REVIEW QUESTIONS
Chapter 2

1. Complete the missing information in the table below:

Symbol	^{51}V	$^{79}Se^{2-}$	$^{59}Ni^{2+}$	$^{31}P^{3-}$	$^{40}Ca^{2+}$
Protons	23	**34**	28	**15**	**20**
Neutrons	**28**	45	31	**16**	**20**
Electrons	**23**	36	**26**	**18**	**18**
Net Charge	0	2–	2+	**3–**	**2+**
Atomic No.	**23**	**34**	**28**	**15**	**20**
Mass No.	51	**79**	**59**	**31**	**40**

2. The following are the results of analysis of two samples containing phosphorous and oxygen. From these results determine if the two samples are the same compound. If the compounds are different, show that the data follows the law of multiple proportions.

	Mass of P	Mass of O	**Mass of Sample**
Sample A	2.581 g	3.322 g	**5.903 g**
Sample B	3.718 g	2.881 g	**6.599 g**

Determine percentage of P in each sample:

$$\textbf{Sample A} = \frac{2.581\ g}{5.903\ g} \times 100 = 43.72\%\ P \qquad \textbf{Sample B} = \frac{3.718\ g}{6.599\ g} \times 100 = 56.34\%\ P$$

Since the two samples do not possess the same percentage of P, they are not the same (Law of Definite Proportions)

Determine ratio of P to O in each sample:

$$\textbf{Sample A} \quad \frac{P}{O} = \frac{2.581\ g}{3.322\ g} = 0.777 \qquad \frac{0.777}{0.777} = 1 \qquad (3)$$

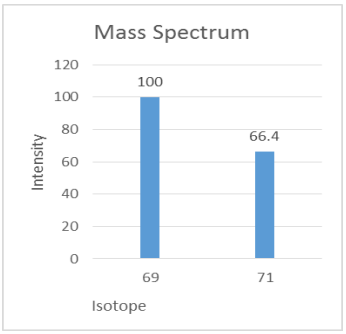
$$\textbf{Sample B} \quad \frac{P}{O} = \frac{3.718\ g}{2.881\ g} = 1.291 \qquad \frac{1.291}{0.777} = 1.66 \qquad (5)$$

Since the ratio of P to O is in small whole numbers, the Law of Multiple Proportions is valid.

3. Gallium has two naturally occurring isotopes with the following masses and natural abundances:

Isotope	Mass (amu)	Abundance (%)
Ga-69	68.9258	60.108
Ga-71	70.92470	39.892

Using the information above, sketch the mass spectrum of Gallium.



The intensity of the more abundant isotope is set to 100 in the mass spectrum. The intensity of the other isotope can be calculated relative to the other as shown below:

$$\text{Ga-69} = 100\% \qquad \text{Ga-71} = \frac{39.892}{60.108} \times 100 = 66.4\%$$

4. On a dry day, your body can accumulate static charges from walking across a carpet or from brushing your hair. If your body develops a charge of –15 μC, how many excess electrons has is acquired, and what is the mass (in grams) of these electrons? (Use the information about mass of charge of electrons included in page 2 of Chapter 2 lecture notes)

$$-15\ \cancel{\mu C} \times \frac{1\times10^{-6}\ \cancel{C}}{1\ \cancel{\mu C}} \times \frac{1\ \text{electron}}{-1.60218\times10^{-19}\ \cancel{C}} = 9.4\times10^{13}\ \text{electrons}$$

$$9.4\times10^{13}\ \cancel{\text{electrons}} \times \frac{5.5\times10^{-4}\ \cancel{\text{amu}}}{1\ \cancel{\text{electron}}} \times \frac{1\ \text{g}}{6.02\times10^{23}\ \cancel{\text{amu}}} = 8.6\times10^{-14}\ \text{g}$$

5. Three different samples of a solid containing mercury and oxygen were analyzed and the following data was obtained:

	Mass of Sample	Mass of Mercury	Mass of Oxygen
Sample A	1.0410 g	0.9641 g	0.0769 g
Sample B	1.5434 g	1.4293 g	0.1141 g
Sample C	1.2183 g	1.1283 g	0.0900 g

Are these data consistent with the hypothesis that the material is a compound?

Calculate the percentage of mercury in each sample:

$$\text{Sample A} \qquad \%\ \text{mercury} = \frac{0.9641\ \text{g}}{1.0410\ \text{g}} \times 100 = 92.61\%$$

$$\text{Sample B} \qquad \%\ \text{mercury} = \frac{1.4293\ \text{g}}{1.5434\ \text{g}} \times 100 = 92.61\%$$

$$\text{Sample C} \qquad \%\ \text{mercury} = \frac{1.1283\ \text{g}}{1.2183\ \text{g}} \times 100 = 92.61\%$$

Since all sample have the same percentage of one element (fixed composition), all samples are therefore the same compound.

