Name_____ *K Ch* _____ (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 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. (Please count your exam and make sure there are 14 real pages + periodic table & other charts.)

1 mole = molar mass = 6.022×10^{23} M = (# moles) / (Liter solution), $M_1V_1 = M_2V_2$

{ $P_{total} = P_a + P_b + P_c + \ldots \chi_a = P_a / P_{total} = n_a / n_{total}$ }

$PV=nRT$, $(P_1V_1)/(P_2V_2)=T_1/T_2$ R=0.08206 (L atm)/(mol K),   K=°C+273.15

molar V at STP = 22.4 Liters   760 torr = 760 mm Hg = 1.00 atm

I am a graduating Senior [(Yes) or (No)]   (200 pts on exam which will be a maximum of 100%)

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, 52 pts total)

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

2) Identify an anion.   2) __A__
   A) An atom that has gained an electron.
   B) An atom that has lost an electron.
   C) An atom that has lost a neutron and a proton.
   D) An atom that has gained a neutron.

3) Which of the following elements is a nonmetal?   3) __B__
   A) K   B) N   C) Ba   D) Be   E) Ce

4) Identify the number of electron groups around a molecule with a tetrahedral shape.   4) __B__
   A) 5   B) 4   C) 1   D) 2   E) 3

5) Which of the compounds of CH_3CO_2H, $Ca(OH)_2$, KOH, and HI, behave as acids when they are dissolved in water?   5) __C__
   A) only HI   B) only KOH
   C) CH_3CO_2H and HI   D) $Ca(OH)_2$ and KOH

6) What is the empirical formula for $C_{12}H_{24}O_6$?   6) __D__
   A) CHO_2 B) CH_2O C) CHO   D) C_2H_4O E) C_2H_5O

7) What is the charge on the Sc ions in Sc_2O_3?

    A) 3+   B) 3–   C) 2+   D) 1+

7) _A_

8) What value of l is represented by a d orbital?

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

8) _B_

9) 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) $n = 2, l = 1, m_l = +1$

    B) $n = 3, l = 0, m_l = 0$

    C) $n = 4, l = 2, m_l = 0$

    D) $n = 1, l = 0, m_l = 0$

    E) $n = 3, l = 3, m_l = -2$

9) _E_

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.

10) _C_

11) A physical change

    A) occurs when water (liquid) is evaporated to water vapor (gas).

    B) occurs when propane (C_3H_8) is burned to produce heat, CO_2 and H_2O.

    C) occurs when glucose $(C_6H_{12}O_6)$ is converted into energy and CO_2 and H_2O within your cells.

    D) occurs when iron (Fe) rusts to produce (FeO and Fe_3O_4).

    E) occurs when Na and Cl combine to make NaCl .

11) _A_

12) Give the approximate bond angle for a molecule with a trigonal planar shape.

    A) 120°   B) 107°   C) 180°   D) 109.5°   E) 90°

12) _A_

13) Calculate the mass percent composition of sulfur in $Al_2(SO_4)_3$. (FW aluminum sulfate = 342.21 g/mol , S atomic mass = 32.07 g/mol)

    A) 42.73 %   B) 28.12 %   C) 35.97 %   D) 9.372 %   E) 21.38 %

13) _B_

14) Which of the following are examples of intensive properties?

    A) mass

    B) volume

    C) density

    D) None of the above are examples of intensive properties.

    E) All of the above are examples of intensive properties.

14) _C_

15) Which of the following represent the Lewis structure for Cl?

    A) ·Ç̈l: B) :Ç̈l: C) ·Ç̈l: D) Cl·   E) :Ç̈l·

15) _B_

16) Which of the following quantum numbers describes the shape of an orbital? 16) _D_
    A) magnetic quantum number
    B) spin quantum number
    C) principal quantum number
    D) angular momentum quantum number
    E) Schrödinger quantum number

17) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 17) _B_
    A) 13.8 torr   B) 715 torr   C) 760 torr   D) 28.1 torr   E) 31.8 torr

18) Determine the name for aqueous HF. 18) _A_
    A) hydrofluoric acid
    B) hydrogen fluorate
    C) fluorous acid
    D) hydrofluorous acid
    E) fluoric acid

19) An ionic bond is best described as 19) _D_
    A) the sharing of electrons.
    B) the attraction that holds the atoms together in a polyatomic ion.
    C) the attraction between 2 nonmetal atoms.
    D) the transfer of electrons from one atom to another.
    E) the attraction between 2 metal atoms.

20) Identify the charges of the protons, neutrons, and electrons. 20) _C_
    A) protons 0, neutrons +1, electrons −1
    B) protons 0, neutrons −1, electrons +1
    C) protons +1, neutrons 0, electrons −1
    D) protons −1, neutrons 0, electrons +1
    E) protons +1, neutrons −1, electrons 0

21) A substance composed of two or more elements in a fixed, definite proportion is 21) _E_
    A) a heterogeneous mixture.
    B) a solution.
    C) a homogeneous mixture.
    D) an alloy.
    E) a compound.

22) The solid compound, K_2SO_4, contains 22) _B_
    A) K_2SO_4 molecules.   B) K^+ and SO_4^{-2} ions.
    C) K^+, S^{6+}, and O^{2-} ions.   D) K_2^+ and SO_4^{-2} ions.

23) Choose the bond below that is most polar. 23) _D_
    A) H–Cl   B) H–I   C) H–Br   D) H–F   E) F–F

24) Which of the following exists as a diatomic molecule?   24) __D__
    A) lithium
    B) carbon
    C) krypton
    D) hydrogen
    E) phosphorus

25) Identify the shortest bond.   25) __A__
    A) triple covalent bond
    B) single covalent bond
    C) double covalent bond
    D) all of the above bonds are the same length

26) The atomic mass for cadmium is   26) __B__
    A) 48   B) 112.41   C) 20   D) 40.08

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. You can use the back of the page for scratch paper. 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. (80 pts)

Please show all work for full credit and for partial credit.

1.   Name of elements and element symbols: (8 pts, 4 pts each)

a.   The symbol for the element __nitrogen__ is ___N___ (4 pts)

b.   The name of the element __Mg__ is

_____magnesium_____ (4 pts)

2.   Match the following to the letters shown by filling in the parenthesis. The letters may only be used one time or not at all. Each parenthesis should have one letter. If you put in an incorrect letter into the parenthesis, you will lose points. It is possible that the parenthesis correct answer may have more than one correct answer. (2 pts each, 4 pts total)

(a)   transition metal elements (b) lanthanide, actinide elements (c) main group elements   (d) alkali metal elements (e) alkaline earth elements (f) halogens (g) noble gases (h) s block (i) p block (j) d block (k) f block   (l) principal quantum number or period number (m) group number

(e) accept
       h

Periodic Table of the Elements

(b, k)

3. The following all refers to the element **Se** (14 pts, 1 pt per blank)

a. Write the symbol of the element in the format $^A_Z X$ $^{79}_{34} Se$ (1 pts)

b. Number of protons in the element is __34__ protons (1 pt)

c. Number of electrons for a neutral atom is __34__ electrons (1 pt)

d. Number of neutrons is _____ neutrons. (1 pt) Show work.

$$79 - 34 =$$

e. Atomic number for the element is __34_____ (1 pt)

f. Atomic mass for the element is __78.96__ (1 pt)

g. How many atoms does **one mole** of the element contain __6.022×10^{23}__ (1 pt)

h. How much does **one atom** of the element weigh __78.96__ amu (1 pt)

i. How much does **one mole** of the element weigh __78.96__ grams (1 pt)

j. What is the group number of the element exactly as written in the periodic table which you have attached to your exam (If the number on my periodic table is written as a Roman numeral write your answer as a Roman numeral. If the number on my periodic table is written as an Arabic number, write you answer as an Arabic number or you will lose points.)?

__VI A__ (1 pt)

k. If the element is in its ionic state, what is the charge (or oxidation state) of the atom. __−2__
(1 pt) Show work. $6 - 8 = -2$

l. How many total electrons is in the element ? __34_____ (1 pt)

m. How many valence electrons does the element have ? __6_____ (1 pt) Show work or explain.

n. Give the Lewis Dot Symbol for the element . __·Se·_____ (1 pt)

4. Circle the following compounds which are **ionic** You may circle one, many, all or none. (12 pts, 2 pts each)

CCl₄   (Mg₃N₂)   (K Br)   SO₂   F₂   (Na₂SO₄)
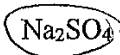
5   For the following reagent, give the oxidation state or charge of the listed. Either explain why or show work for your oxidation state number answer. (8 pts total)

a. Between **In** and **O** what is the oxidation state or charge on the **In** in the ionic formula

___+3___ Explain. (2 pts)   + group #

b. Between **In** and **O** what is the oxidation state or charge on the **O** in the ionic formula

___-2___ Explain. (1 pt)   group # -8

$$6 - 8 = -2$$

c. Show your work for your calculation of the ionic formula between **In** and **O**
(2 pt)

$$(\# \ In)(+3) + (\# \ O)(-2) = zero$$

$$\# \ In = 2 \qquad \# \ O = 3 \qquad In_2 O_3$$

d. In $In_2(SO_4)_3$ what is the oxidation state or charge on the S Show work. (3 pts) $[In_2 (SO_4)_3]$

$$In = +3,$$

$$SO_4^{-2} \ (\text{memorized charge on } SO_4)$$

$$O \ is \ -2 \rightarrow (S)\xi + 4(-2) = -2$$

$$S = -2 + 8 = +6$$

6 For the following formula, give the formula mass (or molar mass). Show work. (4 pts)

Al PO₄

$$Al \quad P \quad O$$
$$(27.0) + (30.97) + 4(16.00) = 121.97$$

7. If you have the following ionic compound, is the reagent soluble or insoluble in water. Circle the correct choices below to answer this question. (6 pts total)
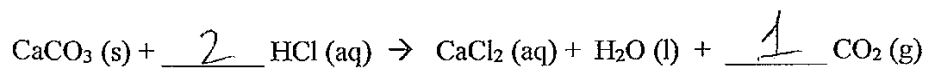
Pb (NO₃)₂ NO_3 ~ normally (not exception)

The anion (by itself without the cation) is [(soluble) or (insoluble)] (circle one) (3 pt)

The ionic compound (the anion with the cation) is [(soluble) or (insoluble)] (circle one) (3 pt)

8. Balance the following reactions by: (8 pts, 2 pts per blank)

a. filling in the blanks. (you can fill the blank with a **one but not a zero**)

CaCO₃ (s) + __2__ HCl (aq) → CaCl₂ (aq) + H₂O (l) + __1__ CO₂ (g)

b. show the number count for the element Cl separately for the reactant and products

reactant atom count of Cl __2__   product atom count of Cl __2__

9 Given the following reactants, write out the products by filling in the blanks. You do not need to balance the reactions in either part of this question. (4 pt, 2 pts per blank)

