

Name Key (print) Name NW = no work (sign)

Please show work for partial credit and full credit on the Long Answers and in some of the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If I cannot read your work, I obviously cannot grade it. (2 pts print and sign exam) If you run out of space, please continue on the back page of the exam and clearly tell me where the remaining answer can be found. $M = \text{moles/liter solution}$ $N_A = 6.022 \times 10^{23}$

$1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr}$ $K = ^\circ\text{C} + 273.15$ $P_{\text{total}} = P_A + P_B + P_C + \dots$ $X = n_A / n_{\text{total}} = P_A / P_{\text{total}}$
 $1 \text{ mole of gas} = 22.4 \text{ Liters}$ $PV = nRT$ $R = 0.08206 \text{ (L atm)/(mol K)}$ $(P_2 V_2) / (P_1 V_1) = T_2 / T_1$

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, 46 pts total)

- 1) Identify the compound with ionic bonding. 1) D
 A) He B) Na C) S D) NaBr E) H₂O
- 2) How many valence electrons do the noble gases (group VIIIA) possess? 2) D
 A) 7 B) 6 C) 1 D) 8 E) 2
- 3) Give the name for H₂SO₄. 3) A
 A) sulfuric acid
 B) hyposulfurous acid
 C) persulfuric acid
 D) persulfurous acid
 E) sulfurous acid
- 4) Which of the following is an acid-base reaction? 4) B
 A) $\text{MgSO}_4(\text{aq}) + \text{Ba}(\text{NO}_3)_2(\text{aq}) \rightarrow \text{Mg}(\text{NO}_3)_2(\text{aq}) + \text{BaSO}_4(\text{s})$
 B) $2 \text{HCl}(\text{aq}) + \text{Ca}(\text{OH})_2(\text{aq}) \rightarrow 2 \text{H}_2\text{O}(\text{l}) + \text{CaCl}_2(\text{aq})$
 C) $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$
 D) $\text{Fe}(\text{s}) + 2 \text{AgNO}_3(\text{aq}) \rightarrow 2 \text{Ag}(\text{s}) + \text{Fe}(\text{NO}_3)_2(\text{aq})$
 E) None of the above are acid base reactions.
- 5) Identify acetic acid. (CH₃COOH) 5) C
 A) strong electrolyte, strong acid
 B) strong electrolyte, weak acid
 C) weak electrolyte, weak acid
 D) nonelectrolyte
 E) weak electrolyte, strong acid
- 6) Identify a cation. 6) A
 A) An atom that has lost an electron.
 B) An atom that has gained an electron.
 C) An atom that has gained a neutron.
 D) An atom that has lost a proton and a neutron.

- 7) Predict the charge that a Mg ion would have.
 A) 3+ B) 2- C) 2+ D) 6- E) 1+ 7) C
- 8) Identify the compound with the smallest dipole moment in the single bond in the gas phase.
 A) LiF B) ClF C) Cl₂ D) HF 8) C
- 9) Which of the following elements is a metal?
 A) Fe B) Br C) Kr D) As E) S 9) A
- 10) Which compound has the longest carbon-carbon bond length?
 A) H₂C=CH₂ B) HC≡CH
 C) H₃C-CH₃ D) all bond lengths are the same 10) C
- 11) Au is an example of
 A) a homogeneous mixture. B) an element.
 C) a compound. D) a heterogeneous mixture. 11) B
- 12) Identify the number of VSEPR electron pairs around a molecule with a tetrahedral shape.
 A) 5 B) 4 C) 1 D) 2 E) 3 12) B
- 13) An anion of -2 indicates that an element has
 A) gained two protons.
 B) lost two protons.
 C) lost two neutrons.
 D) lost two electrons.
 E) gained two electrons. 13) E
- 14) How many H⁺ ions can the acid, H₂SO₄, donate per molecule?
 A) 1 B) 3 C) 0 D) 2 14) D
- 15) Which of the following quantum numbers describes the distance of the electron from the nucleus?
 A) angular momentum quantum number
 B) magnetic quantum number
 C) Schrödinger quantum number
 D) spin quantum number
 E) principal quantum number 15) E
- 16) Give the numbers for *m_l* for a p subshell (*l* = 1).
 A) 1, 2 B) -1, 0, 1 C) 0, 1 D) -2, -1, 0, 1, 2 16) B
- 17) An ionic bond is best described as
 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 attraction between 2 metal atoms.
 E) the transfer of electrons from one atom to another. 17) E

- 18) Which of the compounds HNO_3 , $\text{Ca}(\text{OH})_2$, KOH , and HI , behave as bases when they are dissolved in water?
A) only HI
B) $\text{Ca}(\text{OH})_2$ and KOH
C) HNO_3 and HI
D) only KOH
- 19) For a wave the distance between adjacent crests is called
A) frequency
B) median
C) amplitude
D) wavelength
E) area
- 20) Give the approximate bond angle for a molecule with an octahedral shape.
A) 120°
B) 109.5°
C) 90°
D) 180°
E) 105°
- 21) Isotopes differ in the number of
A) protons.
B) neutrons.
C) beta particles.
D) electrons.
E) neutrons and protons.
- 22) Determine the name for aqueous HF .
A) hydrofluorous acid
B) fluoric acid
C) hydrofluoric acid
D) hydrogen fluoride
E) fluorous acid
- 23) Identify the correct charges of the protons, neutrons, and electrons.
A) protons -1 , neutrons 0 , electrons $+1$
B) protons 0 , neutrons -1 , electrons $+1$
C) protons $+1$, neutrons 0 , electrons -1
D) protons $+1$, neutrons -1 , electrons 0
E) protons 0 , neutrons $+1$, electrons -1

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

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work. (84 pts)

1. Circle the following which is an element (not a Compound). You may circle one, all or none of the choices. (7 pts total, 1 pt each)

NO₂

Ca

Br₂

NaBr

H₂O

O₂

He

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

HBr

CH₃COOH

HNO₃

HF

H₂SO₄

3. Match the following to the letters shown. The letters may be used one time, many times or not at all. (8 pts total, 2 pts each)

- (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

Handwritten annotations on the periodic table:

- (a, j) points to the top-left corner.
- (d) points to the alkali metal column.
- (m) points to the noble gas column.
- (c) points to the main group elements.
- (g) is circled with "accepted" written next to it.
- (i) is circled with "did not accept" written next to it.
- "ok - C, H" is circled.
- "same s block" is circled.
- "OK" is circled.

4 Give the correct formula for the compound made from the following element and polyatomic ions. The ion charges are given together with the element and polyatomic ion symbol. (show work) (8 pts)

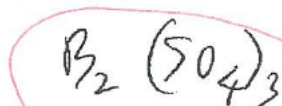
B(+3) SO_4^{2-} (-2)

$$\text{B} \quad \text{SO}_4^{2-}$$
$$(+3)x + (-2)y = \text{zero}$$

↑ ↑ ↑

(2pt) 2 3 (2pt)

NW-2



4pts

5. Is the molecule PbSO_4 [(soluble) or (insoluble)] (circle one) in water? Explain using the solubility chart. (8 pts)

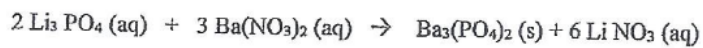
(4pts)

SO_4^{2-} are soluble except for
 Pb^{+2} insoluble

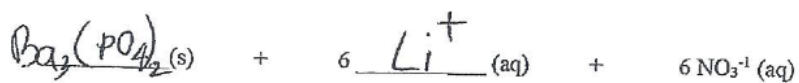
(NW-4pts)

6. For the following precipitation reaction written as the molecular equation, fill in the blanks to write the total ionic equation and the net ionic equation. (12 pts, 2 pts each)

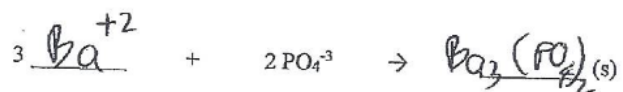
Molecular equation



total ionic equation:



Net ionic equation



2 pts each blank

7. Give the oxidation state of the following atom. Either show work or explain where you got the oxidation state. (8 pts, 2 pts each, show work)

Mg zero 1pt

element in most stable state 1pt

S in SO_3^{2-} +4 1pt

O is -2

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

$$S = -2 + 6$$

$$S = +4$$

Mg in MgCl_2 +2 1pt

ionic
is going # +2 1pt

O_2 zero

element in most stable state 1pt

8a. How many orbitals (orbitals are m_l) are in the f subshell? (f is the angular momentum quantum number of $l = 3$)

$-3, -2, -1, 0, +1, +2, +3$ or 7

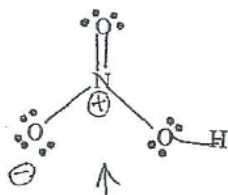
[(0) (1) (3) (5) (7)] (circle one) (6 pts total, 3 pts each this number)

b. How many maximum number of electrons are allowed in the f subshell?

