

PROBLEM SOLVING BY DIMENSIONAL ANALYSIS

Answers to Problems: Dimensional Analysis

NOTE: The following problems can be solved using relationships or conversion factors other than those shown. In some cases, alternative conversion factors are indicated.

1. Convert 3.56 g to cg.

$$? \text{cg} = 3.56 \text{g} \times \frac{100 \text{cg}}{1 \text{g}} = 356 \text{cg}$$

2. Convert 42.5 mL to dL.

$$? \text{dL} = 42.5 \text{mL} \times \frac{1 \text{cL}}{10 \text{mL}} \times \frac{1 \text{dL}}{10 \text{cL}} = 0.425 \text{dL}$$

This can also be solved using the relationship $100 \text{ mL} = 1 \text{ dL}$

3. Convert 204 dm to km.

$$? \text{km} = 204 \text{dm} \times \frac{1 \text{m}}{10 \text{dm}} \times \frac{1 \text{km}}{1000 \text{m}} = 0.0204 \text{km}$$

4. Convert 45.4 kg to Mg.

$$? \text{Mg} = 45.4 \text{kg} \times \frac{1 \text{Mg}}{1000 \text{kg}} = 0.0454 \text{Mg} = 4.54 \times 10^{-2} \text{Mg}$$

This can also be solved using the relationships $1000 \text{ g} = 1 \text{ kg}$ and $1\,000\,000 \text{ g} = 1 \text{ Mg}$

5. Convert 2.60 cL to μL .

$$? \mu\text{L} = 2.60 \text{cL} \times \frac{10 \text{mL}}{1 \text{cL}} \times \frac{1000 \mu\text{L}}{1 \text{mL}} = 26000 \mu\text{L} = 2.60 \times 10^4 \mu\text{L}$$

This can also be solved using the relationships $100 \text{ cL} = 1 \text{ L}$ and $1 \times 10^6 \mu\text{L} = 1 \text{ L}$

6. Convert 254 pm to nm.

$$? \text{nm} = 254 \text{pm} \times \frac{1 \text{nm}}{1000 \text{pm}} = 0.254 \text{nm} = 2.54 \times 10^{-1} \text{nm}$$

This can also be solved using the relationships $1 \times 10^{12} \text{ pm} = 1 \text{ m}$ and $1 \text{ m} = 1 \times 10^9 \text{ nm}$

7. The mass of a hydrogen atom is 1.67×10^{-24} g. Express this mass in pg.

$$? \text{ pg} = 1.67 \times 10^{-24} \text{ g} \times \frac{1 \times 10^{12} \text{ pg}}{1 \text{ g}} = 1.67 \times 10^{-12} \text{ pg}$$

8. The diameter of a carbon atom is 182 pm. What is the diameter in a) nm b) cm c) m ?

a)
$$? \text{ nm} = 182 \text{ pm} \times \frac{1 \text{ nm}}{1000 \text{ pm}} = 1.82 \times 10^{-1} \text{ nm}$$

This can also be solved using the relationships $1 \times 10^{12} \text{ pm} = 1 \text{ m}$ and $1 \text{ m} = 1 \times 10^9 \text{ nm}$

b)
$$? \text{ cm} = 182 \text{ pm} \times \frac{1 \text{ nm}}{1000 \text{ pm}} \times \frac{1 \mu\text{m}}{1000 \text{ nm}} \times \frac{1 \text{ mm}}{1000 \mu\text{m}} \times \frac{1 \text{ cm}}{10 \text{ mm}} = 1.82 \times 10^{-8} \text{ cm}$$

This can also be solved using the relationships $1 \times 10^{12} \text{ pm} = 1 \text{ m}$ and $1 \text{ m} = 100 \text{ cm}$

c)
$$? \text{ m} = 182 \text{ pm} \times \frac{1 \text{ m}}{1 \times 10^{12} \text{ pm}} = 1.82 \times 10^{-10} \text{ m}$$

9. In a gas chromatography experiment, a $5.0 \mu\text{L}$ sample of gasoline was analyzed. Express this volume in mL.

$$? \text{ mL} = 5.0 \mu\text{L} \times \frac{1 \text{ mL}}{1000 \mu\text{L}} = 5.0 \times 10^{-3} \text{ mL}$$

This can also be solved using the relationships $1 \text{ L} = 1 \times 10^6 \mu\text{L}$ and $1 \text{ L} = 1 \times 10^3 \text{ mL}$

10. The speed of light is 3.0×10^{10} cm/s. Calculate the length of a light year in a) m b) km.
(A light year is the distance light travels in one year [365 days])

$$1 \text{ light year} = \frac{? \text{ m}}{1 \text{ year}} = \frac{3.0 \times 10^{10} \text{ cm}}{1 \text{ s}} \times \frac{60 \text{ s}}{1 \text{ min}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{24 \text{ hr}}{1 \text{ day}} \times \frac{365 \text{ days}}{1 \text{ year}} \times \frac{1 \text{ m}}{100 \text{ cm}} = \frac{9.5 \times 10^{15} \text{ m}}{\text{year}}$$

Note: This set up is simplified by using the relationship that a light year will be expressed as the distance in meters that light travels in one year

11. How many dg are there in 1.0 kg of flour?

$$? \text{ dg} = 1.0 \text{ kg} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{10 \text{ dg}}{1 \text{ g}} = 1.0 \times 10^4 \text{ dg}$$

12. A jogger runs a km in 6.0 minutes. Calculate her speed in a) km/hr b) m/min c) cm/s.

a) $? \frac{\text{km}}{\text{hr}} = \frac{1.0 \text{ km}}{6.0 \text{ min}} \times \frac{60 \text{ min}}{1 \text{ hr}} = \frac{10 \text{ km}}{\text{hr}}$

b) $? \frac{\text{m}}{\text{min}} = \frac{1.0 \text{ km}}{6.0 \text{ min}} \times \frac{1000 \text{ m}}{1 \text{ km}} = \frac{167 \text{ m}}{\text{min}} = 170 \text{ m/min}$ (2 significant figures)

c) $? \frac{\text{cm}}{\text{s}} = \frac{1.0 \text{ km}}{6.0 \text{ min}} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{100 \text{ cm}}{1 \text{ m}} \times \frac{1 \text{ min}}{60 \text{ s}} = \frac{278 \text{ cm}}{\text{s}} = 280 \text{ cm/s}$

(2 significant figures)