Problem set for Exam 1 key Chemistry 102

Know definitions of basic terminology

1. Complete table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 12.3 km | $$12.3 km ×\frac{1000 m}{1 km}=12300 m$$ |  | 26.2 L | $$26.2μL ×\frac{1 L }{1 ×10^{6}μL}×\frac{1000 mL}{1 L}×\frac{1 cm^{3}}{1 mL}= 0.0262 cm^{3} $$ |
| 235 cm | $$235 cm ×\frac{1m}{100 cm}×\frac{1 ×10^{6}μm }{1 m}=2.35 ×10^{6}μm$$ |  | 2384g | $$2384 μg ×\frac{1 g}{1 ×10^{6}μg}×\frac{1 kg}{1000 g}= 2.384×10^{-6} kg$$ |
| 0.22 L | $$0.22 L ×\frac{1 ×10^{6}μL }{1 L}=2.2 ×10^{5}μL$$ |  | 27.23 cc | $$27.23cc ×\frac{1 mL}{1 cc}= 27.23 mL$$ |

1. Define the number of significant figures:

3.200\*107 => 4 0.00230700 => 6 102000 =>3

5.700\*10-6 => 4 200.000 => 6 107.30020 =>8

1. Please write the following numbers using scientific notations:

0.0000527 = 5.27\*10-5 7236.470\*10-5 = 7.236470\*10-2 127584\*10-2 = 1.27584\*103

78560.07\*106 = 7.856007\*1010 54000000\*10-6 = 5.4\*101 0.000245\*103 2.45\*10-1

0.000735\*10-2 = 7.35\*10-6 0.00245\*10-3 = 2.45\*10-6

1. Please fill the empty cells in the table:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Atomic symbol | Atomic Number | Protons | Neutrons | electrons | Isotope mass | Isotope notation $$$$ |
| F | 9 | 9 | 10 | 9 | 19 | $$$$ |
| Rh | 45 | 45 | 58 | 45 | 103 | $$$$ |
| Au | 79 | 79 | 118 | 79 | 197 | $$$$ |
| Os | 76 | 76 | 114 | 76 | 190 | $$$$ |
| Pb2+ | 82 | 82 | 125 | 80 | 207 | $$$$ |

1. The boiling temperature of ethyl alcohol is 78oC.
	1. What is the boiling temperature in oF?

$$℉=\frac{9}{5}℃+32=\frac{9}{5}\left(78^{o}C\right)+32=172℉ $$

* 1. What is the boiling temperature in K?

$$K=℃+273.15=78^{o}C+273.15=351 K$$

1. Please write full, short hand electron configuration and number of valence electrons for **Sr**:

Full**: 1s2 2s2 2p6 3s2 3p6 3d10 4s24p6 5s2**

Short hand: [**Kr] 5s2**

Valence electrons: 2

1. Oil of wintergreen is the methyl ester of hydroxybenzoic acid. Its chemical formula is C8H8O3.
2. Calculate the molar mass of oil of wintergreen.

$$molar mass=8\left({12.01 g}/{mol}\right)+8\left({1.008 g }/{mol}\right)+3\left({16.00 g}/{mol}\right)$$

$$=96.08+8.064+48.00$$

$$={152.14 g}/{mol}$$

1. Calculate the mass of 3.82 moles of oil of wintergreen.

$$?g C\_{8}H\_{8}O\_{3}=3.82 mol C\_{8}H\_{8}O\_{3}×\frac{152.14 g C\_{8}H\_{8}O\_{3}}{1 mol C\_{8}H\_{8}O\_{3}}=581 g C\_{8}H\_{8}O\_{3}$$

1. Calculate the number of molecules of oil of wintergreen in a sample containing 8.36 x 10-4 mol of oil of wintergreen.

$$molec C\_{8}H\_{8}O\_{3}=8.36×10^{-4} mol C\_{8}H\_{8}O\_{3}×\frac{6.022×10^{23}molec C\_{8}H\_{8}O\_{3}}{1 mol C\_{8}H\_{8}O\_{3}}=5.03×10^{20} molec C\_{8}H\_{8}O\_{3}$$

1. A gem has a mass of 6.37g. When the gem is placed in a graduated cylinder containing 2.00 mL of water, the water level rises to 4.17 mL. What is the density of the gem in g/mL?

$$volume gem=4.17 mL-2.00 mL=2.17 mL$$

$$density=\frac{mass}{volume}=\frac{6.37 g}{2.17 mL}=2.94 {g}/{mL}$$

1. Draw Lewis Electron Dot Structures for the following atoms/molecules.
	1. N



* 1. PCl3 (Phosphorous is the central atom)



* 1. HCN (Carbon atom is in the center.)



