DIMENSIONAL ANALYSIS (FACTOR LABEL METHOD)

Name _____

Using this method, it is possible to solve many problems by using the relationship of one unit to another. For example, 12 inches = one foot. Since these two numbers represent the same value, the fractions 12 in/1 ft and 1 ft/12 in are both equal to one. When you multiply another number by the number one, you do not change its value. However, you may change its unit.

Example 1: Convert 2 miles to inches.

$$2 \text{ miles} \times \frac{5{,}280 \text{ ft}}{1 \text{ mile}} \times \frac{12 \text{ inches}}{1 \text{ ft}} = 126{,}720 \text{ in}$$

(Using significant figures, 2 mi = 100,000 in.)

Example 2: How many seconds are in 4 days?

$$4 \text{ days} \times \frac{24 \text{ hrs}}{1 \text{ day}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{60 \text{ sec}}{1 \text{ min}} = 345{,}600 \text{ sec}$$

(Using significant figures, 4 days = 300,000 sec.)

Solve the following problems. Write the answers in significant figures.

1. 3 hrs = _____ sec
2. 0.035 mg = _____ cg
3. 5.5 kg = _____ lbs
4. 2.5 yds = _____ in
5. 1.3 yrs = _____ hr (1 yr = 365 days)
6. 3 moles = _____ molecules (1 mole = 6.02×10^{23} molecules)
7. 2.5×10^{24} molecules = _____ moles
8. 5 moles = _____ liters (1 mole = 22.4 liters)
9. 100. liters = _____ moles
10. 50. liters = _____ molecules
11. 5.0×10^{24} molecules = _____ liters
12. 7.5×10^{3} mL = _____ liters

1) $3\ \text{hrs} \times \frac{60\ \text{min}}{1\ \text{hr}} \times \frac{60\ \text{sec}}{1\ \text{min}} = 180\ \text{sec}$

2) $0.035\ \text{mg} \times \frac{1\ \text{g}}{1000\ \text{mg}} \times \frac{100\ \text{cg}}{1\ \text{g}} = 0.0035\ \text{cg}$

3) $5.5\ \text{kg} \times \frac{2.2\ \text{lbs}}{1\ \text{kg}} = 12\ \text{lbs}$

4) $2.5\ \text{yds} \times \frac{3\ \text{ft}}{1\ \text{yd}} \times \frac{12\ \text{in}}{1\ \text{ft}} = 90\ \text{in}$

5) $1.3\ \text{yrs} \times \frac{365\ \text{days}}{1\ \text{yrs}} \times \frac{24\ \text{hrs}}{1\ \text{day}} \approx 11000\ \text{hrs}$

6) $3\ \text{moles} \times \frac{6.02 \times 10^{23}\ \text{molecules}}{1\ \text{mole}} = 2 \times 10^{24}$

7) $2.5 \times 10^{24}\ \text{molecules} \times \frac{1\ \text{mole}}{6.02 \times 10^{23}\ \text{molecules}} = 4.2\ \text{moles}$

8) $5\ \text{moles} \times \frac{22.4\ \text{L}}{1\ \text{mole}} = 100\ \text{L}$

9) $100\ \text{L} \times \frac{1\ \text{mole}}{22.4\ \text{L}} = 4.46\ \text{moles}$

10) $50\ \text{L} \times \frac{1\ \text{mole}}{22.4\ \text{L}} \times \frac{6.02 \times 10^{23}\ \text{molecules}}{1\ \text{mole}} = 1.3 \times 10^{24}\ \text{molecules}$

11) $5.0 \times 10^{24}\ \text{molecules} \times \frac{1\ \text{mole}}{6.02 \times 10^{23}\ \text{molecules}} \times \frac{22.4\ \text{L}}{1\ \text{mole}} = 180\ \text{L}$

12) $7.5 \times 10^{3}\ \text{mL} \times \frac{1\ \text{L}}{1000\ \text{mL}} = 7.5\ \text{L}$