

## AP WORKSHEET 01B: Isotopes and Mass Spectrometry

1. Many elements have a number of isotopes.

(a) Define the term **isotope**. (2)

(b) Complete the following table. (22)

Row	Isotope symbol	Atomic #	# Protons	# Neutrons	Mass #
1	$^{13}\text{C}_6$				
2		17		18	
3			26		56
4			17		37
5				2	3
6		52			128
7			50	70	

(c) Consider the 2<sup>nd</sup> and 4<sup>th</sup> row in the table. What three things do they have in common?

(3)

(d) Consider the 2<sup>nd</sup> and 4<sup>th</sup> row in the table. Give two differences? (2)

(e) Naturally occurring Ni is found to have the following approximate isotopic abundance;

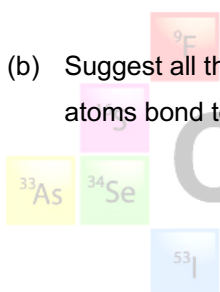
$^{58}\text{Ni}$  68%,  $^{60}\text{Ni}$  26%,  $^{62}\text{Ni}$  4.0% and  $^{64}\text{Ni}$  2.0%

Calculate the average relative atomic mass of Ni to two decimal places. (2)

2. The results taken from a mass spectrum of chlorine gas show peaks at  $m/z$  35.00 and  $m/z$  37.00 (The  $m/z$  peaks on a mass spectrum identify the different isotopes of an element that are present in the sample).

(a) Given that the relative abundances of Cl 35.00 and Cl 37.00 are 77.50% and 22.50% respectively, calculate the average relative atomic mass of chlorine atoms to **four significant figures**. (2)

(b) Suggest all the possible masses of Cl<sub>2</sub> **molecules** that are made when two chlorine atoms bond together. (3)



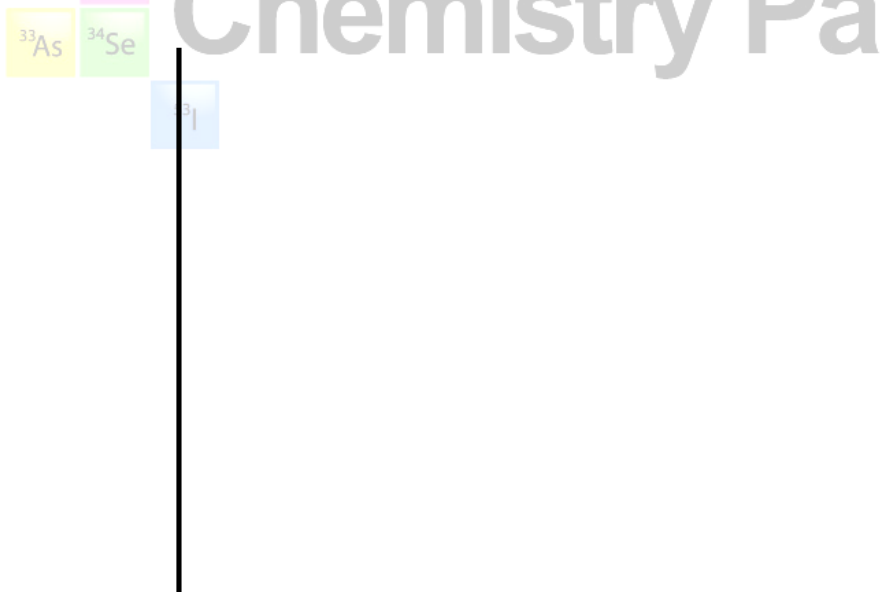
(c) Which of the molecules you have suggested in (b) will be the most abundant? Explain your answer. (2)

3. Naturally occurring bromine molecules,  $\text{Br}_2$  have masses of 158, 160 and 162. They occur in the relative abundances 25.69%, 49.99% and 24.31% respectively. What is the average atomic mass of bromine atoms? What is the relative abundance of  $^{79}\text{Br}$  and  $^{81}\text{Br}$  isotopes? (4)

4. An unknown element 'Z' is analyzed in a mass spectrometer and is found to have the following isotopes with the corresponding relative abundances.

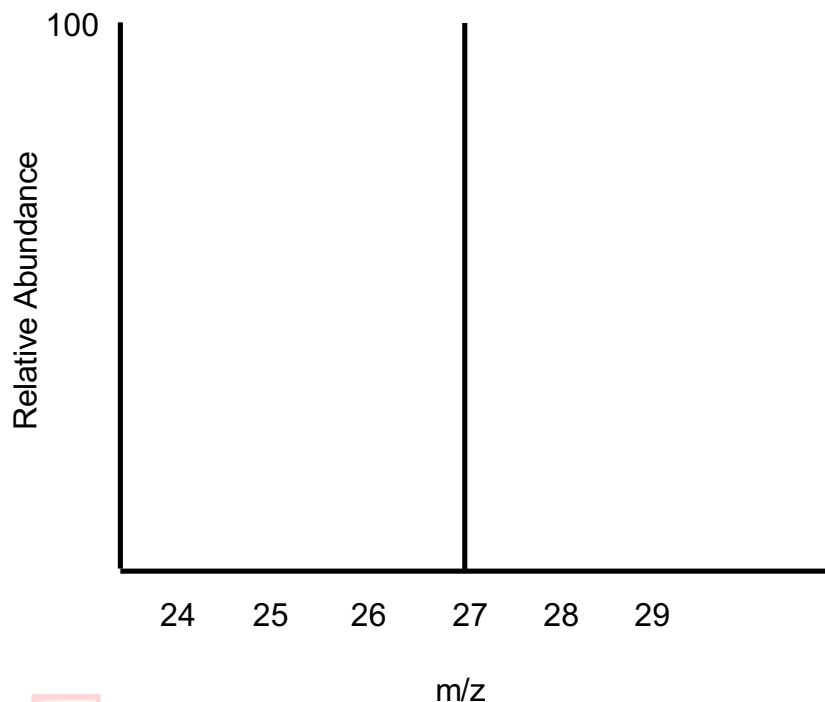
Isotope	$Z^{50}$	$Z^{52}$	$Z^{53}$	$Z^{54}$
Relative abundance	4.34	83.79	9.50	2.37

- (a) Using the axis below, sketch the expected mass spectrum that these data would provide. Label the axes and pay attention to the size of any lines that you draw. (4)

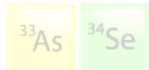


- (b) Calculate the average atomic mass of Z and identify the element. (3)

5. Consider the following mass spectrum that was generated from the analysis of an element.



- (a) What does the existence of only a single peak in the spectrum suggest about the element?



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- (b) Identify the element.

6. Copper has an atomic mass of 63.5456 amu and has two stable isotopes. Copper-63 has a mass of 62.9296 amu, and copper-65 has a mass of 64.9278 amu.

- (a) Calculate the percent abundance of each isotope of copper.
- (b) Sketch the expected mass spectrum of the copper.