General Chemistry I Lecture Fall 2016 12/5/16 Final Exam Pink Dr. Hahn Exam # _____

Name Key (print) Name _____ (sign)

Please show work for partial credit and full credit on the Long Answers and in some of the Short Answer Questions. Multip choice questions have no partial credit. Please write anything you want graded legibly. If you run out of space, please continue on the empty back pages but clearly label where the remaining answer can be found. (If I can't find your answer or cannot read it, I obviously cannot grade it). Return your entire exam including the periodic table. (Please count your exam pages and make sure there are 9 real pages + periodic table + VSEPRT table + solubility table.)

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

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

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (2 pts each, 24 pts total)

1) The atomic number is equal to
A) the sum of the number of the neutrons and electrons.
B) the sum of the number of protons, neutrons, and electrons.
C) the sum of the number of protons and neutrons.
(D) the number of the protons. 1) D

2) Identify a state of matter.
(A) solid
B) volume
C) odor
D) melting point
E) density 2) A

BA = bad attempt

NA = no attempt

NW = no work

3) When dissolved in water, KOH behaves as
(A) a base that forms K^+ and OH^- ions.
B) an acid that forms K^+ and OH^- ions.
C) an acid that forms KO^- and H^+ ions.
D) a base that forms KO^- and H^+ ions. 3) A

4) Identify the cation.
A) Br B) O^{2-} (C) Sr^{2+} D) Kr E) I_2 4) C

5) A cation of +2 indicates that an element has
A) lost two neutrons.
(B) lost two electrons.
C) gained two protons.
D) lost two protons.
E) gained two electrons. 5) B

6) Which of the following is a precipitation reaction? 6) A

(A) $2\ NaI(aq) + Hg_2(NO_3)_2(aq) \rightarrow Hg_2I_2(s) + 2\ NaNO_3(aq)$

B) $KCl(aq) + LiI(aq) \rightarrow KI(aq) + LiCl(aq)$

C) $HCl(aq) + KOH(aq) \rightarrow KCl(aq) + H_2O(l)$

D) $Zn(s) + 2\ AgNO_3(aq) \rightarrow 2\ Ag(s) + Zn(NO_3)_2(aq)$

E) None of the above is a precipitation reaction.

7) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 7) A

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

8) Which of the following elements is in Period 4? 8) D

A) Bi B) He C) Ag (D) Ca E) Zr

9) Identify the species that has the smallest radius. 9) A

(A) N^{+3} B) N^0 C) N^{-2} D) N^{-5} E) N^{+1}

10) Identify the shortest bond. 10) B

A) double covalent bond

(B) triple covalent bond

C) single covalent bond

D) all of the above bonds are the same length

11) Which of the following exists as a diatomic molecule? 11) A

(A) oxygen

B) krypton

C) phosphorus

D) lithium

E) carbon

12) Which reaction below represents the first ionization of O? 12) D

A) $O^-(g) \rightarrow O(g) + e^-$

B) $O(g) + e^- \rightarrow O^-(g)$

C) $O^+(g) + e^- \rightarrow O(g)$

(D) $O(g) \rightarrow O^+(g) + e^-$

E) $O^-(g) + e^- \rightarrow O^{2-}(g)$

II. Short Answers (45 pts)

1. Circle the following which is an element (4 pts total, ½ pts each)

$CuCl_2$ (Cu) NaBr (Na) SO_2 Al_2O_3 (O_2) (Ni)

2. Given the following list of chemical formulas, circle all which are covalent (4 pts total, ½ pts each)

Li_2O (F_2) (CCl_4) $Ca\,Cl_2$ Na_2S K_2O (NO_2) (PCl_3)

3. For the element **S** answer all of the following about the element under this number. (10 pts total, 1 pts each blank)

a) How many protons 16 b) How many total electrons for the neutral atom 16

c) What group is the element in 6A d) What period is the element in 3

e) What is the likely charge on the element −2 Explain or show work.

$6 - 8 = -2$ 1/2 pt.

f) Is the element a [(metal) or (nonmetal)] (circle one)

g) Give the **valence** electron configuration of the same element in the format. ($1s^2$, $2s^2$, $2p^6$, ...)

$3s^2, 3p^4$

h) Give the **valence** electron configuration diagram for the same element showing a line for an orbital and up and down arrows for the +1/2 and -1/2 electrons

(**format** required: ↑↓ (1s) ↑ (2s) ___ (2p) ___ ___) (format is not necessarily the answer)

i) How many valence electrons does the element have ? 6

j) Give the Lewis Dot symbol (Lewis dot structure) for the same element by itself . 

