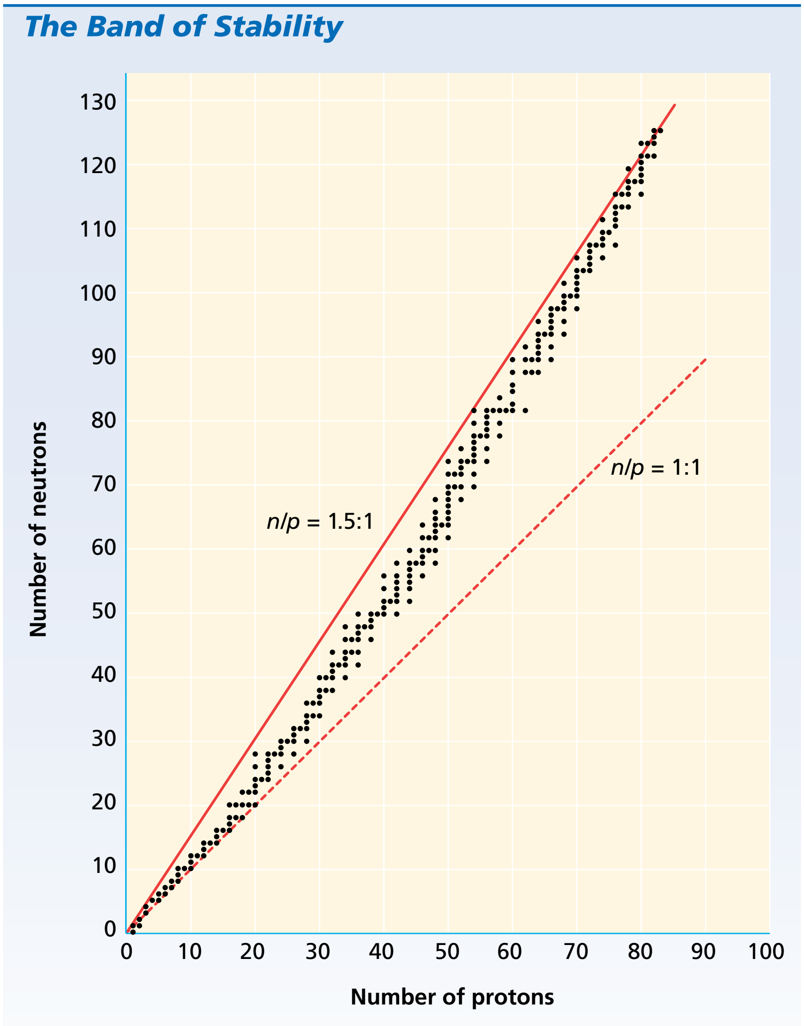

FIGURE 2 The neutron-proton ratios of stable nuclides cluster together in a region known as the band of stability. As the number of protons increases, the ratio increases from 1:1 to about 1.5:1.

range of the nuclear force allows them to attract only protons very close to them, as shown in **Figure 3.** As the number of protons in a nucleus increases, the repulsive electrostatic force between protons increases faster than the nuclear force. More neutrons are required to increase the nuclear force and stabilize the nucleus. Beyond the atomic number 83, bismuth, the repulsive force of the protons is so great that no stable nuclides exist.

Stable nuclei tend to have even numbers of nucleons. Of the stable nuclides, more than half have even numbers of both protons and neutrons. Only five nuclides have odd numbers of both. This indicates that stability of a nucleus is greatest when the nucleons—like electrons—are paired.

The most stable nuclides are those having 2, 8, 20, 28, 50, 82, or 126 protons, neutrons, or total nucleons. This extra stability at certain numbers supports a theory that nucleons—like electrons—exist at certain energy levels. According to the **nuclear shell model,** *nucleons exist in different energy levels, or shells, in the nucleus. The numbers of nucleons that represent completed nuclear energy levels—2, 8, 20, 28, 50, 82, and 126—are called* **magic numbers.**

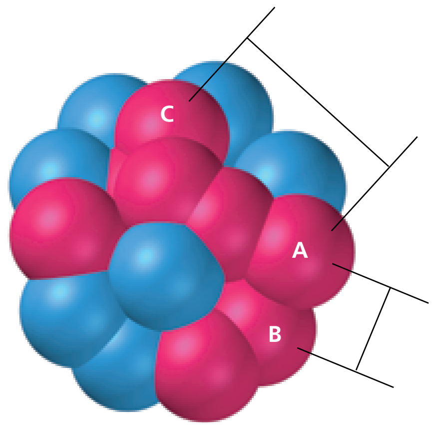

FIGURE 3 Proton A attracts proton B through the nuclear force but repels it through the electrostatic force. Proton A mainly repels proton C through the electrostatic force because the nuclear force reaches only a few nucleon diameters.