Chemistry 141 Name

Dr. Cary Willard

Exam 1a February 23, 2010

Multiple Choice (30 points)

Page 3 (16 points)

Page 4 (16 points)

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Page 6 (20 points)

Page 7 (16 points)

Page 8 (16 points)

Total (125 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. The Scientific Method
   1. is just a theory.
   2. is a strict set of rules and procedures that lead to inarguable fact.
   3. isn't used much in modern chemistry.
   4. is a framework for proving an argument you know to be true.
   5. is based on continued observation and experiment.
2. A chemical change
   1. occurs when paper is shredded.
   2. occurs when water is vaporized.
   3. occurs when methane gas is burned.
   4. occurs when salt is dissolved in water.
   5. occurs when kool-aid is stirred into water.
3. A student performs an experiment to determine the density of a sugar solution. She obtains the following results: 4.71 g/mL, 4.73 g/mL, 4.67 g/mL, 4.69 g/mL. If the actual value for the density of the sugar solution is 4.40 g/mL, which statement below best describes her results?
   1. Her results are precise, but not accurate.
   2. Her results are accurate, but not precise.
   3. Her results are both precise and accurate
   4. Her results are neither precise nor accurate.
   5. It isn't possible to determine with the information given.
4. Dalton's Atomic Theory states
   1. that all elements have several isotopes.
   2. that matter is composed of small indestructible particles.
   3. that the properties of matter are determined by the properties of atoms.
   4. that energy is neither created nor destroyed during a chemical reaction.
   5. that an atom is predominantly empty space.



1. Read the length of the metal bar with the correct number of significant figures.
   1. 20 cm
   2. 15 cm
   3. 15.1 cm
   4. 15.10 cm
   5. 15.100 cm
2. Which of the species below has 28 protons and 26 electrons?
   1. Cr4+
3. The anticaking ingredient magnesium silicate, MgSiO3, contains
   1. MgSi6+and O-2 ions.
   2. MgSiO3 molecules.
   3. Mg2+ and SiO32- ions.
   4. Mg2+, Si4+, and O2- ions.
   5. Mg2+, Si1+, and O3-3 ions.
4. Which of the following contains the MOST atoms? You shouldn't need to do a calculation here.
   1. 10.0 g Ne
   2. 10.0 g He
   3. 10.0 g Ar
   4. 10.0 g Kr
   5. 10.0 gMg
5. What is the empirical formula for C4H10O2?
   1. CHO
   2. C2H5O
   3. C2H4O
   4. CHO2
   5. CH2O
6. Which of the following is one possible form of pentane?
   1. CH3CH=CHCH2CH3
   2. CH3CH2CH2 CH2CH2CH3
   3. CH3CH2CH2CH2CH3
   4. CH3CH2CH2CH2CH2NH2
   5. CH3CH2-O-CH2CH2CH3
7. Choose the statement below that is TRUE.
   1. The term "strong electrolyte" means that the substance is extremely reactive.
   2. A strong acid solution consists of only partially ionized acid molecules.
   3. The term "weak electrolyte" means that the substance is inert.
   4. A molecular compound that does not ionize in solution is considered a strong electrolyte.
   5. A weak acid solution consists of mostly nonionized acid molecules.
8. Which of the following is an oxidation-reduction reaction?
   1. 
   2. 
   3. 
   4. 
   5. All of the above are oxidation-reduction reactions.
9. Determine the oxidation state of P in .
   1. +3
   2. +6
   3. +2
   4. 0
   5. -3
10. What element is undergoing reduction (if any) in the following reaction?



* 1. Zn
  2. N
  3. O
  4. Ag
  5. This is not an oxidation-reduction reaction.