6. An α particle ($^{4}He^{2+}$) has a mass of 4.00151 amu. Find the value of its charge-to-mass ratio in Coulombs/kg (C/Kg).

$$2\ \cancel{\text{protons}} \times \frac{1.60218\times10^{-19}\text{C}}{1\ \cancel{\text{proton}}} \times \frac{1}{4.00151\ \cancel{\text{amu}}} \times \frac{6.02\times10^{23}\ \cancel{\text{amu}}}{1\ \cancel{\text{g}}} \times \frac{10^{3}\ \cancel{\text{g}}}{1\ \text{kg}} = 4.82\times10^{7}\ \text{C/kg}$$

7. Write isotopic symbols in the form of X-A (e.g. C-13) for each isotope listed below:

a) The copper isotope with 34 neutrons **Cu-63**

b) The uranium isotope with 146 neutrons **U-238**

8. Use the mass spectrum of lead, shown below, to determine the atomic mass of lead. (Estimate the values from the graph to 3 significant figures)

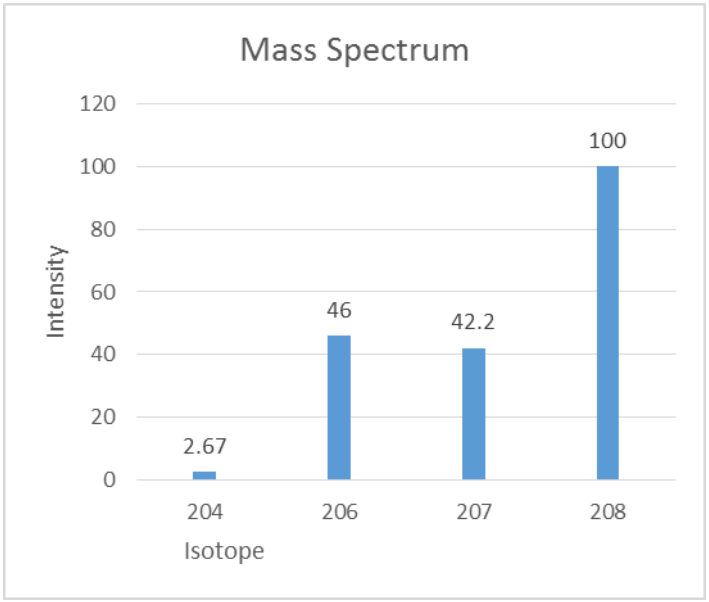
Calculate relative abundance of each isotope from its intensity in the mass spectrum

$$\text{Pb-204} = \frac{2.67}{190.87}\times100 = 1.40\%$$

$$\text{Pb-206} = \frac{46.0}{190.87}\times100 = 24.1\%$$

$$\text{Pb-207} = \frac{42.2}{190.87}\times100 = 22.1\%$$

$$\text{Pb-209} = \frac{100}{190.87}\times100 = 52.4\%$$



Atomic mass = (204x0.0140)+(206x0.241)+(207x0.221)+(209x0.524)= 207.8 amu

9. The atomic mass of fluorine is 18.998 amu and its mass spectrum shows a large peak at this mass. The atomic mass of chlorine is 35.45 amu, but the mass spectrum of chlorine does not have a peak at this mass. Explain the difference.

The fluorine isotope with mass of 19 amu is abundant by a very large amount, causing the average mass of fluorine to be close to 19 and producing a large peak in its mass spectrum. Chlorine however, has two isotopes which are not in great excess of one another. Therefore, the average mass of chlorine is not equal to one of its isoptopes and therefore no peak appears at this value in its mass spectrum.

10. Calculate the molar mass of each substance shown below:

a) $(NH_4)_3PO_4$ **149.12 g/mol**

b) $CuSO_4 \bullet 5\ H_2O$ **249.71 g/mol**

11. Calculate the mass (in grams) of each of the following:

a) $2.3x10^{-3}$ mol Sb

$$2.3x10^{-3}\ \text{mol} \times \frac{121.76\ \text{g}}{1\ \text{mol}} = 0.28\ \text{g}$$

b) $1.8x10^{22}$ lead atoms

$$1.8x10^{22}\ \text{atoms} \times \frac{1\ \text{mol}}{6.02x10^{23}\ \text{atoms}} \times \frac{207.5\ \text{g}}{1\ \text{mol}} = 6.2\ \text{g}$$

12. Brass is a copper and zinc alloy containing 37.0% zinc by mass and has a density of 8.48 g/cm^3. A brass fitting has a total volume of 112.5 cm^3. How many copper atoms does this fitting contain?

$$112.5\ \text{cm}^3\ \text{brass} \times \frac{8.48\ \text{g}}{1\ \text{cm}^3} \times \frac{63.0\ \text{g Cu}}{100\ \text{g brass}} \times \frac{1\ \text{mol}}{63.55\ \text{g}} \times \frac{6.02x10^{23}\ \text{atoms}}{1\ \text{mol}} = 5.69x10^{24}\ \text{atoms Cu}$$