

Measurement and Calculation

For very large and very small numbers
use **scientific notation**

125,000,000

becomes

1.25×10^8



0.000031

becomes

3.1×10^{-5}

Try These

123,000,000,000,000

0.000000303

Using your Calculator

$$4.86 \times 10^7$$

To enter a number in scientific notation

REMEMBER

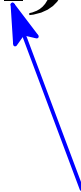
$$4.86 \times 10^7$$

How it's Done

4.86x10⁷

type in 4.86

For negative exponents

$$6.03 \times 10^{-9}$$


Q1

Enter the following numbers into your calculator

$$2.86 \times 10^{10}$$

$$9.37 \times 10^{-14}$$

Try these on your calculator

$$\frac{(3.99 \times 10^4)(8.61 \times 10^{11})}{(2.05 \times 10^{-3})}$$

$$(9.02 \times 10^{-6}) - (2.18 \times 10^{-6})$$

Use your calculator wisely

Perform the following operations:

$$\frac{(3.0)(19)(0.35)}{(11)(81)(2.3 \times 10^{-4})}$$

Significant Figures

How long is the piece of wood?



the stick is 100 cm long

What you use to measure defines
how to write the value!

**Rules for determining
the number of significant figures**

All integers are significant 127 yards has 3 sf

SOME 0's are **not** significant

large numbers with no decimal 93,000 miles has 2 sf

small numbers after decimal, before first integer

0.00039 meters has 2 sf

Rounding off

Round off by going out **one more digit** than wanted

round the following off to 3 sf's

23470

0.004305

6401^{*}

Rules for math operations

When multiplying and dividing,
round answer off to the number
in the calculation with the **fewest sf's**

$$\frac{(2.765)(8100)}{(2340)(87.1)}$$

Try One

Q3

**Calculate the volume of a rectangular solid,
round off to proper significant figures.**

$$[V = (l)(w)(h)]$$

length = 7.11 inches, width = 8.3 inches, height = 11.43 inches

Adding and Subtracting

Report your answer to the number
in the calculation that has
the **fewest decimal places**

$$\begin{array}{r} 8.312 \\ 3.1 \\ 0.0032 \\ \hline \end{array}$$

Q4

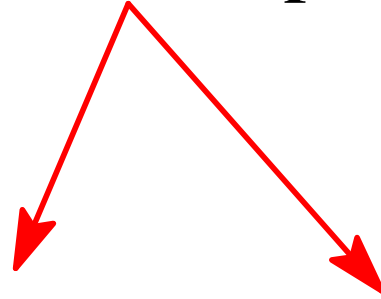
Add the Following

(report to correct significant figs)

$$\begin{array}{r} 31.5 \text{ m} \\ 8.631 \\ + 0.0015 \text{ m} \\ \hline \end{array}$$

Be Careful!

Note: not the same exponent of 10



$$(2.863 \times 10^4 - 1.22 \times 10^3) = ?$$

cannot use decimal rule until both
are to the **same larger exponent of 10**

Q5

Try One

Subtract the following

$$(2.861 \times 10^{-3}) - (1.51 \times 10^{-4})$$

A Practical Application

Determine the density of a liquid if 28.96g occupies 12 mL

$$D = \frac{M}{V} = \frac{28.96\text{g}}{12 \text{ mL}}$$

Dimensional Analysis-

A method of problem solving

if

$$a=b$$

$$\frac{a}{b} = ?$$

$$\frac{b}{a} = ?$$

$$c \left(\frac{a}{b} \right) = ?$$

Applying this

$$12 \text{ inches} = 1 \text{ foot}$$

$$\frac{12 \text{ inches}}{1 \text{ foot}} = 1 \quad \frac{1 \text{ foot}}{12 \text{ inches}} = 1$$

Problem: Convert 192 inches to feet

$$192 \text{ inches} \left(\frac{\quad}{\quad} \right)$$

Problem: Convert 13 feet to inches

$$13 \text{ feet} \left(\frac{\quad}{\quad} \right)$$


Terminology

12 inches = 1 foot

Convert 192 inches to feet

A Map

how to get there

where to start  where you are going

The Look of Identities in a Problem

There are 2 dozen cookies in a box

Pack 36 books per carton

A car travels at 55 miles/hour

Note: identities relate one thing to another

The Look of Given in a Problem

A car travels for 6 hours

The distance to San Antonio is 71 miles

A beaker contains 65.5 g of mercury

Analyzing a Problem

given?

question?

identity?

There are 255 seeds in each pack of marigolds.

How many packs are needed to plant 1275 seeds?

Diagramming the problem

255 seeds = 1 pack

1275 seeds \longrightarrow **packs**

1. Common Knowledge Identities

A car has been traveling for 38 miles at a speed of 45 miles/hr. How many minutes has the car been traveling?

