Chemistry 141 Name

Dr. Cary Willard

Exam 1a February 2008

Multiple Choice (26 points)

Nomenclature (10 points)

Page 1 (6 points)

Page 2 (20 points)

Page 3 (15 points)

Page 4-5 (30 points)

Page 6 (13 points)

Total (120 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) |

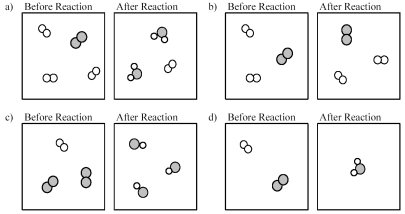
Lanthanide series

Actinide series

Multiple Choice (26 points) – Give the best answer for each of the following questions.



1. To the correct number of significant figures, what is the temperature reading on the Celsius thermometer?
   1. 15oC
   2. 15.67 oC
   3. 16 oC
   4. 15.6 oC
   5. 16.36 oC
2. Which of the following is **not** explained by Dalton's atomic theory?
   1. the law of multiple proportions
   2. conservation of mass during a chemical reaction
   3. the existence of more than one isotope of an element
   4. the law of definite proportions
   5. all of these are explained by Dalton’s atomic theory
3. A propane molecule contains 3 atoms of carbon. The number 3 represents how many significant figures?
   1. one
   2. two
   3. three
   4. ten
   5. infinite
4. Which subatomic particle has the smallest mass?
   1. a proton
   2. a neutron
   3. an electron
   4. an alpha particle
   5. a hydrogen atom



1. Which of the following drawings depicts a chemical reaction consistent with Dalton's atomic theory?
   1. drawing a)
   2. drawing b)
   3. drawing c)
   4. drawing d)
   5. none of them are consistent
2. Which of the following statements does not describe a **physical** property of chlorine?
   1. The freezing point of chlorine is -101oC.
   2. Chlorine combines with sodium to form table salt.
   3. The color of chorine gas is green.
   4. The density of chlorine gas at standard temperature and pressure is 3.17 g/L.
   5. All of the above describe physical properties.
3. Most elements in the periodic table are
   1. semi-metals.
   2. non-metals.
   3. noble gases.
   4. metals.
   5. halogens
4. What is the oxidation number of the oxygen atom in H2O2?
   1. -1
   2. -1/2
   3. +2
   4. +1
   5. -2
5. 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. K2SO4(aq)
   4. CuSO4 (*aq)*
   5. AgNO3 (*aq)*
6. Given the chemical equation: N2 + 3 H2 🡪 2 NH3. On a **microscopic** level, what do the coefficients mean?
   1. 1 formula unit of nitrogen reacts with 3 formula units of hydrogen to give 2 formula units of ammonia.
   2. 1 molecule of nitrogen reacts with 3 molecules of hydrogen to give 2 molecules of ammonia.
   3. 1 atom of nitrogen reacts with 3 atoms of hydrogen to give 2 atoms of ammonia.
   4. 28 g of nitrogen reacts with 6 grams of hydrogen to give 34 grams of ammonia.
   5. 1 mole of nitrogen reacts with 3 moles of hydrogen to give 2 moles of ammonia.
7. 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.
   5. Statements b and d are false.
8. In which of the following sets do all species have the same number of protons?
   1. Br-, Kr, Sr2+
   2. Mg2+, Sr2+, Ba2+
   3. C, N3-, O2-
   4. O, O2-, O2+
9. Which species functions as the oxidizing agent in the following reduction-oxidation reaction:

Zn(s) + Cu+2(aq) 🡪 Cu(s) + Zn+2(aq)

* 1. Zn2+(*aq*)
  2. Cu2+(*aq*)
  3. Cu(*s*)
  4. Zn(*s*)
  5. This is not a redox reaction

Nomenclature (10 points)

Give the IUPAC name or correct chemical formula for the following compounds

Mn2S3  manganese(III) sulfide vanadium(III) acetate V(C2H3O2)3

Zn(BrO2)2 zinc bromite Dichlorine heptoxide Cl2O7

Na2TeO4 sodium tellurate aluminum arsenide AlAs

(NH4)2CO3 ammonium carbonate cuprous iodide hexahydrate CuI·6 H2O

H2SO4 sulfuric acid hydrogen hydroxide H2O

Problems

1. (6 points) Complete the following double displacement reaction with balanced molecular, total ionic, and net ionic equations.