4. If you have a compound made up of the elements **Mg** and **Cl** (6 pts total)

a) What are the charges on the ions made from those elements (show work) (2 pts)

(1 pt) (1 pt)

Mg^{+2} - group 2, Cl^{-1} - group 7 − 8 = −1

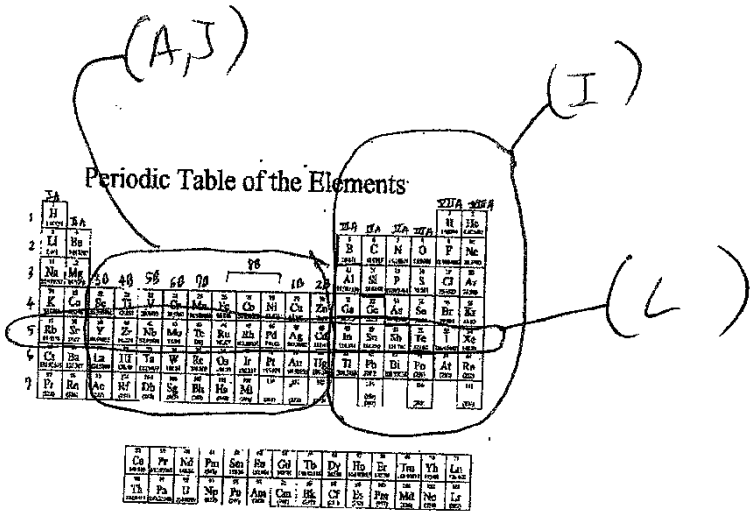
b) Write the formula for the compound made from those elements. Showing work on how you arrived at the formula. (4 pts)

$Mg^{+2} \quad Cl^{-1} \rightarrow MgCl_2$

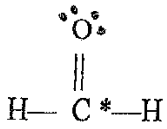
Mg (+2) + Cl (−1) = Zero

5. Match the following to the letters shown. The letters may only be used one time or not at all. (9 pts total, 3 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) a period (M) a group



6 VSEPRT Problem: Answer the following for the following correct Lewis Dot structure **at the atom with the *** (12 pts total , 2 pts each)



What is the **VSEPRT # electron pairs ("electron groups" according to your textbook)** 3

How many lone pair electrons does the atom with the * have ? zero

What is the VSEPRT geometry of electron pairs ? trigonal planar

What is the VSEPRT geometry of the molecule ? trigonal planar

What is the bond angle between H—C=O ? 120°

What is the hybridization of the atom with the * ? sp^2

III. Long Answer (34 pts) Please show work. If you get the final correct number without showing your work, you will lose points.

1. Theoretical Yield (20 pts)

$2\,Mg\,(s) + O_2\,(g) \rightarrow 2\,MgO\,(s)$

a. What is the theoretical yield in grams for the magnesium oxide {[FW (MgO) = 40.31 g MgO/ mol MgO], [FW (Mg) = 24.31 g Mg/mol Mg] } from the reaction above if you start with 2.78 grams of Mg (s) (show work) (15 pts)

Yield in grams 4.61 g MgO

5 5 5 5

$2.78\,g\,Mg \times \frac{mol\,Mg}{24.31\,g\,Mg} \times \frac{2\,mol\,MgO}{2\,mol\,Mg} \times \frac{40.31\,g\,MgO}{1\,mol\,MgO} =$

4.61 g MgO

5

15A -1

b. If you start out with enough O_2 to make 5.48 grams of MgO, is the limiting reagent [(Mg) or (O_2)] (circle one) (5 pts)

consistent w/ (a)

2 If you weigh out 7.23 grams of a reagent (K Br) (molar mass KBr = 119.00 g KBr / mol KBr) and then add it to a volumetric flask and then add enough water to fill up to the 500.0 mL line, calculate the molarity of the solution. (14 pts)

(Molarity = # moles / liter of solution)

BA - 7pt

$$7.23\text{ g KBr} \times \frac{1\text{ mol KBr}}{119.00\text{ g KBr}} = 0.0608\text{ mol KBr}$$ 4

$$500.0\text{ ml} \times \frac{1\text{ l}}{1000\text{ ml}} = 0.500\text{ l soln}$$ 4

$$M = \frac{0.0608\text{ mol KBr}}{0.500\text{ l soln}} = 0.122\text{ M KBr}$$ 4

or

$$\frac{7.23\text{ g KBr}}{500.0\text{ ml soln}} \times \frac{1\text{ mol KBr}}{119.00\text{ g KBr}} \times \frac{1000\text{ ml soln}}{1\text{ l soln}} = 0.122\text{ M KBr}$$

3 3 3 3

mult-1

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

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

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (2 pts each, 24 pts total)

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

2) When dissolved in water, KOH behaves as 2) B
A) an acid that forms K^+ and OH^- ions.
(B) a base that forms K^+ and OH^- ions.
C) a base that forms KO^- and H^+ ions.
D) an acid that forms KO^- and H^+ ions.

