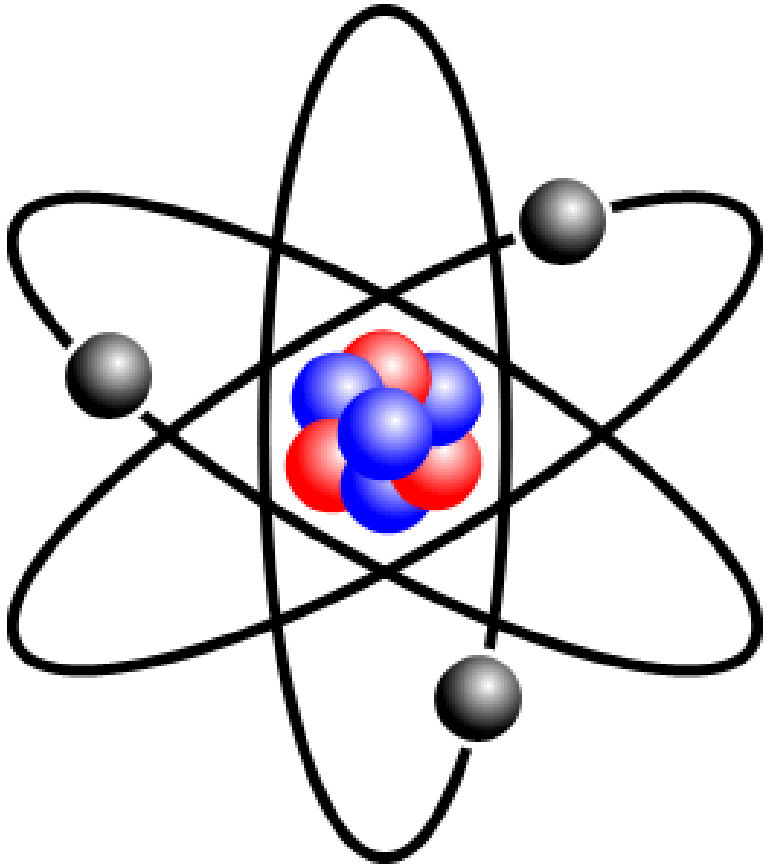
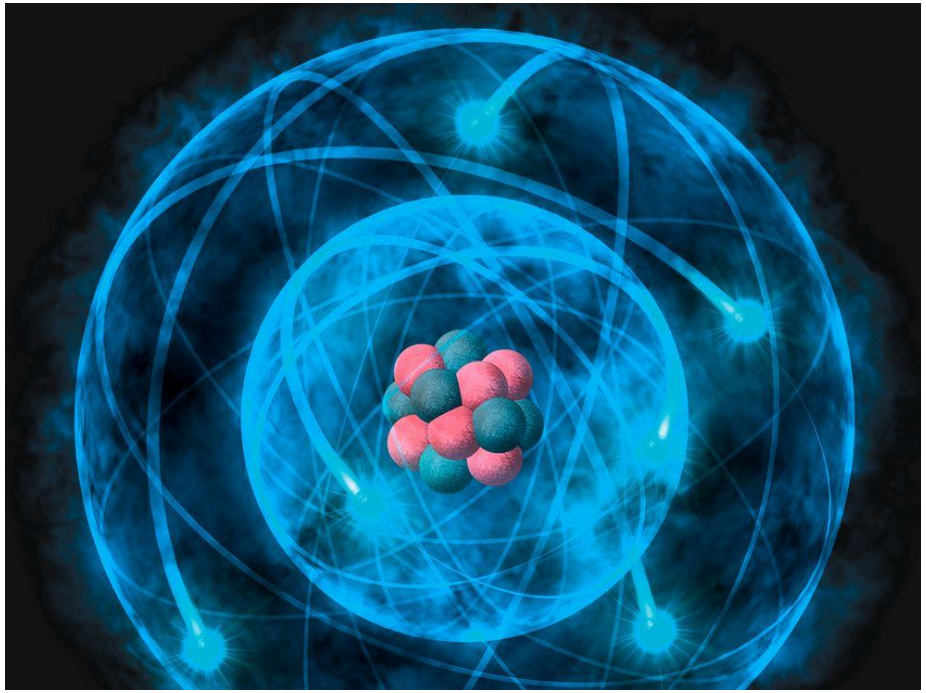
[3.2] The Atom

