Chem 111 **Summer 2014** **Exam I** **Whelan**

Question 1 (7 Points)

a) How many **significant figures** are there in each of the following numbers?

0.927790 6 0.060464 5 1.00×10^3 3

b) There are **12 eggs in a dozen**. A farm produces **747 dozen** eggs a month, how should the **number of eggs** per month be reported? 8.96×10^3

c) The number **447.496** rounded to **4 significant figures** is: 447.5

Question 2 (4 Points)

a) When **17.2** is **subtracted** from **45.58**, the result should be reported with **digit(s)** 1 after the decimal point.

b) When **85.49** is divided by **59.6**, the answer should be reported to significant 3 digit(s).

Question 3 (3 Points)

A copy of your chemistry textbook is found to have a volume of **2.81×10^3 mL**. Using unit analysis, show what the **volume** of this copy of your chemistry textbook is in **L**.

1 g = 1000 mg	1000 mL = 1 L	100 cm = 1 m
1000 mg = 1 g	1 mL = 1 cm^3	1000 mm = 1 m

No need to do the calculation – just set up the correct dimensional analysis conversions – **you may not need to fill in all the boxes**.

$$2.81 \times 10^3 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{\quad}{\quad}$$

Question 4 (3 Points)

A **0.0635** L sample of a liquid has a mass of **87.6** g. Identify it as either **nonane** (density = **0.719** g/mL) or **iodoheptane** (density = **1.38** g/mL). iodoheptane

Question 5 (3 Points)

The element **copper** has two stable isotopes, **copper-63** with an atomic mass of **62.93** amu and **copper-65** with an atomic mass of **64.93** amu. From the atomic weight of **Cu** = **63.54** one can conclude that:

- ☐ **copper-65** has the highest percent natural abundance
- ☐ both isotopes have the same percent natural abundance
- ☐ most **copper** atoms have an atomic mass of **63.54**
- ☑ **copper-63** has the highest percent natural abundance

Question 6 (6 Points)

A certain element consists of two stable isotopes.
The first has an **atomic mass of 107 amu** and a percent natural abundance of **51.8%**.
The second has an **atomic mass of 109 amu** and a percent natural abundance of **48.2%**.
What is the **atomic mass** of the element?

$0.518(107) + 0.482(109) = 107.964$ amu

108 amu

Question 7 (3 Points)

Decide if the following statements are true (**T**) or false (**F**):

You must get all three correct to obtain credit – no partial credit awarded.

a) **Protons** and **neutrons** are **equal in mass**, but **opposite in charge**. F

b) The **mass of a proton** is **about the same** as the **mass of a neutron**. T

c) The **electron** acts as a **buffer zone** in the **nucleus** F

Question 8 (10 Points)

The following questions pertain to the **periodic table** given at the **front of this exam**:

a. The **atomic number** for the element that is in **group 4A** and **period 2**? 6

b. The **atomic weight** for the element in **group 3A** and **period 4**? 69.72

c. **Check** the **elements** that would be expected to have **similar properties**?

❒ Pb ❒ Cl ❒ Be ❒ I ❒ Rn

d. What is the **symbol** of the **alkali metal** that is in **period 5**? Rb

e. **Check** any of the following that are **metals**? (Z = atomic number)

❒ Fe (Z=26) ❒ N (Z=7) ❒ Br (Z=35) ❒ Ba (Z=56) ❒ None of these

Question 9 (3 Points)

Order the following (from 1-3) in order of the **greatest force of attraction**:
(**1 being the greatest** and **3 the smallest**)

a) K^+ and Cl^- separated by a distance of 347 pm 2

b) Ca^{2+} and S^{2-} separated by a distance of 347 pm 1

c) K^+ and I^- separated by a distance of 412 pm 3

Question 10 (8 Points)

Give the correct **formula** for the following **polyatomic ions**:

a) **Phosphide** P^{3-}

b) **Phosphate** PO_4^{3-}

c) **Dihydrogen phosphate** $H_2PO_4^-$

d) **Ammonium** NH_4^+

Question 11 (8 Points)

a. **Name** the compound with the formula **MgS**? Magnesium sulfide

b. **Name** the compound with the formula **$Fe(NO_2)_2$**? Iron(II) nitrite

c. What is the **formula** for **sodium hydrogen carbonate**? $NaHCO_3$

d. What is the **formula** for **copper(II) sulfite**? $CuSO_3$

Question 12 (4 Points)

How many **atoms** of **sulfur** are present in **4.37 moles** of **S_2F_{10}**? ***Show Work***

$$4.37 \text{ mol } S_2F_{10} \left| \frac{2 S}{1 S_2F_{10}} \right. = 8.74 \text{ mol S}$$

$$8.74 \text{ mol S} \left| \frac{6.023 \times 10^{23} \text{ atoms}}{1 \text{ mol}} \right. = 5.26 \times 10^{24} \text{ atoms S}$$

5.26×10^{24} **atoms of S**

Question 13 (4 Points)

How many **moles** of fluorine are present in **1.73×10^{22} molecules** of O_2F_2? ***Show Work***

$$1.73 \times 10^{22} \text{ molecules } O_2F_2 \left| \frac{1 \text{ mol}}{6.023 \times 10^{23} \text{ molecules}} \right. = 0.0287 \text{ mol } O_2F_2$$

$$0.0287 \text{ mol } O_2F_2 \left| \frac{2 \text{ F}}{1 \ O_2F_2} \right. = 0.0574 \text{ mol F}$$

0.0574 **mol F**

Question 14 (6 Points)

A compound is found to contain **45.71% oxygen** and **54.29%** fluorine by weight and a molecular weight of **70.00 g.mol^{-1}**. What is the **formula** of this compound?

