Chemistry 141 Name

Dr. Cary Willard

Exam 1a February 26, 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. What symbol is used to express the factor, 10-6?
   1. M
   2. m
   3. n
   4. μ
2. Convert 100 cm3 to m3.
   1. 1 x 104 m3
   2. 1 x 10-4 m3
   3. 1 x 108 m3
   4. 1 x 100 m3
3. Which of the following statements does not describe a **chemical** property of oxygen?
   1. The pressure is caused by collision of oxygen molecules with the sides of a container.
   2. When coal is burned in oxygen, the process is called combustion.
   3. Iron will rust in the presence of oxygen.
   4. Oxygen combines with carbon to form carbon dioxide gas.
4. A student measured the diameter of a sphere and determined the average value. His measurements are 6.17cm, 6.16cm, 6.16cm and 6.17cm If the true diameter is 6.18 cm, what can be said about the student's results?
   1. It is accurate and precise.
   2. It is accurate but not precise.
   3. It is precise but not accurate.
   4. It is neither precise nor accurate.
5. To the correct number of significant figures, what is the temperature reading on the following Celsius thermometer?
   1. 21oC
   2. 21.7 oC
   3. 21.70 oC
   4. 22 oC
6. Sodium metal and water react to form hydrogen and sodium hydroxide. If 5.98 g of sodium react with water to form 0.26 g of hydrogen and 10.40 g of sodium hydroxide, what mass of water was consumed in the reaction?
   1. 4.68 g
   2. 10.66 g
   3. 5.98 g
   4. 10.14 g
7. Which of the following is a part of Dalton's atomic theory?
   1. Atoms break down during radioactive decay.
   2. Isotopes of the same element have different masses.
   3. Atoms contain protons, neutrons, and electrons.
   4. Atoms are rearranged but not changed during a chemical reaction.
8. Most of the alpha particles directed at a thin gold foil in Rutherford's experiment
   1. passed through the foil but were deflected at an angle.
   2. passed directly through the foil undeflected.
   3. were absorbed by the foil.
   4. bounced directly back from the foil.
9. How many protons (p) and neutrons (n) are in an atom of calcium-46?
   1. 26 p, 20 n
   2. 46 p, 60 n
   3. 20 p, 26 n
   4. 20 p, 46 n
10. The solid compound, Na2CO3, contains
    1. Na+, C4+, and O2- ions.
    2. Na+ ions and CO32-ions.
    3. Na2CO3 molecules.
    4. Na2+ and CO32- ions.
11. 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.
12. Which statement about elemental analysis by combustion is **not** correct?
    1. Oxygen is determined from the amount of H2O formed.
    2. Only carbon and hydrogen can be determined directly from CO2 and H2O.
    3. Hydrogen is determined from the amount of H2O formed.
    4. Carbon is determined from the amount of CO2 formed.
13. What is the molar concentration of sodium ions in a 0.350 M Na3PO4 solution?
    1. 1.05 M
    2. 0.117 M
    3. 0.350 M
    4. 1.40 M
14. What is the oxidation number of the oxygen atom in H2O2?
    1. +2
    2. +1
    3. −2
    4. −1
15. Which species functions as the oxidizing agent in the following reduction-oxidation reaction:

5 Fe+2(aq) + MnO4-1(aq) + 8 H+1(aq) 🡪 Mn+2(aq) + 5 Fe+3(aq) + 4 H2O(aq)

* 1. Mn2+(*aq*)
  2. MnO4-(*aq*)
  3. H+(*aq*)
  4. Fe2+(*aq*)

1. (5 points) Give the IUPAC name for the following compounds
   1. (NH4)2S ammonium sulfide
   2. Cu2SO4 copper(I) sulfate or cuprous sulfate
   3. P2O7 diphosphorous heptoxide
   4. Ag3N silver nitride
   5. KMnO4 potassium permanganate
2. (5 points) Write the correct formula for each of the following compounds
   1. potassium acetate KC2H3O2
   2. trisulfur pentachloride S3Cl5
   3. zinc hypochlorite Zn(ClO)2
   4. ferrous hydroxide Fe(OH)2
   5. sulfuric acid H2SO4
3. (8 points) If the average yearly rainfall in San Diego is 11.6 inches and the Grossmont College soccer field is located on a piece of land that is 246 yards by 175 yards, how many gallons of rain fall on the soccer field in an average year?
4. (6 points) Complete the following precipitation reaction with balanced molecular, total ionic, and net ionic equations.
   1. 3 AgNO3*(aq)* + Na3PO4*(aq)* 🡪 3 NaNO3*(aq)* + Ag3PO4*(s)*
   2. Balanced total ionic equation

3 Ag+1(aq) + 3 NO3-1(aq) + 3 Na+1(aq) + PO4-3(aq) 🡪 3 Na+1(aq) + 3 NO3-1(aq) + Ag3PO4*(s)*

* 1. Balanced net ionic equation

3 Ag+1(aq) + PO4-3(aq) 🡪 Ag3PO4*(s)*

1. (8 points) Mirex is an insecticide that contains 22.01% C and 77.99% Cl, and has a molecular mass of 545.6 amu. Calculate the empirical and molecular formulas of Mirex.

