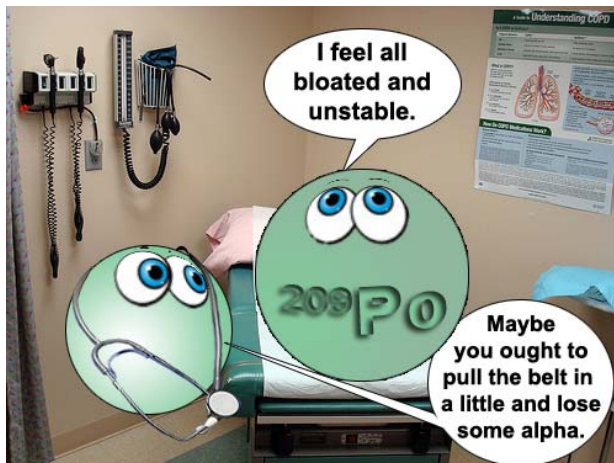


What is Radioactivity?

Protons repel each other. The higher the atomic number of an atom is, the greater the repulsion among protons is. This makes the nucleus unstable. Atoms with atomic numbers above 82 have no stable isotopes. Neutrons help to stabilize the nucleus by adding forces of attraction, without increasing the repulsion. Hydrogen is the only element that does not always have neutrons. As the number of protons increases, the number of neutrons needed to keep the nucleus stable increases. The ratio of neutrons to protons in stable nuclei is between 1:1 and 1.5:1, the higher ratio being associated with larger nuclei that have larger repulsive forces. Stable atoms have a ratio of neutrons to protons that falls in the belt of stability.

The box below shows a comparison of neutron to proton ratios for lead-206, a stable isotope, and uranium-235, a radioactive isotope. Lead falls in the belt of stability, while uranium does not.



Sample Problems

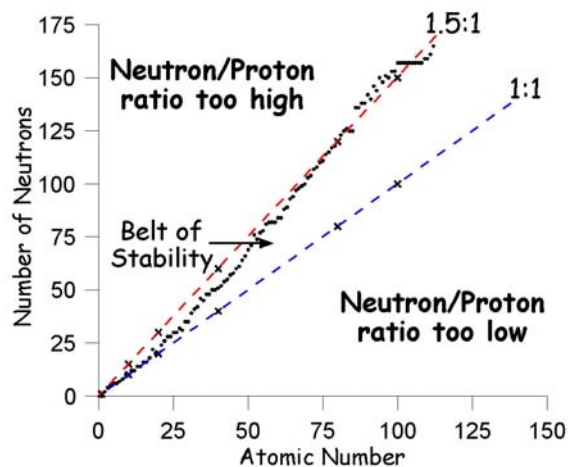
Look up the atomic number (Z) on the *Periodic Table*. Subtract the atomic number from the mass number (A) to get the number of neutrons (N).

Lead-206

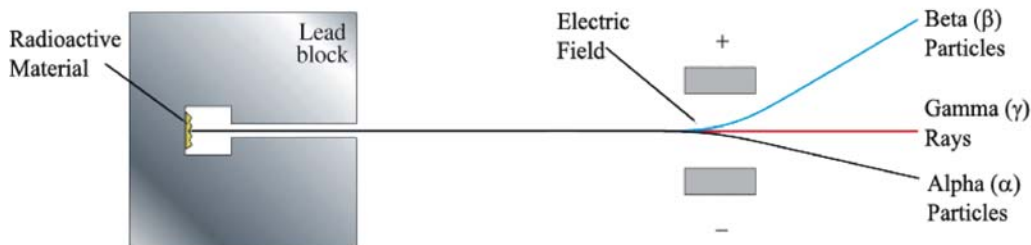
$$\begin{aligned} A &= 206 \\ Z &= 84 \\ N &= A - Z = 122 \\ N/Z &= 122/84 = 1.45 \end{aligned}$$

Uranium-235

$$\begin{aligned} A &= 235 \\ Z &= 92 \\ N &= A - Z = 143 \\ N/Z &= 143/92 = 1.55 \end{aligned}$$



Radioactivity. Unstable nuclei break apart or decay. Decaying nuclei release high speed particles and energy called radioactive emissions. Radioactive emissions separate in an electric field into three main types: alpha particles which are the same as a helium nucleus and have a positive charge; beta particles which are the same as a negatively charged electron except that they erupt from the nucleus; and gamma rays which are massless, chargeless energy. Sometimes atoms also give off positrons which are the same mass and size as an electron, but have a positive charge.



(CONTINUED ON THE NEXT PAGE) →

Answer the questions below based on your reading and your knowledge of chemistry.

1. Determine whether each of the isotopes below is stable or unstable by first determining the N/Z ratio..

	<u>N/Z</u>	<u>Stable/Unstable</u>
a. ^3H	_____	_____
b. ^{14}N	_____	_____
c. ^{14}O	_____	_____
d. ^{97}Kr	_____	_____
e. ^{206}Pb	_____	_____

2. Calculate the N/Z ratio for elements with atomic numbers 104 through 109. Are they in the belt of stability? Are they stable? How do you know? What does this show about the belt of stability? _____

3. Why are all elements with atomic numbers above 82 unstable? _____

4. What is radioactivity? _____

5. What are three common types of radioactivity given off by unstable atoms? How are they similar? How are they different? _____
