Conversion Factors

1 dollar = 4 quarters = 10 dimes = 20 nickels = 100 pennies

Different ways to express the same amount of money

1 meter =10 decimeters =100 centimeters =1000 millimeters

Different ways to express length

Whenever two measurements are equivalent, a ratio of the two measurements will equal 1.

$$1\text{ m} = \frac{100\text{ cm}}{1\text{m}} = 1$$

Conversion factor

Conversion Factors

Conversion factor – a ratio of equivalent measurements

100 cm / 1 m

1000 mm / 1 m

The measurement on the top is equivalent to the measurement on the bottom

Read "one hundred centimeters per meter" and "1000 millimeters per meter"

Smaller number	→	1 m	←	larger unit
Larger number	→	100 cm	←	smaller unit

Conversion Factors

When a measurement is multiplied by a conversion factor, the numerical value is generally changed, but the actual size of the quantity measured remains the same.

Conversion factors within a system of measurements are defined quantities or exact quantities.

Therefore, they have an unlimited number of significant figures and do not affect the rounding of a calculated answer.

How many significant figures does a conversion factor within a system of measurements have?

Dimensional Analysis

Dimensional analysis – a way to analyze and solve problems using the units, or dimensions, of the measurements.

How many minutes are there in exactly one week?

60 minutes = 1 hour24 hours = 1 day
7 days = 1 week

$$\frac{1\ \text{week}}{} \left| \frac{7\ \text{days}}{1\ \text{week}} \right| \frac{24\ \text{hours}}{1\ \text{day}} \left| \frac{60\ \text{minutes}}{1\ \text{hour}} \right. = 10{,}080\ \text{min}$$

1.0080×10^4 min

Dimensional Analysis

How many seconds are in exactly a 40-hr work week?

60 minutes = 1 hour24 hours = 1 day
7 days = 1 week60 seconds = 1 minute

$$\frac{40\ \text{hr}}{} \left|\ \frac{60\ \text{min}}{1\ \text{hr}}\ \right|\ \frac{60\ \text{sec}}{1\ \text{min}} = 144{,}000\ \text{s}$$

1.44000×10^5 s

Dimensional Analysis

An experiment requires that each student use an 8.5 cm length of Mg ribbon. How many students can do the experiment if there is a 570 cm length of Mg ribbon available?

$$570 \text{ cm ribbon} \times \frac{1 \text{ student}}{8.5 \text{ cm ribbon}} = 67 \text{ students}$$

2 sig figs

Dimensional Analysis

A 1.00º increase on the Celsius scale is equivalent to a 1.80º increase on the Fahrenheit scale. If a temperature increases by 48.0ºC, what is the corresponding temperature increase on the Fahrenheit scale?

$$\frac{48.0^\circ\text{C}}{} \left| \frac{1.80^\circ\text{F}}{1.00^\circ\text{C}} \right. = 86.4^\circ\text{F}$$

A chicken needs to be cooked 20 minutes for each pound it weights. How long should the chicken be cooked if it weighs 4.5 pounds?

$$\frac{4.5\ \text{lb}}{} \left| \frac{20\ \text{min}}{\text{lb}} \right. = 90\ \text{min}$$

Dimensional Analysis

Gold has a density of 19.3 g/cm^3. What is the density in kg/m^3

$$\frac{19.3\ \text{g}}{\text{cm}^3} \left| \frac{1\ \text{kg}}{1000\ \text{g}} \right| \frac{1 \times 10^6\ \text{cm}^3}{\text{m}^3} = 1.93 \times 10^4\ \text{kg / m}^3$$

There are 7.0 x 10^6 red blood cell (RBC) in 1.0 mm^3 of blood. How many red blood cells are in 1.0 L of blood?

