Chemistry 115 Name

Dr. Cary Willard

Exam 2b October 18, 2012

 Multiple Choice (20 points)

 Nomenclature (16 points)

 Page 5 (16 points)

 Page 6 (15 points)

 Page 7 (14 points)

 Page 8 (19 points)

 Total (100 points)

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

Avogadro’s number = 6.022 x 1023 /mol

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 (20 points)

1. In ionic compounds, \_\_\_\_\_\_\_\_ lose their valence electrons to form positively charged \_\_\_\_\_\_\_\_.
	1. nonmetals, cations
	2. metals, anions
	3. metals, cations
	4. metals, polyatomic ions
	5. nonmetals, anions
2. To form an ion, a sodium atom
	1. loses one electron.
	2. gains one electron.
	3. gains two electrons.
	4. loses seven electrons.
	5. loses two electrons.
3. An ionic compound
	1. has a net positive charge.
	2. has a net negative charge.
	3. contains only cations.
	4. contains only anions.
	5. has a net charge of zero.
4. Which of the following polyatomic ions has a positive charge?
	1. hydroxide
	2. cyanide
	3. hydrogen carbonate
	4. ammonium
	5. nitrate
5. A group of covalently bonded atoms that has an overall electrical charge is called a(n) \_\_\_\_\_\_\_\_.
	1. ionic compound
	2. anion
	3. polyatomic ion
	4. cation
	5. molecule
6. Which of the following elements forms a diatomic molecule?
	1. nitrogen
	2. sodium
	3. sulfur
	4. iron
	5. neon
7. 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.
8. A chemical equation is balanced when
	1. the total number of molecules is the same in reactants and products.
	2. the charge on each atom is the same in reactants and products.
	3. the total number of ions is the same in reactants and products.
	4. the sum of the coefficients of the reactants is equal to the sum of the coefficients of the products.
	5. the number of atoms of each element is the same in reactants and products.
9. The following reaction takes place when an electric current is passed through water. It is an example of a \_\_\_\_\_\_\_\_ reaction.

2 H2O (*l*) 2 H2 (*g*) + O2 (*g*)

* 1. decomposition
	2. combination
	3. single replacement
	4. combustion
	5. double replacement
1. Given the following equation, what is the correct form of the conversion factor needed to convert the number of moles of O2 to the number of moles of Fe reacted?

4 Fe(*s*) + 3 O2 (*g*) → 2 Fe2O3 (*s*)

* 1. 
	2. 
	3. 
	4. 
	5. 

Part 2 – Nomenclature (16 points)

1. (8 points) Name the following compounds

|  |  |  |  |
| --- | --- | --- | --- |
|  | Cation name | Anion name | Compound name |
| Na3PO3 | sodium ion | phosphite ion | sodium phosphite |
| Ti2O3 | titanium(III) ion | oxide ion | titanium(III) oxide |
| Ca(C2H3O2)2 | calcium ion | acetate ion | calcium acetate |
| SF6 |  |  | sulfur hexafluoride |

1. (8 points) Give the correct formula for the following compounds

|  |  |  |  |
| --- | --- | --- | --- |
|  | Cation formula | Anion formula | Compound formula |
| iron(II) hypochlorite | Fe+2 | ClO-1 | Fe(ClO)2 |
| zinc oxide | Zn+2 | S-2 | ZnS |
| aluminum sulfate | Al+3 | SO4-2 | Al2(SO4)3 |
| dinitrogen tetroxide |  |  | N2O4 |

Part 2 – Problems and Short Answer (64 points)

1. (3 points) Calculate the mass of 7.34 moles of chromium metal (Cr)..

$$?g Cr=7.34 mol Cr×\frac{52.00 g Cr}{1 mol Cr}=382 g Cr$$

1. (3 points) Calculate the number of atoms of chromium in 4.59 moles of chromium.

$$?atoms Cr=4.59 mol Cr×\frac{6.022×10^{23}atom Cr}{1 mol Cr}=2.76×10^{24}atom Cr$$

1. (6 points) Succinic acid is a byproduct of the fermentation of sugar. It is often added to soft drinks to give them a sweet/salty taste. Succinic acid is 40.7% C, 5.12% H, and 54.2% O. What is the empirical formula of succinic acid?,

$$40.7 g C×\frac{1 mol C}{12.01 g C}=3.39 mol C$$

$$5.12 g H×\frac{1 mol H}{1.008 g H}=5.08 mol H$$

$$54.2 g O×\frac{1 mol O}{16.00 g O}=3.39 mol O$$

$$C\_{\frac{3.39}{3.39}}H\_{\frac{5.08}{3.39}}O\_{\frac{3.39}{3.39}}$$

$$C\_{1}H\_{1.5}O\_{1} or C\_{2}H\_{3}O\_{2} $$

1. (4 points) Altretamine, an anti cancer medication has an empirical formula of C3H6N2 and a molar mass of 210 g/mol. What is the molecular formula of the compound?