Li2CO3 *(aq)* + NiCl2 *(aq)* 🡪

Balanced total ionic equation

Balanced net ionic equation

1. (6 points) A 6.48 M solution of lithium oxalate (Li2C2O4) has a density of 1.206 g/mL. What is the mass percent of lithium oxalate in the solution?

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1. (8 points) An astronaut exploring a planet in another solar system has discovered some new elements. They are striped (St), polka-dotted (Pk), wrinkled (Wr), and grumpy (Gr). The following reactions are performed. Determine the relative activity (<, >, or ?)for each pair and the activity series for these elements.

St + Pk+2  🡪 NR St Pk

St + Wr+2 🡪 Wr + St+2 St Wr

Wr + Gr2 🡪 Wr+2 + 2 Gr-1 Wr Gr

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1. (6 points) Balance the following redox half reaction that occurs in basic solution

Br2(g) 🡪 BrO4-1(aq)

1. (7 points) Balance the following redox reaction in acidic solution.

MnO2 + HNO2 🡪 NO3-1 + Mn+2

1. (8 points) Thiopene is a liquid compound of the elements C, H, and S. A sample of thiophene weighing 7.96 g was burned in oxygen, giving 16.65 g CO2. Another sample was subjected to a series of reactions that transformed all of the sulfur in the compound to barium sulfate. If 7.96 g of thiophene gave 22.09 g of barium sulfate, BaSO4, what is the empirical formula of thiophene? Its molecular mass is 84 amu. What is its molecular formula?
2. (30 points) Acrylonitrile, C3H3N, is the starting material for the production of a kind of synthetic fiber (acrylics). It can be made from propylene, C3H6, by the reaction with nitric oxide, NO as shown by the reaction below:

4C3H6(g) + 6 NO(g) 🡪 4 C3H3N(g) + 6 H2O(g) + N2(g)

* 1. Calculate the molar mass of acrylonitrile.
  2. Calculate the number of molecules of acrylonitrile that contains 3.47 mol of carbon.
  3. Calculate the number of moles of hydrogen in a sample of acrylonitrile containing 2.88 moles of nitrogen.
  4. Calculate the mass of acrylonitrile that contains 5.871 x 1024 atoms of carbon.
  5. How many moles of acrylonitrile will be produced if 6.902 moles of nitric oxide are reacted with excess propylene?

4C3H6(g) + 6 NO(g) 🡪 4 C3H3N(g) + 6 H2O(g) + N2(g)

* 1. How many grams of propylene are required to make 15.0 grams of nitrogen gas?
  2. If 35.0 grams of propylene is reacted with 35.0 grams of nitric oxide, how many grams of acyrlonitrile will be produced?
  3. Which reactant from part g is present in excess and how many moles will remain after reaction?
  4. If 36.4 g of acrylonitrile are produced from the reaction in part g, what is the percent yield?

1. (6 points) A certain lead ore contains the compound PbCO3. A sample of the ore weighing 1.526 g was treated with nitric acid, which dissolved the PbCO3. The resulting solution was filtered from undissolved rock and treated with Na2SO4. This gave a precipitate of PbSO4, which was dried and found to have a mass of 1.081 g. What is the percentage by mass of lead in the ore? (Assume all the lead is precipitated as PbSO4.)
2. (7 points) If a volume of 35.07 mL of HCl is used to completely neutralize 3.050 g of Na2CO3 according to this equation, what is the molarity of the HCl?

Na2CO3(aq) + 2 HCl(aq) 🡪 2 NaCl(aq) + CO2(g) + H2O(l)