3) Which of the following exists as a diatomic molecule? 3) B
A) lithium
(B) oxygen
C) phosphorus
D) krypton
E) carbon

BA = Bad attempt
NA = no attempt

4) Identify the species that has the smallest radius. 4) A
(A) N^{+3} B) N^0 C) N^{-2} D) N^{-5} E) N^{+1}

5) The atomic number is equal to 5) C
NW = no work
A) the sum of the number of protons, neutrons, and electrons.
B) the sum of the number of protons and neutrons.
(C) the number of the protons.
D) the sum of the number of the neutrons and electrons.

6) A cation of +2 indicates that an element has 6) B
A) lost two neutrons.
(B) lost two electrons.
C) gained two protons.
D) gained two electrons.
E) lost two protons.

7) Which of the following is a precipitation reaction? 7) B

A) $KCl(aq) + LiI(aq) \rightarrow KI(aq) + LiCl(aq)$

(B) $2\ NaI(aq) + Hg_2(NO_3)_2(aq) \rightarrow Hg_2I_2(s) + 2\ NaNO_3(aq)$

C) $Zn(s) + 2\ AgNO_3(aq) \rightarrow 2\ Ag(s) + Zn(NO_3)_2(aq)$

D) $HCl(aq) + KOH(aq) \rightarrow KCl(aq) + H_2O(l)$

E) None of the above is a precipitation reaction.

8) Which reaction below represents the first ionization of O? 8) A

(A) $O(g) \rightarrow O^+(g) + e^-$

B) $O^-(g) + e^- \rightarrow O^{2-}(g)$

C) $O^+(g) + e^- \rightarrow O(g)$

D) $O(g) + e^- \rightarrow O^-(g)$

E) $O^-(g) \rightarrow O(g) + e^-$

9) Which of the following elements is in Period 4? 9) E

A) He B) Zr C) Ag D) Bi (E) Ca

10) Identify a state of matter. 10) B

A) melting point

(B) solid

C) volume

D) density

E) odor

11) Identify the cation. 11) B

A) O^{2-} (B) Sr^{2+} C) I_2 D) Br E) Kr

12) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 12) A

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

II. Short Answers (45 pts)

1. Circle the following which is a compound (4 pts total, ½ pts each)

$CuCl_2$ Cu NaBr Na SO_2 Al_2O_3 O_2 Ni

2. Given the following list of chemical formulas, circle all which are ionic (4 pts total, ½ pts each)

Li_2O F_2 CCl_4 $CaCl_2$ Na_2S K_2O NO_2 PCl_3

3. For the element **Br** answer all of the following about the element under this number. (10 pts total, 1 pts each blank)

a) How many protons 35 b) How many total electrons for the neutral atom 35

c) What group is the element in 7A d) What period is the element in 4

e) What is the likely charge on the element -1 Explain or show work.

7 − 8 = −1 (−½ pt)

f) Is the element a [(metal) or (nonmetal)] (circle one)

g) Give the **valence** electron configuration of the same element in the format. ($1s^2$, $2s^2$, $2p^6$, ...)

$4s^2$, $4p^5$

h) Give the **valence** electron configuration diagram for the same element showing a line for an orbital and up and down arrows for the +1/2 and -1/2 electrons

(**format** required: ↑↓ (1s) ↑ (2s) ___ (2p) ___ ___) (format is not necessarily the answer)

↑↓ (4s) ↑↓ ↑↓ ↑ (4p)

i) How many valence electrons does the element have ? 7

j) Give the Lewis Dot symbol (Lewis dot structure) for the same element by itself. ·· Br ··

4. If you have a compound made up of the elements **Na** and **O** (6 pts total)

a) What are the charges on the ions made from those elements (show work) (2 pts)