p. 145 – 149 in Textbook





We will be learning about <u>three</u> different parts of the atom today

1. What makes up an atom

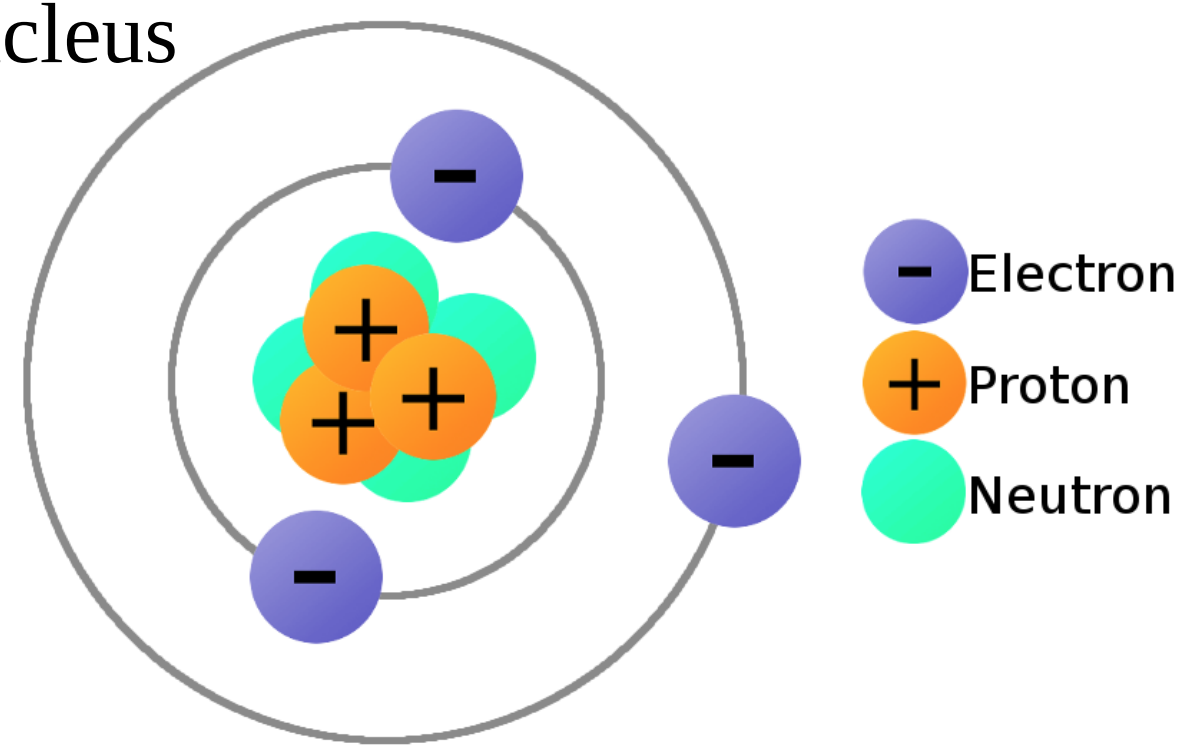
2. Where an atom's mass is found

3. What are isotopes

What does the atom consist of?

The atom can be further divided into subatomic particles:

1. **Proton**: a **positively** charged subatomic particle found in the nucleus
2. **Neutron**: a **neutral** subatomic particle found in the nucleus
3. **Electron**: a **negatively** charged subatomic particle found orbiting the nucleus



