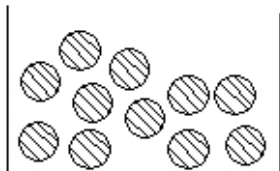
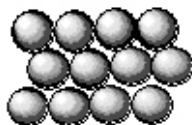


- 2.2 Molecular pictures must show the structures of individual particles (e.g., atoms, molecules, etc.) and the differences between phases. All these particles have monatomic units. A gas is mostly empty space, a liquid is tightly packed but not entirely regular, and a solid has a regular repeating structure.

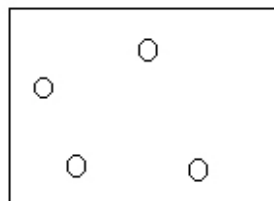
(a) liquid mercury



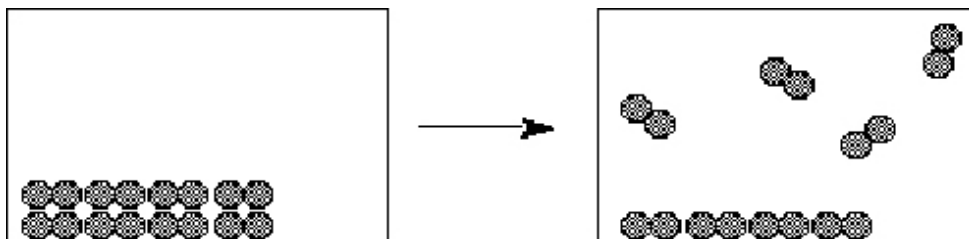
(b) solid iron



(c) gaseous neon



- 2.78 Molecular pictures must show that atoms of every element are conserved. The solid-gas transformation is correctly represented, but the number of molecules is not conserved. Here is one way to show a correct picture:



- 1.68 To identify each molecular picture, compare its contents with the definitions of element, compound, and mixture: (a) pure element (one type of atom); (b) heterogeneous mixture (one portion contains different elements than the other); (c) single chemical compound (two different elements, all molecules the same); and (d) homogeneous solution (two elements uniformly mixed).

- 2.14 Charge per proton and mass per proton can be found in Table 2-1. Because the total charge of the protons is simply the sum of the charges of the individual protons, to determine the number of protons, divide the total charge by the charge of a single proton:

$$(a) \#_{\text{protons}} = \frac{\text{total charge}}{\text{charge per proton}} = \frac{2.44 \times 10^{-12} \text{ C}}{1.6022 \times 10^{-19} \text{ C/e}^-} = 1.52 \times 10^7 \text{ protons}$$

- (b) To determine the mass of all of the protons, multiply the number of protons calculated above by the mass of a single proton:

$$m_{\text{protons}} = (\#_{\text{protons}})(m_{\text{proton}}) = 1.52 \times 10^7 \text{ protons} \left(\frac{1.6726 \times 10^{-27} \text{ kg}}{1 \text{ proton}} \right) = 2.54 \times 10^{-20} \text{ kg}$$

Extra:

We covered the Rutherford model in class. You should be able to explain the experimental setup, the observations, the conclusions and sketch the Rutherford model of the atom.

- 2.20 The left superscript in an isotopic symbol is the mass number, A , which is the sum of protons and neutrons; the left subscript is the atomic number, Z , which is the number of protons, and a right superscript indicates (protons – electrons), when this quantity is non-zero.

(a) 30 protons, 36 neutrons, 28 electrons; (b) 7 p , 8 n , 7 e ; (c) 35 p , 46 n , 34 e ;
(d) 35 p , 44 n , 36 e ; and (e) 92 p , 146 n , 92 e .

- 2.22 An isotopic symbol has the elemental symbol prefaced by a superscript giving the mass number, A , which is the sum of protons and neutrons, and a subscript giving the atomic number, Z (the number of protons). Use the periodic table in your text to determine which elemental symbol corresponds to the atomic number.