Show Work

O	F
45.71 g	54.29 g
$\frac{45.71 \text{ g}}{16.00 \text{ g.mol}^{-1}}$	$\frac{54.29 \text{ g}}{19.00 \text{ g.mol}^{-1}}$
2.857 mol	2.857 mol
$\frac{2.857 \text{ mol}}{2.857 \text{ mol}}$	$\frac{2.857 \text{ mol}}{2.857 \text{ mol}}$
1	1

Empirical formula: OF

OF: $16.00 + 19.00 = 35 \text{ g.mol}^{-1}$

$$\frac{70.00 \text{ g.mol}^{-1}}{35.00 \text{ g.mol}^{-1}} = 2$$

O_2F_2

O_2F_2

Question 15 (6 Points)

When the following molecular equations are balanced using the **smallest possible integer coefficients**, the values of these coefficients are:

a) __ Mg_3N_2 (s) + 6 H_2O (l) → 3 $Mg(OH)_2$ (aq) + 2 NH_3(aq)

b) When aqueous solutions of barium hydroxide, **$Ba(OH)_2$**, and nitric acid, **HNO_3** are combined, **barium nitrate** and **water** are formed.

__ $Ba(OH)_2$ (aq) + 2 HNO_3 (aq) → __ $Ba(NO_3)_2$ + 2 H_2O

Question 16
4 Points

An iron nail rusts when exposed to oxygen. According to the following reaction, how many **moles of oxygen** gas are necessary to form **0.632 moles iron(III) oxide**?

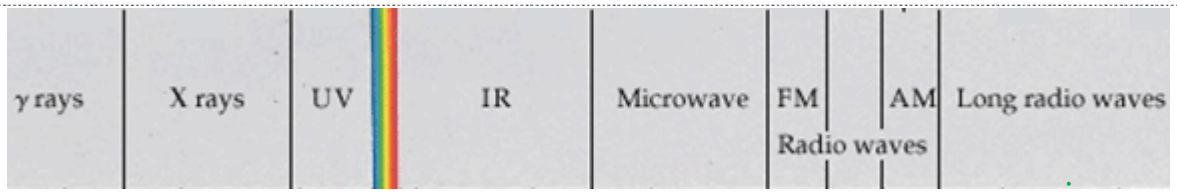
iron (s) + oxygen (g) = iron(III) oxide (s)

$$4\ Fe(s) + 3O_2 = 2\ Fe_2O_3(s)$$

$$0.632\ mol\ Fe_2O_3 \left| \frac{3\ O_2}{2\ Fe_2O_3} \right. = 0.948\ mol\ O_2$$

0.948 **mol oxygen gas**

Question 17
6 Points



a) Put the following forms of electromagnetic radiation in order of **increasing frequency**:

3	Gamma ray	1. Lowest Frequency
2	Ultraviolet	2. Second Highest Frequency
1	Radio wave	3. Highest Frequency

b) Put the following forms of electromagnetic radiation in order of **increasing energy**:

1	AM	1. Smallest Energy
3	Microwave	2. Second Highest Energy
2	FM	3. Highest Energy

Question 18
4 Points

A local AM radio station broadcasts at a frequency of **636 kHz**. Calculate the wavelength in **meters** at which it is broadcasting. ***Show Work***

$$636\ kHz \left| \frac{1000\ Hz}{1\ kHz} \right. = 6.36 \times 10^5\ s^{-1}$$

$$\lambda \nu = c$$

$$\lambda (6.36 \times 10^5\ s^{-1}) = 2.998 \times 10^8\ m.s^{-1}$$

$$\lambda = \frac{2.998 \times 10^8\ m.s^{-1}}{6.36 \times 10^5\ s^{-1}} = 471\ m$$

471 m

Question 19
8 Points

The wavelength of a particular color of red light is **529 nm**. What is the **energy** of this light in **J.mol^{-1}**?

Show Work

$$529\ nm \left| \frac{1 \times 10^{-9}\ m}{1\ nm} \right. = 5.29 \times 10^{-7}\ m$$

$$\lambda \nu = c$$

$$5.29 \times 10^{-7}\ m\ (\nu) = 2.998 \times 10^{8}\ m.s^{-1}$$

$$\nu = \frac{2.998 \times 10^{8}\ m.s^{-1}}{5.29 \times 10^{-7}\ m}$$

$$= 5.67 \times 10^{14}\ s^{-1}$$

$$E = h\nu$$

$$= 6.626 \times 10^{-34}\ J.s\ (5.67 \times 10^{14}\ s^{-1})$$

$$= 3.76 \times 10^{-19}\ J$$

$$E = 3.76 \times 10^{-19}\ J\ (6.023 \times 10^{23}\ mol^{-1})$$

$$= 2.26 \times 10^{5}\ J.mol^{-1}$$

2.26×10^{5} **J.mol^{-1}**

Do Not Write Below This

Exam I Score