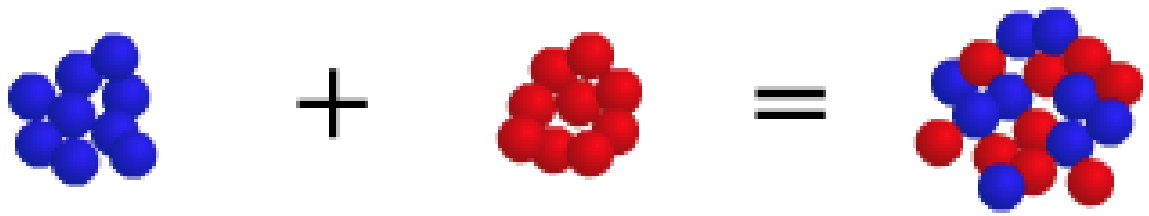
Mass of proton = 1.0 g/mol

Mass of neutron = 1.0 g/mol

Mass of electron = 0.000549 g/mol

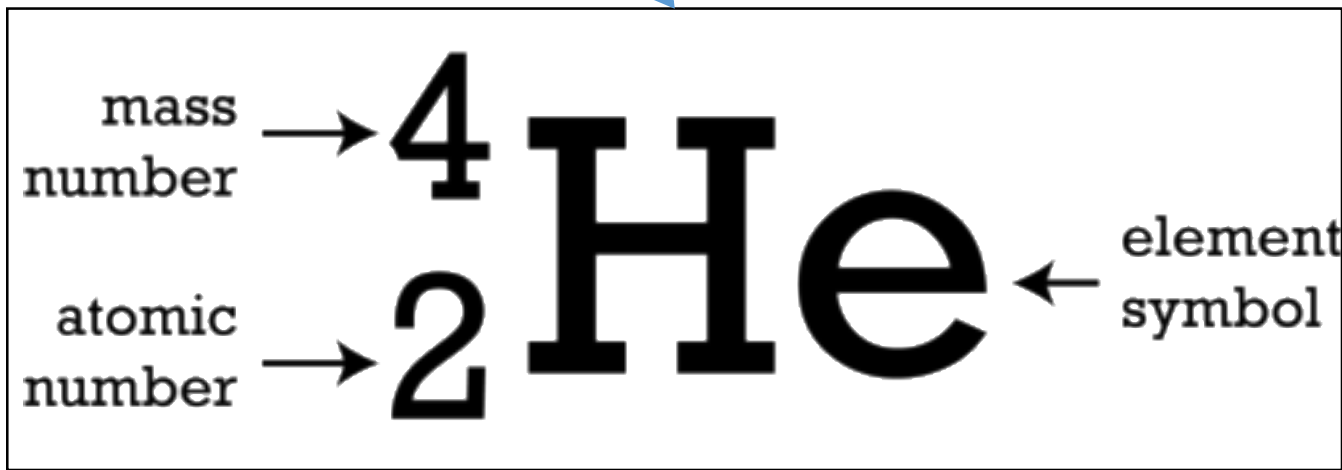
Atomic Number

- **Atomic Number:** Number of **protons** in the atom & each element has a different atomic number
- **Mass number**: Number of **protons** and **neutrons** in an atom. Protons and neutrons account for the majority of the atom's mass, in **amu** (atomic mass units)

