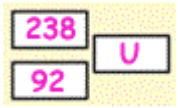
Chem 111 **Spring 2006** **Exam I Key** **Whelan**

Question 1 (6 Points)

1. Give the **number** of significant figures in: **1600** — **2**
2. **[23.56-2.3]/1.248x10^3**
   Report the answer in the **correct number of significant figures**: — **1.70x10^{-2}**
3. Diamond has a density of **3.513 g/cm^3**. If a carat equals **0.200g**.
   What is the **volume in cm^3** of a 1.32-carat diamond? — **7.51x10^{-2}**

Question 2 (6 Points)

A neutral atom has 92 **protons** and 146 **neutrons**. Fill in the three blanks to complete the atomic symbol



Question 3 (6 Points)

Which if any of the following species has the same number of **neutrons** as it does **electrons**? Circle the correct answer(s).

$^{47}_{24}Cr^{+}$ ^{24}Mg $^{59}Co^{2+}$ $^{35}Cl^{-}$ $^{125}_{50}Sn$

Question 4 (10 Points)

Use the Periodic Table accompanying this exam to answer the following questions:

1. **Name** the only **diatomic gas** in **Period 4** — **Bromine**
2. Symbol for the **heaviest Alkali Earth** element. — **Ra**
3. Symbol for **transition metal** in **Group VIB**, **Period 6**. — **W**
4. The **Actinides** belong to what Period? — **7**
5. Group **VIIIA** are collectively referred to as: — **Noble Gases**

Question 6 (8 Points)

Give the **sign** and **magnitude** of the charge associated with the following:

1. Hydrogen sulfate ion — **-1**
2. Selenide ion — **-2**
3. Chromate ion — **-2**
4. Group VIA elements — **-2**

Question 7 (4 Points)

Sb has two naturally occurring isotopes:

Isotope	Exact Mass	Natural Abundance
^{121}Sb	**120.904**	**57.30%**
^{123}Sb	**122.904**	**42.70%**

What is the average atomic mass of Sb? (Give your answer to **3 decimal places**)

120.904(0.5730) + 122.904(0.4270) = **121.758**

Question 8
6 Points

1. What amount in **moles**, is represented by **3.00g** of P_2F_4? **[Show Work]**

Molar Mass: 2(30.97) + 4(19.00) = **137.79 g/mol**

$$\frac{3.00\ g\ P_2F_4}{137.79\ g} \times 1\ mol = \mathbf{2.17 \times 10^{-2}\ mol\ P_2F_4}$$

2. What is the **percent** carbon in CCl_4? **7.81%**

Question 9
6 Points

Mesitylene is composed of **carbon** and **hydrogen** only. It is **89.93% C** and its molar mass is **120.19 g/mol**. What is the molecular formula of mesitylene? **[Show All Work]**

C	H
89.93 g	10.07g
7.498 mol	**9.970 mol**
7.948 / 7.948	9.770 / 7.948
1	1.331
3	**4**

C_3H_4

$C_3H_4 = 3(12.01) + 4(1.01) =$ **40.07 g/mol**

$$\frac{120.19\ g/mol}{40.07\ g/mol} = 3$$

C_9H_{12}

Question 10
4 Points

Using the **smallest whole number integers** possible, balance the following chemical equations.

1. **2** $AgNO_3(aq) + K_2CrO_4(aq) = Ag_2CrO_4(s) + 2\ KNO_3(aq)$
2. **2** $C_2H_6(g) + 7\ O_2(g) = 6\ H_2O(g) + 4\ CO_2(g)$

Question 11
4 Points

Give the **correct name** for each of the following ionic compounds.

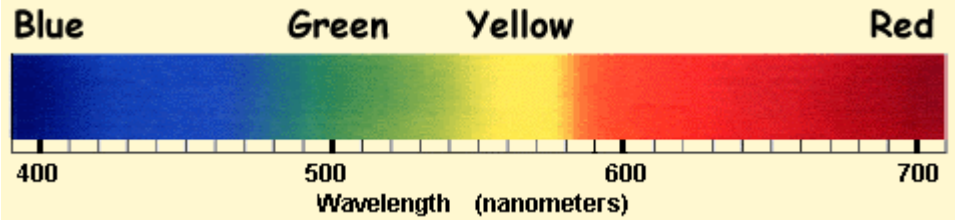
1. $Ca(NO_2)_2$ — **Calcium nitrite**
2. Na_2S — **Sodium sulfide**
3. $Fe(OH)_3$ — **Iron(III) hydroxide**
4. K_2CrO_4 — **Potassium chromate**

Question 12
4 Points

Give the **correct formula** for each of the following ionic compounds.