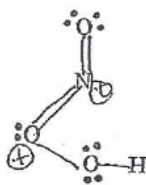
[(2) (6) (10) (14)] (circle one) (3 pts)

$$2 \times 7 = 14$$

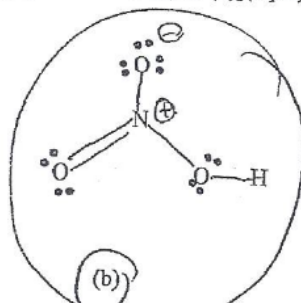
9. Given the following correct Lewis Dot structure, circle the structure which is the one correct resonance structures for the original correct Lewis Dot structure. (i.e. one of the structures is a valid resonance structure, the other is not a valid resonance structure) [circle either (a) or (b)] (5 pts)



(correct Lewis Dot structure)



(a)

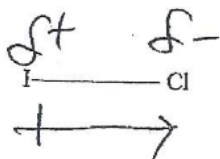


(b)

Resonance, only move e- & charge not

10a. For the bond between the atoms show the dipole of the bond using either the dipole moment arrow

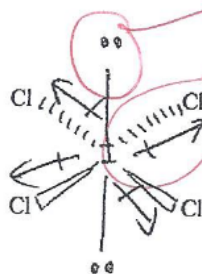
$(\overset{+}{\text{---}}\overset{-}{\text{---}})$ or the delta symbols (δ^+ / δ^-) (12 pts total, 4 pts each letter)



Cl is more ϵ than I
(closer to π)

4pt (wrong direction -4pt)

b. For the 3D drawing below, show all non-zero individual dipole moment arrows. (4 pts)



1pt
look
arrow

actually wrong arrow
1/2

c. Is the molecule above [(polar) or (nonpolar)] (circle one of the two parenthesis) Explain giving at least 2 sentences. (4 pts)

vector sum = zero \rightarrow nonpolar

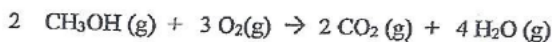
2pt

2pt

Part III. Long Answer Please show work for full credit and to receive partial credit. (68 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. **Dimensional Analysis Problem:** For the reaction shown, if you start with 579.2 mL of the gas CH_3OH how many atoms of the element O (in the molecule CO_2) do you have? ($N_A = 6.022 \times 10^{23}$, 1 mole = 22.4 Liters) (show work) (22 pts)



$$\begin{aligned}
 & 579.2 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{1 \text{ mol}}{22.4 \text{ L}} \times \frac{2 \text{ mol CO}_2}{2 \text{ mol CH}_3\text{OH}} \times \frac{2 \text{ atoms O}}{1 \text{ molecule CO}_2} \times \frac{6.022 \times 10^{23} \text{ atoms O}}{1 \text{ mol of O atoms}} = \\
 & 3.114 \times 10^{22} \text{ atoms O (in CO}_2\text{)}
 \end{aligned}$$

Handwritten notes and corrections in red ink:

- 4 pt (circled) next to the first CH₃OH
- 4 pt (circled) next to the second CH₃OH
- 4 pt (circled) next to the third CH₃OH
- 3 pt (circled) next to the 2 mol CO₂
- 3 pt (circled) next to the 1 mol CO₂
- 4 pt (circled) next to the 1 mol of O atoms

attempt -10

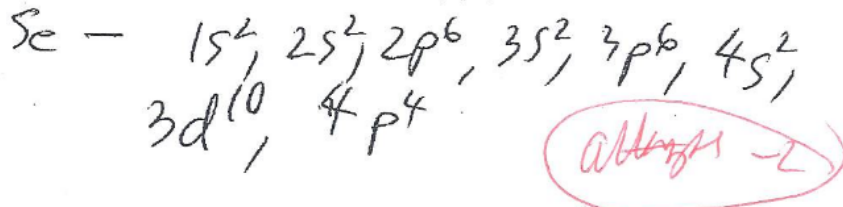
bad attempt -14

really bad attempt -17

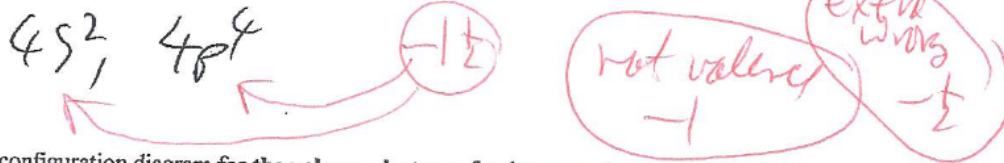
meth d

2. Electron Configuration Problem: (24 pts)

(a). Give the electron configuration for the element Se using the notation ($1s^2, 2s^2, \dots$). Show all electrons starting from the lowest energy levels. (4 pts)



(b). What is the valence electron configuration for the element Se? use same notation as in (a) above (3 pts)



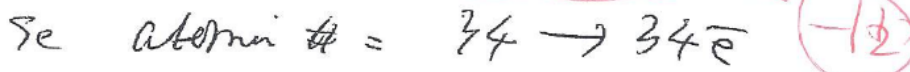
(c). Give the electron configuration diagram for the valence electrons for the same element Se (4 pts) (use the notation $\frac{1 \downarrow}{1s} \frac{1 \downarrow}{2s} \dots$ in which you use arrows to represent electrons)



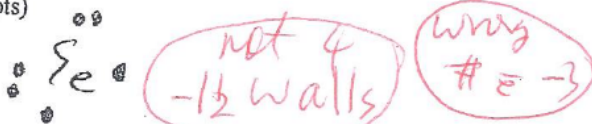
(d). How many valence electrons is in the same element Se? Explain. (3 pts) -1 1/2



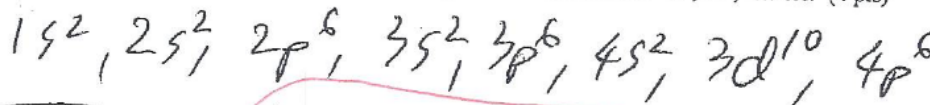
(e). How many total electrons is in the same element Se? Explain (3 pts)



(f). Give the Lewis Dot Symbol for the element Se (3 pts)



(g). For the ion Se^{2-} , give the electron configuration in the format $1s^2, 2s^2, \dots$ etc. (4 pts)



3. **Other Type Problem:** If you have 378.2 grams of the compound NaCl (FW NaCl = 58.44 g/mol) (22 pts)

a. How many moles of NaCl do you have? Show work. (7 pts)

$$\# \text{ moles} = 378.2 \text{ g NaCl} \times \frac{1 \text{ mol NaCl}}{58.44 \text{ g NaCl}} = 6.472$$

(2 pt)
 (2 pt)
 (3 pt)
 (bad attempt)
 -5

b. If you dissolve the compound in water enough to make up 4230.2 milli Liters of the NaCl solution, what is the molarity? Show work. (7 pts)

$$m = \frac{\# \text{ moles}}{\text{liters}} = \frac{6.472}{4230.2 \text{ ml} \times \frac{1 \text{ l}}{1000 \text{ ml}}} = 4.2302$$

(4 pt)
 (-1 pt) not done
 (bad attempt)
 -5

$$m = \frac{6.472 \text{ mol}}{4.2302 \text{ l}} = 1.52995 \text{ M} \rightarrow 1.530 \text{ M (sig figs)}$$

(bad attempt)
 -5

c. If you dilute the solution which you made up above by adding more water to make up a **total solution** of volume 7578.2 mL, what is the new molarity. Show work. ($M_{\text{dilute}} V_{\text{dilute}} = M_{\text{concentrated}} V_{\text{concentrated}}$) (8 pts)

$$M_{\text{con}} = 1.530 \quad V_{\text{con}} = 4230.2 \text{ ml}$$

$$M_{\text{dil}} = ? \quad V_{\text{dil}} = 7578.2 \text{ ml}$$

$$(1.530)(4230.2 \text{ ml}) = (M_{\text{dil}})(7578.2 \text{ ml})$$

(1 pt)
 (wvs)
 -2

$$M_{\text{dil}} = \frac{(1.530)(4230.2 \text{ ml})}{(7578.2 \text{ ml})} = 0.8541 \text{ M}$$