$Ag\,NO_3$ (aq) + $Ca\,Cl_2$ (aq) → __$Ag\,Cl$__ (aq) (s) + __$Ca(NO_3)_2$__ (s) (aq)
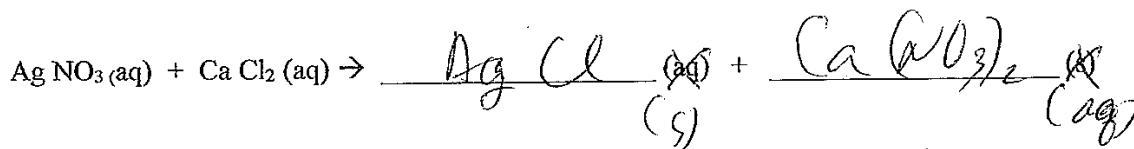
10 For the symbol to represent an electron configuration, (circle one parenthesis under each letter, do not circle one of the letters) (6 pts, 2 pts each)

$7\,d^5$ 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)

11. Give the Lewis Dot Structure of the following by completing the following. (6 pts total)

a. Show your work for the count of the valence electrons in the entire molecule. $F\,H_2C\,As\,O\,H_2$ (3 pts)

F   H   C   As   O   H

$7 + 2(1) + 4 + 5 + 6 + 2(1) = 26$

b. Given the following two structures, choose the correct structure and then explain one reason why the other structure is incorrect. (3 pts)

(a)   (2) C in period 2 cannot have
       (2) H has more than duet

(b)
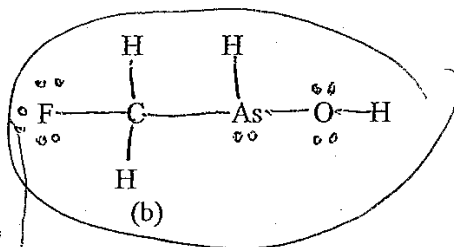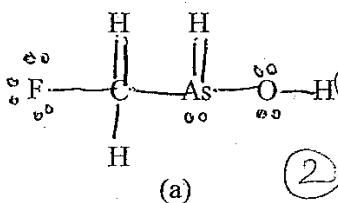
① C in period 2 cannot have more than octet
② H has more than duet

① $15 \times 2 = 30\,\bar{e}$
   pairs too many $\bar{e}$

$13\,\bar{e} \times 2 = 26\,\bar{e}$
pairs

Part III.   Long Answer   Please <u>show work</u> for full credit and to receive partial credit. **(66 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.

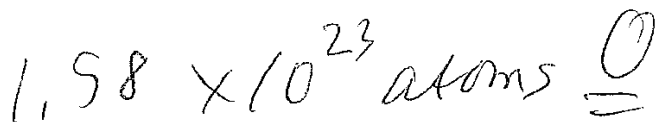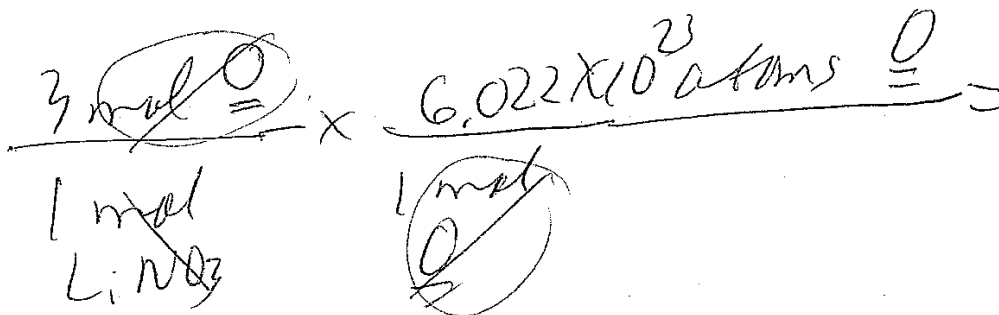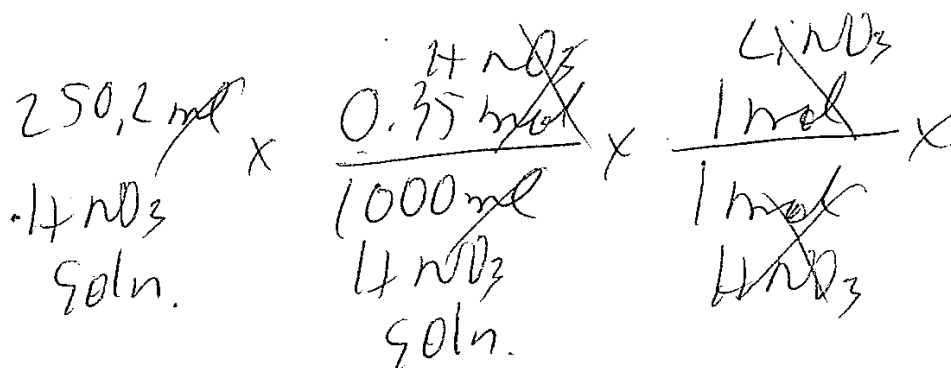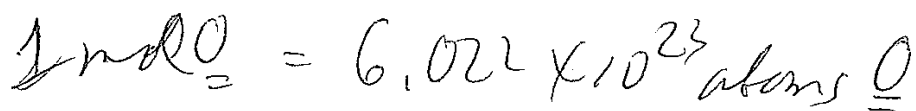1. In the following reaction: (22 pts)

    $HNO_3 + LiOH \rightarrow LiNO_3 + H_2O$
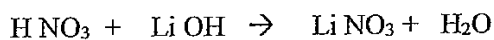
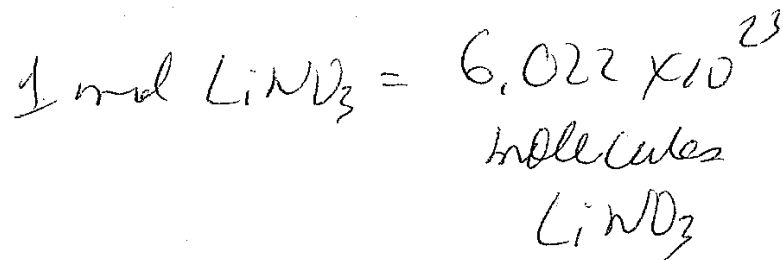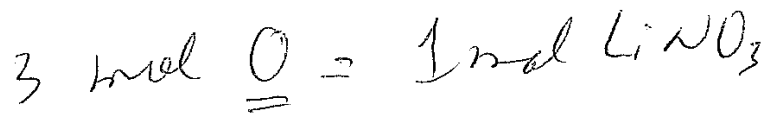   If you have   250.2   mL of a 0.35 M solution of HNO_3

    a. How many grams of the $LiNO_3$ (FW = 68.95 g/mol) do you generate assuming complete reaction ? (10 pts)

$$250.2 \, ml \, \underset{HNO_3 \atop soln}{} \times \frac{0.35 \, mol \, HNO_3}{1000 \, ml \, HNO_3 \, soln.} \times \frac{1 \, mol \, LiNO_3}{1 \, mol \, HNO_3} \times \frac{68.95 \, g \, LiNO_3}{1 \, mol \, LiNO_3}$$

$$= 6.0 \, g \, LiNO_3$$

b. how many atoms of oxygen (in the Li NO₃) do you have in that expected yield of product ?
(Avogadro's number is 6.02 x 10²³) (12 pts)

$$3 \text{ mol } \underline{\underline{O}} = 1 \text{ mol } LiNO_3$$

$$1 \text{ mol } LiNO_3 = 6.022 \times 10^{23} \text{ molecules } LiNO_3$$

$$1 \text{ mol } \underline{\underline{O}} = 6.022 \times 10^{23} \text{ atoms } \underline{O}$$

$$250.2 \text{ mL} \times \frac{0.75 \text{ mol } HNO_3}{1000 \text{ mL } HNO_3 \text{ soln.}} \times \frac{1 \text{ mol } LiNO_3}{1 \text{ mol } HNO_3} \times$$

$$\frac{3 \text{ mol } \underline{\underline{O}}}{1 \text{ mol } LiNO_3} \times \frac{6.022 \times 10^{23} \text{ atoms } \underline{O}}{1 \text{ mol } \underline{O}} =$$

$$1.58 \times 10^{23} \text{ atoms } \underline{O}$$

2. a). For the element **Cs** give the electron configuration in the format ($1s^2$, $2s^2$, $2p^6$, ...) (7 pts)
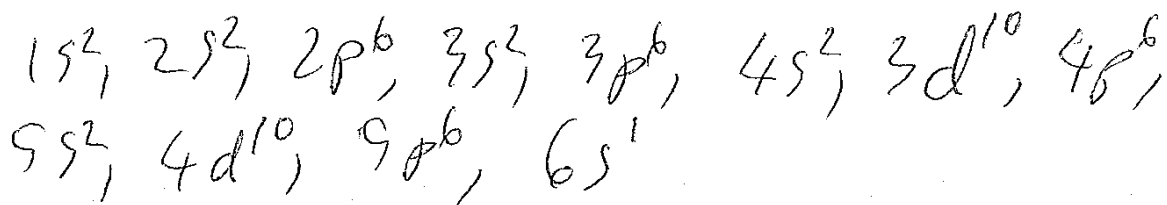
$1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$, $3d^{10}$, $4p^6$,
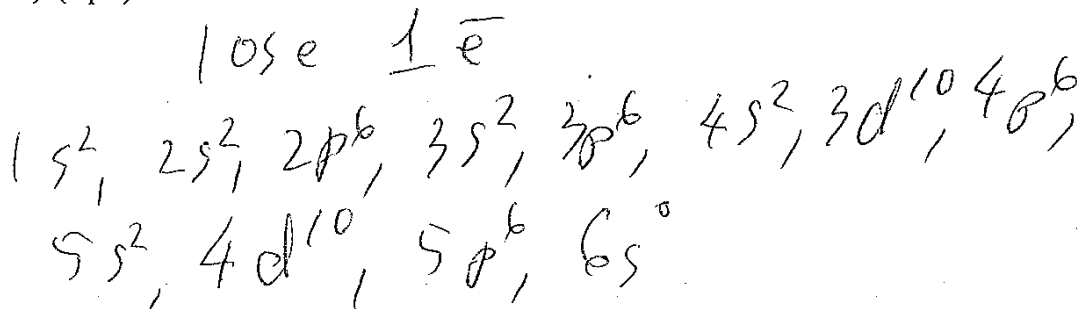$5s^2$, $4d^{10}$, $5p^6$, $6s^1$

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

$6s^1$

c) Give the **valence orbital diagram** (valence electrons only not all electrons) for the element in (a) above (in the format ⇅ ⇅ .... using up and down arrows to represent electrons) (5 pts)
   1s 2s

$\underline{\uparrow}$
$6s$
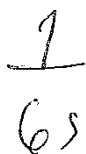
d) For the charged ion **Cs^{+1}** , give the **complete** electron configuration in the format ($1s^2$, $2s^2$, $2p^6$, ...) (5 pts)

| 0 s e $\underline{1 \, e}$

$1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$, $3d^{10}$, $4p^6$,
$5s^2$, $4d^{10}$, $5p^6$, $6s^0$

3 If you add 350.2 mL of CO_2 (g) at STP into a 602.5 mL of water, assuming that all of the carbon dioxide dissolves in the water and generates the acid H_2CO_3 by the reaction below, [molar V at STP = 22.4 Liters] (22 pts total)

CO_2 (g) + H_2O (l) $\rightarrow$ H_2CO_3 (aq)
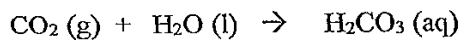
a. How many moles of the carbonic acid would be generated ? (6 pts)

$$\frac{350.2 \ mL}{CO_2} \times \frac{1 \ l \ CO_2}{1000 \ mL \ CO_2} \times \frac{1 \ mol \ CO_2}{22.4 \ l \ CO_2} \times$$

$$\frac{1 \ mol \ H_2CO_3}{1 \ mol \ CO_2} = 0.0156 \ mol \ H_2CO_3$$

b. If you have the above moles of the carbonic acid in the total volume of 602.5 mL of carbonic acid & water solution, what is the molarity of the carbonic acid in the water? [M = # moles / Liter solution] (16 pts)

$$M = \frac{\# \, moles}{\# \, liter \, soln.}$$

$$602.5 \, ml \, soln. \times \frac{1 \, l \, soln}{1000 \, ml \, soln.} = 0.6025 \, l$$

$$M = \frac{0.0156 \, mol \, H_2CO_3}{0.6025 \, l \, soln.} = 0.0259 \, M$$

Name_____*K Ch*_____ (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 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.   (Please count your exam and make sure there are 14 real pages + periodic table
& other charts.)