1. Ammonium carbonate — **$(NH_4)_2CO_3$**
2. Potassium chlorite — **$KClO_2$**
3. Aluminum oxide — **Al_2O_3**
4. Perchloric acid — **$HClO_4$**

Question 13
6 Points



The yellow region has greater energy than the **red** region while the green region has a **greater/higher** frequency than the yellow region. The blue region has the **greatest/highest** frequency of all the regions depicted.

Question 14
6 Points

A chemical reaction can be initiated by light that carries energy of $5.34\times10^{5}\ J.mol^{-1}$. Only light less than a certain wavelength will initiate the reaction.
What is the longest wavelength, in meters, that can deliver the required energy?
[Show All Work]

$$E = \frac{5.34\times10^{5}\ J.mol^{-1}}{6.023\times10^{23}\ mol^{-1}} = 8.866\times10^{-19}\ J$$

$$\nu = \frac{E}{h} = \frac{8.866\times10^{-19}\ J}{6.626\times10^{-34}\ J.s} = 1.338\times10^{15}\ s^{-1}$$

$$\lambda = \frac{c}{\nu} = \frac{2.998\times10^{8}\ m.s^{-1}}{1.338\times10^{15}\ s^{-1}} = 2.241\times10^{-7}\ m$$

Question 15
4 Points

1. Potassium has three naturally occurring isotopes (^{39}K, ^{40}K, ^{41}K). ^{40}K has a very low natural abundance. Which of the other two is the more abundant? ^{39}K
2. Circle the expected approximate abundance of the more abundant isotope?

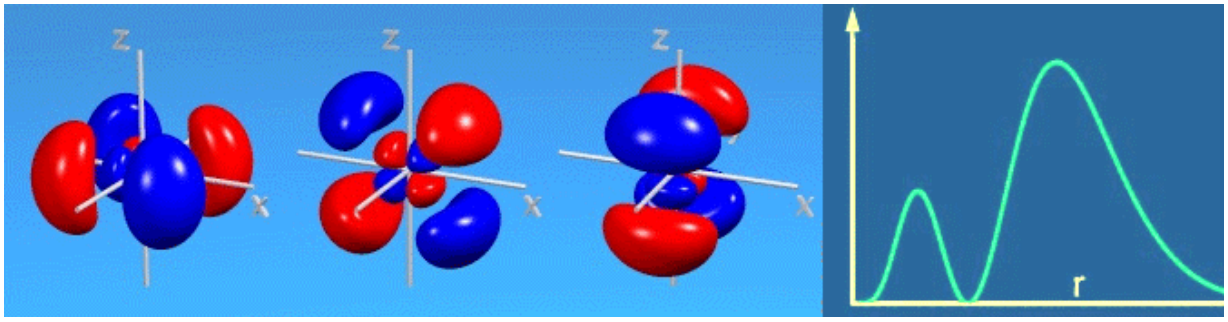
<30% >30% <60% >60% <90% **>90%**

Question 16
6 points

1. How many orbitals are there with an **n** value equal to 3? **9**
2. How many **nodal** surfaces are associated with a **4s** orbital? **3**
3. One of the following wave functions (orbitals) is not a solution of the Schrodinger Equation. Circle the one that is not.

2s 2p 7s 3d 4f 5g **2d** 9p

Question 17
4 points



1. The orbitals depicted above are what type: **d**
2. The n value of these orbitals is: **4**

Question 18
10 Points

1. Give the **complete electronic configuration** for:

   Cl: $1s^2 2s^2 2p^6 3s^2 3p^5$

   Ca: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

2. Give the **Noble Gas** (Valence) configuration for

   S: $[Ne]3s^2 3p^4$

   K: $[Ar]4s^1$

3. Give the **symbol(s)** of the **Period 4** transition metals (elements 21-30) that is/are **diamagnetic**: **Zn**

Do Not Write Below This Line

Exam I Score