1. What reagent would distinguish between Ag+ and Fe3+?
   1. NaNO3
   2. NaOH
   3. NaI
   4. NaClO3
   5. K2CO3

Part 2 - Problems

1. (5 points) Give the IUPAC name for the following compounds
   1. Fe3(PO4)2 iron(II) phosphate or ferrous phosphate
   2. (NH4)2S ammonium sulfide
   3. Br3O8 tribromine octaoxide
   4. Na2CrO4 sodium chromate
   5. Ag2SO3 silver sulfite
2. (5 points) Write the correct formula for each of the following compounds
   1. Cupric hydroxide Cu(OH)2
   2. Xenon pentaiodide XeI5
   3. Manganese(II) carbonate MnCO3
   4. Mercury(II) phosphide Hg3P2
   5. Acetic acid HC2H3O2
3. (6 points) Among many alternative units that might be considered as a measure of time is the shake rather than the second. Based on the expression “faster than a shake of a lamb’s tail.” We’ll define 1 shake as equal to 2.5 x 10-4 s. If a car is traveling at 55 mi/hr, what is its speed in cm/shake?
4. (8 points) Silver exists as only two isotopes in nature, 107Ag (atomic mass 106.90510 amu, 51.839%) and 109Ag. Using the average atomic mass of silver (107.8682 amu), determine the atomic mass of 109Ag.

|  |  |  |  |
| --- | --- | --- | --- |
| isotope | mass | abundance | Mass of 100 atoms |
|  | 106.90509 amu | 51.839% |  |
|  | ???=108.91 amu  Actual 108.90476 | 100%-51.839%  =48.161% | 10786.82 amu-5541.9 amu=5245.0 amu |
| Weighted average | 107.8682 amu | 100% | 10786.82 amu |

1. (8 points) The metabolism of alcohol in primates is facilitated by a zinc containing enzyme called alcohol dehydrogenase. This enzyme contains four Zn atoms per molecule and is 0.174% Zn by mass. What is the molar mass of the enzyme?
2. (15 points) Cantharidin was first isolated by a French chemist in 1810. It is used by many insects to protect their eggs from predators. The molecular formula of cantharidin is C10H12O4. Answer the following questions regarding cantharidin.
   1. Calculate the molar mass of cantharidin.
   2. Calculate the mass of cantharidin that contains 7.520 x 1025 atoms of carbon.
   3. Calculate the number of moles of hydrogen in 3.62 moles of cantharidin.
   4. Calculate the number of molecules of cantharidin that contains 386 atoms of oxygen.
   5. Calculate the mass in grams of one molecule of cantharidin.
3. (15 points) Complete and balance equations for the following double displacement reactions if that occur. Circle the substances that will dissociate in reactions a, b and c. Write the total ionic and net ionic equations for reaction d.
   1. Mg(NO3)2*(aq)*+ Na2CrO4*(aq)* 🡪 *(aq)*

Mg(NO3)2*(aq)* + Na2CrO4*(aq)* 🡪 MgCrO4 + 2 NaNO3*(aq)*

* 1. HC3H5O3*(aq)* (lactic acid) + LiOH*(aq)* 🡪

HC3H5O3*(aq)* + LiOH*(aq)* 🡪 LiC3H5O3*(aq)* + H2O

* 1. Ba(NO3)2*(aq)* + NaC2H3O2*(aq)* 🡪

Ba(NO3)2*(aq)* + NaC2H3O2*(aq)* 🡪 NaNO3*(aq)* + Ba(C2H3O2)2*(aq)*

No reaction!!

* 1. NaHSO3*(aq)* + H2C2O4*(aq)* 🡪

2 NaHSO3*(aq)* + H2C2O4*(aq)* 🡪 Na2C2O4*(aq)* + 2 H2SO3*(aq)*

Decomposes to

2 NaHSO3*(aq)* + H2C2O4*(aq)* 🡪 Na2C2O4*(aq)* + 2 H2O*(l)* + 2 SO2*(g)*

* + 1. Balanced total ionic equation

2 Na+1*(aq)* + HSO3-1*(aq)* + H2C2O4*(aq)* 🡪2 Na+1*(aq)* + C2O4-2*(aq)* + 2 H2O*(l)* + 2 SO2*(g)*

* + 1. Balanced net ionic equation

HSO3-1*(aq)* + H2C2O4*(aq)* 🡪C2O4-2*(aq)* + 2 H2O*(l)* + 2 SO2*(g)*

1. (9 points) Balance the following reaction in acid

IO3-1 + I-1🡪 I3-1

Oxidation half reaction

8(3 I-1 🡪 I3-1 + 2 e-1)

