

Name Key (print) Name \_\_\_\_\_ (sign)

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$M_1V_1 = M_2V_2$  (FW = formula mass or formula weight) {  $P_{total} = P_a + P_b + P_c + \dots$ ,  $\chi_a = P_a / P_{total} = n_a / n_{total}$  }  
 {  $PV = nRT$ ,  $(P_1V_1)/(P_2V_2) = T_1/T_2$ ,  $R = 0.08206$  (L atm)/(mol K),  $K = ^\circ C + 273.15$  } molar V at STP = 22.4 Liters  
 760 torr = 760 mm Hg = 1.00 atm

**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, 24 pts total)

- 1) Identify acetic acid. ( $CH_3COOH$ )
- A) strong electrolyte, weak acid
  - B) nonelectrolyte
  - C) weak electrolyte, strong acid
  - D) weak electrolyte, weak acid
  - E) strong electrolyte, strong acid

1) D

- 2) Each of the following sets of quantum numbers is supposed to specify an orbital. Which of the following sets of quantum numbers contains an error?

- A)  $n = 3, l = 0, m_l = 0$
- B)  $n = 3, l = 3, m_l = -2$
- C)  $n = 2, l = 1, m_l = +1$
- D)  $n = 1, l = 0, m_l = 0$
- E)  $n = 4, l = 2, m_l = 0$

$l = 0, \dots, (n-1)$  for  $n = 3$   
 $l \rightarrow$  only up to 0

2) B

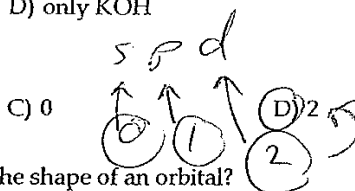
- 3) Which of the compounds of  $CH_3CO_2H$ ,  $Ca(OH)_2$ ,  $KOH$ , and  $HI$ , behave as acids when they are dissolved in water?

- A)  $Ca(OH)_2$  and  $KOH$
- B)  $CH_3CO_2H$  and  $HI$
- C) only  $HI$
- D) only  $KOH$

3) B

- 4) What value of  $l$  is represented by a d orbital?

- A) 1
- B) 3



4) D

- 5) Which of the following quantum numbers describes the shape of an orbital?

- A) angular momentum quantum number
- B) spin quantum number
- C) magnetic quantum number
- D) Schrödinger quantum number
- E) principal quantum number

no such thing

5) A

6) No two electrons can have the same four quantum numbers is known as the  
A) Heisenberg uncertainty principle  
B) Hund's rule  
C) Aufbau principle  
D) Pauli exclusion principle

6) D

7) The volume of a gas is proportional to number of moles of a gas is known as  
A) Ideal Gas Law  
B) Dalton's Law  
C) Charles's Law  
D) Avogadro's Law  
E) Boyle's Law

7) D

8) Identify the polyprotic acid.  
A)  $H_2SO_4$  B) HCl C) LiOH D) LiCl E)  $Ca(OH)_2$

8) A

9) The atmospheric pressure is 715 mm Hg. What is the pressure in torr?  
A) 13.8 torr B) 31.8 torr C) 28.1 torr D) 760 torr E) 715 torr

9) E

10) How many valence electrons does an atom of Al possess?  
A) 2 B) 8 C) 1 D) 3 E) 5

10) D

11) Determine the oxidation state of P in  $PO_3^{3-}$ .  
A) +2 B) 0 C) +3 D) -3 E) +6

11) C

12) Which of the following is an acid-base reaction?  
A)  $Fe(s) + 2 AgNO_3(aq) \rightarrow 2 Ag(s) + Fe(NO_3)_2(aq)$   
B)  $2 HClO_4(aq) + Ca(OH)_2(aq) \rightarrow 2 H_2O(l) + Ca(ClO_4)_2(aq)$   
C)  $C(s) + O_2(g) \rightarrow CO_2(g)$   
D)  $MgSO_4(aq) + Ba(NO_3)_2(aq) \rightarrow Mg(NO_3)_2(aq) + BaSO_4(s)$   
E) None of the above are acid base reactions.

12) B

group IIIA # valence e = group #

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

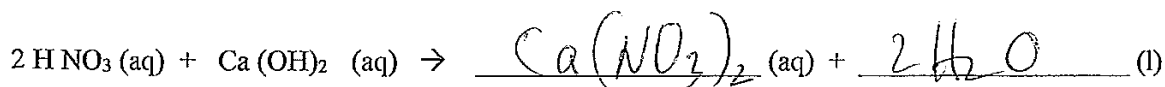
$$P = -3 + 6 = +3$$

**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. (40 pts)

Please show all work for full credit and for partial credit. {  $P_{total} = P_a + P_b + P_c + \dots$ ,  $\chi_a = P_a / P_{total} = n_a / n_{total}$  }  
{  $PV = nRT$ ,  $(P_1V_1)/(P_2V_2) = T_1/T_2$ ,  $R = 0.08206$  (L atm)/(mol K),  $K = ^\circ C + 273.15$  } molar V at STP = 22.4 Liters  
 $760\text{mmHg} = 1.00\text{ atm}$

1 a. Complete the following acid base reaction. Assume complete forward reaction as written. Your fill in the blank part does not need to be a balanced chemical reaction but the part that I provided is balanced. (4 pts, 2 pts each blank) (12 pts all parts of #1)



b. If you have 2 moles of  $\text{HNO}_3$

how many moles of  $\text{Ca}(\text{OH})_2$  will you need? 1 moles  $\text{Ca}(\text{OH})_2$  (4 pts)

c. If you have a solution of 0.25 M of the  $\text{HNO}_3$

that means 0.25 moles of  $\text{HNO}_3$

in 1000 mL of the  $\text{HNO}_3$  solution (4 pts, 2 pts each blank)

2 For the following reagent, give the oxidation state of the element listed. Either explain why or show work for your oxidation state number answer. (6 pts total, 2 pts each)

a. In  $H_2$  oxidation state of H is zero Explain why.

element in most stable state

$NH_4^{+1}$  b. What is the oxidation state of H in the molecule +1 Explain why.

not element, group # = 1

c. What is the oxidation state of N in the molecule -3 Explain why.

$$N + 4(+1) = +1$$

$$N = +1 - 4$$

$$N = -3$$

3. If you have 12.5 moles of  $H_2$  at STP

How many Liters of  $H_2$  gas do you have? 280 Liters (show work) (1 mole any gas = 22.4 Liters) (5 pts)

$$12.5 \text{ mol } H_2 \times \frac{22.4 \text{ l}}{1 \text{ mol } H_2} = 280 \text{ l}$$

4. You have 25.2 mm Hg of  $O_2(g)$  together with  $H_2(g)$  in a gas cylinder,

with a total pressure of 890.3 mm Hg, what is the pressure of the  $H_2$  865.1 (show work)

{  $P_{total} = P_a + P_b + P_c + \dots$ ,  $\chi_a = P_a / P_{total} = n_a / n_{total}$  } (5 pts)

$$890.3 \text{ mmHg} - 25.2 \text{ mmHg} = 865.1 \text{ mmHg}$$

5 For the symbol to represent an electron configuration, (circle one parenthesis under each letter, do not circle one of the letters) (6 pts, 2 pts each)

- 5  $f^3$
- a) 5 represents [period number] (angular momentum quantum number) ] (circle one)
  - b) the f represents [angular momentum quantum number] (shell number)] (circle one)
  - c) the 3 represents [(period number) or number of electrons within 5 f] (circle one)

6. Considering periodic trends, circle the correct elements (6 pts, 3 pts each)

a. Which is smaller as the element [(F) or (Br)] (circle one)

b. Which has higher ionization energy [(Si) or (Cl)] (circle one)

Si bigger Cl smaller

IE small

IE big

**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. If you have a gas at 32.5 °C, at 750.2 torr in a 250.2 mL container and heat it to 70.5 °C, with a new volume of 150.1 mL, what is the new pressure? [use one of the following equations: { $PV=nRT$ ,  $(P_1V_1)/(P_2V_2)=T_1/T_2$   $R=0.08206$  (L atm)/(mol K)}] (15 pts)

$$T_1 = 32.5^\circ\text{C} + 273 = 305.5 \quad T_2 = 70.5^\circ\text{C} + 273 = 343.5$$

$$P_1 = 750.2 \text{ torr} / 760 = 0.987 \text{ atm} \quad P_2 = ?$$

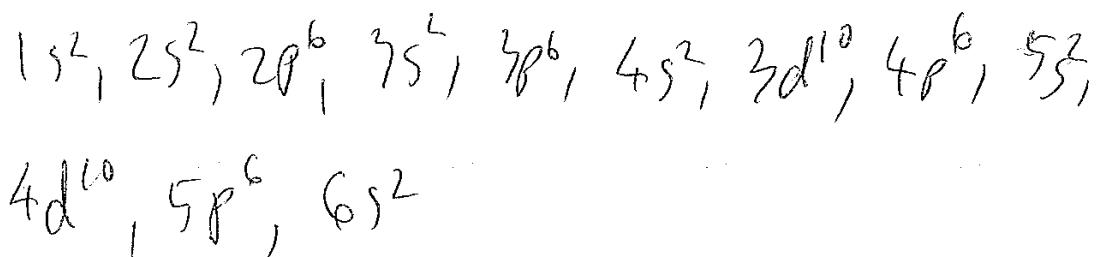
$$V_1 = 250.2 \text{ mL} / 1000 = 0.2502 \text{ L} \quad V_2 = 150.1 \text{ mL} / 1000 = 0.1501 \text{ L}$$

$$\frac{P_2 V_2}{P_1 V_1} = \frac{T_2}{T_1} \rightarrow \frac{(P_2)(0.150)}{(0.987)(0.2502)} = \frac{343.5}{305.5}$$

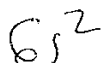
$$P_2 =$$

$$P_2 = 1.85 \text{ atm}$$

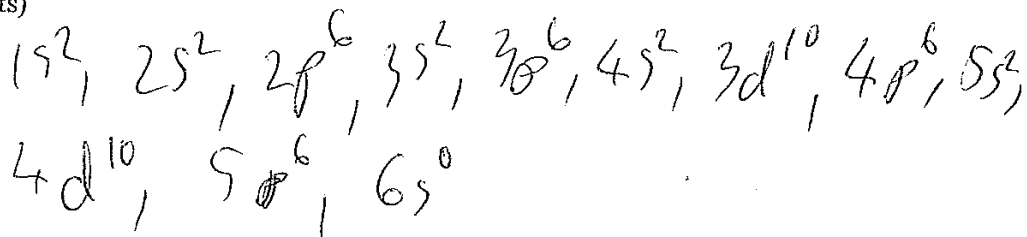
2. a). For the element **Ba** give the electron configuration in the format ( $1s^2, 2s^2, 2p^6, \dots$ ) (20 pts total, 5 pts each letter)