(bad attempt) -5

(attempt) -4

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 $1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr}$ $K = ^\circ\text{C} + 273.15$ $P_{\text{total}} = P_A + P_B + P_C + \dots$ $X = n_A / n_{\text{total}} = P_A / P_{\text{total}}$
 $1 \text{ mole of gas} = 22.4 \text{ Liters}$ $PV = nRT$ $R = 0.08206 (\text{L atm}) / (\text{mol K})$ $(P_2 V_2) / (P_1 V_1) = T_2 / T_1$

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, 46 pts total)

- 1) Give the approximate bond angle for a molecule with an octahedral shape. 1) B
 A) 105° B) 90° C) 120° D) 109.5° E) 180°
- 2) Identify the correct charges of the protons, neutrons, and electrons. 2) D
 A) protons +1, neutrons -1, electrons 0
 B) protons -1, neutrons 0, electrons +1
 C) protons 0, neutrons +1, electrons -1
 D) protons +1, neutrons 0, electrons -1
 E) protons 0, neutrons -1, electrons +1
- 3) Give the name for H_2SO_4 . 3) E
 A) persulfuric acid
 B) sulfurous acid
 C) persulfurous acid
 D) hyposulfurous acid
 E) sulfuric acid
- 4) Identify the compound with the smallest dipole moment in the single bond in the gas phase. 4) B
 A) ClF B) Cl_2 C) LiF D) HF
- 5) Which of the following quantum numbers describes the distance of the electron from the nucleus? 5) B
 A) angular momentum quantum number
 B) principal quantum number
 C) magnetic quantum number
 D) spin quantum number
 E) Schrödinger quantum number
- 6) Predict the charge that a Mg ion would have. 6) C
 A) $3+$ B) $1+$ C) $2+$ D) $6-$ E) $2-$
- 7) Identify the number of VSEPR electron pairs around a molecule with a tetrahedral shape. 7) C
 A) 2 B) 3 C) 4 D) 5 E) 1

- 8) How many valence electrons do the noble gases (group VIIIA) possess?
 A) 1 B) 8 C) 6 D) 7 E) 2 8) B
- 9) Which of the following is an acid-base reaction?
 A) $2 \text{HCl(aq)} + \text{Ca(OH)}_2\text{(aq)} \rightarrow 2 \text{H}_2\text{O(l)} + \text{CaCl}_2\text{(aq)}$
 B) $\text{C(s)} + \text{O}_2\text{(g)} \rightarrow \text{CO}_2\text{(g)}$
 C) $\text{MgSO}_4\text{(aq)} + \text{Ba(NO}_3)_2\text{(aq)} \rightarrow \text{Mg(NO}_3)_2\text{(aq)} + \text{BaSO}_4\text{(s)}$
 D) $\text{Fe(s)} + 2 \text{AgNO}_3\text{(aq)} \rightarrow 2 \text{Ag(s)} + \text{Fe(NO}_3)_2\text{(aq)}$
 E) None of the above are acid base reactions. 9) A
- 10) An anion of -2 indicates that an element has
 A) lost two electrons.
 B) gained two protons.
 C) lost two protons.
 D) lost two neutrons.
 E) gained two electrons. 10) E
- 11) Give the numbers for m_l for a p subshell ($l = 1$).
 A) -2, -1, 0, 1, 2 B) -1, 0, 1 C) 0, 1 D) 1, 2 11) B
- 12) Determine the name for aqueous HF.
 A) hydrogen fluorate
 B) hydrofluorous acid
 C) hydrofluoric acid
 D) fluorous acid
 E) fluoric acid 12) C
- 13) Identify acetic acid. (CH_3COOH)
 A) strong electrolyte, weak acid
 B) weak electrolyte, weak acid
 C) weak electrolyte, strong acid
 D) strong electrolyte, strong acid
 E) nonelectrolyte 13) B
- 14) Which of the compounds HNO_3 , Ca(OH)_2 , KOH , and HI behave as bases when they are dissolved in water?
 A) HNO_3 and HI B) only HI
 C) only KOH D) Ca(OH)_2 and KOH 14) D
- 15) For a wave the distance between adjacent crests is called
 A) median
 B) amplitude
 C) area
 D) frequency
 E) wavelength 15) E

- 16) Which compound has the longest carbon-carbon bond length?
 A) $\text{H}_3\text{C}-\text{CH}_3$ B) $\text{H}_2\text{C}=\text{CH}_2$
 C) $\text{HC}\equiv\text{CH}$ D) all bond lengths are the same
- 17) Identify the compound with ionic bonding.
 A) Na B) H_2O C) He D) S E) NaBr
- 18) Identify a cation.
 A) An atom that has lost an electron.
 B) An atom that has lost a proton and a neutron.
 C) An atom that has gained an electron.
 D) An atom that has gained a neutron.
- 19) An ionic bond is best described as
 A) the attraction between 2 metal atoms.
 B) the transfer of electrons from one atom to another.
 C) the sharing of electrons.
 D) the attraction that holds the atoms together in a polyatomic ion.
 E) the attraction between 2 nonmetal atoms.
- 20) Which of the following elements is a metal?
 A) Fe B) Br C) S D) As E) Kr
- 21) Au is an example of
 A) a homogeneous mixture.
 C) a heterogeneous mixture. B) an element.
 D) a compound.
- 22) How many H^+ ions can the acid, H_2SO_4 , donate per molecule?
 A) 2 B) 3 C) 1 D) 0
- 23) Isotopes differ in the number of
 A) beta particles.
 B) electrons.
 C) neutrons and protons.
 D) neutrons.
 E) protons.

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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1. Circle the following which is a compound (not an element). You may circle one, all or none of the choices. (7 pts total, 1 pt each)



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

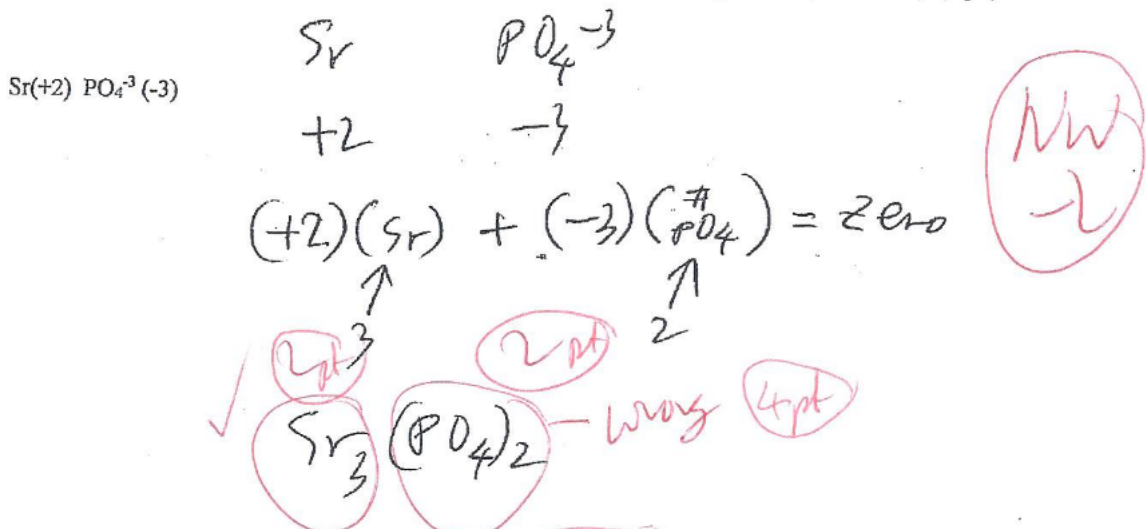


3. Match the following to the letters shown. The letters may be used one time, many times or not at all. (8 pts total, 2 pts each)

- (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

4 Give the correct formula for the compound made from the following element and polyatomic ions. The ion charges are given together with the element and polyatomic ion symbol. (show work) (8 pts)