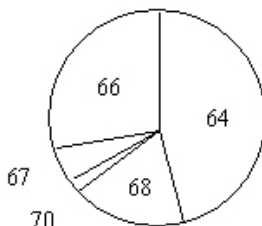
(a) Helium (He) has 2 protons, $Z = 2$; $A = 2 + 1 = 3$; ${}^3_2\text{He}$;

(b) Zinc (Zn) has 30 protons (see periodic table). ${}^{66}_{30}\text{Zn}$;

(c) Element 54 is xenon (Xe). $A = 54 + 78 = 132$. ${}^{132}_{54}\text{Xe}$;

(d) Nitrogen (N) has $Z = 7$. $A = 7 + 7 = 14$. ${}^{14}_7\text{N}$.

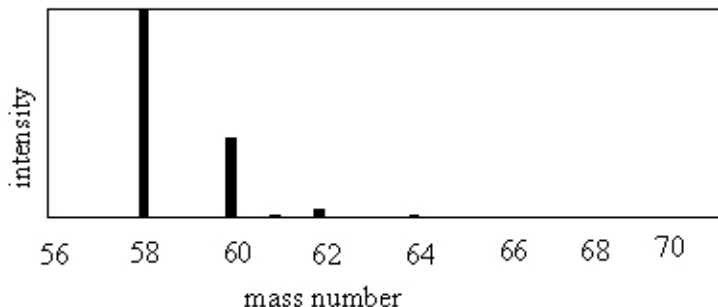
- 2.26 A pie chart is a circular chart with each piece of the pie proportional in size to the percentage of the isotope that it represents.



The relative mass is calculated by multiplying the mass number of each isotope with the fraction of its isotopic abundance and summing over all isotopes.

$$\begin{aligned}\text{Relative mass} &= 64(0.486) + 66(0.279) + 67(0.041) + 68(0.188) + 70(0.006) \\ &= 65.469\end{aligned}$$

- 2.68 An atomic mass spectrum contains a peak at each isotopic mass, and the peak heights are proportional to the isotopic abundances. For nickel there are 5 peaks:



The relative mass from the periodic table is 58.693. This makes sense since the peak at mass 58 is more than twice the height of the peak at mass 60 (and all the other peaks are small, and larger than 58).

- 1.46 The question asks for a comparison of the masses of two objects of different densities and shapes. For each object, $m = \rho V$.

The sphere of Al has $\rho = 2.70 \text{ g cm}^{-3}$, $V = \left(\frac{4}{3}\right)\pi r^3$, and $r = \text{diameter}/2 = 1.00 \text{ cm}$;

$$V = \frac{4\pi(1.00\text{cm})^3}{3} = 4.19 \text{ cm}^3;$$

$$m(\text{aluminum}) = 4.19 \text{ cm}^3 \left(\frac{2.70 \text{ g}}{1 \text{ cm}^3}\right) = 11.3 \text{ g};$$

The cube of Fe has $\rho = 7.86 \text{ g cm}^{-3}$ and $V = l w h = (2.00 \text{ cm})^3 = 8.00 \text{ cm}^3$;

$$m(\text{iron}) = 8.00 \text{ cm}^3 \left(\frac{7.86 \text{ g}}{1 \text{ cm}^3}\right) = 62.9 \text{ g}$$

The iron cube has more mass than the aluminum sphere.

- 1.94 The question asks for the mass of CO in a room. The data provided are the amount of CO per cubic meter of air and the dimensions of the room in feet. From the dimensions, we can calculate the volume of the room and convert it into cubic meters.

$$V = l w h = (12 \text{ ft})(9.5 \text{ ft})(10.5 \text{ ft}) \left(\frac{0.3048 \text{ m}}{1 \text{ ft}}\right)^3 = 33.9 \text{ m}^3;$$

$$m = 33.9 \text{ m}^3 \left(\frac{5.5 \text{ mg}}{1.000 \text{ m}^3}\right) \left(\frac{10^{-3} \text{ g}}{1 \text{ mg}}\right) = 0.19 \text{ g}$$