Molar mass of C2H2O = 3(12) + 6(1) + 2(14) = 70 g/mol

 There are 210/70 or 3 units of this in the compound

Molecular formula = C9H18N6

1. (15 points) Terephthalic acid (C8H6O4) is used in the manufacture of plastic bottles.
	1. Calculate the molar mass of terephthalic acid.

$$molar mass=8\left({12.01 g}/{mol}\right)+6\left({1.008 g }/{mol}\right)+4\left({16.00 g}/{mol}\right)$$

$$=96.08+6.048+64.00$$

$$={166.13 g}/{mol}$$

* 1. How many moles of terephthalic acid are there in 52.6 grams of terephthalic acid?.

$$?mol C\_{8}H\_{6}O\_{4}=52.6 g C\_{8}H\_{6}O\_{4}×\frac{1 mol C\_{8}H\_{6}O\_{4}}{166.1 g C\_{8}H\_{6}O\_{4}}=0.317 mol C\_{8}H\_{6}O\_{4}$$

* 1. Calculate the mass of one molecule of terephthalic acid.

$$?g C\_{8}H\_{6}O\_{4}=1 molecule C\_{8}H\_{6}O\_{4}×\frac{1 mol C\_{8}H\_{6}O\_{4}}{6.022×10^{23}molec C\_{8}H\_{6}O\_{4}}×\frac{166.13 g C\_{8}H\_{6}O\_{4}}{1 mol C\_{8}H\_{6}O\_{4}}=2.76×10^{-22}g C\_{8}H\_{6}O\_{4}$$

* 1. Calculate the number of atoms of carbon in 6.00 g of terephthalic acid.

$$?atoms C=6.00 g C\_{8}H\_{6}O\_{4}×\frac{1 mol C\_{8}H\_{6}O\_{4}}{166.13 g C\_{8}H\_{6}O\_{4}}×\frac{8 mol C}{1 mol C\_{8}H\_{6}O\_{4}}×\frac{6.022×10^{23}atom C}{1 mol C}=1.74×10^{23}atom C$$

or

$$?atoms C=6.00 g C\_{8}H\_{6}O\_{4}×\frac{1 mol C\_{8}H\_{6}O\_{4}}{166.13 g C\_{8}H\_{6}O\_{4}}×\frac{6.022×10^{23}molec C\_{8}H\_{6}O\_{4}}{1 mol C\_{8}H\_{6}O\_{4}}×\frac{8 atom C}{1 molecule C\_{8}H\_{6}O\_{4}}=1.74×10^{23}atom C$$

1. (6 points) Balance the following equations
	1. 2 Al + 6 HCl 🡪 2 AlCl3 + 3 H2
	2. 2 Cr(NO3)3 + 3 Na2SO4 🡪 1 Cr2(SO4)3 + 6 NaNO3
2. (4 points) Write and balance the chemical reaction described by the following description of a reaction. Be sure to include all state labels.

sodium metal reacts with liquid water to form hydrogen gas and aqueous lithium hydroxide.

2 Na(s) + 2 H2O(l) 🡪 2 NaOH(aq) + H2(g)

1. (4 points) Define what is meant by an endothermic reaction. Give an example of an exothermic reaction or process.

An exothermic reaction is a reaction that requires heat or energy in order to proceed. Burning methane in a Bunsen burner is an example of an exothermic process. The reaction generates heat.

1. (19 points) Ammonia (NH3) and oxygen gas react to form nitrogen and water.

4 NH3(g) + 3 O2(g) 🡪 2 N2(g) + 6 H2O(g)

* 1. .How many moles of oxygen gas are required to completely react with 8.24 moles of ammonia?

$$?mol O\_{2}=8.24 mol NH\_{3}×\frac{3 mol O\_{2}}{4 mol NH\_{3} }=6.18 mol O\_{2}$$

* 1. Calculate the mass of nitrogen gas that will be formed from the reaction of 3.97 grams of ammonia with excess oxygen gas?

$$?g N\_{2}=3.97 g NH\_{3}×\frac{1 mol NH\_{3}}{17.03 g NH\_{3}} ×\frac{2 mol N\_{2}}{4 mol NH\_{3}}×\frac{28.02 gN\_{2} }{1 mol N\_{2}}=3.27 g N\_{2}$$

* 1. How many molecules of water will result from the reaction of 4.51 moles of oxygen gas with excel ammonia?

$$?molecule H\_{2}O=4.51 mol ×\frac{6 mol H\_{2}O}{3 mol O\_{2} }×\frac{6.022×10^{23}molecule H\_{2}O}{1 mol H\_{2}O}=6.43×10^{24}molecule H\_{2}O$$

* 1. If 6.00 g of ammonia and 6.00 g of oxygen gas are put into a reaction vessel and allowed to react, how many grams of nitrogen gas will result?

$$?g N\_{2}=6.00 g NH\_{3}×\frac{1 mol NH\_{3}}{17.03 g NH\_{3}} ×\frac{2 mol N\_{2}}{4 mol NH\_{3}}×\frac{28.02 gN\_{2} }{1 mol N\_{2}}=4.94 g N\_{2}$$

$$?g N\_{2}=6.00 g O\_{2}×\frac{1 mol O\_{2}}{32.00 g O\_{2}} ×\frac{2 mol N\_{2}}{3 mol O\_{2}}×\frac{28.02 gN\_{2} }{1 mol N\_{2}}=3.50 g N\_{2}$$

* 1. If 3.34 g of nitrogen gas are recovered from the reaction in part d above, what is the percent yield of the reaction?

$$\% yield=\left(\frac{actual mass}{theoretical mass}\right)×100\%=\left(\frac{3.34 g N\_{2}}{3.50 g N\_{2}}\right)×100\%=95.4\% yield$$