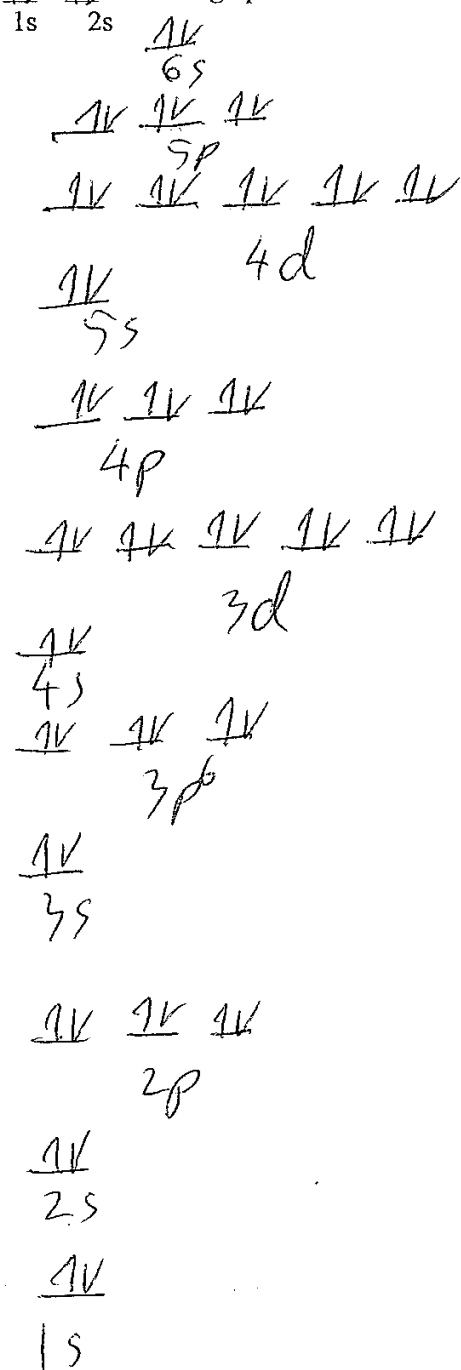
b) Give the valence electron configuration for the element in # (a) above, in the same format. (5 pts)



c) For the charged ion  $\text{Ba}^{+2}$ , give the complete electron configuration in the format ( $1s^2, 2s^2, 2p^6, \dots$ ) (5 pts)



d) Give the orbital diagram (for all electrons not just the valence electrons) for the element in (a) above (in the format  $\uparrow\downarrow$   $\uparrow\downarrow$ .... using up and down arrows to represent electrons) (5 pts)





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 {  $PV = nRT$ ,  $(P_1V_1)/(P_2V_2) = T_1/T_2$   $R = 0.08206$  (L atm)/(mol K),  $K = ^\circ C + 273.15$  } molar V at STP = 22.4 Liters  
 760 torr = 760 mm Hg = 1.00 atm

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, 24 pts total)

- 1) What value of l is represented by a d orbital? 1) C  
 A) 0 B) 1 (C) 2 D) 3
- 2) Identify acetic acid. ( $CH_3COOH$ ) 2) C  
 A) strong electrolyte, strong acid  
 B) strong electrolyte, weak acid  
(C) weak electrolyte, weak acid  
 D) nonelectrolyte  
 E) weak electrolyte, strong acid
- 3) Which of the compounds of  $CH_3CO_2H$ ,  $Ca(OH)_2$ ,  $KOH$ , and  $HI$ , behave as acids when they are dissolved in water? 3) B  
 A)  $Ca(OH)_2$  and  $KOH$  (B)  $CH_3CO_2H$  and  $HI$   
 C) only  $KOH$  D) only  $HI$
- 4) No two electrons can have the same four quantum numbers is known as the 4) C  
 A) Hund's rule B) Heisenberg uncertainty principle  
(C) Pauli exclusion principle D) Aufbau principle
- 5) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 5) C  
 A) 28.1 torr B) 31.8 torr (C) 715 torr D) 760 torr E) 13.8 torr
- 6) The volume of a gas is proportional to number of moles of a gas is known as 6) B  
 A) Boyle's Law  
(B) Avogadro's Law  
 C) Dalton's Law  
 D) Ideal Gas Law  
 E) Charles's Law

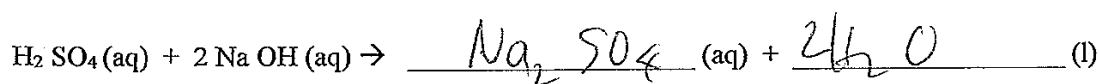
- 7) Identify the polyprotic acid. 7) C  
 A) LiOH      B) HCl      C)  $\text{H}_2\text{SO}_4$       D)  $\text{Ca}(\text{OH})_2$       E) LiCl
- 8) Each of the following sets of quantum numbers is supposed to specify an orbital. Which of the following sets of quantum numbers contains an error? 8) C  
 A)  $n = 4, l = 2, m_l = 0$   
 B)  $n = 3, l = 0, m_l = 0$   
 C)  $n = 3, l = 3, m_l = -2$   
 D)  $n = 2, l = 1, m_l = +1$   
 E)  $n = 1, l = 0, m_l = 0$
- 9) Which of the following quantum numbers describes the shape of an orbital? 9) B  
 A) Schrödinger quantum number  
 B) angular momentum quantum number  
 C) principal quantum number  
 D) spin quantum number  
 E) magnetic quantum number
- 10) Determine the oxidation state of P in  $\text{PO}_3^{3-}$ . 10) E  
 A) 0      B) +6      C) -3      D) +2      E) +3
- 11) How many valence electrons does an atom of Al possess? 11) A  
 A) 3      B) 2      C) 5      D) 8      E) 1
- 12) Which of the following is an acid-base reaction? 12) C  
 A)  $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$   
 B)  $\text{MgSO}_4(\text{aq}) + \text{Ba}(\text{NO}_3)_2(\text{aq}) \rightarrow \text{Mg}(\text{NO}_3)_2(\text{aq}) + \text{BaSO}_4(\text{s})$   
 C)  $2 \text{HClO}_4(\text{aq}) + \text{Ca}(\text{OH})_2(\text{aq}) \rightarrow 2 \text{H}_2\text{O}(\text{l}) + \text{Ca}(\text{ClO}_4)_2(\text{aq})$   
 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.

**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.

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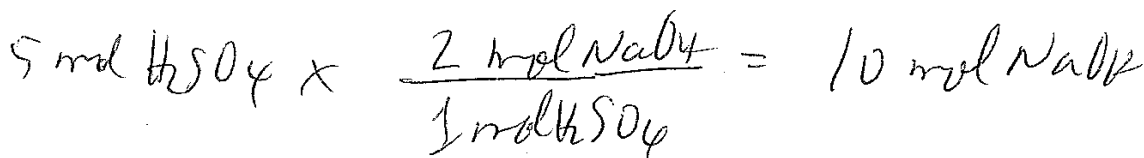
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 $\{ PV = nRT, (P_1 V_1) / (P_2 V_2) = T_1 / T_2, R = 0.08206 \text{ (L atm) / (mol K)}, K = ^\circ\text{C} + 273.15 \}$  molar V at STP = 22.4 Liters  
760 mm Hg = 1.00 atm

1 a. Complete the following acid base reaction. Assume complete forward reaction as written. Your fill in the blank part does not need to be a balanced chemical reaction but the part that I provided is balanced. (4 pts, 2 pts each blank) (12 pts all parts of #1)



b. If you have 5 moles of  $\text{H}_2\text{SO}_4$

how many moles of NaOH will you need? 10 moles NaOH (4 pts)



c. If you have a solution of 0.15 M of the  $\text{H}_2\text{SO}_4$

that means 0.15 moles of  $\text{H}_2\text{SO}_4$

in 1000 mL of the  $\text{H}_2\text{SO}_4$  solution (4 pts, 2 pts each blank)

2 For the following reagent, give the oxidation state of the element listed. Either explain why or show work for your oxidation state number answer. (6 pts total, 2 pts each)

a. In Na oxidation state of Na is zero Explain why.

element in most stable state

$\text{NO}_3^-$  b. What is the oxidation state of the O (oxygen) in the molecule -2 Explain why.

not element group VI  $-8 = -2$

c. What is the oxidation state of the N in the molecule +5 Explain why.

$$N + 3(-2) = -1$$

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

3. If you have 7.3 moles of  $\text{N}_2$  at STP

How many Liters of  $\text{N}_2$  gas do you have? 163.5 Liters (show work) (1 mole any gas = 22.4 Liters) (5 pts)

$$7.3 \text{ mol } \text{N}_2 \times \frac{22.4 \text{ l } \text{N}_2}{1 \text{ mol } \text{N}_2} = 163.5 \text{ l}$$

4. You have 0.85 atm of  $N_2$  (g) together with He (g) in a gas cylinder,

with a total pressure of 1.78 atm, what is the pressure of the He 0.93 (show work)  
{  $P_{total} = P_a + P_b + P_c + \dots$   $\chi_a = P_a / P_{total} = n_a / n_{total}$  } (5 pts)

$$1.78 \text{ atm} = P_{N_2} + P_{He} = 0.85 + P_{He}$$

$$P_{He} = 1.78 - 0.85 = 0.93 \text{ atm}$$

5. For the symbol to represent an electron configuration, (circle one parenthesis under each letter, do not circle one of the letters) (6 pts, 2 pts each)

2 p<sup>3</sup> a) the 3 represents [ (period number) or (number of electrons within 2 p) ] (circle one)

b) 2 represents [ (period number) or (angular momentum quantum number) ] (circle one)

c) the p represents [ (angular momentum quantum number) or (shell number) ] (circle one)

6. Considering periodic trends, circle the correct elements (6 pts, 3 pts each)

a. Which has lower ionization energy [ (O) or (Se) ] (circle one)

Se bigger than O

Se lower IE than O

b. Which is bigger as an element [ (Ca) or (K) ] (circle one)

