Practice

Understanding Concepts

1. Create a table with four columns. At the top of the columns, write the following headings: Subatomic particle; Relative atomic mass (u); Charge; Location. In the first column, write the names of the three subatomic particles, and complete the table.
2. What two particles are responsible for most of the mass of an atom?
3. Compare the mass number of an atom to its relative atomic mass. Why might they be different?
4. An atom has 14 protons and 13 neutrons. What is its mass number?
5. An atom has 15 protons and has a mass number of 31.
   (a) What is its atomic number?
   (b) How many neutrons does it have?
   (c) What element is it?
6. How many neutrons can be found in the nucleus of an atom of chlorine-37?
7. Two atoms respectively have $Z = 15$, $A = 30$ and $Z = 14$, $A = 30$. Are they isotopes of each other? Explain.
8. **Figure 4** shows a graph produced by a mass spectrometer.
   (a) What are the atomic masses of the three isotopes of magnesium?
   (b) How many neutrons would each isotope possess?
   (c) What is the relative abundance (as a percentage) of each of the three isotopes?

Radioisotopes

Many elements have one or more isotopes that are unstable. Atoms of unstable isotopes decay, emitting radiation as their nucleus changes. Depending on the isotope, these nuclear changes might happen very quickly or extremely slowly. And the radiation they emit could be fairly harmless or very dangerous to living cells. Isotopes that can decay in this way are known as **radioisotopes** and are said to be **radioactive.** Numerous experiments have shown that radioisotopes give off three types of radiation: alpha particles, beta particles, and gamma rays (**Table 1**).

Table 1: Characteristics of Nuclear Radiation

Radiation	Approximate speed	Penetration in air	Effective barrier
alpha (α, $^{4}_{2}He^{2+}$, $^{4}_{2}He$)	variable, but relatively slow	a few centimetres	a sheet of paper
beta (β, e^{-}, $^{0}_{-1}e$)	variable, but relatively fast	a few metres	1-2 mm of metal
gamma (γ)	very fast (speed of light)	unlimited	1 m of lead or concrete

An alpha particle is composed of two protons and two neutrons, which is equivalent to a $^{4}_{2}He$ nucleus. (Because it carries no electrons it has a charge of 2+. Its charge is usually omitted in nuclear equations.) The radioactive decay of uranium-238, which results in the production of an alpha particle, alters the composition of its nucleus, producing thorium-234:

$$^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$$

DID YOU KNOW ?

Weighted Averages

A good example of a weighted average is the calculation of your final mark in a course. If you did really well in the majority of your assessed work, but very poorly in one assignment, your overall mark would still be fairly high.

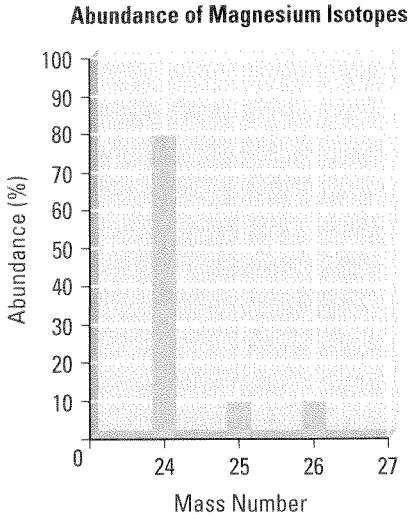

Figure 4
Mass spectrum of magnesium showing the relative abundance of its isotopes in a naturally occurring sample

radioisotope: a radioactive isotope of an element, occurring naturally or produced artificially

radioactive: capable of spontaneously emitting radiation in the form of particles and/or gamma rays