IsotopesKey

Monday, January 23, 2017　　9:03 AM

1. The image to the right shows the relationship between the number of neutrons and protons for stable nuclei.
   a. As stable nuclei get larger, do the number of protons increase more quickly or slowly than the number of neutrons? Neutrons.

   What would the graph look like if the opposite were true? See red line on graph

   b. Using your understanding of Coulomb's law, propose a reason that one subatomic particle needs to be more abundant than the other as nuclei get larger. Protons are positively charged. As the number of protons grow and are forced into a small area, the total coulombic repulsion gets exceedingly large. The role of neutrons can be understood as charge spacers – they keep the protons from getting too close together. As the total positive charge grows, more spacers (neutrons) are needed to keep the repulsion under control.
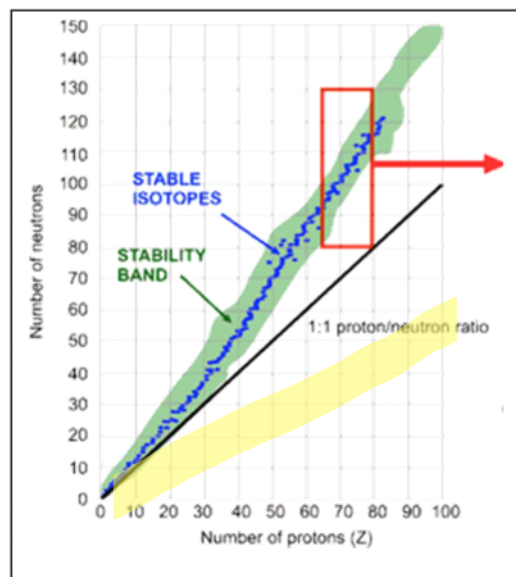
2. Two stable isotopes of lithium exist. Lithium-6 has an exact mass of 6.015 amu and lithium-7 has an exact mass of 7.016 amu.
   a. How do you find the average mass of lithium? Periodic table

   b. What is the average mass of lithium? 6.94

   c. Is this number closer to the mass of ^{6}Li or ^{7}Li? Based on this, which isotope do you think is more abundant? ^{7}Li because the average is weighted toward it.

   d. Calculate the natural abundance of each isotope.

$$X = \% \ ^6Li$$
$$Y = \% \ ^7Li$$

$$1 = X + Y$$
$$X = 1 - Y$$

$$6.94 = 6.015X + 7.016Y$$
$$6.94 = 6.015(1-Y) + 7.016Y$$
$$6.94 = 6.015 - 6.015Y + 7.016Y$$
$$0.925 = 1.001Y$$

$$X = 1 - 0.924 \qquad Y = 0.924$$
$$X = 0.076 \qquad \boxed{92.4\%}$$
$$\boxed{7.6\%}$$