Chemistry 141 Name

Martin Larter

Exam 1a September 17, 2015

Multiple Choice (30 points)

Page 5 (10 points)

Page 6 (9 points)

Page 7 (15 points)

Page 8 (8 points)

Page 9 (19 points)

Page 10 (21 points)

Total (112 points)

Percent (100 %)

All work must be shown to receive credit. Give all answers to the correct number of significant figures

Avogadro’s number = 6.022 x 1023 /mol

4 quarts = 1 gallon

36 in = 1 yard

12 in = 1 ft

1 cc = 1cm3 = 1 mL

Area of a circle = πr2

Volume of a sphere = 4/3 πr3

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

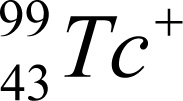
Multiple Choice (30 points) – Give the best answer for each of the following questions.

1. An element \_\_\_\_\_\_\_\_\_\_
   1. Can be separated into its components by physical methods.
   2. May have different chemical properties depending on its source.
   3. Cannot be separated into simpler substances by chemical methods.
   4. Can also be a compound.
   5. Exists only as atoms and not as molecules.
2. Which of the following represents a chemical property of copper metal?
   1. Copper metal conducts heat.
   2. Copper metal reacts with nitric acid to produce copper(II) nitrate.
   3. Copper metal melts at 1085°C.
   4. Copper metal conducts electricity.
   5. Copper metal has an orange color.
3. As a summer intern at the National Institute of Standards and Technology, a student performed three measurements to determine the density of water at 25C to four significant figures. She obtained the following results. The known density of water at 25C to three significant figures is 0.958 g/mL.

|  |
| --- |
| ***Trial***  ***Density* (g/mL)** |
| 1 0.9345 |
| 2 0.9346 |
| 3 0.9348 |

The measurements were \_\_\_\_\_\_\_\_\_\_

* 1. Sufficiently precise but not accurate.
  2. Sufficiently accurate but not precise.
  3. Both sufficiently precise and accurate.
  4. Neither sufficiently precise nor accurate.
  5. Not repeated an adequate number of times.

1. Which statement best describes isotopes?
   1. They have the same atomic mass.
   2. They have the same total number of protons and neutrons.
   3. They have the same number of neutrons but a different number of protons.
   4. They have the same number of protons but a different number of neutrons.
   5. They have very different chemical reactivity.
2. Given the following figure, which of the measurements listed is the best estimate of the length of the aluminum rod?
3. 
   1. 1.8 cm
   2. 1.9 cm
   3. 1.91 cm
   4. 2 cm
   5. 1.910 cm
4. Technetium often is used to image areas of bone growth because it is a radioisotope with a half-life of 6 hours that emits gamma rays. A  ion has \_\_\_\_\_\_\_\_\_\_ protons, \_\_\_\_\_\_\_\_\_\_ neutrons, and \_\_\_\_\_\_\_\_\_\_electrons.
   1. 99, 43, 98
   2. 56, 43, 43
   3. 43, 99, 42
   4. 43, 99, 43
   5. 43, 56, 42
5. For each of the elements below, there are only two naturally occurring isotopes. Using information in your periodic table, identify the pair in which the heavier isotope is the more abundant one.
   1. 63Cu and 65Cu
   2. 79Br and 81Br
   3. 85Rb and 87Rb
   4. 14N and 15N
   5. 10B and 11B
6. Which of the following contains the largest number of atoms?
   1. 1 mol water
   2. 1 mol phosphorus trichloride
   3. 1 mol dinitrogen pentoxide
   4. 1 mol carbon dioxide
   5. All of these contain the same number of atoms.
7. The proof of liquor is defined as the percentage of ethanol it contains times two. If vodka is 80 proof, what is the solvent in vodka?
   1. vodka
   2. water
   3. ethanol
   4. not enough information to answer
   5. the same as the solute in this case
8. Which statements regarding combustion analysis to determine percent composition are *not* correct?
9. The mass of oxygen in the sample compound can be determined from the mass of carbon dioxide that is produced.
10. If a compound contains an element other than carbon and hydrogen, combustion analysis cannot be used to determine its empirical formula.
11. Combustion analysis data alone is not sufficient to determine the molecular formula with certainty.
12. If some CO is produced rather than all CO2, then the empirical formula that is calculated will be too high in carbon.
    1. I and II are not correct.
    2. II and III are not correct.
    3. I, II, and III are not correct.
    4. I, II, and IV are not correct.
    5. II, III, and IV are not correct.
13. In a demonstration of strong electrolytes, weak electrolytes, and nonelectrolytes, Professor Popsnorkle used a lightbulb apparatus that showed how much a solution conducted electricity by the brightness of the lightbulb. When pure water was tested, the bulb did not light. When some acetic acid was added to the water, the bulb burned dimly. When more acetic acid was added to the solution, the bulb burned a little more brightly. In his frustration to make the bulb shine brightly with acetic acid, Professor Popsnorkle started over by testing the beaker of the *pure* acetic acid. What was the result?
    1. The bulb did not light.
    2. The bulb burned dimly.
    3. The bulb burned more than any of the others but still not brightly.
    4. The bulb burned brightly.
    5. Professor Popsnorkle was electrocuted.
14. A cross section of a Mad-Dawg gumball shows an outer layer of citric acid and malonic acid, beneath that a layer of food coloring, sugar, and flavoring, beneath that a layer of sodium bicarbonate (NaHCO3), and finally in the middle—gum! A 12-year-old puts one in his mouth and immediately puckers, smiles, and then foams at the mouth before chewing. Where did the foam come from?
    1. Twelve-year-olds naturally foam at the mouth.
    2. The sodium bicarbonate explodes when exposed to moisture.
    3. The acids react with the sodium bicarbonate, making unstable carbonic acid.
    4. The foam must have been packed in the gum somewhere.
    5. The acids react with the sugar, making a carbon volcano.
15. Which one of the following statements regarding a strong acid is *not* correct?
    1. A strong acid ionizes completely in water.
    2. A strong acid ionizes in water to produce hydronium ions.
    3. A strong acid neutralizes bases.
    4. HCl is an example of a strong acid.
    5. Acids are only strong at a high concentration.
16. In carrying out a titration of a hydrochloric acid solution with a standard sodium hydroxide solution, a student went beyond the end point before reading the volume on the burette. That is, the volume used was larger than the volume required to reach the end point. How will this error affect the calculated concentration of the hydrochloric acid?
    1. The calculated concentration will be larger than the actual concentration.
    2. The calculated concentration will be smaller than the actual concentration.
    3. The calculated concentration will be the correct concentration.
    4. There is no way to tell how this error will affect the calculation.
    5. The calculated concentration will be the actual concentration.

