Chemistry 115 Name

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Exam 2a March 16, 2011

 Multiple Choice (30 points)

 Page 5 (20 points)

 Page 6 (25 points)

 Page 7 (16 points)

 Page 8 (10 points)

 Total (101 points)

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

Avogadros 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 (30 points)

1. When ultraviolet energy is absorbed by an atom, an electron
	1. moves from a higher to a lower energy level.
	2. is ejected from an atom completely.
	3. falls into the nucleus of an atom.
	4. moves from a lower to a higher energy level.
	5. is taken on by an atom.
2. Any *p* sublevel can hold up to \_\_\_\_\_\_\_\_ electrons.
	1. 6
	2. 8
	3. 18
	4. 2
	5. 10
3. Sulfur is a \_\_\_\_\_\_\_\_ block element.
	1. *s*
	2. *p*
	3. *d*
	4. *f*
	5. *g*
4. The atomic radius of bromine is larger than the atomic radius of *\_\_\_\_\_\_\_\_.*
	1. chlorine
	2. uranium
	3. potassium
	4. iodine
	5. xenon
5. Neon has \_\_\_\_\_\_\_\_ valence electrons.
	1. 2
	2. 4
	3. 6
	4. 8
	5. 10
6. In ionic compounds, \_\_\_\_\_\_\_\_ lose their valence electrons to form positively charged \_\_\_\_\_\_\_\_.
	1. metals, anions
	2. nonmetals, cations
	3. metals, polyatomic ions
	4. nonmetals, anions
	5. metals, cations
7. Which one of the following elements forms two or more ions with different ionic charges?
	1. K
	2. Fe
	3. F
	4. Ca
	5. O
8. Which of the following polyatomic ions has a 3- ionic charge?
	1. hydroxide
	2. nitrate
	3. sulfate
	4. phosphate
	5. bicarbonate
9. A sodium ion is an example of a(n) \_\_\_\_\_\_\_\_.
	1. cation
	2. anion
	3. polyatomic ion
	4. nonmetal ion
	5. neutral atom
10. According to the IUPAC nomenclature system, the types of compound that use prefixes in their names are \_\_\_\_\_\_\_\_.
	1. ionic compounds
	2. ionic compounds involving transition metals
	3. polyatomic ions
	4. covalent compounds
	5. compounds that contain polyatomic ions
11. Which of the following properties is most characteristic of an organic molecule?
	1. contain sodium
	2. has C-H bonds
	3. soluble in water
	4. has a high melting point.
	5. has ionic bonds
12. One mol of particles of any substance contains how many particles?
	1. 106
	2. 3 × 10-10
	3. 3 × 1010
	4. 6.022 × 10-23
	5. 6.022 × 1023
13. A chemical equation is balanced when
	1. the total number of molecules is the same in reactants and products.
	2. the total number of ions is the same in reactants and products.
	3. the number of atoms of each element 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 charge on each atom is the same in reactants and products.
14. The reaction of carbon with oxygen to produce carbon monoxide is an example of which class of reaction?

2C (*s*) + O2 (*g*) → 2CO (*g*)

* 1. single replacement
	2. double replacement
	3. combination
	4. catalytic
	5. endothermic
1. In any balanced chemical equation, the number of each type of atom on both sides of the equation is \_\_\_\_\_\_\_\_.
	1. doubled
	2. the same
	3. decreased by one
	4. increased by one
	5. dependent on the temperature

Part 2 – Problems and Short Answer (75 points)

1. (3 points) How do chemists explain the lines of color that are seen in the atomic spectra of the elements?

The lines of color are caused by the energy released as electrons drop from higher energy levels down to lower energy levels. This energy is released as light of a specific wavelength (color).

1. (3 points) Write the complete electron configuration of chlorine.

1s2 2s2 2p6 3s2 3p5

1. (5 points) Write the shorthand electron configuration of molybdenum (Mo)

[Kr] 5s2 4d4

Write the shorthand configuration for a Mo+2 ion.

[Kr] 4d4

1. (5 points) Describe how ionization energies change as you move across the periodic table to the right and explain the reason for this trend.

As you move across the table to the right, the effective charge felt by the outermost electrons increases thereby pulling them closer to the nucleus and thus the electrons are held more tightly.

1. (4 points) Circle the element with the larger atomic radius

Lithium or Cesium ?

Arsenic or Titanium ?