(across period) smaller

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1. You have 70.5 grams of  $H_2$  (gas, FW = 2.02 g/mol) at 770.2 mm Hg and 25.8 °C, what volume does the gas occupy? [use one of the following equations:  $\{PV=nRT, (P_1V_1)/(P_2V_2)=T_1/T_2\}$  R=0.08206 (L atm)/(mol K)] (15 pts)

$$\text{mass} = 70.5 \text{ g } H_2$$

$$PV = nRT$$

$$P = 770.2 \text{ mm Hg} / 760 = 1.0134 \text{ atm}$$

$$T = 25.8^\circ \text{C} + 273.15 = 298.95$$

$$V = ?$$

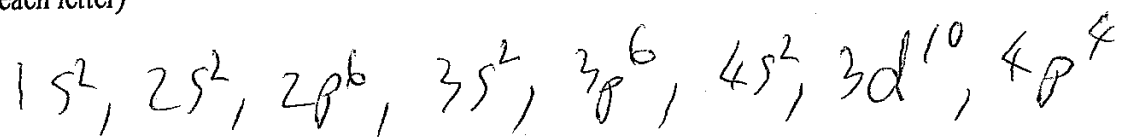
$$n = \frac{\text{mass}}{\text{mm}} = \frac{70.5 \text{ g } H_2}{2.02 \text{ g/mol}} = 34.9 \text{ mol } H_2$$

$$(1.0134 \text{ atm})(V) = \left( \frac{34.9 \text{ mol}}{H_2} \right) \left( 0.08206 \frac{\text{L atm}}{\text{mol K}} \right) (298.95 \text{ K})$$

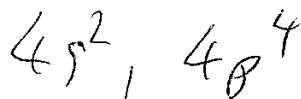
$$V = \frac{(34.9)(0.08206 \text{ L atm})(298.95 \text{ K})}{(1.0134 \text{ atm})}$$

$$V = 844.8 \text{ L}$$

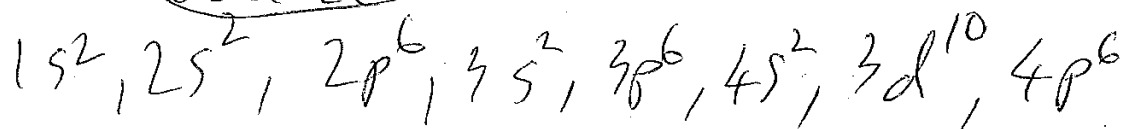
2. a). For the element **Se** give the electron configuration in the format ( $1s^2, 2s^2, 2p^6, \dots$ ) (20 pts total, 5 pts each letter)



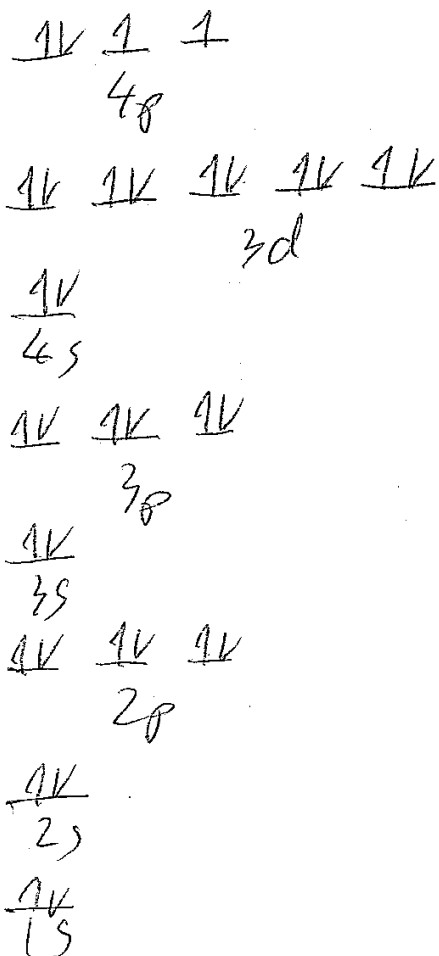
- b) Give the valence electron configuration for the element in # (a) above, in the same format. (5 pts)



- c) For the charged ion **Se<sup>2-</sup>**, give the complete electron configuration in the format ( $1s^2, 2s^2, 2p^6, \dots$ ) (5 pts) add 2e



d) Give the **orbital diagram** (for all electrons **not just the valence electrons**) for the element in (a) above (in the format  $\uparrow\downarrow \uparrow\downarrow \dots$  using up and down arrows to represent electrons) (5 pts)





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- 1) How many  $\text{H}^+$  ions can the acid,  $\text{H}_2\text{SO}_4$ , donate per molecule? 1) B  
 A) 1      B) 2      C) 0      D) 3
- 2) The total pressure of a gas mixture is the sum of the partial pressure of its components is known as 2) C  
 A) Charles's Law  
 B) Avogadro's Law  
C) Dalton's Law  
 D) Ideal Gas Law  
 E) Boyle's Law
- 3) When filling degenerate orbitals, electrons fill them singly first, with parallel spins is known as 3) D  
 A) Heisenberg uncertainty principle      B) Pauli exclusion principle  
 C) Aufbau principle      D) Hund's rule
- 4) Determine the oxidation state of nitrogen in  $\text{NO}_2$ . 4) E  
 A) +2      B) +3      C) +5      D) 0      E) +4
- 5) A cation of +2 indicates that an element has 5) C  
 A) lost two neutrons.  
 B) gained two protons.  
C) lost two electrons.  
 D) gained two electrons.  
 E) lost two protons.
- $$N + 2(-2) = 0$$

$$N = +4$$
- 6) Which of the following quantum numbers describes the orientation of an orbital? 6) D  
 A) angular momentum quantum number  
 B) principal quantum number  
 C) spin quantum number  
D) magnetic quantum number (as in  $p_x, p_y, p_z$ )  
 E) Schrödinger quantum number

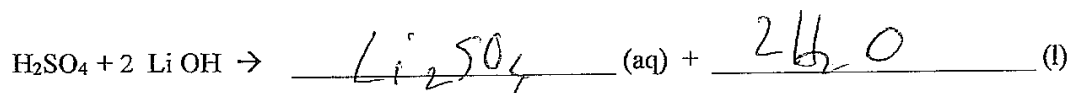
- 7) What is the maximum number of d orbitals that are possible?  
 A) 5      B) 7      C) 9      D) 1      E) 3      7) A
- 8) When dissolved in water, KOH behaves as  
 A) an acid that forms  $\text{KO}^-$  and  $\text{H}^+$  ions.      B) a base that forms  $\text{KO}^-$  and  $\text{H}^+$  ions.  
 C) a base that forms  $\text{K}^+$  and  $\text{OH}^-$  ions.      D) an acid that forms  $\text{K}^+$  and  $\text{OH}^-$  ions.  
 8) C
- 9) Identify HCl.  
 A) nonelectrolyte  
 B) weak electrolyte, strong acid  
 C) weak electrolyte, weak acid  
 D) strong electrolyte, weak acid  
 E) strong electrolyte, strong acid  
 9) E
- 10) What are the possible values of  $l$  if  $n = 6$ ?  
 A) 6      B) -5, -4, -3, -2, -1, 0, +1, +2, +3, +4, or +5  
 C) -4, -3, -2, -1, 0, +1, +2, +3, or +4       D) 0, 1, 2, 3, 4, or 5 ( $n-1=5$ )  
 10) D
- 11) Which of the following is an acid-base reaction?  
 A)  $\text{Fe}(s) + 2 \text{AgNO}_3(aq) \rightarrow 2 \text{Ag}(s) + \text{Fe}(\text{NO}_3)_2(aq)$   
 B)  $2 \text{HClO}_4(aq) + \text{Ca}(\text{OH})_2(aq) \rightarrow 2 \text{H}_2\text{O}(l) + \text{Ca}(\text{ClO}_4)_2(aq)$   
 C)  $\text{MgSO}_4(aq) + \text{Ba}(\text{NO}_3)_2(aq) \rightarrow \text{Mg}(\text{NO}_3)_2(aq) + \text{BaSO}_4(s)$   
 D)  $\text{C}(s) + \text{O}_2(g) \rightarrow \text{CO}_2(g)$   
 E) None of the above are acid base reactions.  
 11) B
- 12) Give the temperature and pressure at STP.  
 A)  $0^\circ\text{C}$  and 1.00 atm  
 B) 0K and 1.00 atm  
 C)  $0^\circ\text{C}$  and 1 mm Hg  
 D) 32K and 1 torr Hg  
 E)  $25^\circ\text{C}$  and 1.00 in Hg  
 12) A

**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. (40 pts)

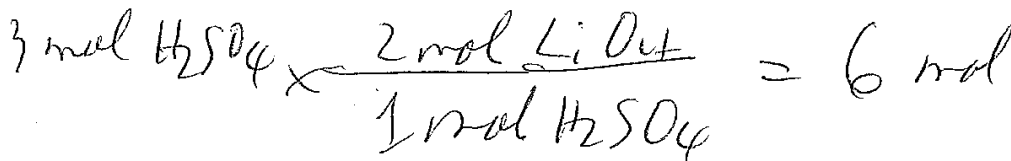
Please show all work for full credit and for partial credit.  $\{ P_{\text{total}} = P_a + P_b + P_c + \dots \chi_a = P_a / P_{\text{total}} = n_a / n_{\text{total}} \}$   
 $\{ PV = nRT, (P_1 V_1) / (P_2 V_2) = T_1 / T_2 \}$   $R = 0.08206 \text{ (L atm) / (mol K)}$ ,  $K = ^\circ\text{C} + 273.15$  } molar V at STP = 22.4 Liters  
 $760 \text{ mm Hg} = 1.00 \text{ atm}$

1 a. Complete the following acid base reaction. Assume complete forward reaction as written. Your fill in the blank part does not need to be a balanced chemical reaction but the part that I provided is balanced. (4 pts, 2 pts each blank) (12 pts all parts of #1)



b. If you have 3 moles of  $\text{H}_2\text{SO}_4$

how many moles of Li OH will you need? 6 moles Li OH (4 pts)



c. If you have a solution of 1.25 M of the  $\text{H}_2\text{SO}_4$

that means 1.25 moles of  $\text{H}_2\text{SO}_4$

in 1000 mL of the  $\text{H}_2\text{SO}_4$  solution (4 pts, 2 pts each blank)

2 For the following reagent, give the oxidation state of the element listed. Either explain why or show work for your oxidation state number answer. (6 pts total, 2 pts each)

a. In Fe oxidation state of Fe is Zero Explain why.

element

SF<sub>6</sub> b. What is the oxidation state of the F in the molecule -2 Explain why.

not element group VII - 8 = -2

c. What is the oxidation state of the S in the molecule +6 Explain why.

$$S + 6(-1) = \text{zero}$$

$$S = +6$$

3. If you have 82.5 moles of He at STP

How many Liters of He gas do you have? 1848 Liters (show work) (1 mole any gas = 22.4 Liters) (5 pts)

$$82.5 \text{ mol He} \times \frac{22.4 \text{ l}}{1 \text{ mol He}} = 1848 \text{ l}$$

