25 M concentration solution of NaOH will you need ? (10 pts)



- b. If you then dilute the concentration of the solution of the NaOH from 0.25 M to 0.15 M how many mL of the new more dilute solution will you then need to complete the reaction ? (HINT: treat this as a dilution problem instead of going back to the stoichiometry of the reaction for easiest solution. However you can answer it any way you want) ( $M_1V_1 = M_2V_2$ ) (10 pts)

2. Gas Law Problem: Answer the following by filling in the blanks (you may use a ? or the word **unknown or the letter symbol (P, V, n or T)** for an unknown variable. You need to come up with the final correct answer with the correct units for the answer. (15 pts)  
(Kelvin = °C + 273.15, 1 atm = 760 torr = 760 mm Hg)

Use the Ideal Gas Law to answer the following. [  $P V = n R T$ ,  $R = 0.08206 \text{ (Liter Atm) / (Mol K)}$ ]

If you have a gas at 1.1 atm and 25°C which occupies 255 mL volume, how many moles of the gas do you have?

P = \_\_\_\_\_ V = \_\_\_\_\_ n = \_\_\_\_\_ T = \_\_\_\_\_ ( 4 pts, 1 pt each)

Final Answer showing all work:

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. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If I cannot read your work, I obviously cannot grade it. (2 pts print and sign exam) If you run out of space, please continue on the back page of the exam and clearly tell me where the remaining answer can be found.  $N_A = 6.022 \times 10^{23}$

$$PV = nRT \quad R = 0.08206(\text{L atm})/(\text{mol K}) \quad (P_2V_2)/(P_1V_1) = T_2/T_1 \quad 1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr}$$

**Part I MULTIPLE CHOICE.** Choose the one alternative that best completes the statement or answers the question. No partial credit for MC. (2 pts per question, 20 pts total)

- 1) Which of the following is an acid-base reaction? 1) \_\_\_\_\_  
 A)  $\text{Fe(s)} + 2 \text{AgNO}_3(\text{aq}) \rightarrow 2 \text{Ag(s)} + \text{Fe(NO}_3)_2(\text{aq})$   
 B)  $\text{C(s)} + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$   
 C)  $2 \text{HCl(aq)} + \text{Ca(OH)}_2(\text{aq}) \rightarrow 2 \text{H}_2\text{O(l)} + \text{CaCl}_2(\text{aq})$   
 D)  $\text{MgSO}_4(\text{aq}) + \text{Ba(NO}_3)_2(\text{aq}) \rightarrow \text{Mg(NO}_3)_2(\text{aq}) + \text{BaSO}_4(\text{s})$   
 E) None of the above are acid base reactions.
- 2) Give the name for  $\text{H}_2\text{SO}_4$ . 2) \_\_\_\_\_  
 A) persulfuric acid  
 B) sulfuric acid  
 C) sulfurous acid  
 D) hyposulfurous acid  
 E) persulfurous acid
- 3) The compound,  $\text{NO}_2$ , is named 3) \_\_\_\_\_  
 A) nitrogen (IV) oxide. B) nitrate.  
 C) nitrogen dioxide. D) nitrite.
- 4) Convert 1.50 atm to mm Hg. (1 atm = 760 mm Hg) 4) \_\_\_\_\_  
 A) 1000 mm Hg  
 B) 760 mm Hg  
 C) 875 mm Hg  
 D) 1140 mm Hg  
 E) 1520 mm Hg
- 5) When dissolved in water, KOH behaves as 5) \_\_\_\_\_  
 A) a base that forms  $\text{KO}^-$  and  $\text{H}^+$  ions. B) a base that forms  $\text{K}^+$  and  $\text{OH}^-$  ions.  
 C) an acid that forms  $\text{KO}^-$  and  $\text{H}^+$  ions. D) an acid that forms  $\text{K}^+$  and  $\text{OH}^-$  ions.
- 6) Identify acetic acid. ( $\text{CH}_3\text{COOH}$ ) 6) \_\_\_\_\_  
 A) weak electrolyte, strong acid  
 B) weak electrolyte, weak acid  
 C) nonelectrolyte  
 D) strong electrolyte, strong acid  
 E) strong electrolyte, weak acid