Problems

1. (5 points) Give the IUPAC name for the following compounds
   1. Al(NO3)3  \_\_\_\_\_\_\_\_\_\_\_
   2. (NH4)2SO3 \_\_\_\_\_\_\_\_\_\_\_
   3. CuMnO4 \_\_\_\_\_\_\_\_\_\_\_
   4. N3O7 \_\_\_\_\_\_\_\_\_\_\_
   5. H3PO4 \_\_\_\_\_\_\_\_\_\_\_
2. (5 points) Write the correct formula for each of the following compounds
   1. potassium chromate \_\_\_\_\_\_\_\_\_\_\_
   2. Acetic acid \_\_\_\_\_\_\_\_\_\_\_
   3. vanadium(III) hypobromite \_\_\_\_\_\_\_\_\_\_\_
   4. Carbon tetraiodide \_\_\_\_\_\_\_\_\_\_\_
   5. Ferrous borate \_\_\_\_\_\_\_\_\_\_\_
3. (9 points) The Curiosity Rover landed on Mars in 2012. After a drive it stopped 14.0 ft away from an interesting rock. Curiosity’s wheels are 50. cm in diameter, and the rover moves at a speed of 2.0 x 102 m/sol, where 1 sol = 1 Martian day of 24.65 hr. (Use proper sig figs. The textbook used them incorrectly.)
   1. How many minutes would it take the rover to move to within 1.0 ft of the rock?
   2. How many rotations of the wheels would be required to move that distance?
   3. One night Curiosity recorded a temperature reported as −137oF. If the daytime temperature was 265K, what was the day/night temperature range in oC?
4. (6 points) A student investigated the accuracy and precision of an autopipette and gathered the data below:

Rated volume 650.0 μL

Rated uncertainty +/- 0.3 μL

Number of trials 50

Average volume delivered 645.8 μL

Standard deviation 0.2 μL

Rate the precision and accuracy of the autopipette as good, fair, or poor and explain why you chose these ratings.

1. (9 points) Complete and balance the following redox reaction that occurs in basic aqueous solution. Identify the oxidation and reduction half-reactions (16 points)

H2O2(*aq*) + Cl2O7(*aq*) 🡪ClO2-(*aq*) + O2(*g*)

1st half reaction (oxidation or reduction)

2nd half reaction (oxidation or reduction)

Overall reaction in basic conditions

1. (8 points) Capsicum is a compound found in hot peppers and it gives these peppers their burn. This compound has also been found to have pharmacological activity as a pain medication. A sample of capsicum was burned in the presence of oxygen and the oxides of carbon, hydrogen, and nitrogen were collected. Capsicum is composed of C, H, N, and O. Given the data below, calculate the empirical and molecular formula of capsicum.

0.7683 g sample of capsicum forms:

1.993 g CO2

0.6116 g H2O

0.1157 g NO2

Molar mass 305.42 g/mol

1. (6 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.
2. (6 points) For the following balanced redox reaction answer the following questions

3 K2SO3 (aq) + H2O (l) + 2 KMnO4 (aq) 🡪 3 K2SO4 (aq) + 2 MnO2 (s) + 2 KOH (aq)

* 1. What is the oxidation number of sulfur in K2SO3 (aq)
  2. What is the element that is reduced?
  3. What is the reducing agent?

1. (7 points) Interpretation of Reactions by Ionic Type Equations. Aqueous solutions of the following substances or their mixtures with water if they are only slightly soluble, are mixed. Write first the conventional equation, second the total ionic equation, and lastly the net ionic equation. If you predict no appreciable reaction, indicate this, and state why
   1. NH3(aq) and Al2(SO4)3 (aq)

Conventional equation:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Total Ionic equation

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Net ionic equation

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. (21 points) The manufacture of aluminum includes the production of cryolite (NaAlF6) from the following reaction:

6 HF(g) + 3 NaAlO2(s) 🡪 Na3AlF6(s) + 3 H2O(l) + Al2O3(s)

* 1. Calculate the molar mass of cryolite.
  2. Calculate the number of atoms of fluorine in 6.78 grams of cryolite.
  3. Calculate the mass of cryolite that contains 48.7 mol of aluminum.
  4. How many moles of aluminum oxide will be produced if 5.714 moles of NaAlO2 are reacted with excess hydrogen fluoride?
  5. Use an IE diagram to determine the mass of all reactants and products when 550.0 g of hydrogen fluoride react with 550.0 g of NaAlO2. If 162.5 g of aluminum oxide were produced from the reaction above, what is the percent yield of the reaction?

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |
|  | 6 HF | + | 3 NaAlO2 | 🡪 | Na3AlF6 | + | 3 H2O | + | Al2O3 |
| I |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| E |  |  |  |  |  |  |  |  |  |
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