38 miles \longrightarrow minutes?

The Metric System and Identities

dimension	measure	symbol
length	meter	m
mass	gram	g
volume	liter	L

Prefixes

prefixes give magnitude to the dimension

Table 3.2 Metric Prefixes*

<i>Large Units</i>			<i>Small Units</i>		
Metric Prefix	Metric Symbol	Multiple	Metric Prefix	Metric Symbol	Multiple
tera-	T	10^{12}	Unit (gram, meter, liter)		$1 = 10^0$
giga-	G	10^9	deci-	d	$0.1 = 10^{-1}$
mega-	M	$1,000,000 = 10^6$	centi-	c	$0.01 = 10^{-2}$
kilo-	k	$1,000 = 10^3$	milli-	m	$0.001 = 10^{-3}$
hecto-	h	$100 = 10^2$	micro-	μ	$0.000001 = 10^{-6}$
deca-	da	$10 = 10^1$	nano-	n	10^{-9}
Unit (gram, meter, liter)		$1 = 10^0$	pico-	p	10^{-12}

*The most important prefixes are printed in **boldface**.

femto f 1×10^{-15}

Using Prefixes to Give Identities

1 mg =

1 GL =

1 μ m =

Problem

2.

Convert 175 g to ng

175 g \longrightarrow ng

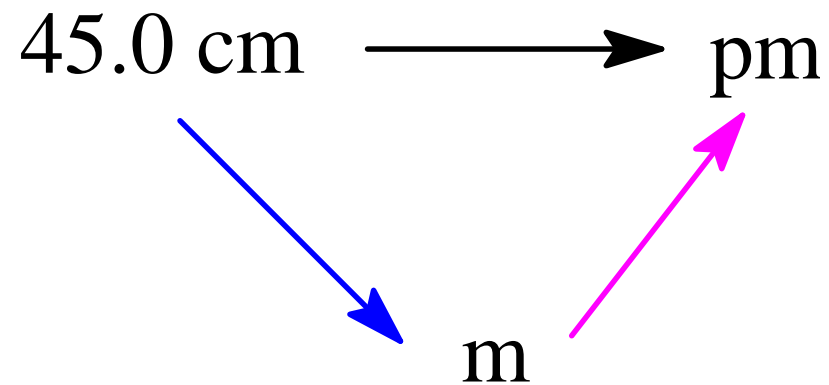
More

3.

Convert 45.0 cm to pm

Note: both have prefixes!

(go through base unit to solve)



Converting Between Metric and English (USCS) Systems

Table 3.3 Metric-USCS Conversion Factors

Mass	Length	Volume
1 lb = 454 g	1 in. \equiv 2.54 cm (definition)	1.06 qt = 1 L
1 oz = 28.3 g	1 ft = 30.5 cm	1 gal = 3.785 L
2.20 lb = 1 kg	39.4 in. = 1 m	1 gal (imp) = 4.546 L
		1 in. ³ = 16.39 cm ³
		1 ft ³ = 2.832 \times 10 ⁴ cm ³
Pressure		Energy
14.69 lb/in. ² = 29.92 in. mercury = 1 atm		1 calorie \equiv 4.184 J (definition)
\equiv 760 torr (definition) = 760 mm mercury		1 Btu = 1.05 kJ
= 101.3 kPa		

Example

4.

Steak costs \$6.00/pound. How many cents would it cost to buy 875 g of steak?

875 g \longrightarrow cents

\$6.00 = 1 pound

pounds \longrightarrow \$

Try One

6.

A car travels 63 miles/hour for a distance of 184 km.

How many seconds will it take to travel this distance? (1 mile = 1.61 km)

% as identities

a chemistry class is 48% female students

26% of all fruit in the bowl are rotten

Example Problem 5.

A box of chocolates contains 36 candies.

46 % of the candies are dark chocolate.

Of the dark chocolate candies, 27 % are filled.

How many filled, dark chocolate candies are in the box?

Volume Measurement

- Volume is a derived unit from length
- 1 mL = 1 cm³ by definition

Density and Dimensional Analysis

$$7. \\ D = \frac{\text{mass}}{\text{volume}}$$

Use this formula **ONLY** if asked to determine density!

If density is given, use as an identity!

**The density of mercury is 13.6 g/mL.
How many kg of mercury does 975 mL weigh?**

Diagram the problem.

Answer

**The density of mercury is 13.6 g/mL.
How many kg of mercury does 975 mL weigh?**

Try This One

8.

The density of ethanol is 0.789 g/cm^3 .

What is the mass in pounds of 1639 mL of ethanol?

Last Word on Significant Figures

**Some number are exact
(have infinite significance)**

counting ("there are 35 candies in the box")

definitions (12 inches = 1 ft)

Temperature Scales-Conversions