↓ sig fig

$$1.85 \times 10^3$$

4. You have 1.2 atm of  $\text{H}_2\text{O}$  (g) together with  $\text{H}_2$  (g) in a gas cylinder,

with a total pressure of 2.77 atm,  $\{ P_{\text{total}} = P_a + P_b + P_c + \dots \chi_a = P_a / P_{\text{total}} = n_a / n_{\text{total}} \}$

What is the mole fraction ( $\chi_a$ ) of  $\text{H}_2\text{O}$  0.43 (show work) (5 pts)

$$\chi_a(\text{H}_2\text{O}) = \frac{P_{\text{H}_2\text{O}}}{P_{\text{total}}} = \frac{1.2 \text{ atm}}{2.77 \text{ atm}} = 0.43$$

5 For the symbol to represent an electron configuration, (circle one parenthesis under each letter, do not circle one of the letters) (6 pts, 2 pts each)

7 d<sup>5</sup> a) 7 represents [ (period number) or (angular momentum quantum number) ] (circle one)

b) the d represents [ (angular momentum quantum number) or (shell number) ] (circle one)

c) the 5 represents [ (period number) or (number of electrons within 7 d) ] (circle one)

6. Considering periodic trends, circle the correct elements (6 pts, 3 pts each)

a. Which is smaller as the element [ (F) or (C) ] (circle one) (→ smaller)

F is smaller

b. Which has higher ionization energy [ (Be) or (Sr) ] (circle one) (size bigger)

(IE smaller ↓)

**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. You have 17.5 grams of He (gas, FW = 4.00 g/mol) in a 250.5 mL container at 892.2 mm Hg, what temperature is the He in your container? [use one of the following equations:  $\{PV=nRT, (P_1V_1)/(P_2V_2)=T_1/T_2, R=0.08206 \text{ (L atm)/(mol K)}\}$ ] (15 pts)

$$17.5 \text{ g He} / 4.00 = 4.38 \text{ mol} \quad PV = nRT$$

$$V = 250.5 \text{ mL} / 1000 = 0.2505 \text{ L}$$

$$P = 892.2 \text{ mm Hg} / 760 = 1.174 \text{ atm}$$

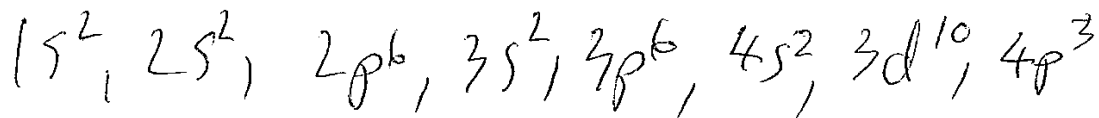
$$T = ?$$

$$(1.174 \text{ atm})(0.2505 \text{ L}) = (4.38 \text{ mol})(0.08206 \frac{\text{L atm}}{\text{mol K}})(T)$$

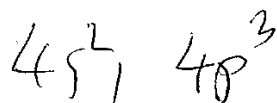
$$T = \frac{(1.174 \text{ atm})(0.2505 \text{ L})}{(4.38 \text{ mol})(0.08206 \frac{\text{L atm}}{\text{mol K}})}$$

$$T = 0.818 \text{ K}$$

2. a). For the element As give the electron configuration in the format ( $1s^2, 2s^2, 2p^6, \dots$ ) (20 pts total, 5 pts each letter)

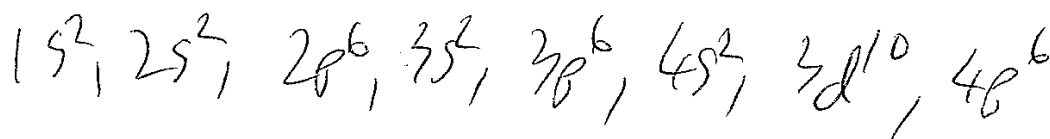


- b) Give the valence electron configuration for the element in # (a) above, in the same format. (5 pts)

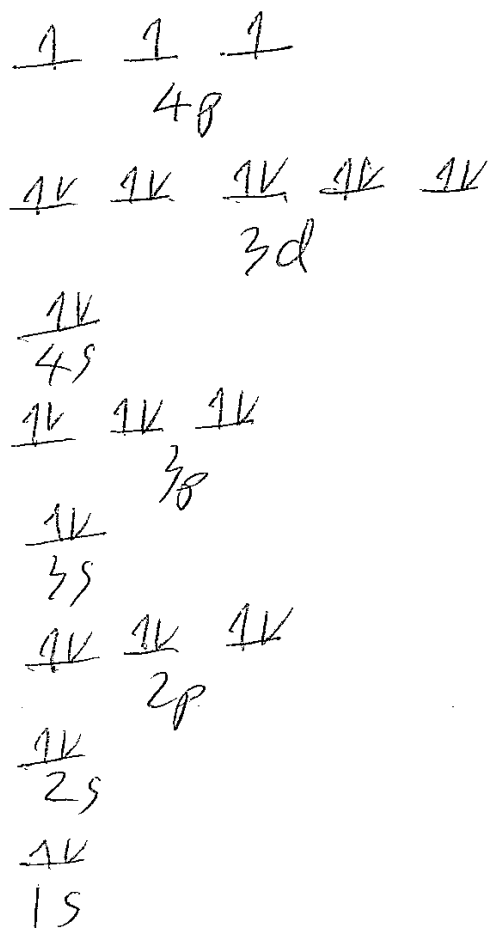


- c) For the charged ion  $As^{3-}$ , give the complete electron configuration in the format ( $1s^2, 2s^2, 2p^6, \dots$ ) (5 pts)

add  $3e^-$



- d) Give the orbital diagram (for all electrons not just the valence electrons) for the element in (a) above (in the format  $\uparrow\downarrow$   $\uparrow\downarrow$ .... using up and down arrows to represent electrons) (5 pts)





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. (1 pt print and sign exam) 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, I obviously cannot grade it). Return your entire exam including the stapled periodic table. If your exam falls apart, please staple everything back together before turning in the exam.

$M_1V_1 = M_2V_2$  (FW = formula mass or formula weight) {  $P_{\text{total}} = P_a + P_b + P_c + \dots \chi_a = P_a / P_{\text{total}} = n_a / n_{\text{total}}$  }  
 {  $PV = nRT$ ,  $(P_1V_1)/(P_2V_2) = T_1/T_2$   $R = 0.08206$  (L atm)/(mol K),  $K = ^\circ\text{C} + 273.15$  } molar V at STP = 22.4 Liters  
 760 torr = 760 mm Hg = 1.00 atm

**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, 24 pts total)

- 1) Identify HCl. 1) A  
 A) strong electrolyte, strong acid  
 B) nonelectrolyte  
 C) strong electrolyte, weak acid  
 D) weak electrolyte, weak acid  
 E) weak electrolyte, strong acid
- 2) A cation of +2 indicates that an element has 2) E  
 A) gained two protons.  
 B) lost two neutrons.  
 C) gained two electrons.  
 D) lost two protons.  
 E) lost two electrons.
- 3) When filling degenerate orbitals, electrons fill them singly first, with parallel spins is known as 3) C  
 A) Aufbau principle  
 B) Heisenberg uncertainty principle  
 C) Hund's rule  
 D) Pauli exclusion principle
- 4) What is the maximum number of d orbitals that are possible? 4) E  
 A) 7  
 B) 1  
 C) 3  
 D) 9  
 E) 5
- 5) Give the temperature and pressure at STP. 5) B  
 A) 0K and 1.00 atm  
 B) 0°C and 1.00 atm  
 C) 0°C and 1 mm Hg  
 D) 25°C and 1.00 in Hg  
 E) 32K and 1 torr Hg
- 6) What are the possible values of  $l$  if  $n = 6$ ? 6) B  
 A) 6  
 B) 0, 1, 2, 3, 4, or 5  
 C) -5, -4, -3, -2, -1, 0, +1, +2, +3, +4, or +5  
 D) -4, -3, -2, -1, 0, +1, +2, +3, or +4

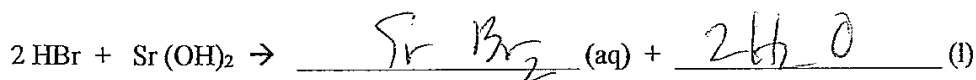
- 7) When dissolved in water, KOH behaves as 7) D  
 A) an acid that forms  $K^+$  and  $OH^-$  ions.      B) an acid that forms  $KO^-$  and  $H^+$  ions.  
 C) a base that forms  $KO^-$  and  $H^+$  ions.       D) a base that forms  $K^+$  and  $OH^-$  ions.
- 8) The total pressure of a gas mixture is the sum of the partial pressure of its components is known as 8) D  
 A) Avogadro's Law  
 B) Charles's Law  
 C) Boyle's Law  
 D) Dalton's Law  
 E) Ideal Gas Law
- 9) How many  $H^+$  ions can the acid,  $H_2SO_4$ , donate per molecule? 9) C  
 A) 1      B) 3       C) 2      D) 0
- 10) Which of the following is an acid-base reaction? 10) C  
 A)  $Fe(s) + 2 AgNO_3(aq) \rightarrow 2 Ag(s) + Fe(NO_3)_2(aq)$   
 B)  $C(s) + O_2(g) \rightarrow CO_2(g)$   
 C)  $2 HClO_4(aq) + Ca(OH)_2(aq) \rightarrow 2 H_2O(l) + Ca(ClO_4)_2(aq)$   
 D)  $MgSO_4(aq) + Ba(NO_3)_2(aq) \rightarrow Mg(NO_3)_2(aq) + BaSO_4(s)$   
 E) None of the above are acid base reactions.
- 11) Which of the following quantum numbers describes the orientation of an orbital? 11) E  
 A) Schrödinger quantum number  
 B) angular momentum quantum number  
 C) spin quantum number  
 D) principal quantum number  
 E) magnetic quantum number
- 12) Determine the oxidation state of nitrogen in  $NO_2$ . 12) D  
 A) +5      B) +2      C) +3       D) +4      E) 0

**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. (40 pts)

Please show all work for full credit and for partial credit.  $\{ P_{\text{total}} = P_a + P_b + P_c + \dots \chi_a = P_a / P_{\text{total}} = n_a / n_{\text{total}} \}$   
 $\{ PV = nRT, (P_1 V_1) / (P_2 V_2) = T_1 / T_2 \}$   $R = 0.08206 \text{ (L atm) / (mol K)}$ ,  $K = ^\circ\text{C} + 273.15$  molar  $V$  at STP = 22.4 Liters  
 $760 \text{ mm Hg} = 1.00 \text{ atm}$