1 mole = molar mass = 6.022 x 10^{23} M = (# moles) / (Liter solution), $M_1V_1 = M_2V_2$

$\{ P_{total} = P_a + P_b + P_c + \ldots X_a = P_a / P_{total} = n_a / n_{total} \}$

$PV = nRT$, $(P_1V_1)/(P_2V_2) = T_1/T_2$ R=0.08206 (L atm)/(mol K),   K=°C+273.15

molar V at STP = 22.4 Liters   760 torr = 760 mm Hg = 1.00 atm

I am a graduating Senior [(Yes) or (No)]   (200 pts on exam which will be a maximum of 100%)

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, 52 pts total)

1) Identify the shortest bond.   1) _A_
   A) triple covalent bond
   B) double covalent bond
   C) single covalent bond
   D) all of the above bonds are the same length

2) Choose the bond below that is __most__ polar.   2) _B_
   A) H-Cl   (B) H-F   C) F-F   D) H-Br   E) H-I

3) What value of ℓ is represented by a d orbital?   3) _D_
   A) 1   B) 0   C) 3   (D) 2

4) Which of the following quantum numbers describes the shape of an orbital?   4) _C_
   A) principal quantum number
   B) Schrödinger quantum number
   (C) angular momentum quantum number
   D) spin quantum number
   E) magnetic quantum number

5) Determine the name for aqueous HF.
  A) hydrofluorous acid
  B) fluorous acid
  C) fluoric acid
  D) hydrofluoric acid
  E) hydrogen fluorate

5) _D_

6) A substance composed of two or more elements in a fixed, definite proportion is
  A) a heterogeneous mixture.
  B) an alloy.
  C) a homogeneous mixture.
  D) a solution.
  E) a compound.

6) _E_

7) What is the empirical formula for $C_{12}H_{24}O_6$?
  A) CH_2O B) CHO_2 C) C_2H_4O D) CHO   E) C_2H_5O

7) _C_

8) Identify the number of electron groups around a molecule with a tetrahedral shape.
  A) 5   B) 4   C) 3   D) 2   E) 1

8) _B_

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

9) _A_

10) Identify the charges of the protons, neutrons, and electrons.
  A) protons 0, neutrons −1, electrons +1
  B) protons −1, neutrons 0, electrons +1
  C) protons 0, neutrons +1, electrons −1
  D) protons +1, neutrons −1, electrons 0
  E) protons +1, neutrons 0, electrons −1

10) _E_

11) Which of the following elements is a nonmetal?
  A) Ba   B) N   C) Be   D) Ce   E) K

11) _B_

12) Identify an anion.
  A) An atom that has lost a neutron and a proton.
  B) An atom that has lost an electron.
  C) An atom that has gained an electron.
  D) An atom that has gained a neutron.

12) _C_

13) Which of the following represent the Lewis structure for Cl?
  A) :C̈l: B) Cl·   C) ·C̈l: D) :C̈l: E) ·C̈l:

13) _A_

14) The atomic mass for cadmium is

14) _D_

    A) 40.08   B) 20   C) 48   (D) 112.41

15) Which of the following is an acid–base reaction?

15) _C_

    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.

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

16) _B_

    A) $Ca(OH)_2$ and KOH (B) CH_3CO_2H and HI

    C) only KOH D) only HI

17) Which of the following are examples of intensive properties?

17) _C_

    A) volume

    B) mass

    (C) density

    D) None of the above are examples of intensive properties.

    E) All of the above are examples of intensive properties.

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

18) _D_

    A) 13.8 torr   B) 760 torr   C) 31.8 torr   (D) 715 torr   E) 28.1 torr

19) A physical change

19) _C_

    A) occurs when Na and Cl combine to make NaCl .

    B) occurs when propane (C_3H_8) is burned to produce heat, CO_2 and H_2O.

    (C) occurs when water (liquid) is evaporated to water vapor (gas) .

    D) occurs when glucose $(C_6H_{12}O_6)$ is converted into energy and CO_2 and H_2O within your cells.

    E) occurs when iron (Fe) rusts to produce (FeO and Fe_3O_4).

20) The solid compound, K_2SO_4, contains

20) _A_

    (A) K^+ and SO_4^{-2} ions.   B) K^+, S^{6+}, and O^{2-} ions.

    C) K_2^+ and SO_4^{-2} ions.   D) K_2SO_4 molecules.

$$\frac{(32.07) * 3}{342.21} \times 100 =$$

21) Calculate the mass percent composition of sulfur in $Al_2(SO_4)_3$. (FW aluminum sulfate = 342.21 g/mol , S atomic mass = 32.07 g/mol)

21) _D_

    A) 9.372 %   B) 21.38 %   C) 35.97 %   (D) 28.12 %   E) 42.73 %

22) What is the charge on the Sc ions in Sc_2O_3? $O \rightarrow (-2)\ 3 = -6$

22) _A_

    (A) 3+   B) 3–   C) 2+   D) 1+

$2\ (Sc) - 6 = zero$ $Sc = 6/2 = +3$

23) Give the approximate bond angle for a molecule with a trigonal planar shape.

23) _E_

    A) 107°   B) 90°   C) 109.5°   D) 180°   (E) 120°

24) How many valence electrons does an atom of Al possess?   24) _A_

    A) 3   B) 1   C) 2   D) 8   E) 5

25) An ionic bond is best described as   25) _A_

    A) the transfer of electrons from one atom to another.

    B) the attraction between 2 metal atoms.

    C) the attraction between 2 nonmetal atoms.

    D) the attraction that holds the atoms together in a polyatomic ion.

    E) the sharing of electrons.

26) Which of the following exists as a diatomic molecule?   26) _A_

    A) hydrogen

    B) phosphorus

    C) carbon

    D) krypton

    E) lithium

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. You can use the back of the page for scratch paper. 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. (80 pts)

Please show all work for full credit and for partial credit.

1.   Name of elements and element symbols: (8 pts, 4 pts each)

a.   The symbol for the element **oxygen** is ___O___ (4 pts)

b.   The name of the element **Na**   is

_____ Sodium _____ (4 pts)

2.   Match the following to the letters shown by filling in the parenthesis. The letters may only be used one time or not at all. Each parenthesis should have one letter. If you put in an incorrect letter into the parenthesis, you will lose points.   It is possible that the parenthesis correct answer may have more than one correct answer.   (2 pts each, 4 pts total)

(a)   transition metal elements (b) lanthanide, actinide elements (c) main group elements   (d) alkali metal elements (e) alkaline earth elements (f) halogens (g) noble gases (h) s block (i) p block (j) d block (k) f block   (l) principal quantum number or period number (m) group number

Periodic Table of the Elements

(a,j)

(l)

Dr. Hahn   General Chemistry I Lecture   Final Exam   Spring 2015   (8:30 T,R form B)   page 5

3. The following all refers to the element **Sr** (14 pts, 1 pt per blank)

a. Write the symbol of the element in the format $^A_Z X$ ____ $^{88}_{38}Sr$ ____ (1 pts)

b. Number of protons in the element is __38__ protons (1 pt)

c. Number of electrons for a neutral atom is __38__ electrons (1 pt)

d. Number of neutrons is __50__ neutrons. (1 pt) Show work.

$$88 - 38 = 50$$

e. Atomic number for the element is __38__ (1 pt)

f. Atomic mass for the element is __87.62__ (1 pt)

g. How many atoms does **one mole** of the element contain __6.022×10^{23}__ (1 pt)

h. How much does **one atom** of the element weigh __87.62__ amu (1 pt)

i. How much does **one mole** of the element weigh __87.62__ grams (1 pt)

j. What is the group number of the element exactly as written in the periodic table which you have attached to your exam (If the number on my periodic table is written as a Roman numeral write your answer as a Roman numeral. If the number on my periodic table is written as an Arabic number, write you answer as an Arabic number or you will lose points.)?

__II A__ (1 pt)

k. If the element is in its ionic state, what is the charge (or oxidation state) of the atom. __+2__ (1 pt) Show work. +2 (+) group #1

l. How many total electrons is in the element ? __38__ (1 pt)

m. How many valence electrons does the element have ? __2__ (1 pt) Show work or explain.

n. Give the Lewis Dot Symbol for the element . __$^{\bullet\bullet}Sr$__ (1 pt)

4. Circle the following compounds which are **covalent**   You may circle one, many, all or none.   (12 pts, 2 pts each)

$\boxed{CCl_4}$ Mg_3N_2 $K Br$ $\boxed{SO_2}$ $\boxed{F_2}$ Na_2SO_4
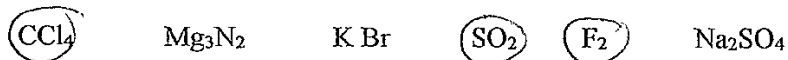
5   For the following reagent, give the oxidation state or charge of the listed.   Either explain why or show work for your oxidation state number answer.   (8 pts total)
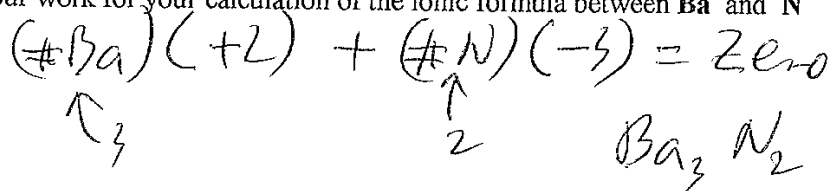
a. Between   **Ba**   and **N**   what is the oxidation state or charge on the   **Ba**   in the ionic formula