$$\frac{7.0 \times 10^6\ \text{RBC}}{1.0\ \text{mm}^3} \left| \frac{1 \times 10^6\ \text{mm}^3}{\text{dm}^3} \right| \frac{1\ \text{dm3}}{1\ \text{L}} = 7.0 \times 10^{12}$$

Dimensional Analysis

1.00 L of neon gas contains 2.69×10^{22} neon atoms. How many neon atoms are in $1.00 mm^3$ of neon gas under the same conditions?

$$\frac{2.69 \times 10^{22} \text{ atoms}}{1.00 \text{ L}} \times \frac{1 \text{ L}}{1 \text{ dm}^3} \times \frac{\text{dm}^3}{1 \times 10^6 \text{ mm}^3}$$

2.69×10^{16} atoms in $1.00 mm^3$ of gas

Questions

What conversion factor would you use to convert between these pairs of units?

Minutes to hours

1 hour / 60 minutes

grams to milligrams

1000 mg / 1 g

Cubic decimeters to milliliters

1000 ml / 1 dm^3

Questions

An atom of gold has a mass of 3.271×10^{-22}g. How many atoms of gold are in 5.00 g of gold?

1.53×10^{22} atoms of gold

Light travels at a speed of 3.00×10^{10} cm/sec. What is the speed of light in km/hour?

1.08×10^{9} km/hr

Questions

Convert the following. Express your answers in scientific notation.

7.5×10^4 J to kJ

7.5×10^1 kJ

3.9×10^5 mg to dg

3.9×10^3dg

2.21×10^{-4} dL to µL

2.21×10^1µL

Questions

Make the following conversions. Express your answers in standard exponential form.

14.8 g to μg

1.48×10^{7} μg

3.75×10^{-3} kg to g

3.72 g

66.3 L to cm^3

6.63×10^{4} cm^3

Density

If a piece of led and a feather of the same volume are weighted, the lead would have a greater mass than the feather.

It would take a much larger volume of feather to equal the mass of a given volume of lead.

Density = mass / volume

$$D = m / v$$

Mass is a <u>extensive</u> property (a property that depends on the size of the sample)

Density is an <u>intensive</u> property (depends on the composition of a substance, not on the size of the sample)

Density

A helium filled balloon rapidly rises to the ceiling when released.

Whether a gas-filled balloon will sink or rise when released depends on how the density of the gas compares with the density of air.

Helium is less dense than air, so a helium filled balloon rises.

Density and Temperature

The volume of most substances increase as the temperature increases.

The mass remains the same despite the temperature and volume changes.

So if the volume changes with temperature while the mass remains constant, then the density must also change with temperature.

The density of a substance generally decreases as its temperature increases. (water is the exception: ice floats because it is less dense than liquid water)

Questions

A student finds a shiny piece of metal that she thinks is aluminum. In the lab, she determines that the metal has a volume of 245cm^3 and a mass of 612g. Was is the density? Is it aluminum?

$$D = 612\text{g} / 245\text{cm}^3 = 2.50\text{g/cm}^3$$

D of aluminum is 2.70 g/cm^3; no it is not aluminum

A bar of silver has a mass of 68.0 g and a volume of 6.48 cm^3. What is the density?

$$D = 68.0\text{g} / 6.48\text{ cm}^3 = 10.5\text{ g/cm}^3$$

Questions

The density of boron is 2.34 g/cm3. Change 14.8 g of boron to cm3 of boron.

$$D = m / v \quad \text{or} \quad v = m / D$$

$$V = \frac{14.8\ \cancel{g}}{} \Big| \frac{cm^3}{2.34\ \cancel{g}} = 6.32\ cm^3$$

Convert 4.62 g of mercury to cm^3 by using the density of mercury -13.5 g/cm^3.