1 a. Complete the following acid base reaction. Assume complete forward reaction as written. Your fill in the blank part does not need to be a balanced chemical reaction but the part that I provided is balanced. (4 pts, 2 pts each blank) (12 pts all parts of #1)



b. If you have 4 moles of HBr

how many moles of  $\text{Sr}(\text{OH})_2$  will you need? 2 moles  $\text{Sr}(\text{OH})_2$  (4 pts)

$$4 \text{ mol HBr} \times \frac{1 \text{ mol Sr}(\text{OH})_2}{2 \text{ mol HBr}} = 2 \text{ mol}$$

c. If you have a solution of 0.75 M of the HBr

that means 0.75 moles of HBr

in 1000 mL of the HBr solution (4 pts, 2 pts each blank)

2 For the following reagent, give the oxidation state of the element listed. Either explain why or show work for your oxidation state number answer. (6 pts total, 2 pts each)

a. In  $O_2$  oxidation state of O is zero Explain why.

most stable form of element

$SO_3^{2-}$

b. What is the oxidation state of the O (oxygen) in the molecule -2 Explain why.

not element

$$\text{group VI } -8 = -2$$

c. What is the oxidation state of the S in the molecule +4 Explain why.

$$S + 3(-2) = -2$$

$$S = -2 + 6 = +4$$

3. If you have 32.5 moles of  $O_2$  at STP

How many Liters of  $O_2$  gas do you have? 728 Liters (show work) (1 mole any gas = 22.4 Liters) (5 pts)

$$32.5 \text{ mol } O_2 \times \frac{22.4 \text{ l}}{1 \text{ mol } O_2} = 728 \text{ l}$$

4. You have 78.2 torr of He (g) together with H<sub>2</sub> (g) in a gas cylinder,

with a total pressure of 792.2 torr, {  $P_{\text{total}} = P_a + P_b + P_c + \dots$ ,  $\chi_a = P_a / P_{\text{total}} = n_a / n_{\text{total}}$  }

What is the mole fraction ( $\chi_a$ ) of He \_\_\_\_\_ (show work) (5 pts)

$$P_{\text{total}} = 792.2 \text{ torr}$$

$$P_{\text{He}} = 78.2 \text{ torr}$$

$$\chi_{\text{He}} = \frac{78.2 \text{ torr}}{792.2 \text{ torr}} = 0.0987$$

5 For the symbol to represent an electron configuration, (circle one parenthesis under each letter, do not circle one of the letters) (6 pts, 2 pts each)

5 p<sup>6</sup> a) the 6 represents [ (period number) or (number of electrons within 5 p) ] (circle one)

b) 5 represents [ (period number) or (angular momentum quantum number) ] (circle one)

c) the p represents [ (angular momentum quantum number) or (shell number) ] (circle one)

6. Considering periodic trends, circle the correct elements (6 pts, 3 pts each)

a. Which has lower ionization energy [(B) or (In)] (circle one)

↓ size increase  
+ IE decrease

b. Which is bigger as an element [(S) or (Al)] (circle one)

(Al → S) smaller

**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. If you have a gas in an internal combustion engine at 650.2 torr and 25.2 °C at a volume of 1.77 Liters and the gas after combustion is at 780.2 °C and volume of 1.77 Liters, what is the new pressure ? [use one of the following equations:  $\{PV=nRT, (P_1V_1)/(P_2V_2)=T_1/T_2$   $R=0.08206$  (L atm)/(mol K)}] (15 pts)

$$P_1 = 650.2 \text{ torr} / 760 = 0.8555 \text{ atm}$$

$$T_1 = 25.2^\circ\text{C} + 273.15 = 298.35 \text{ K}$$

$$V_1 = 1.77 \text{ L}$$

$$P_2 = ?$$

$$T_2 = 780.2^\circ\text{C} + 273.15 = 1053.35 \text{ K}$$

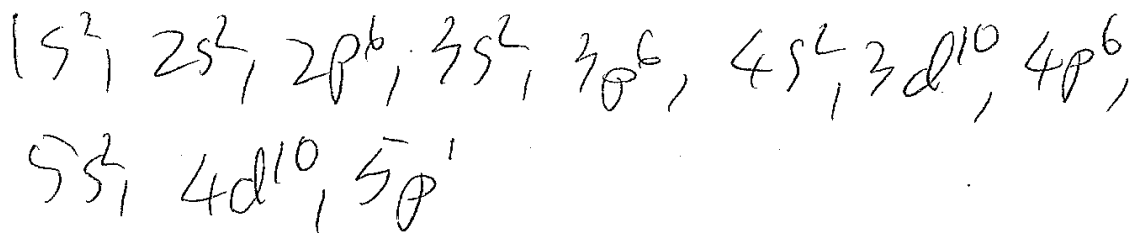
$$V_2 = 1.77 \text{ L}$$

$$\frac{(P_2)(1.77 \text{ L})}{(0.8555 \text{ atm})(1.77 \text{ L})} = \frac{1053.35 \text{ K}}{298.35 \text{ K}}$$

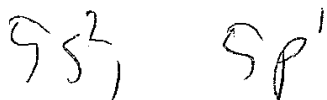
$$P_2 = \left( \frac{1053.35 \text{ K}}{298.35 \text{ K}} \right) (0.8555 \text{ atm})$$

$$P_2 = 3.02 \text{ atm}$$

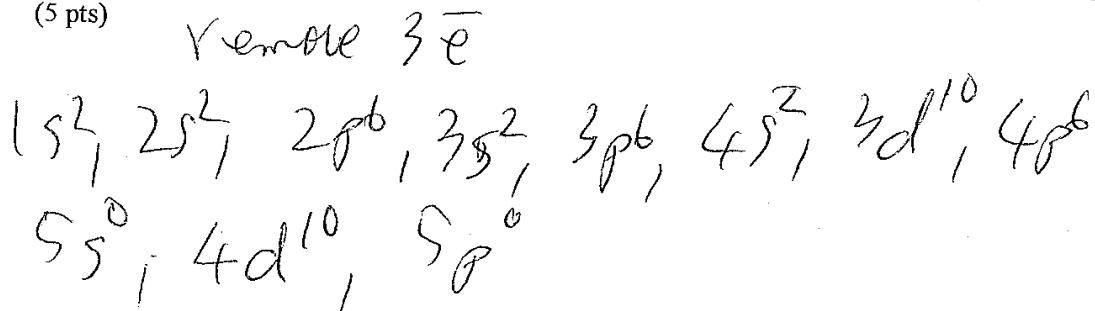
2. a). For the element **In** give the electron configuration in the format ( $1s^2, 2s^2, 2p^6, \dots$ ) (20 pts total, 5 pts each letter)



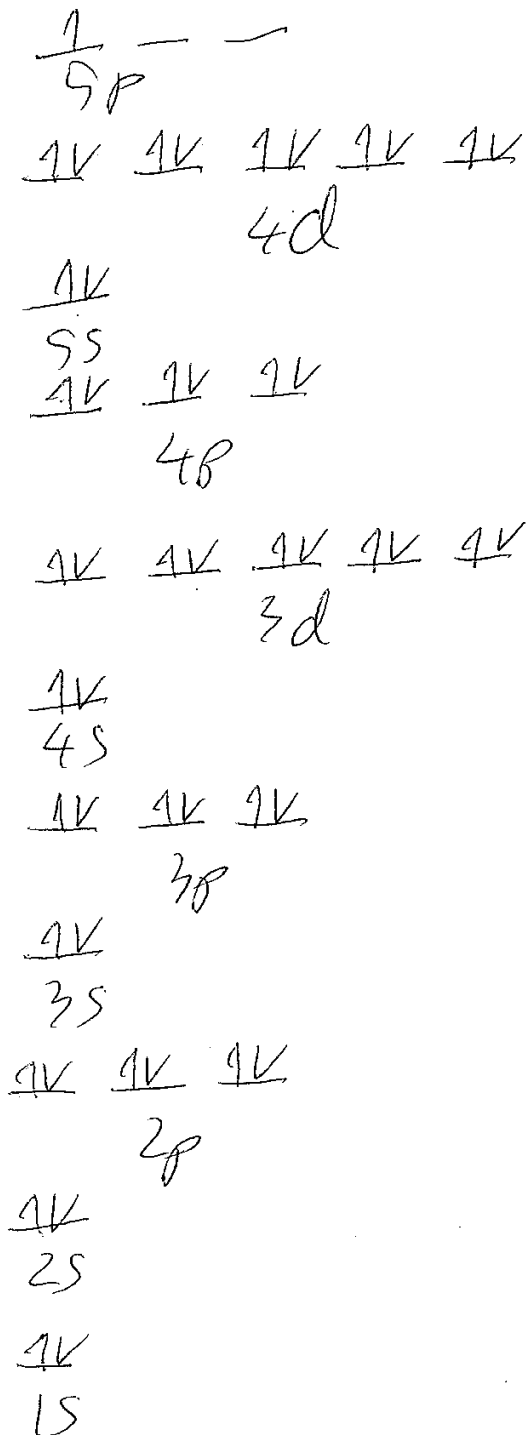
- b) Give the **valence** electron configuration for the element in # (a) above, in the same format. (5 pts)



- c) For the charged ion **In<sup>+3</sup>**, give the complete electron configuration in the format ( $1s^2, 2s^2, 2p^6, \dots$ ) (5 pts)



d) Give the **orbital diagram** (for all electrons **not just the valence electrons**) for the element in (a) above (in the format  $\uparrow\downarrow$   $\uparrow\downarrow$  ... using up and down arrows to represent electrons) (5 pts)





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. (1 pt print and sign exam) 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, I obviously cannot grade it). Return your entire exam including the stapled periodic table. If your exam falls apart, please staple everything back together before turning in the exam.