5. Is the molecule Li_3PO_4 [(soluble) or (insoluble)] (circle one) in water? Explain using the solubility chart. (8 pts)

phosphates are insoluble except for alkali metals
 Li is an alkali metal

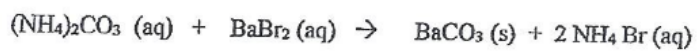
NW-4pt

said phosphate

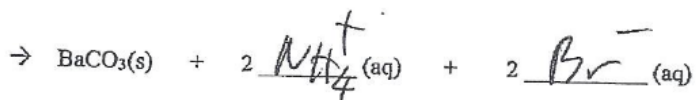
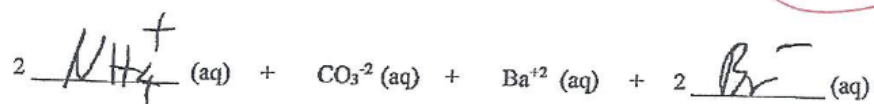
4

6. For the following precipitation reaction written as the molecular equation, fill in the blanks to write the total ionic equation and the net ionic equation. (12 pts, 2 pts each)

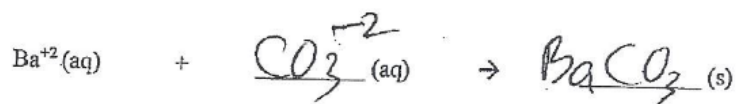
Molecular equation



total ionic equation:



Net ionic equation



2 pt each
blank

7. Give the oxidation state of the following atom. Either show work or explain where you got the oxidation state. (8 pts, 2 pts each, show work)

Cl₂ zero (1pt) S in SO₂ +4 (1pt) O is -2

element in most stable form (1pt) $S + (-2)2 = \text{zero}$ (1pt)
 $S = +4$

Cl in HCl -1 (1pt) N in NO₃⁻¹ +5 (1pt) O is -2 (1pt)

ionic Cl has ox state = (1pt) $N + 3(-2) = -1$ (1pt)
 $N = -1 + 6 = +5$ (1pt)
 group # - 8 = 7 - 8 = -1 $N = +5$

8a. How many orbitals (orbitals are m_l) are in the p subshell? (p is the angular momentum quantum number of l = ~~2~~ 1)

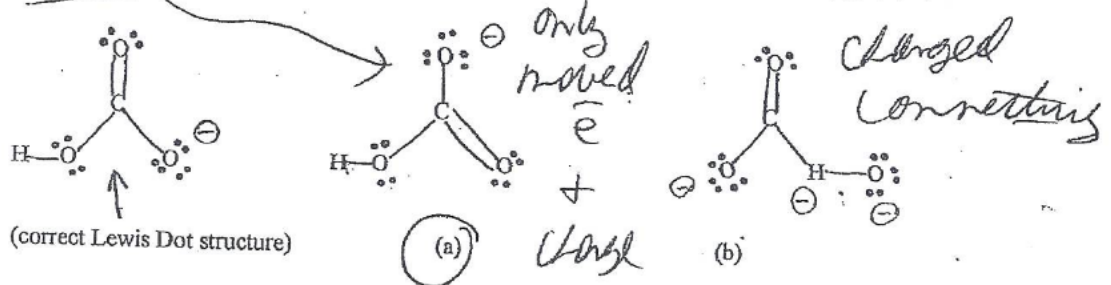
-1, 0, +1

[(0) (1) (3) (5) (7)] (circle one) (6 pts total, 3 pts each this number)

b. How many maximum number of electrons are allowed in the p subshell?

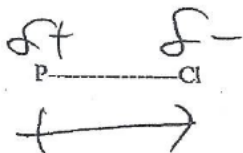
[(2) (6) (10) (14)] (circle one) (3 pts) $3 \times 2 = 6 e^-$

9. Given the following correct Lewis Dot structure, circle the structure which is the one correct resonance structures for the original correct Lewis Dot structure. (i.e. one of the structures is a valid resonance structure, the other is not a valid resonance structure) [circle either (a) or (b)] (5 pts)



10. a. For the bond between the atoms show the dipole of the bond using either the dipole moment

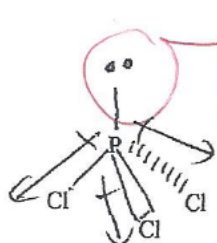
arrow $(\overset{+}{\dashrightarrow})$ or the delta symbols (δ^+ / δ^-) (12 pts total, 4 pts each letter)



Cl is closer to F
+ more electronegative

4 pt
Wrong direction 4 pt

b. For the 3D drawing below, show all non zero individual dipole moment arrows. (4 pts)



no arrow

wrong direction 4 pt

c. Is the molecule above [(polar)] or (nonpolar)] (circle one of the two parenthesis) Explain giving at least 2 sentences. (4 pts)

vector sum \neq zero so polar

2 pt

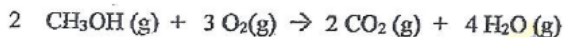
2 pt

Part III. Long Answer Please show work for full credit and to receive partial credit. (68 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. **Dimensional Analysis Problem:** For the reaction shown, if you start with 17.9 mL of the gas O_2 how many atoms of the element H (in the molecule H_2O) do you have? ($N_A = 6.022 \times 10^{23}$, 1 mole = 22.4 Liters) (show work) (22 pts)



$$17.9 \text{ mL } O_2 \times \frac{1 \text{ L } O_2}{1000 \text{ mL } O_2} \times \frac{1 \text{ mol } O_2}{22.4 \text{ L}}$$

$$\times \frac{4 \text{ mol H}_2\text{O}}{3 \text{ mol } O_2} \times \frac{2 \text{ mol H}}{1 \text{ mol H}_2\text{O}} \times \frac{6.022 \times 10^{23} \text{ atoms H}}{1 \text{ mol H}}$$

$$= 1.28 \times 10^{21} \text{ atoms H}$$

mult
4

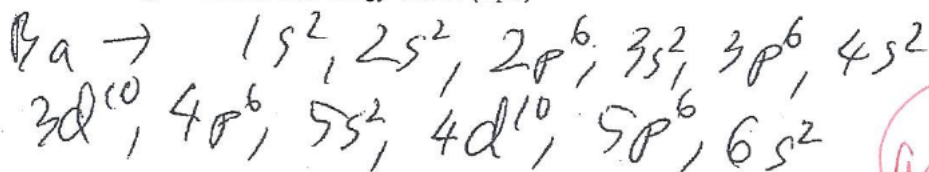
attempts - 10

bad attempt - 14

really - 17
bad attempt

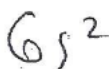
2. Electron Configuration Problem: (24 pts)

(a). Give the electron configuration for the element **Ba** using the notation ($1s^2, 2s^2, \dots$). Show all electrons starting from the lowest energy levels. (4 pts)



accept ✓

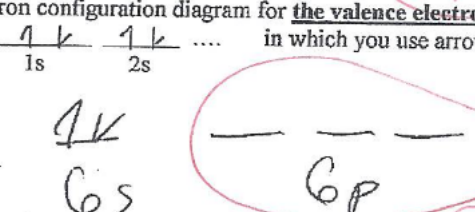
(b). What is the valence electron configuration for the element **Ba**? use same notation as in (a) above (3 pts)



give $5p^6$ extra with ✗

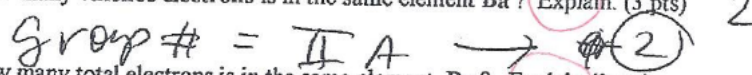
not valence ✓

(c). Give the electron configuration diagram for the valence electrons for the same element **Ba** (4 pts) (use the notation $\uparrow \downarrow \uparrow \downarrow \dots$ in which you use arrows to represent electrons)

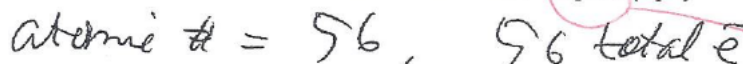


give 1 ✓

(d) How many valence electrons is in the same element **Ba**? Explain. (3 pts)



(e) How many total electrons is in the same element **Ba**? Explain (3 pts)



