Chemistry 141 Name

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Exam 1a September 25, 2008

Multiple Choice (24 points)

Nomenclature (10 points)

Page 1 (17 points)

Page 2 (14 points)

Page 3 (17 points)

Page 4 (14 points)

Page 5 (12 points)

Page 6 (12 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 (30 points) – Give the best answer for each of the following questions.

1. Which of the following elements is a good conductor of heat and electricity?
   1. copper
   2. argon
   3. chlorine
   4. neon
   5. carbon
2. What symbol is used to express the factor, 10-6?
   1. M
   2. μ
   3. m
   4. n
   5. G
3. Which of the following statements does not describe a **chemical** property of oxygen?
   1. Oxygen may be condensed to a liquid at temperatures below 90 K
   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.
   5. All of the above describe chemical properties of oxygen.
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 neither precise nor accurate.
   2. It is accurate and precise.
   3. It is precise but not accurate.
   4. It is accurate but not precise.
   5. It is precise, but the accuracy can not be determined.
5. Which of the following is a part of Dalton's atomic theory?
   1. Isotopes of the same element have different masses.
   2. Atoms contain protons, neutrons, and electrons.
   3. Atoms break down during radioactive decay.
   4. Atoms are rearranged but not changed during a chemical reaction.
   5. Atoms are identified by the number of protons in their nucleus.
6. How many protons (p) and neutrons (n) are in an atom of calcium-46?
   1. 20 p, 26 n
   2. 20 p, 46 n
   3. 26 p, 20 n
   4. 46 p, 60 n
   5. 26 p, 46 n
7. Which statement about diluted solutions is **false**? When a solution is diluted
   1. the concentration of the solution decreases.
   2. the number of moles of solute remains unchanged.
   3. the number of moles of solvent remains unchanged.
   4. the molarity of the solution decreases.
   5. statements a and c are false
8. What is the molar concentration of sodium ions in a 0.350 M Na3PO4 solution?
   1. 0.117 M
   2. 1.05 M
   3. 0.350 M
   4. 1.40 M
   5. 0.700 M
9. 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.
   5. Oxygen is determined from the combination of the amount of CO2 and H2O formed.
10. Which one of the following compounds is insoluble in water?
    1. PbSO4
    2. K2SO4
    3. Mn(NO3)2
    4. Rb2CO3
    5. All of the above are soluble.
11. What is the oxidation number of the chromium atom in CaCr2O7?
    1. +3
    2. +6
    3. +12
    4. −3
    5. −6
12. Which species functions as the reducing 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. MnO4-(*aq*)
  2. Fe3+(*aq*)
  3. Mn2+(*aq*)
  4. H+(*aq*)
  5. Fe2+(*aq*)

Nomenclature (10 points)

(5 points) Give the IUPAC name or correct chemical formula for the following compounds

VBr3  Vanadium (III) Bromide Titanium(III) borate TiBO3

Zn(IO4)2 Zinc periodate Dicarbon heptahydride C2H7

PCl5 Phosphorus pentachloride Cadmium oxide CdO

(NH4)2SO3 Ammonium sulfite Nitric acid HNO3

H3PO4 Phosphoric acid Sodium acetate NaC2H3O2

Problems

1. (6 points) Automobile batteries are filled with sulfuric acid. What is the mass of the acid (in lbs) in 0.3000 gallons of the battery acid solution if the density of the solution is 1.285 g/mL and the solution is 38.08% sulfuric acid by mass?
2. (5 points) What is wrong with the expression “That is just a theory,” if by theory you mean a scientific theory?

When we talk about a scientific theory we are talking about a theory which has be tested, revised, and retested many times. It has withstood the scrutiny of many experiments and is able to both explain and predict behavior. It is not just an idea which might work.

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

Cu(NO3)2(aq) + 2~~NH~~~~3~~(aq)NH4OH🡪Cu(OH)2(s) + 2NH4NO3(aq)

Cu(NO3)2(aq) + 2NH3(aq) +2H2O(l)🡪Cu(OH)2(s)+2NH4NO3(aq)

Balanced total ionic equation

Cu+2(aq) + 2NO3-1(aq) + 2NH3(aq) + 2H2O(l) 🡪 Cu(OH)2(s) + 2NH4+1(aq) + 2NO3-1(aq)

Balanced net ionic equation

Cu+2(aq) + 2NH3(aq) + 2H2O(l) 🡪 Cu(OH)2(s) + 2NH4+1(aq)