$M_1V_1 = M_2V_2$  (FW = formula mass or formula weight) {  $P_{total} = P_a + P_b + P_c + \dots$  }  $\chi_a = P_a / P_{total} = n_a / n_{total}$  }  
 {  $PV = nRT$ ,  $(P_1V_1)/(P_2V_2) = T_1/T_2$  }  $R = 0.08206$  (L atm)/(mol K),  $K = ^\circ C + 273.15$  } molar V at STP = 22.4 Liters  
 760 torr = 760 mm Hg = 1.00 atm

**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, 24 pts total)

- 1) Identify acetic acid. ( $CH_3COOH$ ) 1) \_\_\_\_\_  
 A) strong electrolyte, weak acid  
 B) nonelectrolyte  
 C) weak electrolyte, strong acid  
 D) weak electrolyte, weak acid  
 E) strong electrolyte, strong acid
- 2) Each of the following sets of quantum numbers is supposed to specify an orbital. Which of the following sets of quantum numbers contains an error? 2) \_\_\_\_\_  
 A)  $n = 3, l = 0, m_l = 0$   
 B)  $n = 3, l = 3, m_l = -2$   
 C)  $n = 2, l = 1, m_l = +1$   
 D)  $n = 1, l = 0, m_l = 0$   
 E)  $n = 4, l = 2, m_l = 0$
- 3) Which of the compounds of  $CH_3CO_2H$ ,  $Ca(OH)_2$ ,  $KOH$ , and  $HI$ , behave as acids when they are dissolved in water? 3) \_\_\_\_\_  
 A)  $Ca(OH)_2$  and  $KOH$  B)  $CH_3CO_2H$  and  $HI$   
 C) only  $HI$  D) only  $KOH$
- 4) What value of  $l$  is represented by a d orbital? 4) \_\_\_\_\_  
 A) 1 B) 3 C) 0 D) 2
- 5) Which of the following quantum numbers describes the shape of an orbital? 5) \_\_\_\_\_  
 A) angular momentum quantum number  
 B) spin quantum number  
 C) magnetic quantum number  
 D) Schrödinger quantum number  
 E) principal quantum number

- 6) No two electrons can have the same four quantum numbers is known as the \_\_\_\_\_  
 A) Heisenberg uncertainty principle                      B) Hund's rule  
 C) Aufbau principle    D) Pauli exclusion principle
- 7) The volume of a gas is proportional to number of moles of a gas is known as \_\_\_\_\_  
 A) Ideal Gas Law  
 B) Dalton's Law  
 C) Charles's Law  
 D) Avogadro's Law  
 E) Boyle's Law
- 8) Identify the polyprotic acid. \_\_\_\_\_  
 A)  $\text{H}_2\text{SO}_4$               B)  $\text{HCl}$                       C)  $\text{LiOH}$                       D)  $\text{LiCl}$                       E)  $\text{Ca}(\text{OH})_2$
- 9) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? \_\_\_\_\_  
 A) 13.8 torr              B) 31.8 torr                      C) 28.1 torr                      D) 760 torr                      E) 715 torr
- 10) How many valence electrons does an atom of Al possess? \_\_\_\_\_  
 A) 2                      B) 8                      C) 1                      D) 3                      E) 5
- 11) Determine the oxidation state of P in  $\text{PO}_3^{3-}$ . \_\_\_\_\_  
 A) +2                      B) 0                      C) +3                      D) -3                      E) +6
- 12) Which of the following is an acid-base reaction? \_\_\_\_\_  
 A)  $\text{Fe}(s) + 2 \text{AgNO}_3(aq) \rightarrow 2 \text{Ag}(s) + \text{Fe}(\text{NO}_3)_2(aq)$   
 B)  $2 \text{HClO}_4(aq) + \text{Ca}(\text{OH})_2(aq) \rightarrow 2 \text{H}_2\text{O}(l) + \text{Ca}(\text{ClO}_4)_2(aq)$   
 C)  $\text{C}(s) + \text{O}_2(g) \rightarrow \text{CO}_2(g)$   
 D)  $\text{MgSO}_4(aq) + \text{Ba}(\text{NO}_3)_2(aq) \rightarrow \text{Mg}(\text{NO}_3)_2(aq) + \text{BaSO}_4(s)$   
 E) None of the above are acid base reactions.

**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. (40 pts)

Please show all work for full credit and for partial credit.  $\{ P_{\text{total}} = P_a + P_b + P_c + \dots \chi_a = P_a / P_{\text{total}} = n_a / n_{\text{total}} \}$   
 $\{ PV = nRT, (P_1 V_1) / (P_2 V_2) = T_1 / T_2 \}$   $R = 0.08206 \text{ (L atm) / (mol K)}$ ,  $K = ^\circ\text{C} + 273.15$  } molar V at STP = 22.4 Liters  
 $760 \text{ mm Hg} = 1.00 \text{ atm}$

1 a. Complete the following acid base reaction. Assume complete forward reaction as written. Your fill in the blank part does not need to be a balanced chemical reaction but the part that I provided is balanced. (4 pts, 2 pts each blank) (12 pts all parts of #1)



b. If you have 2 moles of  $\text{HNO}_3$

how many moles of  $\text{Ca}(\text{OH})_2$  will you need? \_\_\_\_\_ moles  $\text{Ca}(\text{OH})_2$  (4 pts)

c. If you have a solution of 0.25 M of the  $\text{HNO}_3$

that means \_\_\_\_\_ moles of  $\text{HNO}_3$

in \_\_\_\_\_ mL of the  $\text{HNO}_3$  solution (4 pts, 2 pts each blank)

2 For the following reagent, give the oxidation state of the element listed. Either explain why or show work for your oxidation state number answer. (6 pts total, 2 pts each)

a. In  $\text{H}_2$  oxidation state of H is \_\_\_\_\_ Explain why.

$\text{NH}_4^{+1}$  b. What is the oxidation state of H in the molecule \_\_\_\_\_ Explain why.

c. What is the oxidation state of N in the molecule \_\_\_\_\_ Explain why.

3. If you have 12.5 moles of  $\text{H}_2$  at STP

How many Liters of  $\text{H}_2$  gas do you have ? \_\_\_\_\_ Liters (show work) (1 mole any gas = 22.4 Liters) (5 pts)

4. You have 25.2 mm Hg of  $O_2(g)$  together with  $H_2(g)$  in a gas cylinder,

with a total pressure of 890.3 mm Hg, what is the pressure of the  $H_2$  \_\_\_\_\_ (show work)

{  $P_{total} = P_a + P_b + P_c + \dots$   $\chi_a = P_a / P_{total} = n_a / n_{total}$  } (5 pts)

5 For the symbol to represent an electron configuration, (circle one parenthesis under each letter, do not circle one of the letters) (6 pts, 2 pts each)

5  $f^3$  a) 5 represents [(period number) (angular momentum quantum number)] (circle one)

b) the f represents [(angular momentum quantum number) (shell number)] (circle one)

c) the 3 represents [(period number) or (number of electrons within 5 f)] (circle one)

6. Considering periodic trends, circle the correct elements (6 pts, 3 pts each)

a. Which is smaller as the element [(F) or (Br)] (circle one)

b. Which has higher ionization energy [(Si) or (Cl)] (circle one)

**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. If you have a gas at 32.5 °C, at 750.2 torr in a 250.2 mL container and heat it to 70.5 °C, with a new volume of 150.1 mL, what is the new pressure? [use one of the following equations: { $PV=nRT$ ,  $(P_1V_1)/(P_2V_2)=T_1/T_2$   $R=0.08206$  (L atm)/(mol K)}] (15 pts)

2. a). For the element **Ba** give the electron configuration in the format ( $1s^2, 2s^2, 2p^6, \dots$ ) (20 pts total, 5 pts each letter)

b) Give the valence electron configuration for the element in # (a) above, in the same format. (5 pts)

c) For the charged ion  $\text{Ba}^{+2}$ , give the complete electron configuration in the format ( $1s^2, 2s^2, 2p^6, \dots$ ) (5 pts)

- d) Give the **orbital diagram** (for all electrons not just the valence electrons) for the element in (a) above (in the format  $\uparrow\downarrow$   $\uparrow\downarrow$ ... using up and down arrows to represent electrons) (5 pts)
- 1s      2s



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. (1 pt print and sign exam) 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, I obviously cannot grade it). Return your entire exam including the stapled periodic table. If your exam falls apart, please staple everything back together before turning in the exam.

$M_1V_1 = M_2V_2$  (FW = formula mass or formula weight)  $\{ P_{total} = P_a + P_b + P_c + \dots \chi_a = P_a / P_{total} = n_a / n_{total} \}$   
 $\{ PV = nRT, (P_1V_1)/(P_2V_2) = T_1/T_2, R = 0.08206 \text{ (L atm)/(mol K)}, K = ^\circ\text{C} + 273.15 \}$  molar V at STP = 22.4 Liters  
 760 torr = 760 mm Hg = 1.00 atm

**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, 24 pts total)

- 1) What value of l is represented by a d orbital? 1) \_\_\_\_\_  
 A) 0 B) 1 C) 2 D) 3
- 2) Identify acetic acid. ( $\text{CH}_3\text{COOH}$ ) 2) \_\_\_\_\_  
 A) strong electrolyte, strong acid  
 B) strong electrolyte, weak acid  
 C) weak electrolyte, weak acid  
 D) nonelectrolyte  
 E) weak electrolyte, strong acid
- 3) Which of the compounds of  $\text{CH}_3\text{CO}_2\text{H}$ ,  $\text{Ca}(\text{OH})_2$ ,  $\text{KOH}$ , and  $\text{HI}$ , behave as acids when they are dissolved in water? 3) \_\_\_\_\_  
 A)  $\text{Ca}(\text{OH})_2$  and  $\text{KOH}$  B)  $\text{CH}_3\text{CO}_2\text{H}$  and  $\text{HI}$   
 C) only  $\text{KOH}$  D) only  $\text{HI}$
- 4) No two electrons can have the same four quantum numbers is known as the 4) \_\_\_\_\_  
 A) Hund's rule B) Heisenberg uncertainty principle  
 C) Pauli exclusion principle D) Aufbau principle
- 5) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 5) \_\_\_\_\_  
 A) 28.1 torr B) 31.8 torr C) 715 torr D) 760 torr E) 13.8 torr
- 6) The volume of a gas is proportional to number of moles of a gas is known as 6) \_\_\_\_\_  
 A) Boyle's Law  
 B) Avogadro's Law  
 C) Dalton's Law  
 D) Ideal Gas Law  
 E) Charles's Law

- 7) Identify the polyprotic acid. 7) \_\_\_\_\_  
 A) LiOH                      B) HCl                      C) H<sub>2</sub>SO<sub>4</sub>                      D) Ca(OH)<sub>2</sub>                      E) LiCl
- 8) Each of the following sets of quantum numbers is supposed to specify an orbital. Which of the following sets of quantum numbers contains an error? 8) \_\_\_\_\_  
 A)  $n = 4, l = 2, m_l = 0$   
 B)  $n = 3, l = 0, m_l = 0$   
 C)  $n = 3, l = 3, m_l = -2$   
 D)  $n = 2, l = 1, m_l = +1$   
 E)  $n = 1, l = 0, m_l = 0$
- 9) Which of the following quantum numbers describes the shape of an orbital? 9) \_\_\_\_\_  
 A) Schrödinger quantum number  
 B) angular momentum quantum number  
 C) principal quantum number  
 D) spin quantum number  
 E) magnetic quantum number
- 10) Determine the oxidation state of P in PO<sub>3</sub><sup>3-</sup>. 10) \_\_\_\_\_  
 A) 0                      B) +6                      C) -3                      D) +2                      E) +3
- 11) How many valence electrons does an atom of Al possess? 11) \_\_\_\_\_  
 A) 3                      B) 2                      C) 5                      D) 8                      E) 1
- 12) Which of the following is an acid-base reaction? 12) \_\_\_\_\_  
 A)  $C(s) + O_2(g) \rightarrow CO_2(g)$   
 B)  $MgSO_4(aq) + Ba(NO_3)_2(aq) \rightarrow Mg(NO_3)_2(aq) + BaSO_4(s)$   
 C)  $2 HClO_4(aq) + Ca(OH)_2(aq) \rightarrow 2 H_2O(l) + Ca(ClO_4)_2(aq)$   
 D)  $Fe(s) + 2 AgNO_3(aq) \rightarrow 2 Ag(s) + Fe(NO_3)_2(aq)$   
 E) None of the above are acid base reactions.