1. During a workout at the gym, you set the treadmill at a pace f 65.0 m/min. How many minutes will you walk if you cover a distance of 6347 ft?

$$?min=6347 ft×\frac{12 in}{1 ft}×\frac{2.54 cm}{1 in}×\frac{1 m}{100cm}×\frac{1 min}{65.0 m}=29.8 min$$

1. Name the following compounds

|  |  |  |  |
| --- | --- | --- | --- |
|  | Cation name | Anion name | Compound name |
| Ba(NO3)2 | Barium ion | Nitrate ion | Barium nitrate |
| Fe(OH)3 | Iron(III) ion | Hydroxide ion | Iron(III) hydroxide |
| Ag2S | Silver ion | Sulfide ion | Silver sulfide |
| P2S3 |  |  | Diphosphorus trisulfide |

1. Give the correct formula for the following compounds

|  |  |  |  |
| --- | --- | --- | --- |
|  | Cation formula | Anion formula | Compound formula |
| Ammonium chloride | NH4+ | Cl- | NH4Cl |
| Lead(IV) sulfate | Pb4+ | SO42- | Pb(SO4)2 |
| Aluminum oxide | Al3+ | O2- | Al2O3 |
| Tetrasulfur octabromide |  |  | S4Br8 |

1. An 800 mg sample of a radioactive isotope decays for 20 days. At the end of the 20 days, 50 mg of the sample remain. What is the half-life of the isotope?

$$800 mg\overset{1}{\overbrace{\rightarrow \rightarrow }}400mg\overset{2}{\overbrace{\rightarrow \rightarrow }}200mg\overset{3}{\overbrace{\rightarrow \rightarrow }}100mg\overset{4}{\overbrace{\rightarrow \rightarrow }}50mg$$

The sample decays for 4 half-lives so 20 days/4 = 5 days/half-life

1. A ruby gemstone contains 52.7% aluminum, 47.1% oxygen, and small traces of chromium. If the ruby was found to contain 0.125 g of aluminum, what is the mass of the ruby?

$$0.125 g aluminum × \frac{100 g ruby}{52.7 g aluminum}=0.237 g ruby$$

1. Write the correct nuclear equation for the
2. Decay of At-218 $\left(\right)$ by alpha particle emission

$$\rightarrow + $$

1. Decay of $$ by beta particle emission

$$\rightarrow +$$

1. Decay of sulfur-31 by Positron emission

$$\rightarrow +$$

1. Predict the orbital or molecular geometry of the numbered atoms:
2. Molecular geometry N1\_\_\_bent\_\_\_
3. Molecular geometry C2\_\_\_\_linear\_\_\_\_\_
4. Molecular geometry O3\_\_\_\_\_bent\_\_\_\_\_\_\_
5. Orbital geometry C4\_\_\_trigional planar\_\_\_\_\_
6. Balance the following equation**:**

\_\_3\_Mg(NO3)2 *(aq)* + \_\_2\_\_Li3PO4*(aq)* → \_\_\_Mg3(PO4)2 (s) + \_6\_\_LiNO3 (aq)

1. Write the balanced molecular (1), total ionic (2), and net ionic equations (3) for the reaction. Assume that all soluble reactants are added in the form of aqueous solutions. Indicate precipitates that are formed. If no reaction occurs, then write **NO RXN**, and do not write a balanced equation. Be sure to **balance** your equations and include your **physical states**

 molecular:

\_\_\_\_MgCl2 *(aq)* + \_\_\_2\_Ag(NO3) *(aq)* → 2 AgCl (s) + Mg(NO3)2 (aq)

Total ionic:

Mg2+ (aq) + 2 Cl- (aq) + 2 Ag+ (aq) + 2 NO3 – (aq) 🡪2 AgCl(s) + Mg2+ (aq) + 2 NO3 – (aq)

