Chemistry 141 Name

Dr. Cary Willard

Exam 1a September 24, 2009

Multiple Choice (30 points)

Page 3 (18 points)

Page 4 (14 points)

Page 5 (20 points)

Page 6 (23 points)

Page 7 (15 points)

Page 8 (16 points)

Total (136 points)

Percent (100 %)

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

4 quarts = 1 gallon

36 in = 1 yard

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) |  | |  |  |  |  |  |  |  |

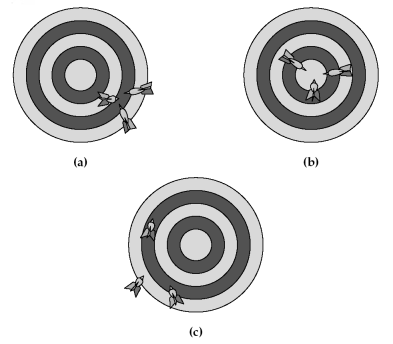
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58  **Ce**  140.1 | 59  **Pr**  140.9 | 60  **Nd**  144.2 | 61  **Pm**  (147) | 62  **Sm**  150.4 | 63  **Eu**  152.0 | 64  **Gd**  157.3 | 65  **Tb**  158.9 | 66  **Dy**  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. Which one of the following statements about temperature scales is **false**?
   1. The boiling point of water on the Fahrenheit scale is 212 degrees.
   2. All temperatures on the Kelvin scale are positive numbers.
   3. The Celsius degree is smaller than the Fahrenheit degree.
   4. The freezing point of water on the Celsius scale is 0 degrees.
2. Which of the following statements does not describe a **physical** property of chlorine?
   1. Chlorine combines with sodium to form table salt.
   2. The freezing point of chlorine is -101¶C.
   3. The color of chorine gas is green.
   4. The density of chlorine gas at standard temperature and pressure is 3.17 g/L.



1. If hitting the bullseye is the desired result, Figure (a) represents
   1. Good accuracy and good precision
   2. Good accuracy and poor precision
   3. Poor accuracy and poor precision.
   4. Poor accuracy and good precision
2. According to history, the concept that all matter is composed of atoms was first proposed by
   1. Dalton, and widely accepted within a few decades.
   2. the Greek philosopher Democritus, but not widely accepted until modern times.
   3. Dalton, but not widely accepted until the work of Mendeleev.
   4. Dalton, but not widely accepted until the work of Einstein.
3. Which are isotopes? An atom that has an atomic number of 34 and a mass number of 76 is an isotope of an atom that has
   1. 42 neutrons and 34 protons.
   2. an atomic number of 32 and a mass number of 76.
   3. an atomic number of 34 and a mass number of 80.
   4. 42 protons and 34 neutrons.
4. To the correct number of significant figures, what is the temperature reading on the following Celsius thermometer?
   1. 15oC
   2. 16 oC
   3. 15.67 oC
   4. 15.6 oC
5. Carbon dioxide is an example of
   1. a homogeneous mixture.
   2. a heterogeneous mixture.
   3. an element.
   4. a compound.
6. Which of the species below has 28 protons and 26 electrons?
7. The gas Freon-11, CCl3F, contains
   1. C4+, Cl3-, and F- ions.
   2. CCl3F molecules.
   3. C4+ and Cl3F4- ions.
   4. C4+, Cl-, and F- ions.
8. Which one of the following statements about balanced equations is **false**? In a balanced reaction
   1. molecules must be balanced on both sides of the reaction arrow.
   2. mass must be conserved.
   3. net charge must be balanced on both sides of the reaction arrow.
   4. atoms must be balanced on both sides of the reaction arrow.
9. Which statement about diluted solutions is **false**? When a solution is diluted
   1. the number of moles of solvent remains unchanged.
   2. the concentration of the solution decreases.
   3. the number of moles of solute remains unchanged.
   4. the molarity of the solution decreases.
10. Which statement about elemental analysis by combustion is **not** correct?
    1. Only carbon and hydrogen can be determined directly from CO2 and H2O.
    2. Oxygen is determined from the amount of H2O formed.
    3. Hydrogen is determined from the amount of H2O formed.
    4. Carbon is determined from the amount of CO2 formed.
11. What reagent could be used to separate Br- from NO3- when added to an aqueous solution containing both?
    1. NaI (*aq)*
    2. Ba(OH)2 (*aq)*
    3. CuSO4 (*aq)*
    4. AgNO3 (*aq)*
12. What is the oxidation number of the chromium atom in K2Cr2O7?
    1. +2
    2. +6
    3. +7
    4. -2
13. Which species functions as the reducing agent in the following reduction-oxidation reaction:

2 P(*s*) + 3 Br2(*l*) 🡪 2 PBr3(*l*)?

* 1. Br-(*aq*)
  2. Br2(*l*)
  3. P3+(*aq*)
  4. P(*s*)

Part 2 - Problems

1. (5 points) Give the IUPAC name for the following compounds
   1. Cu2(SO4)3 copper(II) sulfate or cupric sulfate
   2. (NH4)2CO3  ammonium carbonate
   3. I2O5 diiodine pentoxide
   4. Cd(MnO4)2 cadmium permanganate
   5. KBrO2 potassium bromite
2. (5 points) Write the correct formula for each of the following compounds
   1. Sodium oxalate Na2C2O4
   2. Nitrogen monoxide NO
   3. zinc borate Zn3(BO3)2
   4. ferrous hydroxide Fe(OH)2
   5. phosphoric acid H3PO4
3. The Honda Insight, a hybrid electric vehicle, has an EPA gas mileage rating of 57 mi/gal in the city. How many kilometers can the Insight travel on the amount of gasoline that would fit in a soda pop can? The volume of a soda pop can is 355 mL.
4. (6 points) Bromine exists as only two isotopes in nature, 79Br (atomic mass 78.918 amu, 50.69%) and 81Br. Using the average atomic mass on your periodic table, determine the atomic mass of 81Br.

