Chemistry 115 Name **KEY**

Martin Larter

Exam 2 Summer, 2015

 Multiple Choice (30 points)

 Page 5 (25 points)

 Page 6 (24 points)

 Page 7 (26 points)

Page 8 (12 points)

 Total (117 points)

 Percent (100 %)

All work must be shown to receive credit. Give all answers to the correct number of significant figures

Grossmont College

Periodic Table

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  IA |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | VIIA | NOBLE GASES |
| 1**H**1.008 | IIA |  |  |  |  |  |  |  |  |  |  | IIIA | IVA | VA | VIA | 1**H**1.008 | 2**He**4.002 |
| 3**Li**6.941 | 4**Be**9.012 |  |  |  |  |  |  |  |  |  |  | 5**B**10.81 | 6**C**12.01 | 7**N**14.01 | 8**O**16.00 | 9**F**19.00 | 10**Ne**20.18 |
| 11**Na**23.00 | 12**Mg**24.30 | IIIB | IVB | VB | VIB | VIIB |  VIII VIII VIII | IB | IIB | 13**Al**27.00 | 14**Si**28.09 | 15**P**30.97 | 16**S**32.06 | 17**Cl**35.45 | 18**Ar**39.95 |
| 19**K**39.10 | 20**Ca**40.08 | 21**Sc**44.96 | 22**Ti**47.90 | 23**V**50.94 | 24**Cr**52.00 | 25**Mn**54.94 | 26**Fe**55.85 | 27**Co**58.93 | 28**Ni**58.70 | 29**Cu**63.55 | 30**Zn**65.38 | 31**Ga**69.72 | 32**Ge**72.59 | 33**As**74.92 | 34**Se**78.96 | 35**Br**79.90 | 36**Kr**83.80 |
| 37**Rb**85.47 | 38**Sr**87.62 | 39**Y**88.91 | 40**Zr**91.22 | 41**Nb**92.91 | 42**Mo**95.94 | 43**Tc**(99) | 44**Ru**101.1 | 45**Rh**102.9 | 46**Pd**106.4 | 47**Ag**107.9 | 48**Cd**112.4 | 49**In**114.8 | 50**Sn**118.7 | 51**Sb**121.8 | 52**Te**127.6 | 53**I**126.9 | 54**Xe**131.3 |
| 55**Cs**132.9 | 56**Ba**137.3 | 57**La**138.9 | 72**Hf**178.5 | 73**Ta**180.9 | 74**W**183.9 | 75**Re**186.2 | 76**Os**190.2 | 77**Ir**192.2 | 78**Pt**195.1 | 79**Au**197.0 | 80**Hg**200.6 | 81**Tl**204.4 | 82**Pb**207.2 | 83**Bi**209.0 | 84**Po**(209) | 85**At**(210) | 86**Rn**(222) |
| 87**Fr**(223) | 88**Ra**226.0 | 89**Ac**227.0 | 104**Rf**(261) | 105**Db**(262) | 106**Sg**(263) | 107**Bh**(262) | 108**Hs**(265) | 109**Mt**(266) | 110**??**(269) |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58**Ce**140.1 | 59**Pr**140.9 | 60**Nd**144.2 | 61**Pm**(147) | 62**Sm**150.4 | 63**Eu**152.0 | 64**Gd**157.3 | 65**Tb**158.9 | 66**Dy**162.5 | 67**Ho**164.9 | 68**Er**167.3 | 69**Tm**168.9 | 70**Yb**173.0 | 71**Lu**175.0 |
| 90**Th**232.0 | 91**Pa**231.0 | 92**U**238.0 | 93**Np**(237) | 94**Pu**(244) | 95**Am**(243) | 96**Cm**(247) | 97**Bk**(247) | 98**Cf**(251) | 99**Es**(252) | 100**Fm**(257) | 101**Md**(258) | 102**No**(259) | 103**Lr**(260) |