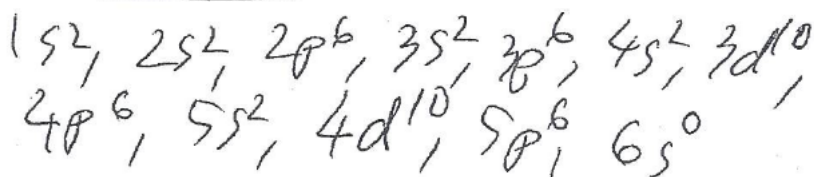
(f) Give the Lewis Dot Symbol for the element **Ba** (-3 pts)



wrong # e -3
not 4 walls -1/2

(g) For the ion Ba^{+2} , give the electron configuration in the format $1s^2, 2s^2, \dots$ etc. (4 pts)

remove $2e^-$



lose $2e^-$ not add $2e^-$ ✓

3. **Other Type Problem:** If you have 17.23 grams of the compound NH_4Cl (FW $\text{NH}_4\text{Cl} = 53.50 \text{ g/mol}$) (22 pts)

a. How many moles of NH_4Cl do you have? Show work. (7 pts)

$$\text{moles } \text{NH}_4\text{Cl} = 17.23 \text{ g} \times \frac{\text{mol } \text{NH}_4\text{Cl}}{53.50 \text{ g}} =$$

(3 pt) NH_4Cl (2 pt)

bad - 5
attempt

$$0.3220 \text{ mol } \text{NH}_4\text{Cl}$$

(2 pt)

b. If you dissolve the compound in water enough to make up 2.5571 milli Liters of the NH_4Cl solution, what is the molarity? Show work. (7 pts)

$$M = \frac{\# \text{ moles}}{\text{L soln.}}$$

$$2.5571 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} = 2.5571 \times 10^{-3} \text{ L}$$

$$M = \frac{0.3220 \text{ mol}}{2.5571 \times 10^{-3} \text{ L}} = 125.9 \text{ M}$$

not done
-12

3 pts

bad
attempt
-5

c. If you dilute the solution which you made up above by adding more water to make up a **total solution** of volume 5.2782 mL, what is the new molarity. Show work. ($M_{\text{dilute}} V_{\text{dilute}} = M_{\text{concentrated}} V_{\text{concentrated}}$) (8 pts)

$$M_{\text{con}} = 125.9 \text{ M} \quad V_{\text{con}} = 2.5571 \text{ mL}$$

$$M_{\text{dil}} = ? \quad V_{\text{dil}} = 5.2782 \text{ mL}$$

$$(125.9 \text{ M})(2.5571 \text{ mL}) = (M_{\text{dil}})(5.2782 \text{ mL})$$

$$M_{\text{dil}} = \frac{(125.9 \text{ M})(2.5571 \text{ mL})}{(5.2782 \text{ mL})} = 61.01 \text{ M}$$

4 pts

attempt
-3

4 pt

bad
attempt

attempt
-4

NW = no work

NA = not attempted

Final General Chemistry I Lecture Fall 2014 12/3/14 Wednesday form 10:30 A Dr. Hahn Exam # _____

Name Key (print) Name _____ (sign)

Please show work for partial credit and full credit on the Long Answers and in some of the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If I cannot read your work, I obviously cannot grade it. (2 pts print and sign exam) If you run out of space, please continue on the back page of the exam and clearly tell me where the remaining answer can be found. $M = \text{moles/liter solution}$ $N_A = 6.022 \times 10^{23}$
 $1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr}$ $K = ^\circ\text{C} + 273.15$ $P_{\text{total}} = P_A + P_B + P_C + \dots$ $X = n_A / n_{\text{total}} = P_A / P_{\text{total}}$
 $1 \text{ mole of gas} = 22.4 \text{ Liters}$ $PV = nRT$ $R = 0.08206 (\text{L atm}) / (\text{mol K})$ $(P_2 V_2) / (P_1 V_1) = T_2 / T_1$

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, 46 pts total)

- 1) Which of the following exists as a diatomic molecule? 1) D
A) carbon
B) krypton
C) phosphorus
 D) hydrogen
E) lithium
- 2) A double covalent bond contains _____ of electrons. 2) A
 A) 2 pairs B) 0 pairs C) 1 pair D) 3 pairs E) 4 pairs
- 3) Give the approximate bond angle for a molecule with a linear shape. 3) A
 A) 180° B) 109.5° C) 105° D) 120° E) 90°
- 4) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 4) E
A) 28.1 torr B) 31.8 torr C) 760 torr D) 13.8 torr E) 715 torr
- 5) When dissolved in water, KOH behaves as 5) D
A) a base that forms KO^- and H^+ ions.
C) an acid that forms KO^- and H^+ ions. B) an acid that forms K^+ and OH^- ions.
 D) a base that forms K^+ and OH^- ions.
- 6) Give the name for HNO_3 . 6) C
A) hydrogen nitride
B) nitrous acid
 C) nitric acid
D) hydrogen nitrite
E) hydrogen nitrate
- 7) H_2O is an example of 7) A
 A) a compound. B) a heterogeneous mixture.
C) an element. D) a homogeneous mixture.

- 8) Identify the correct description of an atom. 8) D
 A) electrons in nucleus; protons and neutrons in orbitals
 B) neutrons in nucleus; protons and electrons in orbitals
 C) protons and electrons in nucleus; neutrons in orbitals
 D) protons and neutrons in nucleus; electrons in orbitals
 E) neutrons and electrons in nucleus; protons in orbitals
- 9) What is the empirical formula for $C_8H_{16}O_4$? 9) E
 A) C_2H_5O B) CHO C) CH_2O D) CHO_2 E) C_2H_4O
- 10) Which of the following is an acid-base reaction? 10) A
 A) $2 HCl(aq) + Ca(OH)_2(aq) \rightarrow 2 H_2O(l) + CaCl_2(aq)$
 B) $Fe(s) + 2 AgNO_3(aq) \rightarrow 2 Ag(s) + Fe(NO_3)_2(aq)$
 C) $MgSO_4(aq) + Ba(NO_3)_2(aq) \rightarrow Mg(NO_3)_2(aq) + BaSO_4(s)$
 D) $C(s) + O_2(g) \rightarrow CO_2(g)$
 E) None of the above are acid base reactions.
- 11) Describe the shape of a p orbital. 11) D
 A) spherical
 B) three balls
 C) eight balls
 D) dumbbell shaped
 E) four balls
- 12) Choose the bond below that is most polar. (C & H have almost the same electronegativities) 12) E
 A) H-I B) H-Cl C) H-Br D) C-H E) H-F
- 13) Identify the compound with covalent bonding. 13) B
 A) S B) H_2O C) Na D) He E) NaBr
- 14) Determine the name for aqueous HBr. 14) B
 A) hydrobromous acid
 B) hydrobromic acid
 C) hydrogen bromate
 D) bromous acid
 E) bromic acid
- 15) A cation of +2 indicates that an element has 15) B
 A) lost two protons.
 B) lost two electrons.
 C) lost two neutrons.
 D) gained two electrons.
 E) gained two protons.
- 16) Predict the charge that an ion formed from Se would have. 16) E
 A) 1- B) 6+ C) 3- D) 4+ E) 2-

- 17) Give the numbers for m_l for a d subshell ($l = 2$).
 A) -1, 0, 1 **B) -2, -1, 0, 1, 2** C) 1, 2, 3 D) 0, 1, 2 17) B
- 18) Which of the following elements is a nonmetal?
 A) K B) Ce **C) Br** D) Be E) Ni 18) C
- 19) How many H^+ ions can the acid, H_3PO_4 , donate per molecule?
 A) 1 **B) 3** C) 2 D) 0 19) B
- 20) How many valence electrons do the alkali metals (group IA) possess?
A) 1 B) 7 C) 6 D) 2 E) 8 20) A
- 21) Which compound has the highest carbon-carbon bond strength?
A) $H-C\equiv C-H$ B) $H_2C=CH_2$
 C) H_3C-CH_3 D) all bond strengths are the same 21) A
- 22) Identify the number of VSEPR electron pairs around a molecule with a trigonal bipyramidal shape.
 A) 2 B) 3 **C) 5** D) 1 E) 4 22) C
- 23) Identify an anion.
 A) An atom that has lost a neutron and a proton.
B) An atom that has gained an electron.
 C) An atom that has gained a neutron.
 D) An atom that has lost an electron. 23) B

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

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work. (84 pts)

1 Given the following list of chemical formulas, circle all which are ionic (7 pts total, 1 pt each)



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



3. For the following symbols give the element name. For the following element name, write down the element symbol. (8 pts total, 2 pts each)