24 I-1 🡪 8 I3-1 + 16 e-1

Reduction half reaction

3 IO3-1 + 18 H+1 + 16 e-1🡪 I3-1 + 9 H2O

Overall balanced equation

3 IO3-1 + 18 H+1 + 24 I-1 🡪 8 I3-1 + I3-1 + 9 H2O

IO3-1 + 6 H+1 + 8 I-1 🡪 3 I3-1 + 3 H2O

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

SeO3-2 + Cl2 🡪 SeO4-2 + Cl-1

Oxidation half reaction

SeO3-2 + H2O 🡪 SeO4-2 + 2 H+1 + 2 e-1

Reduction half reaction

Cl2 + 2 e-1🡪 2 Cl-

overall reaction in acid

SeO3-2 + Cl2 + H2O 🡪 SeO4-2 + 2 Cl-1+ 2 H+1

2 H+1 + 2 OH-1🡪 2 H2O

overall reaction in base

SeO3-2 + Cl2 + 2 OH-1🡪 SeO4-2 + 2 Cl-1+ H2O

1. (8 points) A solution of sulfuric acid is prepared by diluting 65.3 mL of a 12.0 M solution of sulfuric acid to 250.0 L with water.
   1. What is the final concentration of sulfuric acid in the dilute solution?
   2. What is the pH of the final solution?

[H+] = 2[H2SO4] = 2(0.003134 M) = 0.006268 M H+

1. (8 points) When suspected drunk drivers are tested with a Breathalyzer, the alcohol (ethanol) in the exhaled breath is oxidized to acetic acid with an acidic solution of potassium dichromate:

3 CH3CH2OH*(aq)* + 2 Cr2O7-2*(aq)* + 16 H+*(aq)* 🡪 3 CH3CO2H*(aq)* + 4 Cr+3*(aq)* + 11 H2O*(l)*

This same reaction is also used to test the concentration of alcohol in the blood. If a suspected drunk driver has their blood tested for alcohol and 15.00 mL of blood are titrated with 35.64 mL of a 0.01023 M solution of potassium dichromate, what is the BAC or blood alcohol concentration? BAC is defined as (g alcohol per ml blood) x 100%.

1st mass of ethanol in sample

2nd BAC

1. (15 points) You mix 732.0 mL of 0.2187 M lithium sulfate with 350.0 mL of 0.5988 M titanium(III) nitrate. Write the reaction and determine the number of grams of titanium(III) sulfate solid 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.)

3 Li2SO4(aq) + 2 Ti(NO3)3(aq) 🡪 6 LiNO3(aq) + Ti2(SO4)3(s)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | X = 0.0534 mol |  | X=0.1048mol |  |  |  |  |
|  | 3 Li2SO4 | + | 2 Ti(NO3)3 | 🡪 | 6 LiNO3 | + | Ti2(SO4)3 (s) |
| I | 0.1601 mol |  | 0.2096 mol |  | 0 mol |  | 0 mol |
|  | -3x |  | -2x |  | +6x |  | + x |
| E | 0.1601 – 3x |  | 0.2096-2x |  | 6x |  | 1x |
|  | =0.1601-3(.0534)  =0 mol |  | =0.1497-2(.0534)  =0.1028 mol |  | =6(0.0534)  =0.3202 mol |  | =0.0534 mol |

concentrations of all ions present after mixing.

Moles Ti2(SO4)3 produced 0.0534 Mass Ti2(SO4)3 produced 20.5 g

Moles Li+1 = 0.3202 mol [Li+1] = 0.2959 M

Moles SO4-2 = 0.0 mol [SO4-2] = 0.0 M

Moles Ti+3 = 0.1028 mol [Ti+2] = 0.0950 M

Moles NO3-1 = 0.6287 mol [NO3-1] = 0.5811 M