Lanthanide series

Actinide series

**Part I: Multiple Choice (30 points):**

1. How does a molecule **differ** from a formula unit?
2. A molecule is composed of atoms and a formula unit is not.
3. A molecule is a binary compound and a formula unit is a multi-atom compound.
4. A molecule is always larger than a formula unit.
5. **A molecule is generally used to describe the particles in a covalent compound and a formula unit is generally used to describe the components of an ionic compound.**
6. Molecules and formula units are the same.
7. A negative monoatomic ion or anion is names as the stem of the parent
8. Element.
9. **Element with an –ide ending.**
10. Element with an –ate ending.
11. Element with an –ite ending.
12. Element with an –ous ending.
13. Which of the following exists in its natural state as a diatomic?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. **Bromine**
 | 1. Iron
 | 1. Boron
 | 1. Zirconium
 | 1. all of the above
 |

1. A chemical equation is balanced when
2. The charge on each atom is the same in reactants and products.
3. The sum of the coefficients of the reactants is equal to the sum of the coefficients of the products.
4. The total number of molecules is the same in reactants and products.
5. The total number of ions is the same in reactants and products.
6. **The number of atoms of each element is the same in reactants in products**
7. Which pair of formulas illustrates the Law of Multiple Proportions?
	1. CH3Cl and CH3OH
	2. H2O and HOH
	3. CH3CH3 and CBr3CBr3
	4. CuCl2 and CuBr
	5. **H2O and H2O2**
8. Which of the following is a **part of Dalton's atomic theory**?
9. Isotopes of the same element have different masses.
10. Atoms contain protons, neutrons, and electrons.
11. **Atoms are rearranged but not changed during a chemical reaction**
12. Atoms break down during radioactive decay.
13. Atoms are identified by the number of protons in their nucleus
14. Avogadro's number is the number of
	1. **Particles in 1 mol of a substance.**
	2. Amu in 1 mol of a substance.
	3. Grams in 1 mol of a substance.
	4. Moles in 6.022 × 1023 grams of an element.
	5. Moles in 6.022 × 1023 amu of an element.
15. Which of the following is **NOT evidence** that a chemical reaction has occurred?

|  |  |  |
| --- | --- | --- |
| * 1. Color change
 | * 1. Solid formation
 | * 1. Gas formation
 |
| * 1. Temperature change
 | * 1. **All of the above are signs of a chemical reaction**
 |

1. The empirical formula of a compound:
2. Describes the mass relationships in a molecule.
3. Is the same as the molecular formula
4. Indicates the structure of the molecule.
5. **Indicates the simplest ratio of atoms in the compound.**
6. Is none of the above
7. Reactions that are characterized by the formation of a solid from two previously clear solutions.

|  |  |  |
| --- | --- | --- |
| 1. Oxidation-reduction rxn
 | 1. Gas evolving reaction
 | 1. Precipitation reaction
 |
| 1. Neutralization reaction
 | 1. None of the above
 |  |

1. A combination of chemical symbols and subscripts showing the actual number of atoms of each element present in a molecule.

|  |  |  |
| --- | --- | --- |
| 1. **molecular formula**
 | 1. formula unit
 | 1. empirical formula
 |
| 1. molecule
 | 1. none of the above
 |  |

1. Different isotopes of an element are atoms of that element which have
2. The same atomic number and the same mass number
3. Different atomic number and the same mass number
4. **The same atomic number and different mass number**
5. Different atomic number and different mass number
6. None of the above
7. The atomic mass of an element is
8. The mass of the most abundant isotope of that element
9. **The weighted average of the masses of the naturally occurring isotopes of that element**
10. The arithmetic average of the masses of the isotopes of that element
11. The ratio of the mass of one atom of an isotope of that element to the mass of hydrogen
12. None of the above
13. An aqueous solution is:
	1. An ionic compound with water dissolved in it.
	2. Water with a molecular compound dissolved in it.
	3. Any liquid with another compound dissolved in it.
	4. **Water with another compound dissolved in it.**
	5. None of the above
14. The octet rule indicates that
15. All of the noble gases have eight total electrons.
16. The noble gases react with other compounds to get 8 valence electrons.
17. All of the Group A elements have 8 valence electrons.
18. All of the shells in an atom hold a maximum of 8 electrons.
19. **Atoms lose, gain, or share valence electrons to have 8 valence electrons.**