N nitrogen

aluminum Al

Magnesium Mg

I iodine

Said
iodide
-I

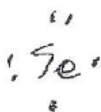
4. Given the following block directly from the periodic table, (10 pts, 1 pt each)

Se

34
Se
78.96

-2 (reversed)
 79
 34 Se

- a. Write the symbol for the element in the form of ${}^A_Z X$ _____
- b. How many protons? 34 c. How many electrons (for a neutral atom)? 34
- c. What is the charge on the element as an ion? -2 explain or show work. $(6 - 8 = -2)$ (-2)
- d. How many neutrons? 45 (show work) $79 - 34 = 45$ (-2)
- e. How many atoms does one mole of the element contain 6.022×10^{23}
- f. How much does one atom of the element weigh 78.96 amu
- g. How much does one mole of the element weigh 78.96 grams
- h. How many valence electrons does the element have? 6 electrons. Explain. same as group # VI (-2)
- i. Give the Lewis Dot Symbol for the element. _____

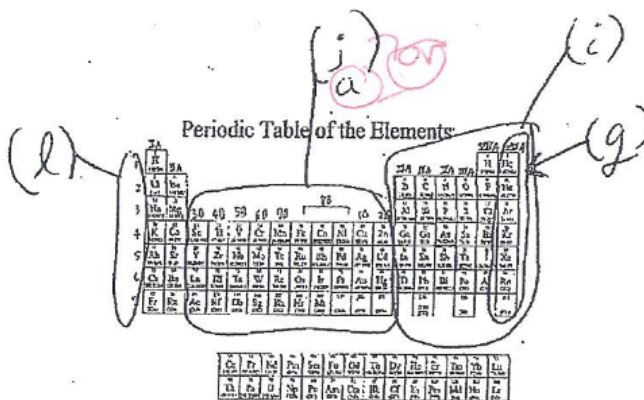


wavy
#8 11

not 4
walls
 -2

5 Match the following to the letters shown. The letters may only be used one time or not at all. (8 pts total, 2 pts each)

- (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



6. For the compound with the formula shown complete the following: (8 pts total)

In one mole of $\text{Be}_3(\text{PO}_4)_2$

you have 2 moles (2 pts) of the polyatomic ion PO_4^{3-}

and 8 moles (2 pts) of the element O

$4 \times 2 = 8$

What is the molar mass of the $\text{Be}_3(\text{PO}_4)_2$? (Show work.) (4 pts)

$$3(9.01) + (30.97)2 + (16.00) \times 8 = 216.97 \text{ g/mol}$$

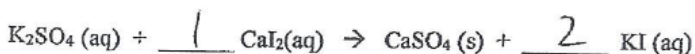
Handwritten work showing the calculation with arrows pointing to the atomic masses and their respective points: Be (9.01) is 1 pt, P (30.97) is 1 pt, O (16.00) is 1 pt, and the final result (216.97 g/mol) is 1 pt.

7. Balancing Chemical Reactions: (10 pts total, 1 pt each blank)

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

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

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



1 pt each blank

of K^+ (reactant) 2 # of SO_4^{2-} (reactant) 1 # of Ca^{+2} (reactant) 1 # of I^- (reactant) 2

of Ca^{+2} (product) 1 # of SO_4^{2-} (product) 1 # of K^+ (product) 2 # of I^- (product) 2

8. For the symbol $2p^6$ (6 pts total, 2 pts each)

a. 2 means [(there are 2 electrons) (period number)] (circle one entire parenthesis)

b. p means [(electrons are being added to the p subshell) (p is principal quantum number, n)] (circle one entire parenthesis)

c. superscript 6 means [(there are 6 electrons in 2p) (period number)] (circle one entire parenthesis)

9. Considering periodic properties: (6 pts, 2 pts each)

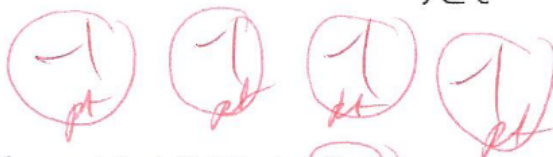
- a. Which atom is bigger? (C) or (O) [(circle one)]
- b. Which atom has higher ionization energy [(C) or (O)] (circle one)
- c. Which atom has the higher electronegativity [(C) or (O)] (circle one)

10. Lewis Dot Structure: (11 pts total)

a. For the molecule PO_4^{3-} how many valence electrons are in the molecule? Show work. (5 pts)

P - group 5
O - group 6
charge + 3

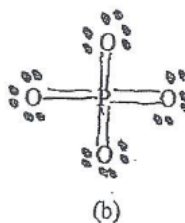
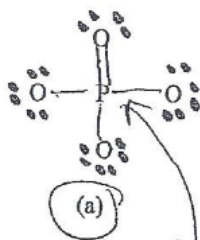
$$5 + 6(4) + 3 = 32e^-$$



b. For the molecule PO_4^{3-} circle the letter under the correct Lewis Dot Structure. (4 pt)

(6 pairs $\times 2 = 12e^-$)

20 pairs $\times 2 = 40e^-$



too many e^-

c. Explain in a few words one incorrect thing about the incorrect Lewis Dot Structure. (2 pt)

- (a) has too many e^-
O has more than octet not allowed
P has way more than octet

Part III. Long Answer Please show work for full credit and to receive partial credit. (68 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. Dimensional Analysis Type Problem: (23 pts)

If you do the reaction below with 37.9 milli liters of a 2.5 Molar solution of KOH dissolved in water, how many atoms of the oxygen (in the molecule K_2SO_4) will you make? (show work) $N_A = 6.022 \times 10^{23}$



Handwritten calculation:

$$\begin{aligned} & \text{37.9 ml} \times \frac{2.5 \text{ mol KOH}}{1000 \text{ ml KOH soln.}} \times \frac{1 \text{ mol K}_2\text{SO}_4}{2 \text{ mol KOH}} \\ & \text{KOH soln.} \end{aligned}$$

Handwritten calculation:

$$\times \frac{4 \text{ mol O}}{1 \text{ mol K}_2\text{SO}_4} \times \frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mol O}} =$$

Handwritten calculation:

$$1.14 \times 10^{23} \text{ atoms of O}$$

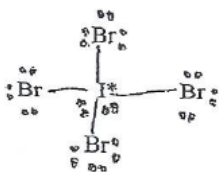
attempts - 11

bad attempt
- 15

math
- 1

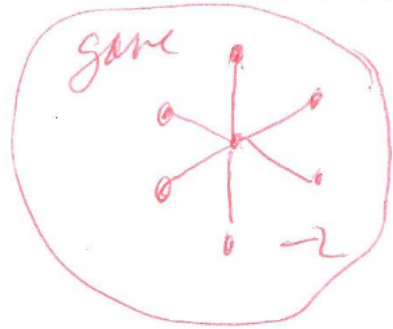
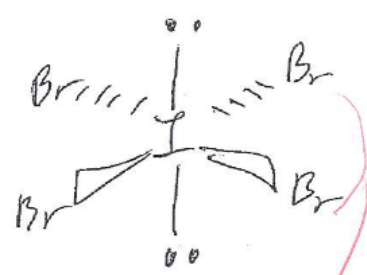
really bad attempt
- 18

2. For the following Lewis Dot structure, complete the following. (23 pts) (I Br_4^-)



- a. How many electron pairs (VSEPR electron pair) are on the atom with the *? 6 (5 pt)
- b. How many lone pairs are on the atom with the *? 2 (5 pt)
- c. What is the geometry of the electron pairs? Octahedral (2 pts)
- d. What is the geometry of the molecule? square planar (2 pts)
- e. What is the hybridization of the atom with the *? sp^3d^2 (2 pts)
- f. What is the bond angle in the molecule? 90° (2 pts)
- g. Draw the molecule above in 3D using the wedge, dash, line drawing in the space next to the Lewis Dot structure. Remember that (coming away from plane) (going below plane) (in plane) Show all lone pairs in your drawing using the 3D wedge, dash, line. (5 pts)

*graded
inconsistent
w/ a/b*



*attempt
-2*

*wrong
placement -1*

3. Gas Law Problem: Answer the following by filling in the blanks (you may use a ? or the word **unknown** or the letter symbol **(P, V, n or T)** for an unknown variable. You need to come up with the final correct answer with the correct units for the answer. (22 pts) (Some useful equations are shown below. You may or may not need some or all of them.)