   ___+2___ Explain. (2 pts) $Group \; 4 \; with \; (+) \; charge$

   $+2$

b. Between   **Ba**   and   **N**   what is the oxidation state or charge on the   **N**   in the ionic formula

   ___-3___ Explain. (1 pt) $Group \; 4 \; -8$

   $5 \; -8 = -3$

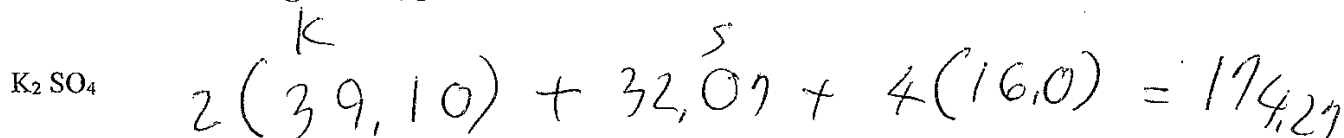c. Show your work for your calculation of the ionic formula between **Ba** and **N**
(2 pt) $(\#Ba)(+2) + (\#N)(-3) = Zero$

   $\; \; \; \; 3 \; \; \; \; \; \; \; \; \; \; \; \; \; \; \; \; \; 2 \; \; \; \; Ba_3 N_2$

d. In   **Ba (NO₃)₂**   what is the oxidation state or charge on the   **N**   Show work. (3 pts)
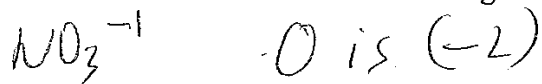
   NO_3^{-1} $O \; is \; (-2)$

   $\left(\underset{N}{Charge} \right) + 3(-2) = -1$

   $\underset{N}{Charge} = -1 + 6 = +5$

6   For the following formula, give the formula mass (or molar mass).   Show work. (4 pts)

K_2SO_4

$2(39.10) + 32.07 + 4(16.0) = 174.27$

7.   If you have the following ionic compound, is the reagent soluble or insoluble in water.   Circle the correct choices below to answer this question.   (6 pts total)
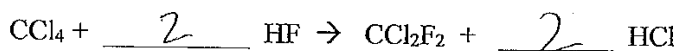
Na_2CO_3

(normally not exception)

The anion (by itself without the cation) is [(soluble) or (insoluble)] (circle one) (3 pt)

The ionic compound (the anion with the cation) is [(soluble) or (insoluble)] (circle one) (3 pt)

It is exception

8.   Balance the following reactions by: (8 pts, 2 pts per blank)

a.   filling in the blanks. (you can fill the blank with a **one but not a zero**)

$CCl_4 + $ __2__ $HF \rightarrow CCl_2F_2 + $ __2__ HCl

b.   show the number count of every atom of the element F   separately for the reactant and products

reactant atom count   of
F __2__

product atom count of
F __2__

9 Given the following reactants, write out the products by filling in the blanks. You do not need to balance the reactions in either part of this question. (4 pt, 2 pts per blank)

$Ba\,Br_2$ (aq) + $Li_2\,CO_3$(aq) → __Li Br__ (aq) + __Ba CO₃__ (s)
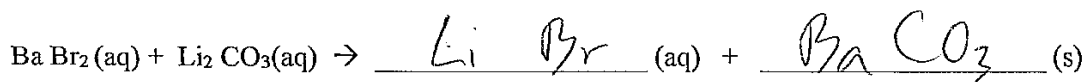
10   For the symbol to represent an electron configuration, (circle one parenthesis under each letter, do not circle one of the letters) (6 pts, 2 pts each)

$5\,p^6$ 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)

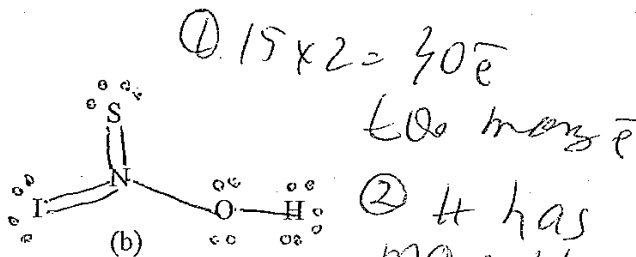11. Give the Lewis Dot Structure of the following by completing the following. (6 pts total)

a. Show your work for the count of the valence electrons in the entire molecules. I S N O H (3 pts)
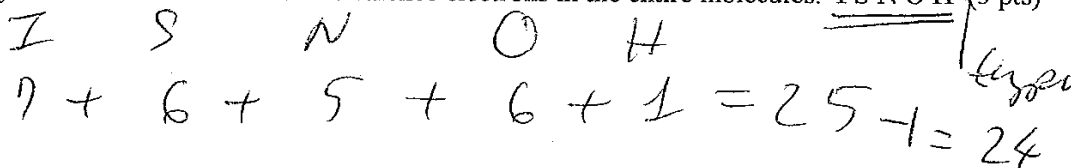
I   S   N   O   H

7 + 6 + 5 + 6 + 1 = 25 -1 = 24   (+1) larger

b. Given the following two structures, choose the correct structure and then explain one reason why the other structure is incorrect. (3 pts)
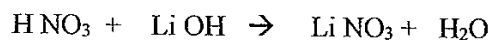
(a)

12 X 2 = 24

(b)
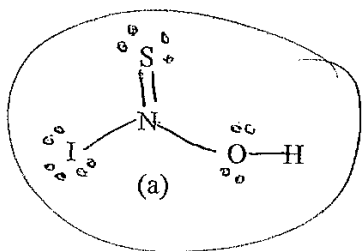
① 15 × 2 = 30 ē
    too many ē
② H has
    more than
    duet
② N has expanded
    octet not allowed
2 too

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. In the following reaction: (22 pts)

   $H NO_3 + Li OH \rightarrow Li NO_3 + H_2O$

   If you have 727.5 mL of a 1.25 M solution of $H NO_3$

   a. How many grams of the $Li NO_3$ (FW = 68.95 g/mol) do you make assuming complete reaction ? (10 pts)

$$727.5 \, mL \atop of \atop H NO_3 \atop Soln. \times \left(\frac{1.25 \, mol \atop H NO_3}{1000 \, mL \atop H NO_3 \atop soln.} \right) \times \left(\frac{1 \, mol \atop Li NO_3}{1 \, mol \atop H NO_3} \right) \times \left(\frac{Li NO_3 \atop 68.95 \, g}{1 \, mol \atop Li NO_3} \right)$$

$$= 62.7 \, g \, Li NO_3$$

b. how many atoms of oxygen (in the Li NO_3 do you have in the expected product ? (Avogadro's number is 6.02 x 10^{23}) (12 pts)
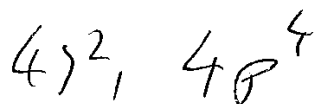
$$727.5 \, ml \text{ of } HNO_3 \text{ soln.} \times \left(\frac{1.25 \, mol \; HNO_3}{1000 \, ml \; HNO_3} \right) \times \left(\frac{1 \, mol \; LiNO_3}{1 \, mol \; HNO_3} \right) \times \frac{3 \, mol \; O}{1 \, mol \; LiNO_3} \times$$

$$\frac{6.022 \times 10^{23} \, atoms \; O}{1 \, mol \; O} = 1.64 \times 10^{24} \, atoms \; \underline{\underline{O}} \text{ in } LiNO_3$$

2. a). For the element Se give the electron configuration in the format ($1s^2$, $2s^2$, $2p^6$, ...) (7 pts)
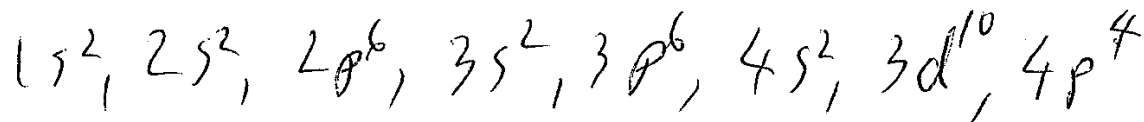
$1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$, $3d^{10}$, $4p^4$

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

$4s^2$, $4p^4$

c) Give the **valence orbital diagram** (for just the valence electrons, not all electrons) for the element in (a) above (in the format ⇅ ⇅ .... using up and down arrows to represent electrons) (5 pts)
  1s 2s

⇅   ⇅ ↑ ↑
4s   4p
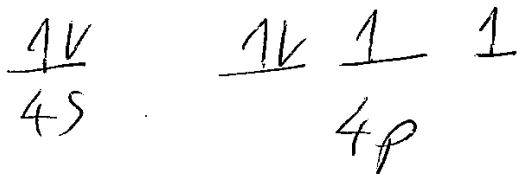
d) For the charged ion Se^{-2} , give the complete electron configuration in the format ($1s^2$, $2s^2$, $2p^6$, ...) (5 pts)

add 2 $\bar{e}$

$1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$, $3d^{10}$, $4p^6$
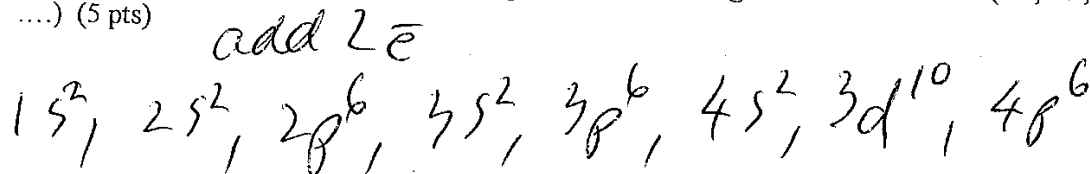
3   If you add 14.5 mL of CO_2 (g) at STP into a 960.2 mL of water, assuming that all of the carbon dioxide dissolves in the water and generates the acid H_2CO_3 by the reaction below, [molar V at STP = 22.4 Liters] (22 pts total)

CO_2 (g) + H_2O (l)   → H_2CO_3 (aq)
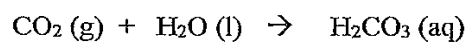
a.   How many moles of the carbonic acid would be generated ? (6 pts)

$$14.5 \, ml \, (CO_2(g)) \times \frac{1 \, l \, CO_2}{1000 \, ml \, CO_2} \times \frac{mol \, CO_2}{22.4 \, l} =$$

$$6.47 \times 10^{-4} \, mol \, CO_2$$

b. If you have the above moles of the carbonic acid in the total volume of 960.2 mL of carbonic acid & water solution, what is the molarity of the carbonic acid in the water ? [M = # moles / Liter solution] (16 pts)

$$M = \frac{\# \text{ mol}}{\text{liters}}$$

$$960.2 \text{ ml} \times \frac{l}{1000 \text{ ml}} = 0.9602 \, l$$

$$M = \frac{6.47 \times 10^{-4} \text{ mol } CO_2}{0.9602 \, l} = 6.74 \times 10^{-4} \, M$$

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 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).
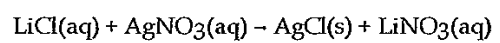
Return your entire exam including the stapled periodic table. If your exam falls apart, please staple everything back together before turning in the exam. (Please count your exam and make sure there are 14 real pages + periodic table + other charts)

1 mole = molar mass = 6.022×10^{23} M = (# moles) / (Liter solution), $M_1V_1 = M_2V_2$

{ $P_{total} = P_a + P_b + P_c + \ldots \chi_a = P_a / P_{total} = n_a / n_{total}$ }

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

I am a graduating Senior [(yes) or (no)] (circle one) (200 pts on exam which will be a maximum of 100%)

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, 52 pts total)

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

1) __C__

$LiCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + LiNO_3(aq)$

A) Ag^+ and NO_3^-

B) Li^+ and Cl^-

C) Li^+ and NO_3^-

D) Ag^+ and Cl^-

E) There are no spectator ions in this reaction.