(8 points) A solution of 46.3% glucose (C6H12O6) has a density of 1.42 g/mL. Calculate the concentration of this solution in molarity.

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

CN-1 + MnO4-1 🡪 CNO-1 + MnO2

1st half reaction

(CN-1 + H2O 🡪 CNO-1 + 2 H+1 +2 e-1) 3

3 CN-1 + 3 H2O 🡪 3 CNO-1 + 6 H+1 +6 e-1

2nd half reaction

(MnO4-1 + 4 H+1 + 3 e-1 🡪 MnO2 + 2 H2O ) 2

2 MnO4-1 + 8 H+1 + 6 e-1 🡪 2 MnO2 + 4 H2O

overall reaction in acid

3 CN-1 + 3 H2O + 2 MnO4-1 + 8 H+1 + 6 e-1 🡪 3 CNO-1 + 6 H+1 +6 e-1 + 2 MnO2 + 4 H2O

3 CN-1 + 2 MnO4-1 + 2 H+1 🡪 3 CNO-1 + 2 MnO2 + H2O

overall reaction in base

3 CN-1 + 2 MnO4-1 + 2 H+1 + 2 H2O 🡪 3 CNO-1 + 2 MnO2 + H2O + 2 H+1 + 2 OH-1

3 CN-1 + 2 MnO4-1 + H2O 🡪 3 CNO-1 + 2 MnO2 + 2 OH-1

1. (15 points) Epinephrine or adrenaline is a hormone commonly called the fight or flight hormone. Its molecular formula is C9H13O3N. Answer the following questions regarding epinephrine.
   1. Calculate the molar mass of epinephrine.
   2. Calculate the mass of epinephrine that contains 6.632 x 1025 atoms of carbon.
   3. Calculate the number of moles of hydrogen in 4.95 moles of epinephrine.
   4. Calculate the number of molecules of epinephrine that contains 640 atoms of oxygen.
   5. Calculate the mass in grams of one molecule of epinephrine.
2. (8 points) A solution of nitric acid is prepared by diluting 18.4 mL of a 12.0 M solution of nitric acid to 25.00 L with water.

What is the final concentration of nitric acid in the dilute solution?

What is the pH of the final solution?

1. (15 points) Balance the equation by inspection.

Al2S3 + 6 H2O 🡪 2 Al(OH)3 + 3 H2S

Using an I, , E diagram, answer the following questions regarding the reaction of 158 g of aluminum sulfide with 131 g of water.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | x = 1.052 |  | x = 1.212 |  |  |  |  |
|  | Al2S3 | + | 6 H2O | 🡪 | 2 Al(OH)3 | + | 3 H2S |
| I | 1.052 mol |  | 7.270 mol |  | 0 mol |  | 0 mol |
|  | -x |  | -6x |  | +2x |  | +3x |
| E | 1.052 – x  =0 mol |  | 7.270 -6x  =0.958 mol |  | 2x  =2.104 mol |  | 3x  =3.156 mol |
|  |  |  |  |  |  |  |  |

How many grams of H2S are formed?

What is the limiting reagent?

Al2S3

How many moles of Aluminum hydroxide are produced?

2.104 mol

How many molecules/formula units of the excess reactant remains?

If 64.8 g of H2S are produced, what is the percent yield of the reaction?

1. (8 points) A sample of a mixture of oxalic acid, H2C2O4, and sodium chloride, NaCl, has a mass of 4.554 g. If a volume of 39.58 mL of 0.5580 M NaOH is required to neutralize all the H2C2O4, what is the mass percent of oxalic acid in the mixture? Oxalic acid is a diprotic acid.

Mass of oxalic acid 0.9942 g % oxalic acid 21.83%

1. (8 points) An element X forms both a dichloride (XCl2) and a tetrachloride (XCl4). Treatment of 10.00 g XCl2 with excess chlorine forms 12.55 g XCl4. Calculate the atomic mass of X.