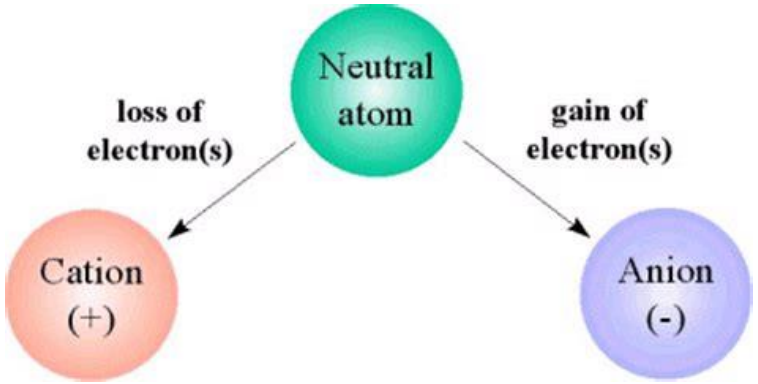


Number of Neutrons + Number of Protons = Mass Number

Nuclear Symbol



Ions

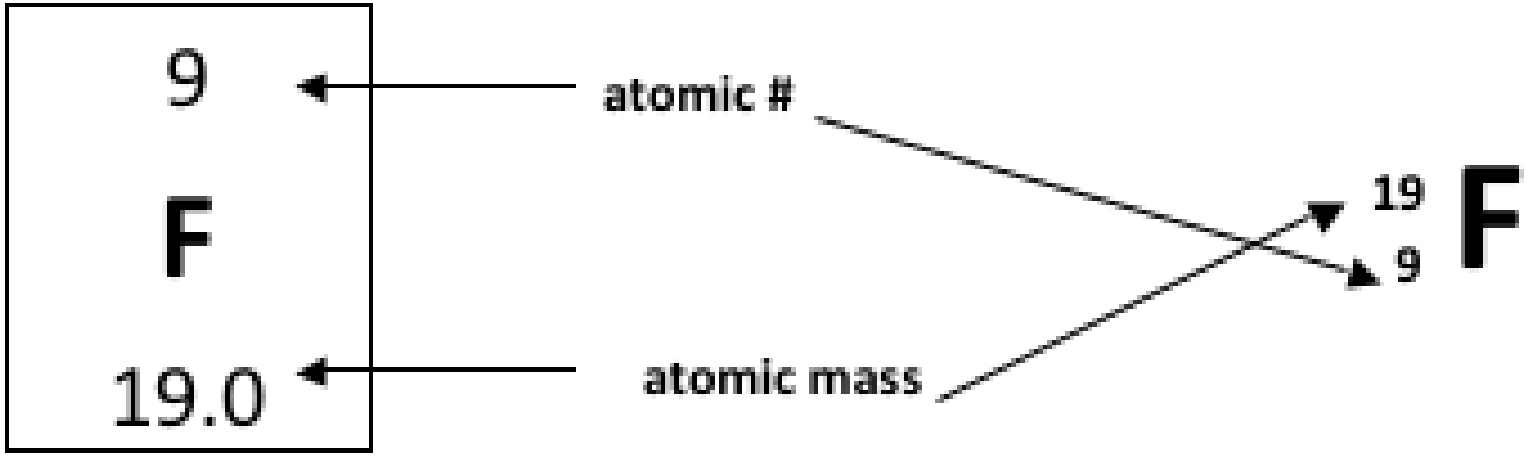


- If electrons are **added** to or **subtracted** from a neutral atom, the resulting particle is called an **ion**.
- If there is a negative charge, then electrons are **added** to the neutral atom: **F^{-}**, **S^{2-}**, **Sb^{-}**
- If there is a positive charge, then electrons are **subtracted** from the neutral atom: **K^{+}**, **V^{3+}**, **As^{+}**

How many electrons are there on each of the following:

Cl^{-}_____ Al^{3+} _____ Fe^{2+} _____ O^{2-} _____

Representing Atomic Number & Mass Number



Atomic Number = 9

Mass number = 19 amu

Number of protons = 9

Number of electrons = 9

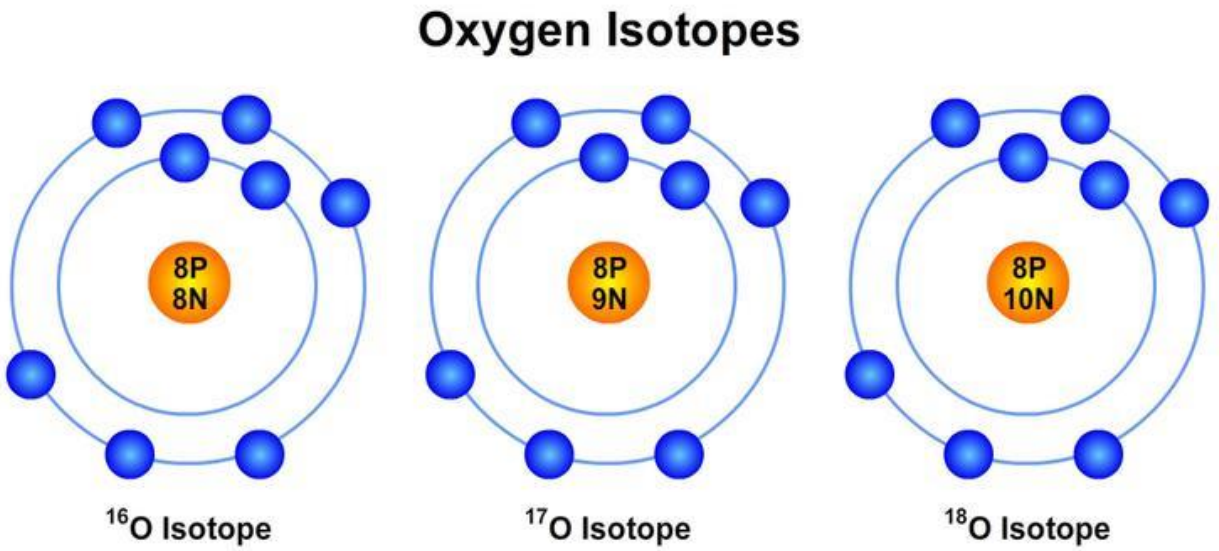
Number of neutrons = Mass number – Atomic number

= 19 – 9

= 10

Atomic Mass

Atomic Mass: the **average** of the mass numbers of all the different isotopes found for a specific element. **This is the number that you find on your periodic table.**



Example:

1. Oxygen-16 mass number = 16.0 amu
2. Oxygen-17 mass number = 17.0 amu
3. Oxygen-18 mass number = 18.0 amu

If all three of these isotopes exist in equal amounts, then the average atomic mass is

$$\frac{16.0 + 17.0 + 18.0 \text{ amu}}{3} = 17.0 \text{ amu}$$

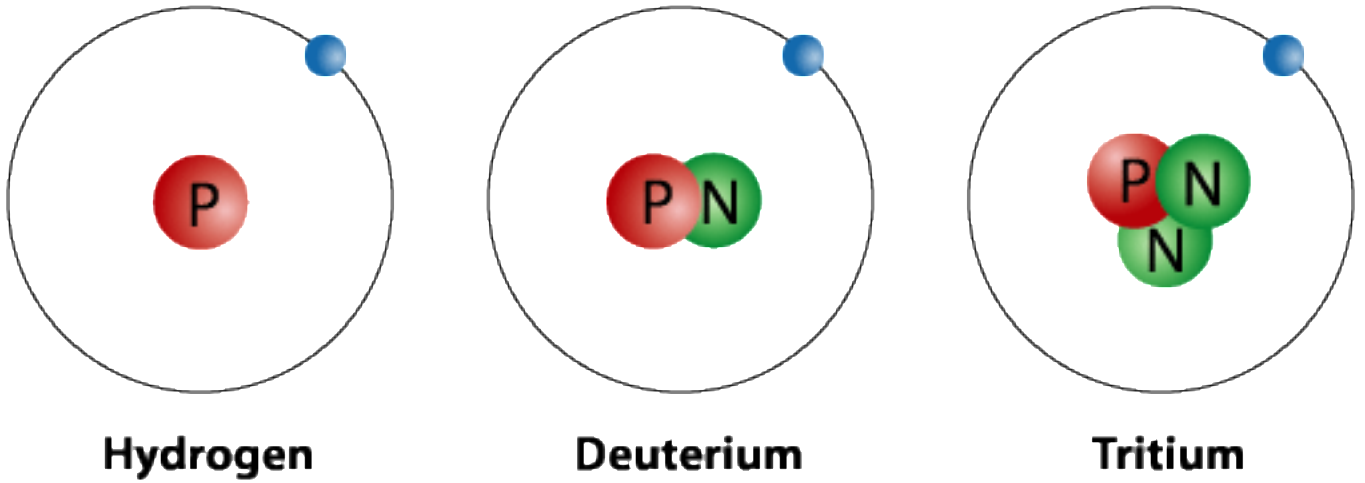
ISOTOPES DON'T EXIST IN EQUAL AMOUNTS

Atomic Number & Mass Number Activity

Complete the following table with the appropriate values. Assume all elements are neutral

Atomic Symbol	Atomic Number	Mass Number	Number of protons	Number of neutrons	Number of electrons
$^{24}_{12}Mg$					
	14			14	
		40		20	
		32			16
$^{}_{17}Cl$					