$Ag^+ + Cl^-$ are not spectators

2) The solid compound, K_2SO_4, contains

2) __D__

A) K_2^+ and SO_4^{-2} ions.

B) K^+, S^{6+}, and O^{2-} ions.

C) K_2SO_4 molecules.

D) K^+ and SO_4^{-2} ions.

3) Which of the following elements is a metal?

3) __A__

A) Fe   B) Kr   C) S   D) Br   E) As

4) Determine the number of protons, neutrons and electrons in the following: 4) _D_

$$^{25}_{12}X$$

    A) $p^+ = 25$ $n° = 12$ $e^- = 13$
    B) $p^+ = 12$ $n° = 25$ $e^- = 12$
    C) $p^+ = 12$ $n° = 13$ $e^- = 25$
    D) $p^+ = 12$ $n° = 13$ $e^- = 12$
    E) $p^+ = 12$ $n° = 12$ $e^- = 13$

$25 - 12 = 13$ neutrons

5) Which molecule or compound below contains a <u>pure</u> covalent bond?   5) _C_
    A) SCl_6 B) PCl_3 C) Br_2 D) Li_2CO_3 E) $NaCl$

6) Which of the following quantum numbers describes the orientation of an orbital?   6) _E_
    A) principal quantum number
    B) Schrödinger quantum number
    C) spin quantum number
    D) angular momentum quantum number
    E) magnetic quantum number

7) Isotopes differ in the number of   7) _B_
    A) beta particles.
    B) neutrons.
    C) neutrons and protons.
    D) electrons.
    E) protons.

$\dfrac{92}{46} = 2$ $\dfrac{(NO_2 \times 2)}{N_2O_4}$

8) Determine the molecular formula of a compound that has a molar mass of 92.0 g/mol and an empirical formula of NO_2. (FW of NO_2 = 46.01 g/mol)   8) _A_
    A) N_2O_4 B) N_2O_5 C) N_2O_3 D) NO_2 E) N_3O_6

9) Which of the following exists as a diatomic molecule?   9) _D_
    A) carbon
    B) phosphorus
    C) krypton
    D) hydrogen
    E) lithium

10) Give the name for HNO_3.   10) _C_
    A) hydrogen nitrate
    B) hydrogen nitrite
    C) nitric acid
    D) hydrogen nitride
    E) nitrous acid

11) When dissolved in water, KOH behaves as   11) _C_
    A) an acid that forms KO^- and H^+ ions.   B) a base that forms KO^- and H^+ ions.
    C) a base that forms K^+ and OH^- ions.   D) an acid that forms K^+ and OH^- ions.

12) Give the approximate bond angle for a molecule with a tetrahedral shape.   12) _B_
    A) 90°   B) 109.5°   C) 120°   D) 105°   E) 180°

13) Identify a cation.   13) _A_
    A) An atom that has lost an electron.
    B) An atom that has gained a neutron.
    C) An atom that has gained an electron.
    D) An atom that has lost a proton and a neutron.

14) How many significant figures are in the measurement, 463.090 m?   14) _D_
    A) 2   B) 3   C) 5   D) 6   E) 4

15) A double covalent bond contains _____ of electrons.   15) _A_
    A) 2 pairs   B) 0 pairs   C) 3 pairs   D) 4 pairs   E) 1 pair

16) A covalent bond is best described as   16) _D_
    A) a bond between a metal and a polyatomic ion.
    B) a bond between two polyatomic ions.
    C) a bond between a metal and a nonmetal.
    D) the sharing of electrons between atoms.
    E) the transfer of electrons.

17) What are the possible values of l if $n = 6$? $0 \text{ to } (n-1)$ 17) _A_
    A) 0, 1, 2, 3, 4, or 5   B) 6
    C) −4, −3, −2, −1, 0, +1, +2, +3, or +4   D) −5, −4, −3, −2, −1, 0, +1, +2, +3, +4, or +5

18) The total pressure of a gas mixture is the sum of the partial pressure of its components is known as   18) _A_
    A) Dalton's Law
    B) Charles's Law
    C) Ideal Gas Law
    D) Avogadro's Law
    E) Boyle's Law

19) Which of the following represent the Lewis structure for N?   19) _D_
    A) N: B) ·N: C) :N: D) ·N: E) N·

20) Identify the number of electron groups around a molecule with a trigonal bipyramidal shape.   20) _D_
    VSEPRT   pairs
    A) 2   B) 1   C) 4   D) 5   E) 3

21) The atomic mass number is equal to   21) _B_
    A) the sum of the number of protons, neutrons, and electrons.
    B) the sum of the number of protons and neutrons.
    C) the sum of the number of the neutrons and electrons.
    D) the sum of the number of the electrons and protons.

22) How many H^+ ions can the acid, H_2SO_4, donate per molecule?   22) _A_
    A) 2   B) 3   C) 0   D) 1

23) Choose the statement below that is TRUE.   23) _A_
    A) A weak acid solution consists of mostly nonionized acid molecules.
    B) A molecular compound that does not ionize in solution is considered a strong electrolyte.
    C) The term "weak electrolyte" means that the substance is inert.
    D) A strong acid solution consists of only partially ionized acid molecules.
    E) The term "strong electrolyte" means that the substance is extremely reactive.

24) In a chemical reaction, matter is neither created or destroyed. Which law does this refer to?   24) _D_
    A) Law of Multiple Proportions
    B) First Law of Thermodynamics
    C) Law of Definite Proportions
    D) Law of the Conservation of Mass
    E) Law of Modern Atomic Theory

25) A cation of +2 indicates that an element has   25) _E_
    A) lost two neutrons.
    B) gained two protons.
    C) gained two electrons.
    D) lost two protons.
    E) lost two electrons.

26) What is the maximum number of d orbitals that are possible?   26) _E_
    A) 7   B) 1   C) 3   D) 9   E) 5

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. You can use the back of the page for scratch paper. 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. (80 pts)

Please show all work for full credit and for partial credit.

1.   Name of elements and element symbols: (8 pts, 4 pts each)

a.   The symbol for the element **carbon** is _____ C _____ (4 pts)

b.   The name of the element **K**   is

_____ Potassium _____ (4 pts)

2.   Match the following to the letters shown by filling in the parenthesis. The letters may only be used one time or not at all. Each parenthesis should have one letter. If you put in an incorrect letter into the parenthesis, you will lose points. It is possible that the parenthesis correct answer may have more than one correct answer. (2 pts each, 4 pts total)

(a)   transition metal elements (b) lanthanide, actinide elements (c) main group elements   (d) alkali metal elements (e) alkaline earth elements (f) halogens (g) noble gases (h) s block (i) p block (j) d block (k) f block   (l) principal quantum number or period number (m) group number

Periodic Table of the Elements

3. The following all refers to the element **Rb** (14 pts, 1 pt per blank)

a. Write the symbol of the element in the format $_z^A X$ _____ $_{37}^{85} Rb$ _____ (1 pts)

b. Number of protons in the element is ___37___ protons (1 pt)

c. Number of electrons for a neutral atom is ___37___ electrons (1 pt)

d. Number of neutrons is _____48_____ neutrons. (1 pt) Show work.

$$85 - 37 = 48$$

e. Atomic number for the element is _____37_____ (1 pt)

f. Atomic mass for the element is _____85.47_____ (1 pt)

g. How many atoms does **one mole** of the element contain _____6.022×10^{23}_____ (1 pt)

h. How much does **one atom** of the element weigh _____85.47_____ amu (1 pt)

i. How much does **one mole** of the element weigh _____85.47_____ grams (1 pt)

j. What is the group number of the element exactly as written in the periodic table which you have attached to your exam (If the number on my periodic table is written as a Roman numeral write your answer as a Roman numeral. If the number on my periodic table is written as an Arabic number, write you answer as an Arabic number or you will lose points.)?

_____I A_____ (1 pt)

k. If the element is in its ionic state, what is the charge (or oxidation state) of the atom. ___+1___ (1 pt) Show work.

+ (group #)

l. How many total electrons is in the element ? _____37_____ (1 pt)

m. How many valence electrons does the element have ? _____1_____ (1 pt) Show work or explain.

group # = # valence e

n. Give the Lewis Dot Symbol for the element . _____Rb•_____ (1 pt)

4. Circle the following compounds which are **ionic** You may circle one, many, all or none.   (12 pts, 2 pts each)

(K₃PO₄)   N₂O₅   (GaCl₃)   CS₂   SF₆   N₂

5   For the following reagent, give the oxidation state or charge of the listed.   Either explain why or show work for your oxidation state number answer.   (8 pts total)
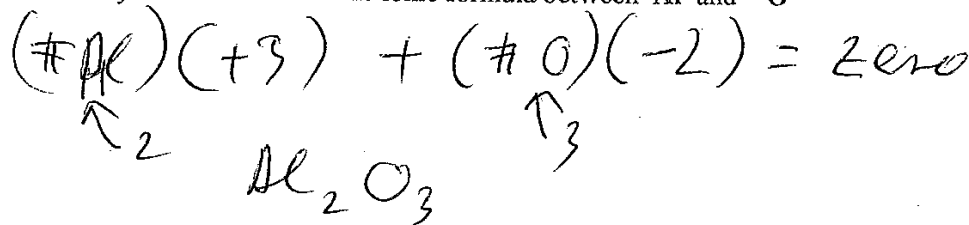
a. Between **Al** and **O** what is the oxidation state or charge on the **Al** in the ionic formula
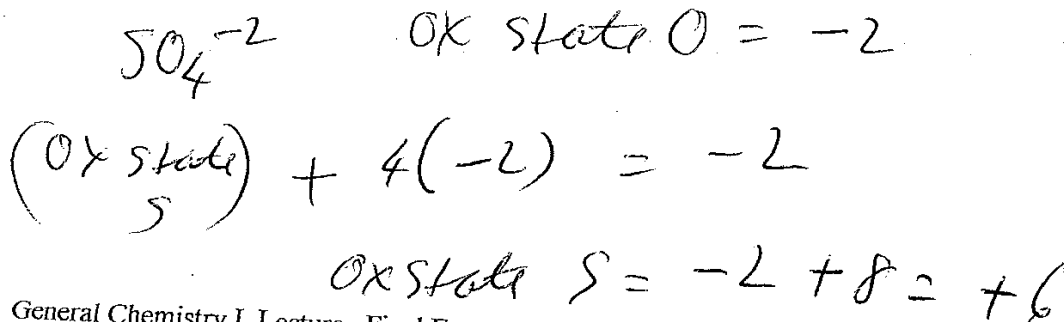
__+3__ Explain. (2 pts)   + (group #)

b. Between **Al** and **O** what is the oxidation state or charge on the **O** in the ionic formula
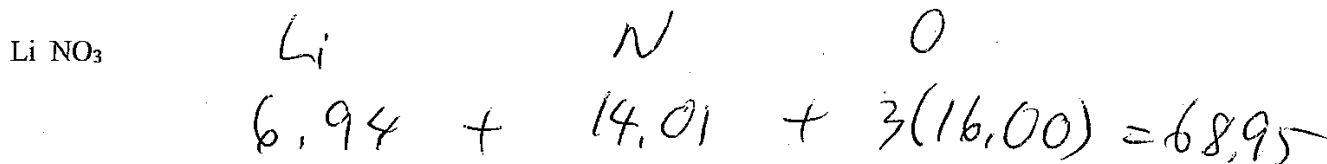
__−2__ Explain. (1 pt)   group # −8