- 7) Which of the compounds  $\text{HNO}_3$ ,  $\text{Ca}(\text{OH})_2$ ,  $\text{KOH}$ , and  $\text{HI}$ , behave as bases when they are dissolved in water? 7) \_\_\_\_\_  
A) only  $\text{HI}$  B) only  $\text{KOH}$   
C)  $\text{Ca}(\text{OH})_2$  and  $\text{KOH}$  D)  $\text{HNO}_3$  and  $\text{HI}$
- 8) What is the empirical formula for  $\text{C}_{12}\text{H}_{24}\text{O}_6$ ? 8) \_\_\_\_\_  
A)  $\text{CHO}$  B)  $\text{CHO}_2$  C)  $\text{C}_2\text{H}_5\text{O}$  D)  $\text{C}_2\text{H}_4\text{O}$  E)  $\text{CH}_2\text{O}$
- 9) Determine the name for aqueous  $\text{HF}$ . 9) \_\_\_\_\_  
A) hydrogen fluoride  
B) fluorous acid  
C) hydrofluorous acid  
D) fluoric acid  
E) hydrofluoric acid
- 10) How many  $\text{H}^+$  ions can the acid,  $\text{H}_2\text{SO}_4$ , donate per molecule? 10) \_\_\_\_\_  
A) 0 B) 2 C) 3 D) 1



**Part II Short Answer:** Write the word or phrase or circle the choice that best completes each statement or answers the question. Some questions may require that you show work. If you do not show work, you may lose points. Even on questions which do not require work, if you legibly show work, you may get some partial credit.

**Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work. (43 pts )**

1. For the molecule  $(\text{NH}_4)_3\text{N}$  what is the molar mass \_\_\_\_\_ grams (show work)

what is the formula mass \_\_\_\_\_ amu (6 pts total)

2. For the compound with the formula shown complete the following:

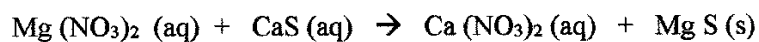
In one mole of  $\text{Ga}_2(\text{SO}_4)_3$

you have \_\_\_\_\_ moles (4 pts) of the polyatomic ion  $\text{SO}_4^{2-}$

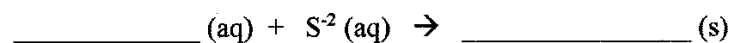
and \_\_\_\_\_ moles (4 pts) of the element **O**

3. For the following precipitation reaction written as the molecular equation, fill in the blanks to write the net ionic equation (8 pts, 4 pts each)

Molecular equation



Net ionic equation:



4. Give the oxidation state of the following atom. Either show work or explain where you got the oxidation state. (6 pts, 3 pts each, show work)

Fe in  $\text{FeCl}_3$  \_\_\_\_\_

S in  $\text{SO}_4^{2-}$  \_\_\_\_\_

5. Is the molecule  $\text{CaS}$  [(soluble) or (insoluble)] (circle one) in water? (5 pts)

6. Circle all of the following which are weak bases. You may circle one, all or none of the choices. (10 pts total, 2 pt each)

$\text{NH}_3$   $\text{Ba}(\text{OH})_2$   $\text{NaOH}$   $\text{KOH}$   $\text{NH}_4\text{OH}$

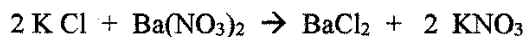
**Part III. Long Answer Please show work for full credit and to receive partial credit. (35 pts)**

**\*\*\*\* Please attempt every problem for partial credit. You will get no partial credit if you just rewrite the question with no change in anything.\*\*\*\***

**Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work otherwise, I obviously cannot grade work I cannot find.**

1. Concentration Problem: (20 pts)

- a. If you do the following reaction, using 17.3 grams of KCl (FW KCl = 74.55 g/mol), how many mL of a 1.5 M concentration solution of Ba(NO<sub>3</sub>)<sub>2</sub> will you need ? (10 pts)



- b. If you then dilute the concentration of the solution of the Ba(NO<sub>3</sub>)<sub>2</sub> from 1.5 M to 0.25 M how many mL of the new more dilute solution will you then need to complete the reaction ? (HINT: treat this as a dilution problem instead of going back to the stoichiometry of the reaction for easiest solution. However you can answer it any way you want) ( $M_1V_1 = M_2V_2$ ) (10 pts)

