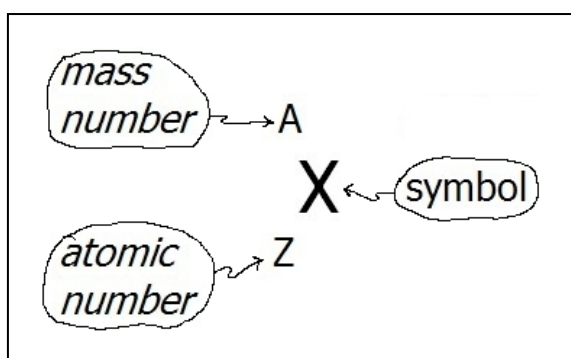


<u>Summary of Subatomic Particles</u>			
<u>Particle</u>	<u>Location</u>	<u>Relative Mass</u>	<u>Charge</u>
e	around nucleus	0.000 55	-1
p	nucleus	1.0073	+1
n	nucleus	1.0087	0

Note: e = electron, p = proton n = neutron

### Nuclide Notation

- a method of representing an element and the number of its subatomic particles



#### atomic number (Z)

- gives position on the Periodic Table
- equals the number of protons in the nucleus

Remember: Atoms are electrically neutral therefore the number of electrons must equal the number of protons in the atom.

- for an atom:      atomic # = # protons = # electrons

## mass number (A)

\* not on the Periodic Table

- equals the number of protons and neutrons in the nucleus

e.g. How many p, e, and n are present in an atom of Beryllium - 9?

atomic # = 4 therefore 4 p and 4 e

$$\text{mass \#} = 9 = p + n$$

$$9 = 4 + n$$

$$n = 5$$

therefore Beryllium - 9 has 4 p, 4 e, and 5 n.

e.g. Represent Beryllium - 9 using nuclide notation.



e.g. complete the following table:

element	nuclide notation	mass #	# p	# e	# n
carbon-12					
		13			7

isotope - atoms of the same element which have different masses (and number of neutrons).

## isotopes and radioisotopes

-some isotopes are stable, others are undergoing nuclear decay and are emitting particles and as a result are radioactive

dangerous isotopes: 1. cause cancer  
2. teratogenesis

useful isotopes: 1. Medical uses  
2. industry (finding gas pipes underground)

## Average Atomic Mass (AAM)

- found on the Periodic Table

e.g.

3
Li
6.94

- not a simple whole number

- AAM is the average mass of an element based on the relative abundance of its isotopes

- units - atomic mass units,  $\mu$

$1 \mu = 1/12$  of a carbon - 12 atom

$1 \mu \sim$  mass of a proton

$1 \mu \sim$  mass of a neutron

This makes the AAM of an element very close to the mass number of the element

- lists of isotopes exist

e.g. in nature, Li exists as 2 isotopes:

lithium - 6; 7.42 %; 6.015  $\mu$

lithium - 7; 92.58 %; 7.016  $\mu$

Calculate the average atomic mass (AAM) for lithium.

$$\text{AAM} = \begin{array}{ccccccc} \text{abundance of} & & \times & \text{mass of} & & \text{abundance of} & \times & \text{mass of} \\ \text{isotope A} & & & \text{isotope A} & + & \text{isotope B} & & \text{isotope B} \end{array}$$

$$= \frac{7.42\%}{100.0} \times 6.025 \mu + \frac{92.58\%}{100\%} \times 7.016 \mu$$

$$= 0.4463130 \mu + 6.4954128 \mu$$

$$= 6.9417258 \mu = 6.94 \mu$$

e.g. Nitrogen exists in nature as two isotopes. One isotope has a relative abundance of 99.63% and a mass of 14.00307 $\mu$ . The AAM is 14.007 $\mu$ .

Find the mass of the other isotope.

nitrogen A; 99.63%; 14.00307 $\mu$

nitrogen B; 100%-99.63%=0.37%; ? $\mu$

AAM = 14.007 $\mu$

$$\text{AAM} = \begin{array}{ccccccc} \text{abundance of} & & \times & \text{mass of} & & \text{abundance of} & \times & \text{mass of} \\ \text{isotope A} & & & \text{isotope A} & + & \text{isotope B} & & \text{isotope B} \end{array}$$

$$14.007\mu = \frac{99.63\%}{100\%} \times 14.00307\mu + \frac{0.37\%}{100\%} \times (\text{mass of B})$$

$$14.007\mu = 13.95125864\mu + (0.0037)(\text{mass of B})$$

$$0.05574136\mu = (0.0037)(\text{mass of B})$$

$$0.05574136\mu / 0.0037 = \text{mass of B}$$

$$15.065\mu = \text{mass of B isotope of nitrogen}$$

e.g. Chlorine has a AAM of 35.453μ. It exists in nature as 2 isotopes:

${}_{17}^{35}\text{Cl}$  with a mass of 34.96885μ

${}_{17}^{37}\text{Cl}$  with a mass of 36.96590μ

Find the percent abundance of each isotope.

Let Y = the abundance of isotope A, therefore abundance of isotope B = 100% - Y

$AAM =$	abundance of isotope A	X	mass of isotope A	+	abundance of isotope B	X	mass of isotope B
---------	------------------------	---	-------------------	---	------------------------	---	-------------------

$$35.453\mu = \frac{Y\%}{100\%} \times 34.96885\mu + \frac{100\% - Y\%}{100\%} \times 36.96590\mu$$

$$3545.3\mu = 34.96885\mu Y + 3696.590\mu - 36.96590\mu Y$$

$$1.99705\mu Y = 151.29\mu$$

$$Y = \frac{151.29\mu}{1.99705\mu}$$

$$Y = 75.76\% \quad \text{and} \quad 100\% - 75.76\% = 24.24\%$$

∴ the abundance of  ${}_{17}^{35}\text{Cl}$  is 75.76% and

∴ the abundance of  ${}_{17}^{37}\text{Cl}$  is 24.24%