1. (6 points) Name the following compounds

|  |  |  |  |
| --- | --- | --- | --- |
|  | Cation name | Anion name | Compound name |
| Ca(NO3)2 | Calcium ion | Nitrate ion | Calcium nitrate |
| Co(OH)3 | cobalt(III) ion | Hydroxide ion | Cobalt(III) hydroxide |
| Ag3N | Silver ion | Nitride ion | Silver nitride |
| S4O6 |  |  | Tetrasulfur hexoxide |

1. (6 points) Give the correct formula for the following compounds

|  |  |  |  |
| --- | --- | --- | --- |
|  | Cation formula | Anion formula | Compound formula |
| Ammonium iodide | NH4+ | I-1 | NH4I |
| Lead(IV) sulfate | Pb+4 | SO4-2 | Pb(SO4)2 |
| Calcium nitride | Ca+2 | N-3 | Ca3N2 |
| Tribromine pentoxide |  |  | Br3O5 |

1. (4 points) Calculate the number of moles of lead in a 94.3 g sample of lead (Pb).

$$?mol Pb=94.3 g Pb×\frac{1 mol Pb}{207.2 g Pb}=0.455 mol Pb$$

1. (4 points) Calculate the number of atoms of lead in 8.66 moles of lead.

$$?atoms Au=8.66 mol Au×\frac{6.022×10^{23}atom Au}{1 mol Au}=5.21×10^{24}atom Au$$

1. (5 points) Nicotine, a stimulant found in tobacco, has the following mass percent composition: 74.10%C, 8.70%H, 17.27%N. The molar mass of nicotine is 162.23 g/mol. Find the molecular formula of nicotine.

$$74.10 g C×\frac{1 mol C}{12.01 g C}=6.17 mol C$$

$$8.70 g H×\frac{1 mol H}{1.008 g H}=8.63 mol H$$

$$17.27 g N×\frac{1 mol N}{14.01 g N}=1.23 mol N$$

$$C\_{\frac{6.17}{1.23}}H\_{\frac{8.63}{1.23}}N\_{\frac{1.23}{1.23}}$$

$$C\_{5}H\_{7}N$$

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 260/52 or 5 units of this in the compound

Molecular formula = C15H10N5

1. (3 points) Calculate the molar mass of methyl salicylate(C8H8O3), the ester responsible for the aroma of wintergreen

$$molar mass=8\left({12.01 g}/{mol}\right)+8\left({1.008 g }/{mol}\right)+3\left({16.00 g}/{mol}\right)$$

$$=96.08+8.064+48.00$$

$$={152.14 g}/{mol}$$

1. (4 points) Calculate the mass of 0.685 moles of methyl salicylate.

$$?g C\_{8}H\_{8}O\_{3}=0.685 mol C\_{8}H\_{8}O\_{3}×\frac{152.14 g C\_{8}H\_{8}O\_{3}}{1 mol C\_{8}H\_{8}O\_{3}}=104 C\_{8}H\_{8}O\_{3}$$

1. (5 points) Calculate the number of atoms of carbon in 6.00 g of methyl salicylate.

$$?atoms C=6.00 g C\_{8}H\_{8}O\_{3}×\frac{1 mol C\_{8}H\_{8}O\_{3}}{152.14 g C\_{8}H\_{8}O\_{3}}×\frac{8 mol C}{1 mol C\_{8}H\_{8}O\_{3}}×\frac{6.022×10^{23}atom C}{1 mol C}=1.90×10^{23}atom C$$

or

$$?atoms C=6.00 g C\_{8}H\_{8}O\_{3}×\frac{1 mol C\_{8}H\_{8}O\_{3}}{152.14 g C\_{8}H\_{8}O\_{3}}×\frac{6.022×10^{23}molec C\_{8}H\_{8}O\_{3}}{1 mol C\_{8}H\_{8}O\_{3}}×\frac{8 atom C}{1 molecule C\_{8}H\_{8}O\_{3}}=1.90×10^{23}atom C$$

1. (4 points) Balance the following equations
	1. 4 HCl + O2 🡪 2 H2O + 2 Cl2
	2. 2 C8H14 + 23 O2 🡪 16 CO2 + 14 H2O
2. (2 points) Name the following hydrocarbon.

 . 3-methyl heptane

1. (4 points) Match each of the following molecules to the correct functional group.
	1.  ketone (11)
	2.  alcohol (1)
	3.  alkyne (4)
	4.  carboxylic acid (8)

Alcohol

Aldehyde

Alkene

Alkyne

Amide

Amine

Aromatic

Carboxylic acid

Ester

Ether

Ketone