**Part II: Short Answer (87 points)**

1. (7 points) Complete the following table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Atomic | Atomic | Mass  | Number of | Number of | Number of  |
| Notation | Number | Number | Protons | Electrons | Neutrons |
| **7834Se2-** |  **34** | 78 | 34 | 36 |  **44** |
| $$$$ |  **54** | 131 |  **54** | **54**  |  **77** |

1. (10 points) Fill out the table below

|  |  |
| --- | --- |
| IUPAC Name | Formula |
| gold (I) sulfide | **Au2S** |
| chlorous acid | **HClO2 (aq)** |
| aluminum sulfite | **Al2(SO3)3** |
| diphosphorus decoxide | **P2O10** |
| lead (II) phosphate | **Pb3(PO4)2** |
| **Ammonium phosphide** | (NH4)3P  |
| **Iron(III) nitrite** | Fe(NO2)3 |
| **Cadmium bicarbonate**  | Cd(HCO3)2  |
| **Hydroiodic acid** | HI (aq) |
| **Tetrachlorine pentoxide** | Cl4O5 |

1. (4 points) What did Rutherford determine about the structure of the atom from his gold-foil experiment?

Rutherford determined that atoms were composed of very small dense centers known as the nucleus surrounded by large regions of nearly empty space inhabited by the electrons

1. (4 points) Balance the following equations

 **2** Sc + **6**  HCl 🡪 **2** ScCl3 + **3** H2

1. (24 points) Tumeric is commonly used as a spice in Indian and Southeast Asian dishes. Tumeric contains a high concentration of curcumin (C20H18O6), a potential anticancer drug and a possible treatment for cystic fibrosis. Answer the following questions regarding curcumin.
	1. Calculate the molar mass of curcumin.

$$?molar mass$$

$$=20 at C\left(\frac{12.01 amu}{atom C}\right)+18 at H\left(\frac{1.008 amu}{1 atom H}\right)+6 at O\left(\frac{16.00 amu}{1 atom O}\right)$$

$$=240.2 amu C+18.14 amu H+96.00 amu O$$

$$=$$

* 1. Find the percent carbon in curcumin



* 1. Calculate the number of moles curcumin in a 527 g sample of curcumin.

$$?mol C\_{20}H\_{18}O\_{6}=527 g C\_{11}H\_{13}NO×\frac{1 mol C\_{20}H\_{18}O\_{6}}{354.3 g C\_{20}H\_{18}O\_{6}}=1.49 mol C\_{20}H\_{18}O\_{6}$$

* 1. Calculate the mass in grams of one molecule of curcumin.

$$?gC\_{20}H\_{18}O\_{6}=1 molec C\_{20}H\_{18}O\_{6}×\frac{1 mol C\_{11}H\_{13}NO}{6.022×10^{23}molec C\_{11}H\_{13}NO}×\frac{354.3 g C\_{20}H\_{18}O\_{6}}{1 mol C\_{20}H\_{18}O\_{6}}= 5.883 × 10^{-22}g C\_{20}H\_{18}O\_{6} $$

* 1. Calculate the number of moles of carbon in a 5.99 mol sample of curcumin.

$$?mol C=5.99 mol C\_{20}H\_{18}O\_{6}×\frac{20 mol C}{1 mol C\_{20}H\_{18}O\_{6}}=120. mol C$$

* 1. Calculate the mass of hydrogen in a 12.8 g sample of curcumin.

$$?g O=12.8 g C\_{20}H\_{18}O\_{6}×\frac{1 mol C\_{20}H\_{18}O\_{6}}{354.3 g C\_{20}H\_{18}O\_{6}}×\frac{18 mol H}{1 mol C\_{20}H\_{18}O\_{6}}×\frac{1.008 g H}{1 mol H}= 0.655 g H$$

* 1. Calculate the mass of a sample of curcumin that contains 8.94 x 1019 atoms of carbon.

$$?g C\_{11}H\_{13}NO=8.94×10^{19}atoms C×\frac{1 mol C}{6.022×10^{23} atom C}×\frac{1 mol C\_{20}H\_{18}O\_{6}}{20 mol C}×\frac{354.3 g C\_{20}H\_{18}O\_{6}}{1 mol C\_{20}H\_{18}O\_{6}}=0.00263 g C\_{20}H\_{18}O\_{6}$$