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

Ideal Gas Law to answer the following. [$PV = nRT$, $R = 0.08206$ (Liter Atm) / (Mol K)]

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

If you have 32.5 moles of a gas at 770 mm Hg and 22.2 °C, how many Liters of the gas do you have ?

$P = \frac{770}{\text{mm Hg}}$ $V = ?$ $n = \frac{32.5}{\text{mol}}$ $T = \frac{22.2^\circ\text{C}}{\text{(8 pts, 2 pt each)}}$

22-8 = 14

$PV = nRT$

$P = 770 \text{ mm Hg} * \frac{1 \text{ atm}}{760 \text{ mm Hg}} = 1.013 \text{ atm}$ (2pt)

$T = 22.2^\circ\text{C} + 273.15 = 295.65 \text{ K}$ (2pt)

$(1.013 \text{ atm})(V) = (32.5 \text{ mol}) \left(\frac{0.08206 \text{ Latm}}{\text{mol K}} \right) (295.65 \text{ K})$
 $V = \frac{(32.5 \text{ mol}) (0.08206 \text{ Latm}) (295.65 \text{ K})}{1.013 \text{ atm}}$

$V = 778.4 \text{ L} \rightarrow \text{3 sig fig} \rightarrow 778 \text{ L}$

math algebra 20

attempt -10

Name Key (print) Name _____ (sign)

Please show work for partial credit and full credit on the Long Answers and in some of the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If I cannot read your work, I obviously cannot grade it. (2 pts print and sign exam) If you run out of space, please continue on the back page of the exam and clearly tell me where the remaining answer can be found. $M = \text{moles/liter solution}$ $N_A = 6.022 \times 10^{23}$

$1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr}$ $K = ^\circ\text{C} + 273.15$ $P_{\text{total}} = P_A + P_B + P_C + \dots$ $X = n_A / n_{\text{total}} = P_A / P_{\text{total}}$
 $1 \text{ mole of gas} = 22.4 \text{ Liters}$ $PV = nRT$ $R = 0.08206 (\text{L atm}) / (\text{mol K})$ $(P_2 V_2) / (P_1 V_1) = T_2 / T_1$

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, 46 pts total)

- 1) H_2O is an example of 1) C
 A) a heterogeneous mixture. B) an element.
 C) a compound. D) a homogeneous mixture.
- 2) A double covalent bond contains _____ of electrons. 2) C
 A) 1 pair B) 4 pairs C) 2 pairs D) 0 pairs E) 3 pairs
- 3) Which of the following exists as a diatomic molecule? 3) E
 A) krypton B) carbon NOH or HON
 C) phosphorus D) lithium
 E) hydrogen
- 4) Choose the bond below that is most polar. (C & H have almost the same electronegativities) 4) B
 A) C-H B) H-F C) H-Br D) H-I E) H-Cl
- 5) Identify the number of VSEPR electron pairs around a molecule with a trigonal bipyramidal shape. 5) D
 A) 4 B) 3 C) 2 D) 5 E) 1
- 6) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 6) A
 A) 715 torr B) 760 torr C) 31.8 torr D) 28.1 torr E) 13.8 torr
- 7) Give the approximate bond angle for a molecule with a linear shape. 7) B
 A) 105° B) 180° C) 90° D) 120° E) 109.5°
- 8) Describe the shape of a p orbital. 8) E
 A) spherical
 B) eight balls
 C) four balls
 D) three balls
 E) dumbbell shaped

- 9) Give the numbers for m_l for a d subshell ($l = 2$).
 A) -1, 0, 1 **B) -2, -1, 0, 1, 2** C) 1, 2, 3 D) 0, 1, 2 9) B
- 10) What is the empirical formula for $C_8H_{16}O_4$? $\frac{1}{4} \cdot 4 = C_2 H_4 O$
 A) C_2H_5O B) CH_2O C) CHO D) CHO_2 **E) C_2H_4O** 10) E
- 11) Which of the following elements is a nonmetal?
 A) K B) Be **C) Br** D) Ni E) Ce 11) C
- 12) Give the name for HNO_3 .
 A) hydrogen nitrite
 B) hydrogen nitride
 C) hydrogen nitrate
 D) nitrous acid
 E) nitric acid 12) E
- 13) Identify an anion.
A) An atom that has gained an electron.
 B) An atom that has lost a neutron and a proton.
 C) An atom that has lost an electron.
 D) An atom that has gained a neutron. 13) A
- 14) A cation of +2 indicates that an element has
 A) lost two protons.
 B) lost two neutrons.
 C) gained two electrons.
D) lost two electrons.
 E) gained two protons. 14) D
- 15) Which of the following is an acid-base reaction?
A) $2 HCl(aq) + Ca(OH)_2(aq) \rightarrow 2 H_2O(l) + CaCl_2(aq)$
 B) $MgSO_4(aq) + Ba(NO_3)_2(aq) \rightarrow Mg(NO_3)_2(aq) + BaSO_4(s)$
 C) $C(s) + O_2(g) \rightarrow CO_2(g)$
 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. 15) A
- 16) Predict the charge that an ion formed from Se would have. *group 6 - 8 = -2*
 A) 3- B) 1- C) 4+ D) 6+ **E) 2-** 16) E
- 17) How many valence electrons do the alkali metals (group IA) possess? *- group #*
 A) 6 B) 7 **C) 1** D) 2 E) 8 17) C
- 18) Identify the correct description of an atom.
 A) neutrons in nucleus; protons and electrons in orbitals
B) protons and neutrons in nucleus; electrons in orbitals
 C) protons and electrons in nucleus; neutrons in orbitals
 D) electrons in nucleus; protons and neutrons in orbitals
 E) neutrons and electrons in nucleus; protons in orbitals 18) B

- 19) How many H^+ ions can the acid, H_3PO_4 , donate per molecule? 19) C
A) 2 B) 0 C) 3 D) 1
- 20) Identify the compound with covalent bonding. 20) D
A) S B) He C) NaBr D) H_2O E) Na
- 21) When dissolved in water, KOH behaves as 21) D
A) an acid that forms KO^- and H^+ ions. B) a base that forms KO^- and H^+ ions.
C) an acid that forms K^+ and OH^- ions. D) a base that forms K^+ and OH^- ions.
- 22) Which compound has the highest carbon-carbon bond strength? 22) C
A) H_3C-CH_3 B) $H_2C=CH_2$
C) $HC\equiv CH$ D) all bond strengths are the same
- 23) Determine the name for aqueous HBr. 23) E
A) hydrogen bromate
B) bromous acid
C) bromic acid
D) hydrobromous acid
E) hydrobromic acid

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. (84 pts)

1 Given the following list of chemical formulas, circle all which are covalent (7 pts total, 1 pt each)

Na Cl



Sr_3P_2

MgF_2



CaBr_2



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



$\text{Ba}(\text{OH})_2$

NaOH

KOH



3. For the following symbols give the element name. For the following element name, write down the element symbol. (8 pts total, 2 pts each)

O Oxygen

sulfur S

Sodium Na

Br bromine

said bromide
+

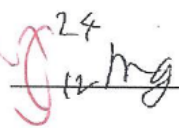
4. Given the following block directly from the periodic table, (10 pts, 1 pt each)

Mg



reversed

a. Write the symbol for the element in the form of ${}^A_Z X$



b. How many protons? 12 c. How many electrons (for a neutral atom)? 12

c. What is the charge on the element as an ion? +2 explain or show work.

Group IIA $\rightarrow +2$

-1/2 pt

d. How many neutrons? 12 (show work)

$24 - 12 = 12$

-1/2 pt

e. How many atoms does one mole of the element contain 6.022×10^{23}

f. How much does one atom of the element weigh 24.31 amu

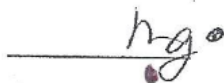
g. How much does one mole of the element weigh 24.31 grams

-1/2 pt

h. How many valence electrons does the element have? 2 electrons. Explain.

Valence e = group # = II = 2

i. Give the Lewis Dot Symbol for the element.