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

H2O2(aq) + Ti+2(aq) 🡪 H2O(l) + Ti+3(aq)

2e-1 + 2 H+1 + H2O2(aq) 🡪 2 H2O(l)

2(Ti+2(aq) 🡪 Ti+3(aq) + 1e-1)

H2O2(aq) + 2 Ti+2(aq) + 2 H+1 🡪 2 H2O(l) + 2 Ti+3(aq)

1. (7 points) If a volume of 31.77 mL of HCl is used to completely neutralize 2.050 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)

1. (12 points) Acetaminophen, an analgesic, has the molecular formula C8H9O2N.
   1. Calculate the molar mass of acetaminophen.
   2. Calculate the number of molecules of acetaminophen that contains 2.86 mol of oxygen.
   3. Calculate the number of moles of hydrogen in a sample of acetaminophen containing 3.48 moles of nitrogen.
   4. Calculate the mass of acetaminophen that contains 9.542 x 1025 atoms of carbon.
2. (5 points) The atomic mass of copper is 63.546 amu. Do any copper isotopes have a mass of 63.546 amu? Explain.

63.546 amu is the weighted average atomic mass of copper atoms. It is very unlikely that any particular isotope would have this mass.

1. (8 points) The action of bacteria on meat and fish produces a poisonous and stinky compound called cadaverine. A 3.922 g sample of cadaverine is burned in oxygen to produce 8.446 g of CO2 and 4.841 g of H2O. If cadaverine is composed of C, H, and N, determine its empirical formula.

The molar mass of the compound is approximately 100 g/mol. Determine the molecular formula for the compound.

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

SbH3(g) 🡪 Sb(s) + 3 H+1 + 3 e-1

3 H+1 (aq) + 3 OH-1 (aq) 🡪 3 H2O(l)

SbH3(g) + 3 OH-1 (aq) 🡪 Sb(s) + 3 H2O(l) + 3 e-1

1. (12 points) Diborane, B2H6, is valuable for the synthesis of new organic compounds. The boron compound can be made by the reaction

2 NaBH4(s) + I2(s) 🡪 B2H6(g) + 2 NaI(s) + H2(g)

* 1. How many moles of sodium iodide will be produced if 5.785 moles of sodium borohydride (NaBH4) are reacted with excess iodine?
  2. How many grams of sodium borohydride are required to make 5.32 x 1025 molecules of diborane?
  3. If 25.0 grams of sodium borohydride are reacted with excess iodine to produce 6.28 of diborane, what is the percent yield?

Theoretical yield

Percent Yield

1. (12 points) You mix 425.0 mL of 0.3533 M sodium phosphate with 150.0 mL of 0.6743 M calcium chloride. Write the reaction and determine the number of grams of calcium phosphate produced, and the final concentration of all ions in the solution using an I, , E diagram.

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

2 Na3PO4(aq) + 3 CaCl2(aq) 🡪 Ca3(PO4)2(s) + 6 NaCl(aq)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2 Na3PO4 | + | 3 CaCl2 | 🡪 | Ca3(PO4)2 | + | 6 NaCl |
|  | X=0.0751 |  | X=0.0337 |  |  |  |  |
| I | 0.1501 mol |  | 0.1012 mol |  | 0 mol |  | 0 mol |
| Δ | -2x |  | -3x |  | +x |  | +6x |
| E | 0.1501-2x mol |  | 0.1012-3x mol |  | x mol |  | 6x mol |
|  | =0.1501-2(.0337)  =0.0827 mol |  | =0.1012-3(.0337)  =0 mol |  | =0.0337 mol |  | =6(0.0337)  =0.2022 mol |

Initial moles Na3PO4

Initial moles CaCl2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2 Na3PO4 | + | 3 CaCl2 | 🡪 | Ca3(PO4)2 | + | 6 NaCl |
| 0.0827 mol |  | 0 mol |  | 0.0337 mol |  | 0.2022 mol |

Moles Ca3(PO4)2 produced 0.0337 mol Mass Ca3(PO4)2 produced 10.5 g

Moles Na+1 =[(0.0828)3 + 0.2022 ] = 0.4506 mol [Na+1] = 0.7837 M

Moles PO4-3 = 0.0827 mol [PO4-3] = 0.144 M

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

Moles Cl-1 = 0.2022 mol [Cl-1] = 0.3517 M

Total volume = 0.5750 L

MW Ca3(PO4)2=310.18 g/mol