Net ionic:

Ag+ (aq) + Cl- (aq) 🡪 AgCl (s)

1. A package of trail mix contains 9.2 g of fat, 13 g of carbohydrate, and 4.2 g of protein.
	1. How many Nutritional Calories will you consume if you eat the entire bag how many kilojoules?

|  |  |
| --- | --- |
| food type | Calories |
| carbohydrate | 4.0 |
| fat | 9.0 |
| protein | 4.0 |

$$9.2 g fat×\frac{9.0 Cal}{1 g fat}=83 Cal$$

$$13 g carb×\frac{4.0 Cal}{1 g carb}=52 Cal$$

$$4.2 g protein×\frac{4.0 Cal}{1 g protein}=17 Cal$$

Total Calories = 83 Cal +52 Cal +17 Cal = 152 Cal

152 Cal x 4.184 kJ/1Cal= 636 kJ

* 1. What percentage of the calories in the package of trail mix comes from fat?

$$\%=\left(\frac{mass part}{mass whole}\right)×100=\left(\frac{83 fat Cal}{152 total Cal}\right)×100=55\% of the calories come from fat$$

1. Column A lists a substance. In Column B, list whether the substance is an element (E), a compound (C), a Heterogeneous Mixture (HM), or a homogeneous mixture (S). In Column C, list TWO physical properties of the substance.

|  |  |  |
| --- | --- | --- |
| Column A | Column B | Column C (anything similar) |
| 1. Summer Sausage | HM | Chunky, Brown |
| 2. Steam | C | Gas, Hot |
| 3. Salt Water | S | Liquid, Clear  |
| 4. Pencil lead (Pb) | E | Grey, Solid |
| 5. Dirt |  HM | Brown, Solid |
| 6. Pepsi  | HM | Brown, Liquid |
| 7. Silver (Ag) | E | Silver, Solid |
| 8. Toothpaste (Na2HPO4) | C | White, Thick |
| 9. A burrito  | HM | Multi-colored, Solid |
| 10. Italian Dressing  | HM | Liquid, Greasy |
| 11. Chicken Soup | HM | Liquid/Solid, Brown |
| 12. Lemonade  | S | Yellow, Liquid |

1. Match each diagram with its correct description. Diagrams will be used once.

A B C D E

\_**C**\_1. Pure Element – only one type of atom present.

\_**E**\_2. Mixture of two elements – two types of uncombined atoms present.

\_**B**\_3. Pure compound – only one type of compound present.

\_**A**\_4. Mixture of two compounds – two types of compounds present.

\_**D**\_5. Mixture of a compound and an element.

1. The specific heat of copper is 0.0920 cal/g °C, and the specific heat of silver is 0.0562 cal/g °C. If 100 cal of heat is added to one g of each metal at 25 °C, what is the expected result?

A) The copper will reach a higher temperature.

B) **The silver will reach a higher temperature.**

C) The two samples will reach the same temperature.

D) The copper will reach a temperature lower than 25 °C.

E) The silver will soften.

1. How many oxygen atoms are in hydroxyapatite, Ca5(PO4)3OH, a major compound in human bones and teeth?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. 1
 | 1. 3
 | 1. 4
 | 1. 5
 | 1. 13
 |

1. The following figure shows a(an):

|  |  |  |
| --- | --- | --- |
| 1. f orbital
 | 1. d orbital
 | 1. s orbital
 |
| 1. **p orbital**
 | 1. none of the above
 |

1. What kind of change (chemical, physical or nuclear) is described by each of the following examples?

|  |  |  |
| --- | --- | --- |
|  | **a)** a worn tire  | A physical change |
|  | **b)** limewater that turns white | A chemical change |
|  | **c)** a bracelet that tarnishes | A chemical change |
|  | **d)** the fission of a uranium nucleus  | A nuclear transformation |
|  | **e)** rusting iron | A chemical change |
|  | **f)** mercury that expands in hot weather | A physical change |
|  | **g)** the fusion of the nuclei of several atoms  | A nuclear transformation |
|  | **h)** food being transformed into energy ransforment en énergie.  | A chemical change |
|  | **i)** salt dissolving in water | A physical change |
|  | **j)** radium emitting radiation | A nuclear transformation |