2. Gas Law Problem: Answer the following by filling in the blanks (you may use a ? or the word **unknown or the letter symbol (P, V, n or T)** for an unknown variable. You need to come up with the final correct answer with the correct units for the answer. (15 pts)  
(Kelvin = °C + 273.15, 1 atm = 760 torr = 760 mm Hg)

Use the Combined Gas Law to answer the following.  $\frac{P_2 V_2}{P_1 V_1} = \frac{T_2}{T_1}$

A gas at 730 torr and 298 K occupies a 7.5 liter cylinder. If you change the pressure of the gas to 770 torr and adjust the volume to 91.2 Liters, what is the new temperature ?

$P_1 =$  \_\_\_\_\_  $V_1 =$  \_\_\_\_\_  $T_1 =$  \_\_\_\_\_  $P_2 =$  \_\_\_\_\_  $V_2 =$  \_\_\_\_\_  $T_2 =$  \_\_\_\_\_ (3 pts, 1/2 pt each)

Final Answer showing all work:

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. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If I cannot read your work, I obviously cannot grade it. (2 pts print and sign exam) If you run out of space, please continue on the back page of the exam and clearly tell me where the remaining answer can be found.  $N_A = 6.022 \times 10^{23}$

$$PV = nRT \quad R = 0.08206(\text{L atm})/(\text{mol K}) \quad (P_2 V_2) / (P_1 V_1) = T_2 / T_1 \quad 1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr}$$

**Part I MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.**  
No partial credit for MC. (2 pts per question, 20 pts total)

- 1) How many H<sup>+</sup> ions can the acid, H<sub>3</sub>PO<sub>4</sub>, donate per molecule? 1) \_\_\_\_\_  
 A) 1                      B) 2                      C) 0                      D) 3
  
- 2) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 2) \_\_\_\_\_  
 A) 760 torr              B) 13.8 torr              C) 715 torr              D) 31.8 torr              E) 28.1 torr
  
- 3) What is the empirical formula for C<sub>8</sub>H<sub>16</sub>O<sub>4</sub>? 3) \_\_\_\_\_  
 A) C<sub>2</sub>H<sub>5</sub>O              B) C<sub>2</sub>H<sub>4</sub>O              C) CHO<sub>2</sub>              D) CHO              E) CH<sub>2</sub>O
  
- 4) Which of the compounds HNO<sub>3</sub>, Ca(OH)<sub>2</sub>, KOH, and HI, behave as bases when they are dissolved in water? 4) \_\_\_\_\_  
 A) Ca(OH)<sub>2</sub> and KOH                      B) HNO<sub>3</sub> and HI  
 C) only HI                                      D) only KOH
  
- 5) Give the name for HNO<sub>3</sub>. 5) \_\_\_\_\_  
 A) nitric acid  
 B) nitrous acid  
 C) hydrogen nitride  
 D) hydrogen nitrate  
 E) hydrogen nitrite
  
- 6) Determine the name for aqueous HBr. 6) \_\_\_\_\_  
 A) hydrobromous acid  
 B) hydrogen bromate  
 C) bromic acid  
 D) hydrobromic acid  
 E) bromous acid
  
- 7) Identify HCl. 7) \_\_\_\_\_  
 A) nonelectrolyte  
 B) strong electrolyte, weak acid  
 C) strong electrolyte, strong acid  
 D) weak electrolyte, weak acid  
 E) weak electrolyte, strong acid

- 8) When dissolved in water, KOH behaves as 8) \_\_\_\_\_
- A) a base that forms  $\text{KO}^-$  and  $\text{H}^+$  ions. B) an acid that forms  $\text{KO}^-$  and  $\text{H}^+$  ions.  
C) an acid that forms  $\text{K}^+$  and  $\text{OH}^-$  ions. D) a base that forms  $\text{K}^+$  and  $\text{OH}^-$  ions.
- 9) Which of the following is an acid-base reaction? 9) \_\_\_\_\_
- A)  $\text{Fe(s)} + 2 \text{AgNO}_3(\text{aq}) \rightarrow 2 \text{Ag(s)} + \text{Fe(NO}_3)_2(\text{aq})$   
B)  $2 \text{HCl(aq)} + \text{Ca(OH)}_2(\text{aq}) \rightarrow 2 \text{H}_2\text{O(l)} + \text{CaCl}_2(\text{aq})$   
C)  $\text{MgSO}_4(\text{aq}) + \text{Ba(NO}_3)_2(\text{aq}) \rightarrow \text{Mg(NO}_3)_2(\text{aq}) + \text{BaSO}_4(\text{s})$   
D)  $\text{C(s)} + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$   
E) None of the above are acid base reactions.
- 10) Give the name for  $\text{PBr}_3$ . 10) \_\_\_\_\_
- A) phosphorus (II) bromide  
B) potassium tribromide  
C) phosphorus tribromide  
D) phosphorus bromide  
E) phosphorus (III) bromide