|  |  |  |  |
| --- | --- | --- | --- |
| isotope | mass | abundance | Mass of 100 atoms |
|  | 78.918 amu | 50.69% |  |
|  | ???=80.92 amu | 100%-50.69%  =49.31% | 7990 amu-4000 amu=3990 amu |
| Weighted average | 79.90 amu | 100% | 7990 amu |

1. Nitrogen fixation in the root nodules of peas and other legumes occurs with a reaction involving a molybdenum containing enzyme named nitrogenase. This enzyme contains two Mo atoms per molecule and is 0.0947% Mo by mass. What is the molar mass of the enzyme?
2. If 45.00 g of a mixture of 25.00% CaCl2 and 75.00% inert material are dissolved in 1.000 liter of water, how many mL of 0.500 M silver nitrate solution will be required to precipitate all of the chloride? The reaction equation is:

2 AgNO3 + CaCl2 🡪 Ca(NO3)2 + 2 AgCl

1. (15 points) Quinine is often used as an anti-malarial drug. Its molecular formula is C20H24O2N2. Answer the following questions regarding quinine.
   1. Calculate the molar mass of quinine.
   2. Calculate the mass of quinine that contains 7.520 x 1025 atoms of carbon.
   3. Calculate the number of moles of hydrogen in 3.62 moles of quinine.
   4. Calculate the number of molecules of quinine that contains 386 atoms of oxygen.
   5. Calculate the mass in grams of one molecule of quinine.
2. (6 points) Complete the following precipitation reaction with balanced molecular, total ionic, and net ionic equations.
   1. V2(CO3)3*(s)* + 6 HNO3*(aq)* 🡪 2 V(NO3)3*(aq)* + 3 H2CO3*(aq)* 🡪 3 H2O(l) + 3 CO2(g)
   2. Balanced total ionic equation

V2(CO3)3*(s)* + 6 H+1(aq) 6 NO3-1*(aq)* 🡪 2 V+3(aq) + 6 NO3-1 *(aq)* + 3 H2O(l) + 3 CO2(g)

* 1. Balanced net ionic equation

V2(CO3)3*(s)* + 6 H+1(aq) 🡪 2 V+3(aq) + 3 H2O(l) + 3 CO2(g)

1. Balance the following reaction in acid

Cr2O6-2 + Fe+2 🡪 Cr+3 + Fe+3

Oxidation half reaction

Fe+2 🡪 Fe+3 + 1 e-1

Reduction half reaction

Cr2O6-2 + 12 H+1 + 4 e-1 🡪 2 Cr+3 + 6 H2O

Overall balanced equation

Cr2O6-2 + 12 H+1 + 4 Fe+2 🡪 2 Cr+3 + 4 Fe+3 + 6 H2O

1. (12 points) Balance the following half reaction that occurs in basic solution

HS-1(aq) + BrO3-1(aq) 🡪 S(s) + Br-1(aq)

Oxidation half reaction

HS-1(aq) + 🡪 S(s) + H+1 + 2 e-1

Reduction half reaction

BrO3-1(aq) + 6 H+1 + 6 e-1🡪 Br-1(aq) + 3 H2O

overall reaction in acid

2 HS-1(aq) + BrO3-1(aq) + 3 H+1 🡪 2 S(s) + Br-1(aq)

3 H2O 🡪 3 H+1 + 3 OH-1

overall reaction in base

2 HS-1(aq) + BrO3-1(aq) + 3 H2O 🡪 3 S(s) + Br-1(aq) + 3 OH-1

1. (8 points) A solution of nitric acid is prepared by diluting 15.2 mL of a 12.0 M solution of nitric acid to 25.00 L with water.
   1. What is the final concentration of nitric acid in the dilute solution?
   2. What is the pH of the final solution?
2. A noncarbonated soft drink contains an unknown amount of citric acid H3C6H5O2. If 100.0 mL of the soft drink requires 33.51 mL of 0.1020 M NaOH to neutralize the citric acid completely, what is the molarity of citric acid in the soft drink?
3. (15 points) You mix 527.0 mL of 0.2754 M sodium phosphate with 250.0 mL of 0.6684 M vanadium(II) chloride. Write the reaction and determine the number of grams of vanadium(III) carbonate produced, and the final concentration of all ions in the solution.

Balanced chemical equation (Check with me before you go on to be sure this is correct.)

2 Na3PO4(aq) + 3 VCl2(aq) 🡪 6 NaCl(aq) + V3(PO4)2(s)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | X = 0.0725 mol |  | X=0.0557mol |  |  |  |  |
|  | 2 Na3PO4(aq) | + | 3 VCl2(aq) | 🡪 | 6 NaCl(aq) | + | V3(PO4)2(s) |
| I | 0.1451 mol |  | 0.1671 mol |  | 0 mol |  | 0 mol |
|  | -2x |  | -3x |  | +6x |  | + x |
| E | 0.1451 – 2x |  | 0.1671-3x |  | 6x |  | 1x |
|  | =0.1451-2(.0557)  =0.0337 mol |  | =0.2005-3(.0557)  =0mol |  | =6(0.0557)  =0.3342 mol |  | =0.0557 mol |

concentrations of all ions present after mixing.

Moles V3(PO4)2 produced 0.0557 Mass V3(PO4)2 produced 19.1

Moles Na+1 = 0.402 mol [Na+1] = 0.517

Moles PO4-3 = 0.0337 [PO4-3] = 0.0434 M

Moles V+2 = 0 mol [V+2] = 0 M

Moles Cl-1 = 0.3342 mol [Cl-1] = 0.430 M