6 −8 = −2

c. Show your work for your calculation of the ionic formula between **Al** and **O** (2 pt)

$$(\#\,Al)(+3) + (\#\,O)(-2) = zero$$
$$\underset{2}{\quad} \qquad \underset{3}{\quad}$$

Al_2O_3

d. In **Al₂(SO₄)₃** what is the oxidation state or charge on the **S**   Show work. (3 pts)

SO_4^{-2} Ox State O = −2

$$(Ox\ State\ S) + 4(-2) = -2$$

Ox State S = −2 + 8 = +6

6   For the following formula, give the formula mass (or molar mass).   Show work. (4 pts)

Li NO₃   Li   N   O

$$6.94 + 14.01 + 3(16.00) = 68.95$$

7. If you have the following ionic compound, is the reagent soluble or insoluble in water.   Circle the
   correct choices below to answer this question.   (6 pts total)

Pb SO₄

(not exception)
The anion (by itself without the cation) is [(soluble) or (insoluble)] (circle one) (3 pt)

The ionic compound (the anion with the cation) is [(soluble) or (insoluble)] (circle one) (3 pt)

Pb is exception

8. Balance the following reactions by: (8 pts, 2 pts per blank)

a. filling in the blanks. (you can fill the blank with a **one but not a zero**)

__2__ Ag NO₃ (aq) + K₂CrO₄ (aq) → Ag₂CrO₄ (s) + __2__ KNO₃ (s)
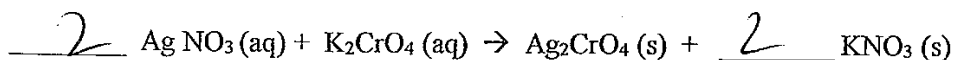
b. show the number count of every atom of the element **Ag**   separately for the reactant and products

reactant atom count   of | product atom count of

        Ag __2__ | Ag __2__
                        |

9   Given the following reactants, write out the products by filling in the blanks. You do not need to balance the reactions in either part of this question. (4 pt, 2 pts per blank)

Sr S + Na₃ PO₄→ _____Na_2S_____ (aq) + _____$Sr_3(PO_4)_2$_____ (s)
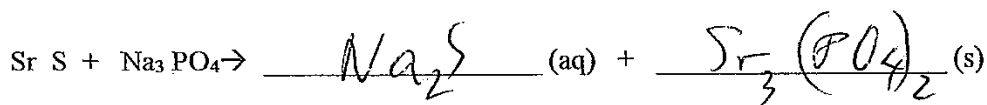
10.   Considering periodic trends, circle the correct elements (6 pts, 2 pts each)

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

b.   Which has lower ionization energy [(O) or (Se)] (circle one)
        Se bigger — lower IE

c.   Which has higher electronegativities [(B) or (O)] (circle one)
        F most EN — O is closer

11.   For the following given Lewis Dot Structure, complete the following: (6 pts, 1 pt per blank)

F — As * — F
      |
      F
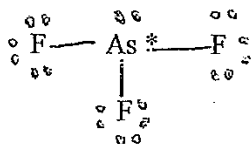
a.   Number of electrons pairs on the atom with the * for VSEPRT ___4___

b.   Number of lone pairs on the atom with the * ___1___

c.   Geometry of the electron pairs at the atom with the * ___tetrahedral___

d.   Geometry of the molecule at the atom with the * ___trigonal pyramidal___

e.   Bond angle at the atom with the * ___109.5°___

f.   Hybridization at the atom with the * ___sp^3___

Part III.   Long Answer   Please <u>show work</u> for full credit and to receive partial credit. (66 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. a.   Given the following reaction (assuming complete reaction), if you start with   475.2 grams of the reagent , $Ba(OH)_2$ (FW = 171.35 g/mol)   what is the theoretical yield of the $BaCl_2$ (FW=208.33 g/mol)   in grams assuming an excess of the acid ?   Show work. (12 pts)

$2\,HCl\ +\ Ba(OH)_2\ \rightarrow\ BaCl_2\ +\ 2\,H_2O$
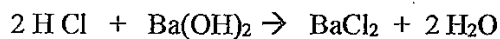
$$475.2\,g\ Ba(OH)_2\ \times\ \frac{mol\ Ba(OH)_2}{171.35\,g\ Ba(OH)_2}\ \times\ \frac{1\ mol\ BaCl_2}{1\ mol\ Ba(OH)_2}$$

$$\times\ \frac{BaCl_2}{208.33\,g}\ \frac{}{1\ mol\ BaCl_2}\ =\ 577.8\,g\ BaCl_2$$

b   How many atoms of the **Cl**   do you have in the theoretical yield of the product. (10 pts)

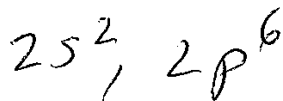$$2 \, Cl \text{ mol} = 1 \text{ mol } BaCl_2$$
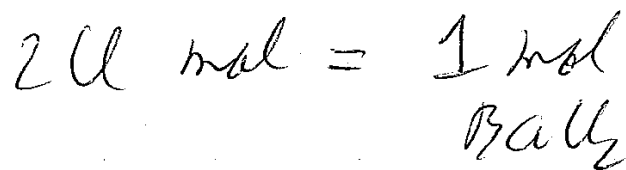
$$475.2 \text{ g } Ba(OH)_2 \times \frac{\text{mol } Ba(OH)_2}{171.35 \text{ g } Ba(OH)_2} \times \frac{1 \text{ mol } BaCl_2}{1 \text{ mol } Ba(OH)_2}$$
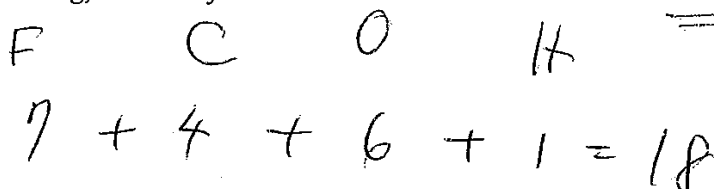
$$\times \frac{2 \text{ mol } Cl}{1 \text{ mol } BaCl_2} \times \frac{6.022 \times 10^{23} \text{ atoms } Cl}{1 \text{ mol } Cl} =$$

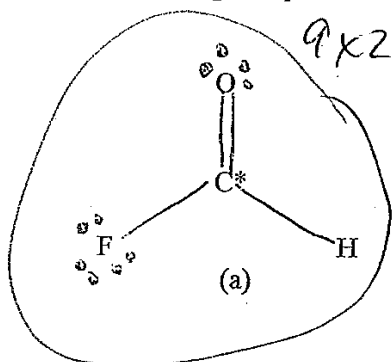$$3.340 \times 10^{24} \text{ atoms } Cl$$

2.

a. What is the valence electron configuration of the C atom in the molecule in the format $(1s^2, 2s^2, 2p^6, ...)$? (3 pts)
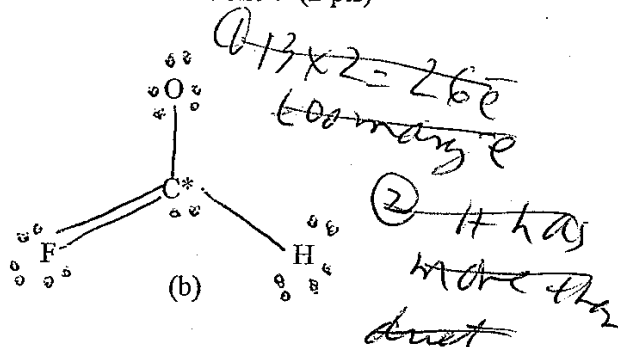
$2s^2, 2p^6$

b. For the following, how many valence electrons is in the molecule F C O H ?   (5 pts)

F   C   O   H

$7 + 4 + 6 + 1 = 18$

c. Given the following two potential Lewis Dot structures which is the correct one ? (2 pts)

$9 \times 2 = 18 e$

(a)

$17 \times 2 = 26 e$

too many e

② It has more than duet

(b)

d. Give at least one problem with the Lewis Dot structure which you did not choose ? (4 pts) ③

① too many e   ② H has more than duet

③ C + F in 2nd period cannot expand octet

e. Given the Lewis Dot structure which you chose, how many VSEPRT electron pairs is on the atom with the * ? (2 pts) ⓐ 3   ⓑ 4

f. How many lone pairs is on the atom with the the * ? (2 pts) ⓐ zero   ⓑ 1

g. What is the VSEPRT geometry of the electron pairs on the atom with the * ? (2 pts)

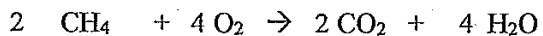ⓐ trigonal planar   ⓑ tetrahedral

h. What is the VSEPRT geometry of the molecule around the atom with the * ? (2 pts)

ⓐ trigonal planar   ⓑ trigonal

Pyramidal

3a   For the following reaction, if you start with 723.2 grams of the reagent CH_4 (FW =16.05 g/mol) and the reaction goes to completion, how many Liters of the gas CO_2 is generated at STP (0°C, 1.0 atm)? (22 pts total, 8 pts part a)

10 pts

[some potentially useful equations are: $(P_1V_1)/(P_2V_2)=T_1/T_2$ $K=°C+273.15$
760 torr = 760 mm Hg = 1.00 atm   molar V at STP = 22.4 Liters]