**Part II Short Answer:** Write the word or phrase or circle the choice that best completes each statement or answers the question. Some questions may require that you show work. If you do not show work, you may lose points. Even on questions which do not require work, if you legibly show work, you may get some partial credit.

**Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work. (43 pts)**

1. For the molecule  $\text{Ga}(\text{NO}_3)_3$  what is the molar mass \_\_\_\_\_ grams (show work)

what is the formula mass \_\_\_\_\_ amu (6 pts total)

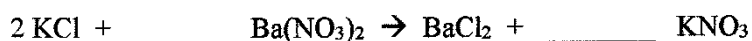
2. If you have 73.2 grams of  $\text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2$ , how many moles is that? \_\_\_\_\_ moles  
(molar mass of  $\text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2$  is 255.43 g/mol)(8 pts) (show work)

3. Balancing Chemical Reactions: (8 pts total, 4 pts each blank)

(a) Given the following unbalanced reaction, balance the reaction by filling in the blanks in the equation

(b) After balancing the reaction give the number of each type of atom (or polyatomic ion) on each side of the reaction by filling in the blanks. Show work for partial credit.

(NOTE: in a balanced chemical reaction, if no coefficient is found before a molecular formula, it means that there is ONE of the molecule formula. A missing coefficient does not mean that there are ZERO of the molecular formula.)



# of  $\text{Ba}^{+2}$  (reactant)                     

# of  $\text{NO}_3^{-1}$  (product)                     

4. Give the oxidation state of the following atom. Either show work or explain where you got the oxidation state. (6 pts, 3 pts each, show work)

$\text{H}_2$                      

P in  $\text{PO}_4^{-3}$                      

5. Is the molecule  $\text{Al}(\text{OH})_3$  [(soluble) or (insoluble)] (circle one) in water? (5 pts)

6. Circle all of the following which are strong bases. You may circle one, all or none of the choices. (10 pts total, 2 pt each)

$\text{NH}_3$   $\text{Ba}(\text{OH})_2$   $\text{NaOH}$   $\text{KOH}$   $\text{NH}_4\text{OH}$

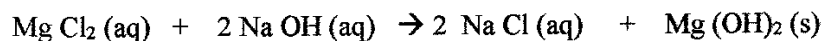


**Part III. Long Answer Please show work for full credit and to receive partial credit. (35 pts)**

**\*\*\*\* Please attempt every problem for partial credit. You will get no partial credit if you just rewrite the question with no change in anything.\*\*\*\***

**Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work otherwise, I obviously cannot grade work I cannot find.**

1. Stoichiometry: In the following reaction if I have 792.3 grams of NaOH (FW= 40.00 g/mol ), how many grams of Mg(OH)<sub>2</sub> (FW = 58.52 g/mol ) will I produce? To solve this problem, complete the following. (20 pts)



- a. Give 3 conversion factors below. HINT: 2 of the conversion factors use the definition of the mole and the third uses the balanced chemical reaction. (9 pts)

Conversion Factor #1:

Conversion Factor #2:

Conversion Factor #3:

- b. Complete the problem by using dimensional analysis and the 3 conversion factors above to answer the question. (11 pts)

2. Gas Law Problem: Answer the following by filling in the blanks (you may use a ? or the word **unknown or the letter symbol (P, V, n or T)** for an unknown variable. You need to come up with the final correct answer with the correct units for the answer. (15 pts)

(Kelvin = °C + 273.15, 1 atm = 760 torr = 760 mm Hg)

Use the Combined Gas Law to answer the following.  $\frac{P_2 V_2}{P_1 V_1} = \frac{T_2}{T_1}$

A gas at 763.2 mm Hg occupies 1.5 Liters at 298 K. At 2.0 Liters and 305 Kelvin, what is the pressure exerted by the same gas ?