*wrong #
e -1*

*not 4 walls
-1/2*

5 Match the following to the letters shown. The letters may only be used one time or not at all. (8 pts total, 2 pts each)

- (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

6. For the compound with the formula shown complete the following: (8 pts total)

In one mole of $(\text{NH}_4)_3\text{N}$

you have 3 moles (2 pts) of the polyatomic ion NH_4^{+1}

and 12 moles (2 pts) of the element H

$$3 \times 4 = 12$$

What is the molar mass of the $(\text{NH}_4)_3\text{N}$? (Show work.) (4 pts)

$$\text{N} - 14.01$$

$$\text{H} - 1.01$$

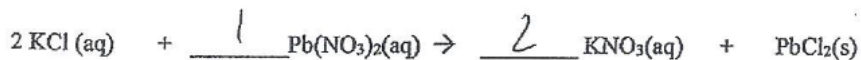
$$(14.01) \underset{\text{N}}{4} + (1.01) \underset{\text{H}}{12} = 68.16 \text{ g/mol}$$

7. Balancing Chemical Reactions: (10 pts total, 1 pt each blank)

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

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

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



1 pt each blank

of K^{+1} (reactant) 2 # of Cl^{-1} (reactant) 2 # of Pb^{+2} (reactant) 1 # of NO_3^{-1} (reactant) 2

K^{+1} (product) 2 # NO_3^{-1} (product) 2 # of Pb^{+2} (product) 1 # Cl^{-1} (product) 2

8. For the symbol $6d^3$ (6 pts total, 2 pts each)

a. 6 means [(period number)(there are 6 electrons)] (circle one entire parenthesis)

b. d means [(electrons are being added to the d subshell)(d is principal quantum number, n)] (circle one entire parenthesis)

c. superscript 3 means [(period number)(there are 3 electrons in 6d)] (circle one entire parenthesis)

9. Considering periodic properties: (6 pts, 2 pts each)

- a. Which atom is bigger? [(F) or (I)] [(I)] ((circle one))
- b. Which atom has higher ionization energy [(F) or (I)] ((circle one))
- c. Which atom has the higher electronegativity [(F) or (I)] ((circle one))

10. Lewis Dot Structure: (11 pts total)

a. For the molecule H_2CO_3 how many valence electrons are in the molecule? Show work. (5 pts)

H - group 1
C - group 4
O - group 6

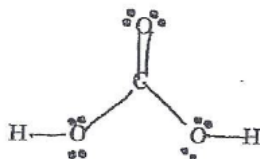
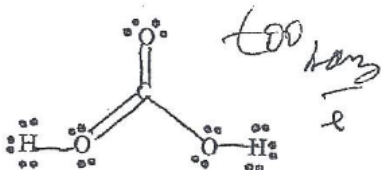
$$2(1) + 4 + 3(6) = 24e^-$$

1 pt 1 pt 1 pt 1 pt

b. For the molecule H_2CO_3 circle the letter under the correct Lewis Dot Structure. (4 pt)

$$19 \text{ pairs} \times 2 = 38e^-$$

$$12 \text{ pairs} \times 2 = 24e^-$$



c. Explain in a few words one incorrect thing about the incorrect Lewis Dot Structure. (2 pt)

Ⓐ too many e⁻ Ⓑ C with more than 4 e⁻ not allowed period 2 Ⓒ H has more than 2 e⁻

Part III. Long Answer Please show work for full credit and to receive partial credit. (68 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. Dimensional Analysis Type Problem: (23 pts)

If you do the reaction below with 652.2 milli liters of a 7.8 Molar solution of H_2SO_4 dissolved in water, how many atoms of the hydrogen in the molecule H_2O (water made in the reaction not the water in which everything is dissolved) will you make? (show work) $N_A = 6.022 \times 10^{23}$



$$652.2 \text{ ml } H_2SO_4 \text{ soln.} \times \frac{7.8 \text{ mol } H_2SO_4}{1000 \text{ ml } H_2SO_4 \text{ soln.}} \times \frac{2 \text{ mol } H_2O}{1 \text{ mol } H_2SO_4} \times \frac{2 \text{ mol } H}{1 \text{ mol } H_2O} \times \frac{6.022 \times 10^{23} \text{ atoms } H}{1 \text{ mol } H} =$$

$$1.225 \times 10^{25} \text{ atoms } H$$

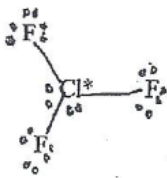
2 pt
math - 1

attempt
- 11

really bad attempt - 18

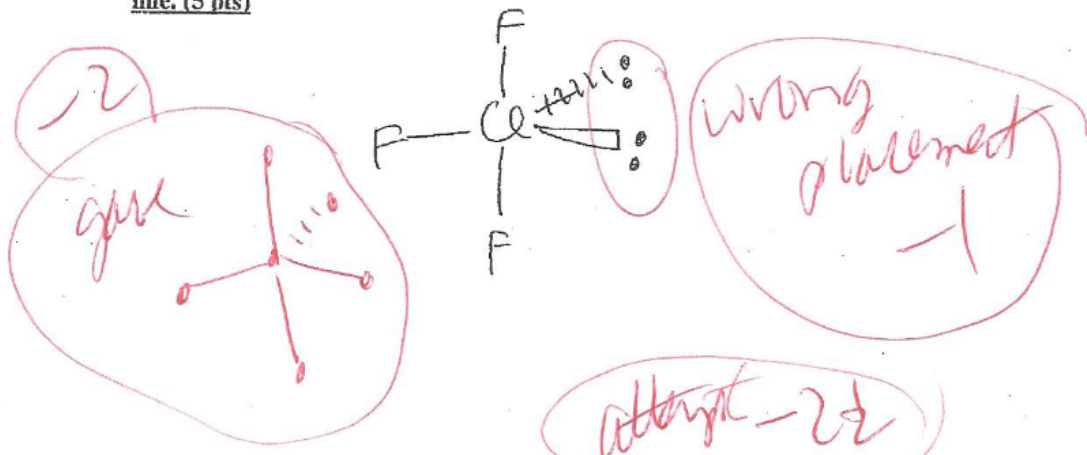
bad attempt
- 15

2. For the following Lewis Dot structure, complete the following. (23 pts)



- a. How many electron pairs (VSEPR electron pair) are on the atom with the *? 5 (5 pt)
- b. How many lone pairs are on the atom with the *? 2 (5 pt)
- c. What is the geometry of the electron pairs? trigonal bipyramidal (2 pts)
- d. What is the geometry of the molecule? T-shaped (2 pts)
- e. What is the hybridization of the atom with the *? sp³d (2 pts)
- f. What is the bond angle in the molecule? 120° + 90° (2 pts)
- g. Draw the molecule above in 3D using the wedge, dash, line drawing in the space next to the Lewis Dot structure. Remember that (coming away from plane) (going below plane) (in plane) **Show all lone pairs in your drawing using the 3D wedge, dash, line.** (5 pts)

*graded
consistent
w@t
@*



3. Gas Law Problem: Answer the following by filling in the blanks (you may use a ? or the word unknown or the letter symbol (P, V, n or T) for an unknown variable. You need to come up with the final correct answer with the correct units for the answer. (22 pts) (Some useful equations are shown below. You may or may not need some or all of them.)

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

Ideal Gas Law to answer the following. $[PV = nRT, R = 0.08206 \text{ (Liter Atm) / (Mol K)}]$

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

A gas at 1.1 atm and 30.5 °C occupies a 7.92 liter cylinder. If you change the pressure of the gas to 770 torr and adjust the temperature to 273 K, what is the new volume in liters?

$P_1 = 1.1 \text{ atm}$ $V_1 = 7.92 \text{ L}$ $T_1 = 30.5^\circ\text{C}$ $P_2 = 770 \text{ torr}$ $V_2 = ?$ $T_2 = 273 \text{ K}$ (6 pts, 1 pt each)

$T_1 = 30.5^\circ\text{C} + 273.15 = 303.65 \text{ K}$ (2 pt)

$P_2 = 770 \text{ torr} \times \frac{1 \text{ atm}}{760 \text{ torr}} = 1.013 \text{ atm}$ (2 pt)

$\frac{(1.013 \text{ atm})(V_2)}{(1.1 \text{ atm})(7.92 \text{ L})} = \frac{273 \text{ K}}{303.65 \text{ K}}$

$V_2 = \left(\frac{273 \text{ K}}{303.65 \text{ K}}\right) \left(\frac{1.1 \text{ atm}}{1.013 \text{ atm}}\right) (7.92 \text{ L})$

$V_2 = 9.73 \text{ L} \rightarrow 2 \text{ sig fig}$
 9.7 L

with algebra

attempt 10