2   CH_4 + 4 O_2 → 2 CO_2 + 4 H_2O

$$723.2 g \frac{CH_4}{CH_4} \times \frac{mol}{16.05 g CH_4} \times \frac{CO_2 \; 2 \, mol}{1 \, mol \; CH_4} \times \frac{CO_2 \; 22.4 \, \ell}{1 \, mol \; CO_2}$$

$$= 1009 \, \ell \; CO_2$$

b.   If that gas is then heated to temperature of 80.9 °C at pressure of 790.2 torr how many Liters will the gas now occupy (16 pts) 12 pts

$$T_1 = 0°C + 273.15$$

$$T_2 = 354.05 K$$
$$T_2 = 80.9°C + 273.15$$

$$P_1 = 1.0 atm$$

$$P_2 = 790.2/760 = 1.08$$
torr
atm

$$V_1 = 1009 l$$
$$CO_2$$

$$V_2 = ?$$

$$\frac{P_2 V_2}{P_1 V_1} = \frac{T_2}{T_1}$$

$$\frac{(1.040 atm)(V_2)}{(1.0 atm)(1009 l)} = \frac{354.05 K}{273.15 K}$$

$$V_2 = \left(\frac{354.05 K}{273.15 K}\right)\left(\frac{1.0 atm}{1.040 atm}\right)(1009 l)$$

$$V_2 = 1258 l$$

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 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. (Please count your exam and make sure there are 14 real pages + periodic table + other charts)

1 mole = molar mass = 6.022×10^{23} M = (# moles) / (Liter solution), $M_1V_1 = M_2V_2$

$\{ P_{total} = P_a + P_b + P_c + \ldots \chi_a = P_a / P_{total} = n_a / n_{total} \}$

$PV = nRT$, $(P_1V_1)/(P_2V_2) = T_1/T_2$ R = 0.08206 (L atm)/(mol K),   K = °C + 273.15

molar V at STP = 22.4 Liters   760 torr = 760 mm Hg = 1.00 atm

I am a graduating Senior [(yes) or (no)] (circle one) (200 pts on exam which will be a maximum of 100%)

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, 52 pts total)

1) Identify the number of electron groups around a molecule with a trigonal bipyramidal shape.   1) __E__
   A) 1   B) 2   C) 4   D) 3   E) 5

2) Which molecule or compound below contains a pure covalent bond?   2) __D__
   A) Li_2CO_3 B) PCl_3 C) NaCl   D) Br_2 E) SCl_6

3) Determine the number of protons, neutrons and electrons in the following: 3) __E__

$^{25}_{12}X$

   25 − 12 = 13 neutrons

   A) $p^+ = 12$ $n° = 13$ $e^- = 25$
   B) $p^+ = 25$ $n° = 12$ $e^- = 13$
   C) $p^+ = 12$ $n° = 12$ $e^- = 13$
   D) $p^+ = 12$ $n° = 25$ $e^- = 12$
   E) $p^+ = 12$ $n° = 13$ $e^- = 12$

4) How many significant figures are in the measurement, 463.090 m?   4) __B__
   A) 4   B) 6   C) 2   D) 5   E) 3

5) Identify a cation.   5) ___B___
    A) An atom that has lost a proton and a neutron.
    B) An atom that has lost an electron.
    C) An atom that has gained an electron.
    D) An atom that has gained a neutron.

6) Which of the following represent the Lewis structure for N?   6) ___B___

    A) $\ddot{\text{N}}$:   B) $\cdot\ddot{\text{N}}$:   C) N·   D) $:\ddot{\text{N}}$:   E) $\cdot\ddot{\text{N}}$:

7) Identify the spectator ions in the following molecular equation.   7) ___B___

$$\text{LiCl(aq)} + \text{AgNO}_3\text{(aq)} \rightarrow \text{AgCl(s)} + \text{LiNO}_3\text{(aq)}$$

    A) Ag^+ and Cl^-

    B) Li^+ and NO_3^-

    C) Ag^+ and NO_3^-

    D) Li^+ and Cl^-

    E) There are no spectator ions in this reaction.

8) What is the maximum number of d orbitals that are possible?   8) ___B___
    A) 3   B) 5   C) 9   D) 1   E) 7

9) Which of the following elements is a metal?   9) ___A___
    A) Fe   B) Br   C) S   D) Kr   E) As

10) Which of the following quantum numbers describes the orientation of an orbital?   10) ___C___
    A) principal quantum number
    B) angular momentum quantum number
    C) magnetic quantum number
    D) Schrödinger quantum number
    E) spin quantum number

11) When dissolved in water, KOH behaves as   11) ___B___
    A) an acid that forms KO− and H+ ions.   B) a base that forms K+ and OH− ions.
    C) a base that forms KO− and H+ ions.   D) an acid that forms K+ and OH− ions.

12) Choose the statement below that is TRUE.   12) ___A___
    A) A weak acid solution consists of mostly nonionized acid molecules.
    B) The term "weak electrolyte" means that the substance is inert.
    C) A strong acid solution consists of only partially ionized acid molecules.
    D) The term "strong electrolyte" means that the substance is extremely reactive.
    E) A molecular compound that does not ionize in solution is considered a strong electrolyte.

13) Isotopes differ in the number of

    A) protons.

    B) electrons.

    C) beta particles.

    D) neutrons.

    E) neutrons and protons.

13) **D**

14) Give the name for HNO_3.

    A) hydrogen nitrate

    B) nitric acid

    C) hydrogen nitride

    D) nitrous acid

    E) hydrogen nitrite

14) **B**

15) The atomic mass number is equal to

    A) the sum of the number of protons, neutrons, and electrons.

    B) the sum of the number of the electrons and protons.

    C) the sum of the number of protons and neutrons.

    D) the sum of the number of the neutrons and electrons.

15) **C**

16) The total pressure of a gas mixture is the sum of the partial pressure of its components is known as

    A) Boyle's Law

    B) Ideal Gas Law

    C) Dalton's Law

    D) Charles's Law

    E) Avogadro's Law

16) **C**

17) Give the approximate bond angle for a molecule with a tetrahedral shape.

    A) 120°   B) 180°   C) 90°   D) 105°   E) 109.5°

17) **E**

18) In a chemical reaction, matter is neither created or destroyed. Which law does this refer to?

    A) Law of Multiple Proportions

    B) Law of Definite Proportions

    C) Law of the Conservation of Mass

    D) Law of Modern Atomic Theory

    E) First Law of Thermodynamics

18) **C**

19) How many H^+ ions can the acid, H_2SO_4, donate per molecule?

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

19) **C**

20) Determine the molecular formula of a compound that has a molar mass of 92.0 g/mol and an empirical formula of NO_2. (FW of NO_2 = 46.01 g/mol)

    A) N_2O_4 B) N_2O_3 C) NO_2 D) N_3O_6 E) N_2O_5

20) **A**

21) A cation of +2 indicates that an element has   21) __D__
   A) lost two neutrons.
   B) gained two protons.
   C) lost two protons.
   D) lost two electrons.
   E) gained two electrons.

22) The solid compound, K_2SO_4, contains   22) __D__

   A) K^+, S^{6+}, and O^{2-} ions.   B) K_2SO_4 molecules.

   C) K_2^+ and SO_4^{-2} ions.   D) K^+ and SO_4^{-2} ions.

23) A covalent bond is best described as   23) __C__
   A) a bond between two polyatomic ions.
   B) a bond between a metal and a nonmetal.
   C) the sharing of electrons between atoms.
   D) a bond between a metal and a polyatomic ion.
   E) the transfer of electrons.

24) Which of the following exists as a diatomic molecule?   24) __E__
   A) phosphorus
   B) carbon
   C) lithium
   D) krypton
   E) hydrogen

25) A double covalent bond contains _____ of electrons.   25) __C__
   A) 3 pairs   B) 1 pair   C) 2 pairs   D) 0 pairs   E) 4 pairs

26) What are the possible values of l if $n = 6$?   26) __C__
   A) 6   B) –4, –3, –2, –1, 0, +1, +2, +3, or +4
   C) 0, 1, 2, 3, 4, or 5   D) –5, –4, –3, –2, –1, 0, +1, +2, +3, +4, or +5

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. You can use the back of the page for scratch paper. 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. (80 pts)

Please show all work for full credit and for partial credit.

1.   Name of elements and element symbols: (8 pts, 4 pts each)

a.   The symbol for the element __hydrogen__ is ___H___ (4 pts)

b.   The name of the element __Fe__   is

_____ Iron _____ (4 pts)

2.   Match the following to the letters shown by filling in the parenthesis. The letters may only be used one time or not at all. Each parenthesis should have one letter. If you put in an incorrect letter into the parenthesis, you will lose points.   It is possible that the parenthesis correct answer may have more than one correct answer. (2 pts each, 4 pts total)

(a)   transition metal elements (b) lanthanide, actinide elements (c) main group elements   (d) alkali metal elements (e) alkaline earth elements (f) halogens (g) noble gases (h) s block (i) p block (j) d block (k) f block   (l) principal quantum number or period number (m) group number

Periodic Table of the Elements

3. The following all refers to the element **P** (14 pts, 1 pt per blank)

a. Write the symbol of the element in the format $^A_Z X$ _____ $^{31}_{15}P$ _____ (1 pts)

b. Number of protons in the element is ___ 15 ___ protons (1 pt)

c. Number of electrons for a neutral atom is ___ 15 ___ electrons (1 pt)

d. Number of neutrons is ___ 16 ___ neutrons. (1 pt) Show work.

$$31 - 15 = 16$$

e. Atomic number for the element is ___ 15 ___ (1 pt)

f. Atomic mass for the element is ___ 30.97 ___ (1 pt)

g. How many atoms does **one mole** of the element contain ___ 6.022×10^{23} ___ (1 pt)

h. How much does **one atom** of the element weigh ___ 30.97 ___ amu (1 pt)

i. How much does **one mole** of the element weigh ___ 30.97 ___ grams (1 pt)

j. What is the group number of the element exactly as written in the periodic table which you have attached to your exam (If the number on my periodic table is written as a Roman numeral write your answer as a Roman numeral. If the number on my periodic table is written as an Arabic number, write you answer as an Arabic number or you will lose points.)?