**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. (40 pts)

Please show all work for full credit and for partial credit. {  $P_{\text{total}} = P_a + P_b + P_c + \dots$ ,  $\chi_a = P_a / P_{\text{total}} = n_a / n_{\text{total}}$  }  
{  $PV = nRT$ ,  $(P_1 V_1) / (P_2 V_2) = T_1 / T_2$ ,  $R = 0.08206 \text{ (L atm) / (mol K)}$ ,  $K = ^\circ\text{C} + 273.15$  } molar V at STP = 22.4 Liters  
 $760 \text{ mm Hg} = 1.00 \text{ atm}$

1 a. Complete the following acid base reaction. Assume complete forward reaction as written. Your fill in the blank part does not need to be a balanced chemical reaction but the part that I provided is balanced. (4 pts, 2 pts each blank) (12 pts all parts of #1)



b. If you have 5 moles of  $\text{H}_2 \text{SO}_4$

how many moles of Na OH will you need?                      moles Na OH (4 pts)

c. If you have a solution of 0.15 M of the  $\text{H}_2 \text{SO}_4$

that means                      moles of  $\text{H}_2 \text{SO}_4$

in                      mL of the  $\text{H}_2 \text{SO}_4$  solution (4 pts, 2 pts each blank)

2 For the following reagent, give the oxidation state of the element listed. Either explain why or show work for your oxidation state number answer. (6 pts total, 2 pts each)

a. In Na oxidation state of Na is \_\_\_\_\_ Explain why.

$\text{NO}_3^{-1}$  b. What is the oxidation state of the O (oxygen) in the molecule \_\_\_\_\_ Explain why.

c. What is the oxidation state of the N in the molecule \_\_\_\_\_ Explain why.

3. If you have 7.3 moles of  $\text{N}_2$  at STP

How many Liters of  $\text{N}_2$  gas do you have? \_\_\_\_\_ Liters (show work) (1 mole any gas = 22.4 Liters) (5 pts)

4. You have 0.85 atm of  $N_2$  (g) together with He (g) in a gas cylinder,

with a total pressure of 1.78 atm, what is the pressure of the He \_\_\_\_\_ (show work)

{  $P_{total} = P_a + P_b + P_c + \dots$   $\chi_a = P_a / P_{total} = n_a / n_{total}$  } (5 pts)

5 For the symbol to represent an electron configuration, (circle one parenthesis under each letter, do not circle one of the letters) (6 pts, 2 pts each)

2 p<sup>3</sup> a) the 3 represents [ (period number) or (number of electrons within 2 p ) ] (circle one)

b) 2 represents [ (period number) or (angular momentum quantum number)] (circle one)

c) the p represents [ (angular momentum quantum number) or (shell number)] (circle one)

6. Considering periodic trends, circle the correct elements (6 pts, 3 pts each)

a. Which has lower ionization energy [(O) or (Se)] (circle one)

b. Which is bigger as an element [(Ca) or (K)] (circle one)

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

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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. You have 70.5 grams of  $H_2$  (gas, FW = 2.02 g/mol) at 770.2 mm Hg and 25.8 °C, what volume does the gas occupy ? [use one of the following equations:  $\{PV=nRT, (P_1V_1)/(P_2V_2)=T_1/T_2$   $R=0.08206$  (L atm)/(mol K)}] (15 pts)

2. a). For the element **Se** give the electron configuration in the format ( $1s^2, 2s^2, 2p^6, \dots$ ) (20 pts total, 5 pts each letter)

b) Give the **valence** electron configuration for the element in # (a) above, in the same format. (5 pts)

c) For the charged ion **Se<sup>-2</sup>**, give the complete electron configuration in the format ( $1s^2, 2s^2, 2p^6, \dots$ ) (5 pts)

- d) Give the **orbital diagram** (for all electrons **not just the valence electrons**) for the element in (a) above (in the format  $\uparrow\downarrow$   $\uparrow\downarrow$  .... using up and down arrows to represent electrons) (5 pts)

$1s$   $2s$



Name \_\_\_\_\_ (print) Name \_\_\_\_\_ (sign)

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$M_1 V_1 = M_2 V_2$  (FW = formula mass or formula weight) {  $P_{\text{total}} = P_a + P_b + P_c + \dots$   $\chi_a = P_a / P_{\text{total}} = n_a / n_{\text{total}}$  }  
 {  $PV = nRT$ ,  $(P_1 V_1) / (P_2 V_2) = T_1 / T_2$   $R = 0.08206$  (L atm)/(mol K),  $K = ^\circ\text{C} + 273.15$  } molar V at STP = 22.4 Liters  
 760 torr = 760 mm Hg = 1.00 atm

**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, 24 pts total)

- 1) How many  $\text{H}^+$  ions can the acid,  $\text{H}_2\text{SO}_4$ , donate per molecule? 1) \_\_\_\_\_  
 A) 1                                      B) 2                                      C) 0                                      D) 3
- 2) The total pressure of a gas mixture is the sum of the partial pressure of its components is known as 2) \_\_\_\_\_  
 A) Charles's Law  
 B) Avogadro's Law  
 C) Dalton's Law  
 D) Ideal Gas Law  
 E) Boyle's Law
- 3) When filling degenerate orbitals, electrons fill them singly first, with parallel spins is known as 3) \_\_\_\_\_  
 A) Heisenberg uncertainty principle                      B) Pauli exclusion principle  
 C) Aufbau principle    D) Hund's rule
- 4) Determine the oxidation state of nitrogen in  $\text{NO}_2$ . 4) \_\_\_\_\_  
 A) +2                                      B) +3                                      C) +5                                      D) 0                                      E) +4
- 5) A cation of +2 indicates that an element has 5) \_\_\_\_\_  
 A) lost two neutrons.  
 B) gained two protons.  
 C) lost two electrons.  
 D) gained two electrons.  
 E) lost two protons.
- 6) Which of the following quantum numbers describes the orientation of an orbital? 6) \_\_\_\_\_  
 A) angular momentum quantum number  
 B) principal quantum number  
 C) spin quantum number  
 D) magnetic quantum number  
 E) Schrödinger quantum number

- 7) What is the maximum number of d orbitals that are possible? 7) \_\_\_\_\_  
 A) 5                      B) 7                      C) 9                      D) 1                      E) 3
- 8) When dissolved in water, KOH behaves as 8) \_\_\_\_\_  
 A) an acid that forms  $\text{KO}^-$  and  $\text{H}^+$  ions.                      B) a base that forms  $\text{KO}^-$  and  $\text{H}^+$  ions.  
 C) a base that forms  $\text{K}^+$  and  $\text{OH}^-$  ions.                      D) an acid that forms  $\text{K}^+$  and  $\text{OH}^-$  ions.
- 9) Identify HCl. 9) \_\_\_\_\_  
 A) nonelectrolyte  
 B) weak electrolyte, strong acid  
 C) weak electrolyte, weak acid  
 D) strong electrolyte, weak acid  
 E) strong electrolyte, strong acid
- 10) What are the possible values of  $l$  if  $n = 6$ ? 10) \_\_\_\_\_  
 A) 6    B) -5, -4, -3, -2, -1, 0, +1, +2, +3, +4, or +5  
 C) -4, -3, -2, -1, 0, +1, +2, +3, or +4                      D) 0, 1, 2, 3, 4, or 5
- 11) Which of the following is an acid-base reaction? 11) \_\_\_\_\_  
 A)  $\text{Fe(s)} + 2 \text{AgNO}_3(\text{aq}) \rightarrow 2 \text{Ag(s)} + \text{Fe(NO}_3)_2(\text{aq})$   
 B)  $2 \text{HClO}_4(\text{aq}) + \text{Ca(OH)}_2(\text{aq}) \rightarrow 2 \text{H}_2\text{O(l)} + \text{Ca(ClO}_4)_2(\text{aq})$   
 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.
- 12) Give the temperature and pressure at STP. 12) \_\_\_\_\_  
 A)  $0^\circ\text{C}$  and 1.00 atm  
 B) 0K and 1.00 atm  
 C)  $0^\circ\text{C}$  and 1 mm Hg  
 D) 32K and 1 torr Hg  
 E)  $25^\circ\text{C}$  and 1.00 in Hg

**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. (40 pts)

Please show all work for full credit and for partial credit. {  $P_{total} = P_a + P_b + P_c + \dots$ ,  $\chi_a = P_a / P_{total} = n_a / n_{total}$  }  
{  $PV = nRT$ ,  $(P_1V_1)/(P_2V_2) = T_1/T_2$ ,  $R = 0.08206$  (L atm)/(mol K),  $K = ^\circ C + 273.15$  } molar V at STP = 22.4 Liters  
 $760 \text{ mm Hg} = 1.00 \text{ atm}$

1 a. Complete the following acid base reaction. Assume complete forward reaction as written. Your fill in the blank part does not need to be a balanced chemical reaction but the part that I provided is balanced. (4 pts, 2 pts each blank) (12 pts all parts of #1)



b. If you have 3 moles of  $\text{H}_2\text{SO}_4$

how many moles of Li OH will you need? \_\_\_\_\_ moles Li OH (4 pts)

c. If you have a solution of 1.25 M of the  $\text{H}_2\text{SO}_4$

that means \_\_\_\_\_ moles of  $\text{H}_2\text{SO}_4$

in \_\_\_\_\_ mL of the  $\text{H}_2\text{SO}_4$  solution (4 pts, 2 pts each blank)

2 For the following reagent, give the oxidation state of the element listed. Either explain why or show work for your oxidation state number answer. (6 pts total, 2 pts each)

a. In Fe oxidation state of Fe is \_\_\_\_\_ Explain why.