$P_1 =$  \_\_\_\_\_  $V_1 =$  \_\_\_\_\_  $T_1 =$  \_\_\_\_\_  $P_2 =$  \_\_\_\_\_  $V_2 =$  \_\_\_\_\_  $T_2 =$  \_\_\_\_\_ (3 pts, 1/2 pt each)

Final Answer showing all work:

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. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If I cannot read your work, I obviously cannot grade it. (2 pts print and sign exam) If you run out of space, please continue on the back page of the exam and clearly tell me where the remaining answer can be found.  $N_A = 6.022 \times 10^{23}$

$$PV = nRT \quad R = 0.08206 (\text{L atm}) / (\text{mol K}) \quad (P_2 V_2) / (P_1 V_1) = T_2 / T_1 \quad 1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr}$$

**Part I MULTIPLE CHOICE.** Choose the one alternative that best completes the statement or answers the question. No partial credit for MC. (2 pts per question, 20 pts total)

- 1) Identify HCl. 1) \_\_\_\_\_  
 A) strong electrolyte, strong acid  
 B) strong electrolyte, weak acid  
 C) weak electrolyte, strong acid  
 D) nonelectrolyte  
 E) weak electrolyte, weak acid
- 2) Determine the name for aqueous HBr. 2) \_\_\_\_\_  
 A) bromous acid  
 B) bromic acid  
 C) hydrobromous acid  
 D) hydrogen bromate  
 E) hydrobromic acid
- 3) Give the name for HNO<sub>3</sub>. 3) \_\_\_\_\_  
 A) hydrogen nitrite  
 B) nitric acid  
 C) hydrogen nitride  
 D) nitrous acid  
 E) hydrogen nitrate
- 4) When dissolved in water, KOH behaves as 4) \_\_\_\_\_  
 A) an acid that forms KO<sup>-</sup> and H<sup>+</sup> ions. B) a base that forms K<sup>+</sup> and OH<sup>-</sup> ions.  
 C) an acid that forms K<sup>+</sup> and OH<sup>-</sup> ions. D) a base that forms KO<sup>-</sup> and H<sup>+</sup> ions.
- 5) Which of the following is an acid-base reaction? 5) \_\_\_\_\_  
 A)  $2 \text{HCl}(\text{aq}) + \text{Ca}(\text{OH})_2(\text{aq}) \rightarrow 2 \text{H}_2\text{O}(\text{l}) + \text{CaCl}_2(\text{aq})$   
 B)  $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$   
 C)  $\text{MgSO}_4(\text{aq}) + \text{Ba}(\text{NO}_3)_2(\text{aq}) \rightarrow \text{Mg}(\text{NO}_3)_2(\text{aq}) + \text{BaSO}_4(\text{s})$   
 D)  $\text{Fe}(\text{s}) + 2 \text{AgNO}_3(\text{aq}) \rightarrow 2 \text{Ag}(\text{s}) + \text{Fe}(\text{NO}_3)_2(\text{aq})$   
 E) None of the above are acid base reactions.
- 6) How many H<sup>+</sup> ions can the acid, H<sub>3</sub>PO<sub>4</sub>, donate per molecule? 6) \_\_\_\_\_  
 A) 1 B) 0 C) 2 D) 3

- 7) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 7) \_\_\_\_\_  
A) 715 torr      B) 31.8 torr      C) 13.8 torr      D) 760 torr      E) 28.1 torr
- 8) What is the empirical formula for  $C_8H_{16}O_4$ ? 8) \_\_\_\_\_  
A) CHO      B)  $CHO_2$       C)  $C_2H_4O$       D)  $CH_2O$       E)  $C_2H_5O$
- 9) Which of the compounds  $HNO_3$ ,  $Ca(OH)_2$ ,  $KOH$ , and  $HI$ , behave as bases when they are dissolved in water? 9) \_\_\_\_\_  
A)  $Ca(OH)_2$  and  $KOH$       B) only  $HI$   
C)  $HNO_3$  and  $HI$       D) only  $KOH$
- 10) Give the name for  $PBr_3$ . 10) \_\_\_\_\_  
A) potassium tribromide  
B) phosphorus (II) bromide  
C) phosphorus tribromide  
D) phosphorus bromide  
E) phosphorus (III) bromide

**Part II Short Answer:** Write the word or phrase or circle the choice that best completes each statement or answers the question. Some questions may require that you show work. If you do not show work, you may lose points. Even on questions which do not require work, if you legibly show work, you may get some partial credit.

**Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work. (43 pts )**

1. For the molecule  $\text{Be}_3(\text{PO}_4)_2$  what is the molar mass \_\_\_\_\_ grams (show work)  
what is the formula mass \_\_\_\_\_ amu (6 pts total)

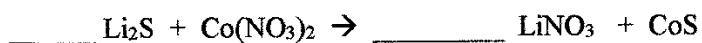
2. If you have 73.2 grams of  $\text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2$ , how many moles is that? \_\_\_\_\_ moles  
(molar mass of  $\text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2$  is 255.43 g/mol )(8 pts) (show work)

3. Balancing Chemical Reactions: (8 pts total, 4 pts each blank)

(a) Given the following unbalanced reaction, balance the reaction by filling in the blanks in the equation

(b) After balancing the reaction give the number of each type of atom (or polyatomic ion) on each side of the reaction by filling in the blanks. Show work for partial credit.

(NOTE: in a balanced chemical reaction, if no coefficient is found before a molecular formula, it means that there is ONE of the molecule formula. A missing coefficient does not mean that there are ZERO of the molecular formula.)



# of S<sup>-2</sup> (reactant)         

# of NO<sub>3</sub><sup>-1</sup> (product)         

4. Give the oxidation state of the following atom. Either show work or explain where you got the oxidation state. (6 pts, 3 pts each, show work)

Cl in HCl                     

N in NO<sub>3</sub><sup>-1</sup>                     

5. Is the molecule Na<sub>2</sub>CO<sub>3</sub> [(soluble) or (insoluble)] (circle one) in water? (5 pts)

6. Circle all of the following which are weak acid. You may circle one, all or none of the choices. (10 pts total, 2 pt each)

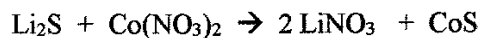
CH<sub>3</sub>COOH   H<sub>2</sub>SO<sub>4</sub>   HNO<sub>3</sub>   HF   HCl

**Part III. Long Answer Please show work for full credit and to receive partial credit. (35 pts)**

**\*\*\*\* Please attempt every problem for partial credit. You will get no partial credit if you just rewrite the question with no change in anything.\*\*\*\***

**Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work otherwise, I obviously cannot grade work I cannot find.**

1. Stoichiometry: In the following reaction if I have 792.3 grams of  $\text{Li}_2\text{S}$  (FW = 45.95 g/mol ), how many grams of  $\text{LiNO}_3$  (FW = 68.95 g/mol ) will I produce? To solve this problem, complete the following. (20 pts)



- a. Give 3 conversion factors below. HINT: 2 of the conversion factors use the definition of the mole and the third uses the balanced chemical reaction. (9 pts)

Conversion Factor #1:

Conversion Factor #2:

Conversion Factor #3:

- b. Complete the problem by using dimensional analysis and the 3 conversion factors above to answer the question. (11 pts)

2. Gas Law Problem: Answer the following by filling in the blanks (you may use a ? or the word **unknown** or the letter symbol **(P,V, n or T)** for an unknown variable. You need to come up with the final correct answer with the correct units for the answer. (15 pts)

(Kelvin = °C + 273.15, 1 atm = 760 torr = 760 mm Hg)

Use the Ideal Gas Law to answer the following. [  $P V = n R T$ ,  $R = 0.08206 \text{ (Liter Atm) / (Mol K)}$ ]

If a 0.25 mole sample of a gas has pressure of 750 mm Hg at a volume of 357 mL, what is the temperature of the gas ?

P = \_\_\_\_\_ V = \_\_\_\_\_ n = \_\_\_\_\_ T = \_\_\_\_\_ ( 4 pts, 1 pt each)

Final Answer showing all work: