**CHAPTER TWO**
**Atomic Number, Mass Number, and Isotopes**

**2.1** The diameter of a neutral helium atom is about 1 x $10^2$ pm. Suppose that we could line up helium atoms side by side in contact with one another. Approximately how many atoms would it take to make the distance from end to end 1 cm?

**2.2** Roughly speaking, the radius of an atom is about10,000 times greater than that of its nucleus. If an atom were magnified so that the radius of its nucleus became 2.0 cm, about the size of a marble, what would be the radius of the atom in miles? (1 mi _ 1609 m.)

**2.3** Use the helium-4 isotope to define atomic number and mass number. Why does a knowledge of atomic number enable us to deduce the number of electrons present in an atom?

**2.4** Why do all atoms of an element have the same atomic number, although they may have different mass numbers?

**2.5** What do we call atoms of the same elements with different mass numbers?

**2.6** Explain the meaning of each term in the symbol $^{A}_{Z}X$.

**2.7** What is the mass number of an iron atom that has 28 neutrons?

**2.8** Calculate the number of neutrons of $^{239}$Pu.

**2.9** For each of the following species, determine the number of protons and the number of neutrons in the nucleus:
$^{3}_{2}He$ $^{4}_{2}He$ $^{24}_{12}Mg$ $^{25}_{12}Mg$ $^{48}_{22}Ti$ $^{79}_{35}Br$ $^{195}_{78}Pt$

**2.10** Indicate the number of protons, neutrons, and electrons in each of the following species:
$^{15}_{7}N$ $^{33}_{16}S$ $^{63}_{29}Cu$ $^{84}_{38}Sr$ $^{130}_{56}Ba$ $^{186}_{74}W$ $^{202}_{80}Hg$

**2.11** Write the appropriate symbol for each of the following isotopes: (a) $Z$ = 11, $A$ =23; (b) $Z$=28, $A$ = 64.

**2.12** Write the appropriate symbol for each of the following isotopes: (a) $Z$ = 74, $A$ =186; (b) $Z$ = 80, $A$ =201.

**2.13** In which one of the following pairs do the two species resemble each other most closely in chemical properties? Explain. (a) $^{1}_{1}H$ and $^{1}_{1}H^{+}$, (b) $^{14}_{7}N$ and $^{14}_{7}N^{3-}$, (c) $^{12}_{6}C$ and $^{13}_{6}C$

**2.14** One isotope of a nonmetallic element has mass number 127 and 74 neutrons in the nucleus. The anion derived from the isotope has 54 electrons. Write the symbol for this anion.

**2.15** Fill in the blanks in the following table:

| Symbol | | $^{54}_{26}Fe^{2+}$ | | | |
|---|---|---|---|---|---|
| Protons | 5 | | | 79 | 86 |
| Neutrons | 6 | | 16 | 117 | 136 |
| Electrons | 5 | | 18 | 79 | |
| Net Charge | | | -3 | | 0 |

**2.16** Which of the following symbols provides more information about the atom: $^{23}$Na or $_{11}$Na? Explain.

**2.17** For the noble gases (the Group 8A elements), $^{4}_{2}$ He, $^{20}_{10}Ne$, $^{40}_{18}Ar$, $^{84}_{36}Kr$, $^{132}_{54}Xe$, (a) determine the number of protons and neutrons in the nucleus of each atom, and (b) determine the ratio of neutrons to protons in the nucleus of each atom. Describe any general trend you discover in the way this ratio changes with increasing atomic number.