1pt 1pt

Na +1 (group 1A) O group 6 6 − 8 = −2

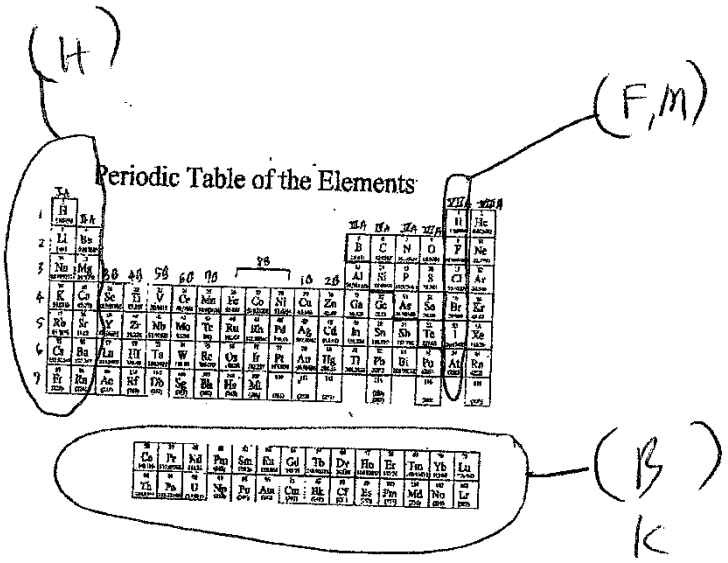
b) Write the formula for the compound made from those elements. Showing work on how you arrived at the formula. (4 pts)

$Na^{+1}\ O^{-2}$ Na_2O

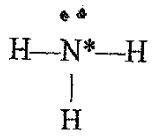
Na(+1) + O(−2) = Zero

5. Match the following to the letters shown. The letters may only be used one time or not at all. (9 pts total, 3 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) a period (M) a group



6 VSEPRT Problem: Answer the following for the following correct Lewis Dot structure **at the atom with the *** (12 pts total , 2 pts each)



What is the **VSEPRT # electron pairs ("electron groups" according to your textbook)** 4

How many lone pair electrons does the atom with the * have ? 1

What is the VSEPRT geometry of electron pairs ? tetrahedral

What is the VSEPRT geometry of the molecule ? trigonal pyramidal

What is the bond angle between H—N—H ? 109.5°

What is the hybridization of the atom with the * ? sp^3

III. Long Answer (34 pts) Please show work. If you get the final correct number without showing your work, you will lose points.

1. Theoretical Yield (20 pts)

$4\ Fe\ (s) + 3\ O_2\ (g) \rightarrow 2\ Fe_2O_3\ (s)$

a. If 78.2 grams of Fe reacts by the above reaction, what is the theoretical yield in grams of the Fe_2O_3 ? {[$FW(Fe_2O_3) = 159.70$ g Fe_2O_3 /mol Fe_2O_3] [$FW(Fe) = 55.85$ g Fe /mol Fe] } (15 pts)

yield in grams _____

$$78.2\text{ g Fe} \times \frac{1\text{ mol Fe}}{55.85\text{ g Fe}} \times \frac{2\text{ mol } Fe_2O_3}{4\text{ mol Fe}} \times \frac{159.70\text{ g } Fe_2O_3}{1\text{ mol } Fe_2O_3}$$

$$= 111.8\text{ g } Fe_2O_3$$

BA

vs. _____

b. If you start out with enough O_2 to make 56.7 grams of Fe_2O_3, is the limiting reagent

[(Fe) or (O_2)] (circle one) (5 pts) consistent with @

2 If you weigh out 3.98 grams of a reagent (Li Cl) (molar mass LiCl = 42.39 g LiCl / mol LiCl) and then add it to a volumetric flask and then add enough water to fill up to the 250.0 mL line, calculate the molarity of the solution. (14 pts)

(Molarity = # moles / liter of solution)

$$3.98\ g\ LiCl \times \frac{1\ mol\ LiCl}{42.39\ g\ Li} = 0.0939\ mol\ LiCl$$

4

pt
-1

$$250.0\ ml\ soln \times \frac{1\ l}{1000\ ml\ soln} = 0.25\ l$$

4

$$M = \frac{0.0939\ mol}{0.25\ l} = 0.376\ M$$

4

OR

$$\frac{3.98\ g\ LiCl}{250.0\ ml\ soln} \times \frac{1\ mol\ LiCl}{42.39\ g\ LiCl} \times \frac{1000\ ml\ soln}{1\ l\ soln} = 0.376\ M$$

math -1