___ VA ___ (1 pt)

k. If the element is in its ionic state, what is the charge (or oxidation state) of the atom. ___ −3 ___
(1 pt) Show work. group # −8
$$5 - 8 = -3$$

l. How many total electrons is in the element ? ___ 15 ___ (1 pt)

m. How many valence electrons does the element have ? ___ 5 ___ (1 pt) Show work or explain. group # = 5

n. Give the Lewis Dot Symbol for the element . ___ (Lewis dot symbol for P) ___ (1 pt)

4. Circle the following compounds which are **covalent** You may circle one, many, all or none.   (12 pts, 2 pts each)

K₃PO₄   (N₂O₅)   GaCl₃   (CS₂)   (SF₆)   (N₂)

5   For the following reagent, give the oxidation state or charge of the listed.   Either explain why or show work for your oxidation state number answer.   (8 pts total)
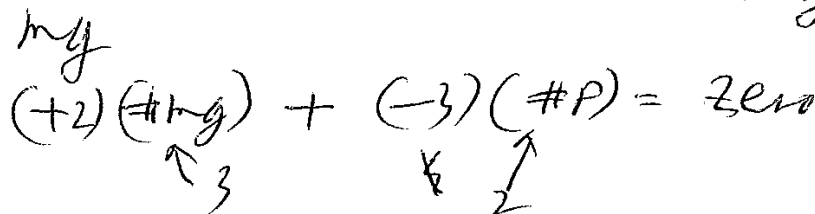
a. Between **Mg** and **P** what is the oxidation state or charge on the **Mg** in the ionic formula
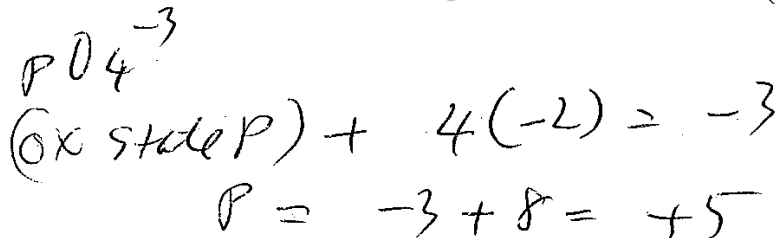
___+2___ Explain. (2 pts)   *gp. # w + charge*

b. Between **Mg** and **P** what is the oxidation state or charge on the **P** in the ionic formula

___−3___ Explain. (1 pt)   *group # −8*

$$5 - 8 = -3$$

c. Show your work for your calculation of the ionic formula between **Mg** and **P** Mg_3P_2
(2 pt)

Mg

$$(+2)(\#Mg) + (-3)(\#P) = zero$$

d. In **Mg₃ (PO₄)₂** what is the oxidation state or charge on the **P** Show work. (3 pts)

$$PO_4^{-3}$$

$$(ox \; state \; P) + 4(-2) = -3$$

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

6 For the following formula, give the formula mass (or molar mass). Show work. (4 pts)

Na_3PO_4 $3(23.0) + (30.97) + 4(16.0) = 163.97 g$
            Na   P   O

7. If you have the following ionic compound, is the reagent soluble or insoluble in water. Circle the correct choices below to answer this question.   (6 pts total)
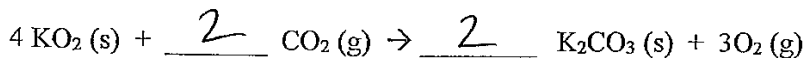
$Ba_3(PO_4)_2$
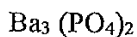
not exception
The anion (by itself without the cation) is [(soluble) or (insoluble)] (circle one) (3 pt)

The ionic compound (the anion with the cation) is [(soluble) or (insoluble)] (circle one) (3 pt)
        Ba not exception

8. Balance the following reactions by: (8 pts, 2 pts per blank)

a. filling in the blanks. (you can fill the blank with a **one but not a zero**)

$4 KO_2 (s) +$ __2__ $CO_2 (g) \rightarrow$ __2__ $K_2CO_3 (s) + 3O_2 (g)$

b. show the number count of every atom of the element K separately for the reactant and products

reactant atom count   of | product atom count of

        K __4__ | K __4__

9   Given the following reactants, write out the products by filling in the blanks. You do not need to balance the reactions in either part of this question. (4 pt, 2 pts per blank)

Pb (NO₃)₂ + K₂ SO₄ → ___K NO₃___ (aq) + ___Pb SO₄___ (s)
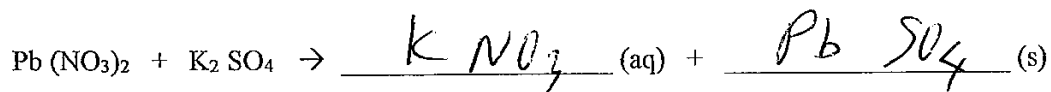
10.   Considering periodic trends, circle the correct elements (6 pts, 2 pts each)

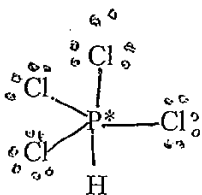a.   Which has lower ionization energy [(O) or (Se)] (circle one)   Se bigger, smaller
                                                                                                      IE
b.   Which is bigger as an element [(Ca) or (K)] (circle one)   (O) smaller)

c.   Which has higher electronegativities [(O) or (Te)] (circle one)

                        F is most En

11.   For the following given Lewis Dot Structure, complete the following: (6 pts, 1 pt per blank)

a.   Number of electrons pairs on the atom with the * for VSEPRT ___5___

b.   Number of lone pairs on the atom with the * ___zero___

c.   Geometry of the electron pairs at the atom with the * ___trigonal bipyramidal___

d.   Geometry of the molecule at the atom with the * ___trigonal bipyramidal___

e.   Bond angle at the atom with the * ___120°, 90°___

f.   Hybridization at the atom with the * ___$sp^3 d$___

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. a. Given the following reaction (assuming complete reaction), if you start with 475.2 grams of the reagent , NaOH (FW = 40.01 g/mol) what is the theoretical yield of the Na_2SO_4 (FW=142.1 g/mol) in grams assuming an excess of the acid ? Show work. (12 pts)

$H_2SO_4 + 2\,NaOH \rightarrow Na_2SO_4 + 2\,H_2O$
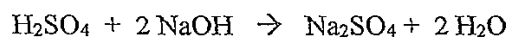
$$475.2\ g\ NaOH \times \frac{mol\ NaOH}{40.01\ g\ NaOH} \times \frac{1\ mol\ Na_2SO_4}{2\ mol\ NaOH} \times \frac{142.1\ g\ Na_2SO_4}{1\ mol\ Na_2SO_4}$$
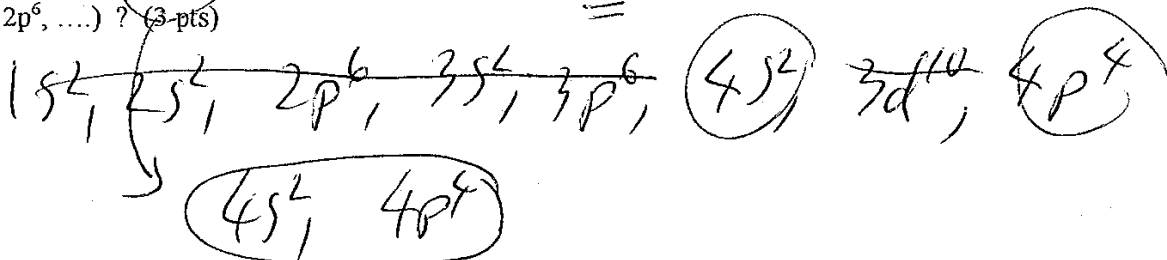
$$= 843.9\ g\ Na_2SO_4$$

b   How many atoms of the **Na** do you have in the theoretical yield. (10 pts)
    (Avogadro's number = 6.022 x 20²³)

$$475.2g \times \frac{NaOH \ mol}{40.01g \ NaOH} \times \frac{1 \ mol \ Na_2SO_4}{2 \ mol \ NaOH} \times \frac{2 \ mol \ Na}{1 \ mol \ Na_2SO_4} \times$$

$$\frac{6.022 \times 10^{23} \ atoms}{1 \ mol \ Na} = 7.152 \times 10^{24} \ atoms \ Na$$

2.

a. What is the valence electron configuration of the **Se** atom in the molecule in the format ($1s^2$, $2s^2$, $2p^6$, ...) ? (3-pts)

$1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, ($4s^2$) $3d^{10}$, ($4p^4$)
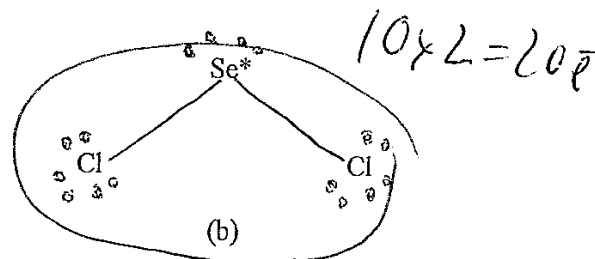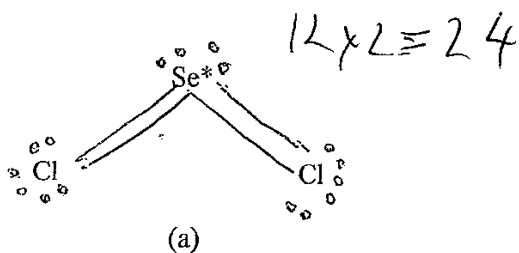
($4s^2$, $4p^4$)

b. For the following, how many valence electrons is in the molecule **Cl₂ Se** ? (5 pts)

$2(7) + 6 = 20\bar{e}$
Cl   Se

c. Given the following two potential Lewis Dot structures which is the correct one ? (2 pts)

$12 \times 2 = 24$

(a)

$10 \times 2 = 20\bar{e}$

(b)

d. Give at least one problem with the Lewis Dot structure which you did not choose ? (4 pts)

① too many $\bar{e}$ ② Since Se + Cl are
3rd row can expand
octet so not reason

e. Given the Lewis Dot structure which you chose, how many VSEPRT electron pairs is on the atom with the * ? (2 pts) ___4___

f. How many lone pairs is on the atom with the the * ? (2 pts) ___2___

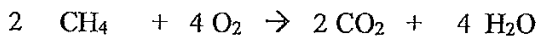g. What is the VSEPRT geometry of the electron pairs on the atom with the * ? (2 pts)
___tetrahedral___

h. What is the VSEPRT geometry of the molecule around the atom with the * ? (2 pts)
___bent___

3a   For the following reaction, if you start with   34.99   grams of the reagent CH_4 (FW = 16.05 g/mol) and the reaction goes to completion, how many Liters of the gas CO_2 is generated at STP (0°C, 1.0 atm)? (22 pts total, 8 pts part a)

10 pts

[some potentially useful equations are: $(P_1V_1)/(P_2V_2) = T_1/T_2$ $K = °C + 273.15$
   760 torr = 760 mm Hg = 1.00 atm   molar V at STP = 22.4 Liters]

2   CH_4 + 4 O_2 → 2 CO_2 +   4 H_2O

$$\frac{34.99 g}{CH_4} \times \frac{mol\ CH_4}{16.05 g\ CH_4} \times \frac{2\ mol\ CO_2}{2\ mol\ CH_4} \times \frac{22.4\ \ell\ CO_2}{1\ mol\ CO_2}$$

$$= 48.83\ \ell\ CO_2$$

b   If that gas is then heated to temperature of 155.2 °C at pressure of 405.1 mm Hg, how many Liters will the gas now occupy (12 pts)

$$T_1 = 0°C + 273.15 = 273.5$$

$$P_1 = 1.0 \, atm$$

$$V_1 = 48.83 \, \ell$$

$$T_2 = 155.2°C + 273.15 = 428.35 \, K$$

$$P_2 = 405.1 \, mm \, Hg / 760 = 0.5330 \, atm$$

$$V_2 = ?$$

$$\frac{P_2 V_2}{P_1 V_1} = \frac{T_2}{T_1} \qquad (0.5330 \, atm)($$

$$\frac{(0.5330 \, atm)(V_2)}{(1.0 \, atm)(48.83 \, \ell)} = \frac{428.35 \, K}{273.5 \, K}$$

$$V_2 = \left(\frac{428.35 \, K}{273.5 \, K}\right)\left(\frac{1.0 \, atm}{0.5330 \, atm}\right)(48.83 \, \ell)$$

$$V_2 = 143.5 \, \ell$$