1. (10 points) Determine the empirical formula of benzyl acetate, the scent of jasmine. It is composed of 71.98%C, 6.71%H, and 21.31%O.

$$71.98 g C×\frac{1 mol C}{12.011 g C}=\frac{5.992839897 mol C}{1.331958247 mol }=4.499270086×2=8.998540173≈9$$

$$6.71 g H×\frac{1 mol H}{1.008 g H}=\frac{6.656746032 mol H}{1.331958247 mol }=4.997713738×2=9.995427476≈10$$

$21.31 g O×\frac{1 mol O}{15.999 g O}=\frac{1.331958247 mol O}{1.331958247 mol }=1×2=2$

**Empirical formula C9H10O2**

1. (4 points) A compound has an empirical formula of C3H2N and a molar mass of 260.4 g/mol. What is the molecular formula of the compound?

**Molar mass of C3H2N = 3(12) + 2(1) + 14 = 52 g/mol**

**There are 260 g/mol /52 g/mol or 5 units of this in the compound**

**Molecular formula = C15H10N5**

1. (12 points) ( Complete the following 3 items for each set of reactants shown below:
2. Determine the type of reaction that would most likely occur (your options are: DR precipitation, DR neutralization, combination, decomposition, single-replacement, combustion, or No Reaction),
3. Predict the products of reaction (**including phases**!), and
4. Balance the equation.
	1. FeCl3 (aq) + **3** NH4OH (aq) 🡪 **Fe(OH)3 (s) + 3 NH4Cl (aq)**

 Type of reaction: **DR precipitation**

* 1. Mg (s) +NaCl(aq) → **No Reaction**

Type of reaction\_\_\_\_\_ **No Reaction or Single Replacement**\_\_

* 1. **\_\_**\_\_ Sr(OH)2 (aq) + \_\_**2**\_\_HClO4 (aq) 🡪 **2 H2O (l) + Sr(ClO4)2 (aq)**

Type of reaction: **DR neutralization**

1. (8 points) A particular element exists in two stable isotopic forms. One isotope has a mass of 34.9689 amu (75.77% abundance). The other isotope has a mass of 36.9659 amu.
2. Calculate the average mass of the element.

$$atomic mass=\left(mass 1\right)\left(\frac{\%abundance 1}{100}\right)+\left(mass 2\right)\left(\frac{\%abundance 2}{100}\right)$$

$$atomic mass=\left(34.9689 amu\right)\left(\frac{75.77\%}{100}\right)+(36.9659 amu)\left(\frac{100-75.77}{100}\right)$$

$$atomic mass=26.49593553 amu+(36.9659 amu)\left(\frac{24.23}{100}\right)$$

$$atomic mass=26.49593553 amu+8.9563757 amu$$

$$atomic mass=35.4527731 amu≈35.45 amu$$

1. Write the name for the element. \_\_\_ chlorine \_\_\_
2. (4 points) Define what is meant by an endothermic reaction. Give an example of an endothermic reaction or process.

**An endothermic reaction is a reaction that requires heat or energy in order to proceed. Cooking an egg is an example of an endothermic process. The egg will not cook unless heat is added.**

**Grossmont College**

**Activity Series**

**Li K Ba Sr Ca Na Mg Al Mn Zn Fe Cd Co Ni Sn Pb (H) Cu Ag Hg Au**

 **Solubility Rules for Ionic Compounds**

**Compounds containing the following ions are generally *soluble* in water:**

1. **Alkali metal ions and ammonium ion**
2. **Acetate ion**
3. **Nitrate ion**
4. **Halide ions (X) (AgX, Hg2X2, and PbX2 are insoluble exceptions)**
5. **Sulfate ion (SrSO4, BaSO4, and PbSO4, are insoluble exceptions)**

**Compounds containing the following ions are generally *insoluble* in water:**

1. **Carbonate ion (see rule 1 exceptions, which are soluble)**
2. **Chromate ion (see rule 1 exceptions, which are soluble)**
3. **Phosphate ion (see rule 1 exceptions, which are soluble)**
4. **Sulfide ion (CaS, SrS, BaS, and rule 1 exceptions are soluble)**
5. **Hydroxide ion [Ca(OH)2, Sr(OH)2, Ba(OH)2, and rule 1 exceptions are soluble]**