Isotopes and Average Atomic Mass

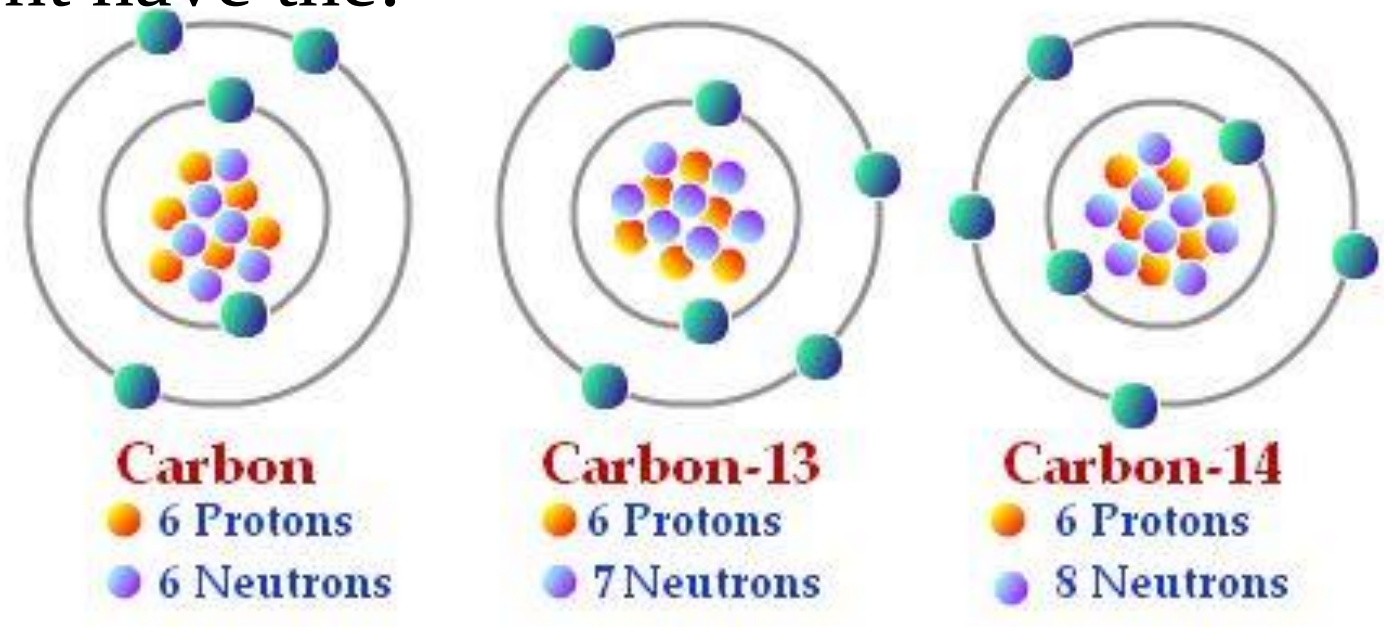


What are isotopes?

- **Isotopes**: Versions of an atom or an element that have the **same number of protons**, but **different numbers of neutrons.**
- The **Average Atomic Mass** of an element is based on the isotopes of that element.

Therefore, isotopes of an element have the:

1. **Same atomic number**
2. **Different mass number**



How to Calculate Average Atomic Mass

1. Find the **atomic mass** of the isotope. You may be given the exact mass or the just a rounded mass.

Isotopes (Silver Ag):	Atomic Mass:
^{107}**Ag**	**106.90509 amu**
^{109}**Ag**	**108.90470 amu**

How to Calculate Average Atomic Mass

2. Find the abundance of the isotope, you may have to look this up or it may be provided to you

Isotopes (Silver Ag):	Atomic Mass:
^{107}Ag ^{109}Ag	51.86% 48.14% 100.00%

How to Calculate Average Atomic Mass

3. Change percentages to decimals. Divide the percentage by 100.

Isotopes (Silver Ag):	Abundance:
^{107}Ag	51.86% ÷100%= 0.5186
^{109}Ag	48.14%÷100%=0.4814

How to calculate Average Atomic Mass (AAM)

4. Calculate the average atomic mass by adding:

$$\mathbf{AAM = (Mass_{(i1)})(Abundance_{(i1)}) + (Mass_{(i2)})(Abundance_{(i2)})}$$

$$\mathbf{AAM = (M_{(1)})(A_{(1)}) + (M_{(2)})(A_{(2)})}$$

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$$AAM = (M_{(1)})(A_{(1)}) + (M_{(2)})(A_{(2)})$$

AAM = [(106.90509 amu)*(0.5186)+(108.90470 amu)*(0.4814)]

AAM = 107.87 AMU

Practice Exercises:

Two carbon isotopes are found. One has a mass number of 12.0 amu and its percent abundance is 98.90% & the other has a mass number of 13.0 amu and has a percent abundance of 1.10%. Calculate its average atomic mass.

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AAM = (Mass $_{(i1)}$)(Abundance $_{(i1)}$) + (Mass $_{(i2)}$)(Abundance $_{(i2)}$)

AAM = (12.0 amu)(0.9890) + (13.0amu)(0.011)

AAM = 12.011 amu

Practice Exercises:

Copper has two naturally occurring isotopes. Cu-63 has an atomic mass of 62.9296 amu and an abundance of 69.15%. What is the atomic mass of the second isotope? What is its nuclear symbol?

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$$63.55amu = (62.9296\ amu)(0.6915) + (X)(0.3085)$$

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$$63.55amu = (62.9296\ amu)(0.6915) + (X)(0.3085)$$

$$63.55amu = 43.52amu + 0.3085X$$

$$20.03amu = 0.3085X$$

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63.55amu = (62.9296 amu)(0.6915) + (X)(0.3085)

63.55amu = 43.52amu + 0.3085X

20.03amu = 0.3085X

64.93 amu = X

HOMEWORK

- Complete problems on handout