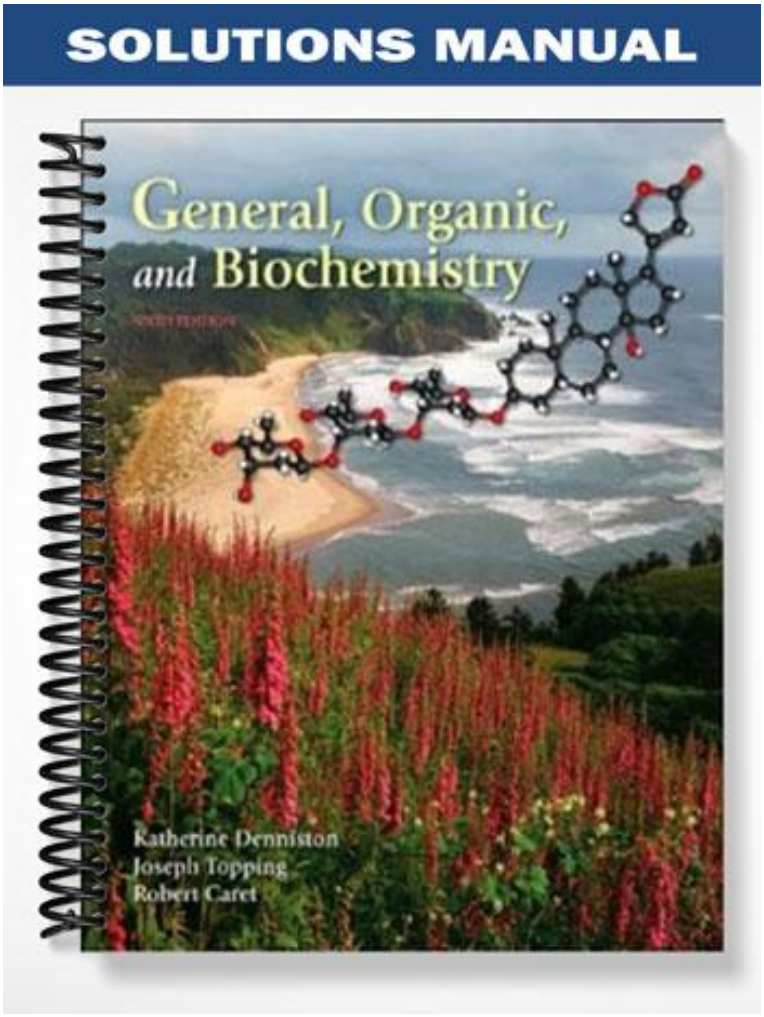
SOLUTIONS MANUAL



Chapter 2
The Composition and Structure of the Atom
Solutions to the Practice Problems

Practice Problems

2.1 a. 16 protons and 16 electrons (atomic number = 16)

32 - 16 = 16 neutrons (mass number - atomic number)

b. 11 protons and 11 electrons (atomic number = 11)

23 - 11 = 12 neutrons (mass number - atomic number)

c. 1 proton and 1 electron (atomic number = 1)

1 – 1 = 0 neutrons (mass number – atomic number)

d. 94 protons and 94 electrons (atomic number = 94)

224 – 94 = 150 neutrons (mass number – atomic number)

2.2 Step 1. Convert each percentage to a decimal fraction.

$$99.63\%\ {}^{14}_{7}\mathrm{N} \times \frac{1}{100\%} = 0.9963\ {}^{14}_{7}\mathrm{N}$$

$$0.37\%\ {}^{15}_{7}\mathrm{N} \times \frac{1}{100\%} = 0.0037\ {}^{15}_{7}\mathrm{N}$$

Step 2.

contributions to atomic mass by N-14 =
(fraction of all N atoms that are N-14) x (mass of a N-14 atom)

= 0.9963 x 14.003 amu

= 13.951 amu

contributions to atomic mass by N-15 =
(fraction of all N atoms that are N-15) x (mass of a N-15 atom)

= 0.0037 x 15.000

= 0.056 amu

Step 3. The weighted average is:

atomic mass of naturally occurring N =
(contribution of N-14) + (contribution of N-15)

$$= 13.951 \text{ amu} + 0.056 \text{ amu}$$
$$= 14.007 \approx 14.01 \text{ amu}$$

2.3 Step 1. Convert each percentage to a decimal fraction.

$$90.48\ \%\ {}^{20}_{10}\text{Ne} \times \frac{1}{100\%} = 0.9048\ {}^{20}_{10}\text{Ne}$$

$$0.27\ \%\ {}^{21}_{10}\text{Ne} \times \frac{1}{100\%} = 0.0027\ {}^{21}_{10}\text{Ne}$$

$$9.25\ \%\ {}^{22}_{10}\text{Ne} \times \frac{1}{100\%} = 0.0925\ {}^{22}_{10}\text{Ne}$$

Step 2.

$$\begin{pmatrix}\text{contributions to}\\ \text{atomic mass by } {}^{20}_{10}\text{Ne}\end{pmatrix} = \begin{pmatrix}\text{fraction of all Ne atoms}\\ \text{that are } {}^{20}_{10}\text{Ne}\end{pmatrix} \times \begin{pmatrix}\text{mass of a}\\ {}^{20}_{10}\text{Ne atom}\end{pmatrix}$$

$$= \quad 0.9048 \times 19.99 \text{ amu}$$

$$= \quad 18.087 \text{ amu}$$

$$\begin{pmatrix}\text{contributions to}\\ \text{atomic mass by } {}^{21}_{10}\text{Ne}\end{pmatrix} = \begin{pmatrix}\text{fraction of all Ne atoms}\\ \text{that are } {}^{21}_{10}\text{Ne}\end{pmatrix} \times \begin{pmatrix}\text{mass of a}\\ {}^{21}_{10}\text{Ne atom}\end{pmatrix}$$

$$= \quad 0.0027 \times 20.99 \text{ amu}$$

$$= \quad 0.057 \text{ amu}$$

$$\begin{pmatrix}\text{contributions to}\\ \text{atomic mass by } {}^{22}_{10}\text{Ne}\end{pmatrix} = \begin{pmatrix}\text{fraction of all Ne atoms}\\ \text{that are } {}^{22}_{10}\text{Ne}\end{pmatrix} \times \begin{pmatrix}\text{mass of a}\\ {}^{22}_{10}\text{Ne atom}\end{pmatrix}$$

$$= \quad 0.9025 \times 21.99 \text{ amu}$$

$$= \quad 2.034 \text{ amu}$$

Step 3. The weighted average is:

atomic mass of naturally occurring neon = (contribution of Ne-20)
+ (contribution of Ne-21)
+ (contribution of Ne-22)

= 18.087 + 0.057 amu + 2.034 amu

= 20.18 amu

2.4 a. Total electrons = 11, valence electrons = 1, energy level = 3
b. Total electrons = 12, valence electrons = 2, energy level = 3
c. Total electrons = 16, valence electrons = 6, energy level = 3
d. Total electrons = 17, valence electrons = 7, energy level = 3
e. Total electrons = 18, valence electrons = 8, energy level = 3

2.5 a. sulfur: $1s^2, 2s^2, 2p^6, 3s^2, 3p^4$
b. calcium: $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$
c. potassium: $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$
d. phosphorus: $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$