SF<sub>6</sub> b. What is the oxidation state of the F in the molecule \_\_\_\_\_ Explain why.

c. What is the oxidation state of the S in the molecule \_\_\_\_\_ Explain why.

3. If you have 82.5 moles of He at STP

How many Liters of He gas do you have? \_\_\_\_\_ Liters (show work) (1 mole any gas = 22.4 Liters) (5 pts)

4. You have 1.2 atm of  $\text{H}_2\text{O}(\text{g})$  together with  $\text{H}_2(\text{g})$  in a gas cylinder,

with a total pressure of 2.77 atm,  $\{ P_{\text{total}} = P_{\text{a}} + P_{\text{b}} + P_{\text{c}} + \dots \chi_{\text{a}} = P_{\text{a}} / P_{\text{total}} = n_{\text{a}} / n_{\text{total}} \}$

What is the mole fraction ( $\chi_{\text{a}}$ ) of  $\text{H}_2\text{O}$  \_\_\_\_\_ (show work) (5 pts)

5 For the symbol to represent an electron configuration, (circle one parenthesis under each letter, do not circle one of the letters) (6 pts, 2 pts each)

7 d<sup>5</sup> a) 7 represents [ (period number) or (angular momentum quantum number) ] (circle one)

b) the d represents [ (angular momentum quantum number) or (shell number)] (circle one)

c) the 5 represents [ (period number) or (number of electrons within 7 d)] (circle one)

6. Considering periodic trends, circle the correct elements (6 pts, 3 pts each)

a. Which is smaller as the element [(F) or (C)] (circle one)

b. Which has higher ionization energy [(Be) or (Sr)] (circle one)

**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. You have 17.5 grams of He (gas, FW = 4.00 g/mol) in a 250.5 mL container at 892.2 mm Hg, what temperature is the He in your container ? [use one of the following equations:  $\{PV=nRT, (P_1V_1)/(P_2V_2)=T_1/T_2 \text{ } R=0.08206 \text{ (L atm)/(mol K)}\}$ ] (15 pts)

2. a). For the element **As** give the electron configuration in the format ( $1s^2, 2s^2, 2p^6, \dots$ ) (20 pts total, 5 pts each letter)

b) Give the valence electron configuration for the element in # (a) above, in the same format. (5 pts)

c) For the charged ion  $As^{-3}$ , give the complete electron configuration in the format ( $1s^2, 2s^2, 2p^6, \dots$ ) (5 pts)

d) Give the orbital diagram (for all electrons not just the valence electrons) for the element in (a) above (in the format  $\begin{array}{c} \uparrow\downarrow \\ 1s \end{array}$   $\begin{array}{c} \uparrow\downarrow \\ 2s \end{array}$  ... using up and down arrows to represent electrons) (5 pts)



Name \_\_\_\_\_ (print) Name \_\_\_\_\_ (sign)

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$M_1V_1 = M_2V_2$  (FW = formula mass or formula weight) {  $P_{total} = P_a + P_b + P_c + \dots$   $\chi_a = P_a / P_{total} = n_a / n_{total}$  }  
 {  $PV = nRT$ ,  $(P_1V_1)/(P_2V_2) = T_1/T_2$   $R = 0.08206$  (L atm)/(mol K),  $K = ^\circ C + 273.15$  } molar V at STP = 22.4 Liters  
 760 torr = 760 mm Hg = 1.00 atm

**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, 24 pts total)

- 1) Identify HCl. 1) \_\_\_\_\_
  - A) strong electrolyte, strong acid
  - B) nonelectrolyte
  - C) strong electrolyte, weak acid
  - D) weak electrolyte, weak acid
  - E) weak electrolyte, strong acid
  
- 2) A cation of +2 indicates that an element has 2) \_\_\_\_\_
  - A) gained two protons.
  - B) lost two neutrons.
  - C) gained two electrons.
  - D) lost two protons.
  - E) lost two electrons.
  
- 3) When filling degenerate orbitals, electrons fill them singly first, with parallel spins is known as 3) \_\_\_\_\_
  - A) Aufbau principle
  - B) Heisenberg uncertainty principle
  - C) Hund's rule
  - D) Pauli exclusion principle
  
- 4) What is the maximum number of d orbitals that are possible? 4) \_\_\_\_\_
  - A) 7
  - B) 1
  - C) 3
  - D) 9
  - E) 5
  
- 5) Give the temperature and pressure at STP. 5) \_\_\_\_\_
  - A) 0K and 1.00 atm
  - B) 0°C and 1.00 atm
  - C) 0°C and 1 mm Hg
  - D) 25°C and 1.00 in Hg
  - E) 32K and 1 torr Hg
  
- 6) What are the possible values of  $l$  if  $n = 6$ ? 6) \_\_\_\_\_
  - A) 6
  - B) 0, 1, 2, 3, 4, or 5
  - C) -5, -4, -3, -2, -1, 0, +1, +2, +3, +4, or +5
  - D) -4, -3, -2, -1, 0, +1, +2, +3, or +4

- 7) When dissolved in water, KOH behaves as \_\_\_\_\_  
A) an acid that forms  $K^+$  and  $OH^-$  ions. B) an acid that forms  $KO^-$  and  $H^+$  ions.  
C) a base that forms  $KO^-$  and  $H^+$  ions. D) a base that forms  $K^+$  and  $OH^-$  ions.
- 8) The total pressure of a gas mixture is the sum of the partial pressure of its components is known as \_\_\_\_\_  
A) Avogadro's Law  
B) Charles's Law  
C) Boyle's Law  
D) Dalton's Law  
E) Ideal Gas Law
- 9) How many  $H^+$  ions can the acid,  $H_2SO_4$ , donate per molecule? \_\_\_\_\_  
A) 1 B) 3 C) 2 D) 0
- 10) Which of the following is an acid-base reaction? \_\_\_\_\_  
A)  $Fe(s) + 2 AgNO_3(aq) \rightarrow 2 Ag(s) + Fe(NO_3)_2(aq)$   
B)  $C(s) + O_2(g) \rightarrow CO_2(g)$   
C)  $2 HClO_4(aq) + Ca(OH)_2(aq) \rightarrow 2 H_2O(l) + Ca(ClO_4)_2(aq)$   
D)  $MgSO_4(aq) + Ba(NO_3)_2(aq) \rightarrow Mg(NO_3)_2(aq) + BaSO_4(s)$   
E) None of the above are acid base reactions.
- 11) Which of the following quantum numbers describes the orientation of an orbital? \_\_\_\_\_  
A) Schrödinger quantum number  
B) angular momentum quantum number  
C) spin quantum number  
D) principal quantum number  
E) magnetic quantum number
- 12) Determine the oxidation state of nitrogen in  $NO_2$ . \_\_\_\_\_  
A) +5 B) +2 C) +3 D) +4 E) 0

**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. (40 pts)

Please show all work for full credit and for partial credit. {  $P_{\text{total}} = P_a + P_b + P_c + \dots$   $\chi_a = P_a / P_{\text{total}} = n_a / n_{\text{total}}$  }  
{  $PV = nRT$ ,  $(P_1 V_1) / (P_2 V_2) = T_1 / T_2$   $R = 0.08206 \text{ (L atm) / (mol K)}$ ,  $K = ^\circ\text{C} + 273.15$  } molar V at STP = 22.4 Liters  
 $760 \text{ mm Hg} = 1.00 \text{ atm}$

1 a. Complete the following acid base reaction. Assume complete forward reaction as written. Your fill in the blank part does not need to be a balanced chemical reaction but the part that I provided is balanced. (4 pts, 2 pts each blank) (12 pts all parts of #1)



b. If you have 4 moles of HBr

how many moles of  $\text{Sr}(\text{OH})_2$  will you need? \_\_\_\_\_ moles  $\text{Sr}(\text{OH})_2$  (4 pts)

c. If you have a solution of 0.75 M of the HBr

that means \_\_\_\_\_ moles of HBr

in \_\_\_\_\_ mL of the HBr solution (4 pts, 2 pts each blank)

2 For the following reagent, give the oxidation state of the element listed. Either explain why or show work for your oxidation state number answer. (6 pts total, 2 pts each)

a. In  $O_2$  oxidation state of O is \_\_\_\_\_ Explain why.

$SO_3^{2-}$  b. What is the oxidation state of the O (oxygen) in the molecule \_\_\_\_\_ Explain why.

c. What is the oxidation state of the S in the molecule \_\_\_\_\_ Explain why.

3. If you have 32.5 moles of  $O_2$  at STP

How many Liters of  $O_2$  gas do you have? \_\_\_\_\_ Liters (show work) (1 mole any gas = 22.4 Liters) (5 pts)

4. You have 78.2 torr of He (g) together with H<sub>2</sub> (g) in a gas cylinder,

with a total pressure of 792.2 torr, {  $P_{\text{total}} = P_a + P_b + P_c + \dots$ ,  $\chi_a = P_a / P_{\text{total}} = n_a / n_{\text{total}}$  }

What is the mole fraction ( $\chi_a$ ) of He \_\_\_\_\_ (show work) (5 pts)

5 For the symbol to represent an electron configuration, (circle one parenthesis under each letter, do not circle one of the letters) (6 pts, 2 pts each)

5 p<sup>6</sup> a) the 6 represents [ (period number) or (number of electrons within 5 p)] (circle one)

b) 5 represents [ (period number) or (angular momentum quantum number)] (circle one)

c) the p represents [ (angular momentum quantum number) or (shell number) ] (circle one)

6. Considering periodic trends, circle the correct elements (6 pts, 3 pts each)

a. Which has lower ionization energy [(B) or (In)] (circle one)

b. Which is bigger as an element [(S) or (Al)] (circle one)

**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. If you have a gas in an internal combustion engine at 650.2 torr and 25.2 °C at a volume of 1.77 Liters and the gas after combustion is at 780.2 °C and volume of 1.77 Liters, what is the new pressure ? [use one of the following equations:  $PV=nRT$ ,  $(P_1V_1)/(P_2V_2)=T_1/T_2$   $R=0.08206$  (L atm)/(mol K)] (15 pts)

2. a). For the element **In** give the electron configuration in the format ( $1s^2, 2s^2, 2p^6, \dots$ ) (20 pts total, 5 pts each letter)

b) Give the valence electron configuration for the element in # (a) above, in the same format. (5 pts)

c) For the charged ion **In<sup>+3</sup>**, give the complete electron configuration in the format ( $1s^2, 2s^2, 2p^6, \dots$ ) (5 pts)

- d) Give the **orbital diagram** (for all electrons **not just the valence electrons**) for the element in (a) above (in the format  $\uparrow\downarrow$   $\uparrow\downarrow$  ... using up and down arrows to represent electrons) (5 pts)
- 1s    2s