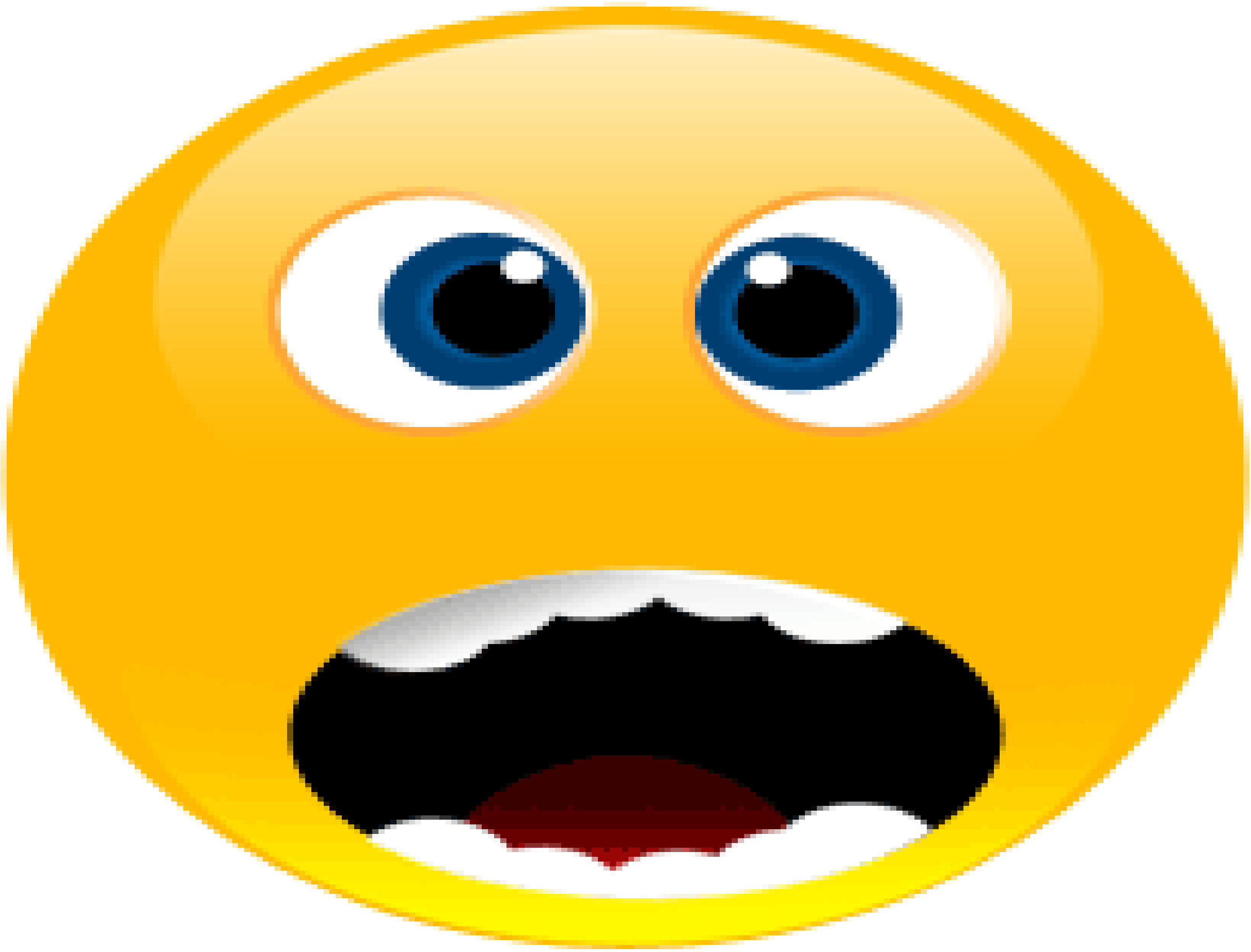
$$V = \frac{46.2\ \cancel{g}}{} \Big| \frac{cm^3}{13.5\ \cancel{g}} = 0.342\ cm^3$$

Density

$$D = m / v$$

$$v = m / D$$

$$m = D \cdot v$$



End of Chapter 3