1.1	The Metric System and SI Units
1.2	Scientific Notation and Significant Digits

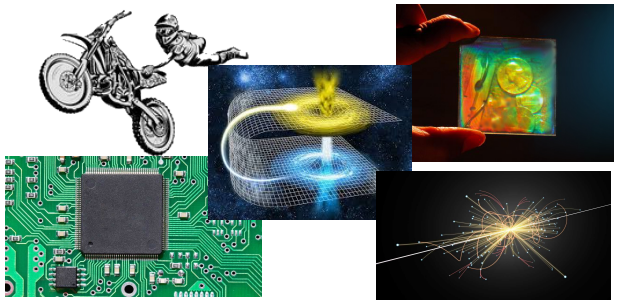
STANDARDS

1.1 I can identify and utilize the metric system, and the fundamental SI units for time, length, and mass.

1.2 I can demonstrate an ability to use scientific notation.

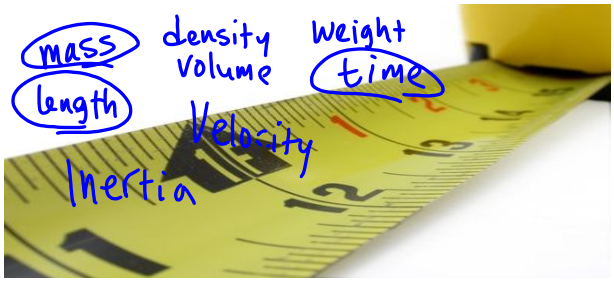
The Scope of Physics

Physics is about trying to find the simple laws that describe all natural phenomena.



Physical Quantities

We define a **physical quantity** either by specifying how it is measured or by stating how it is calculated from other measurements.



Physical Quantities

Measurements of physical quantities are expressed in terms of **units**, which are standardized values.

Systems of Units

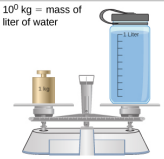
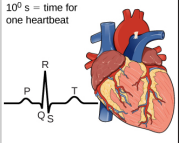
- Imperial System
  - « United States customary units
- International System (SI)
  - « Metric System

SI UNITS

Table 1-1
SI Base Units

Base Quantity	Base Unit	Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	s
Temperature	kelvin	K
Amount of a substance	mole	mol
Electric current	ampere	A
Luminous intensity	candela	cd

The Scale of Physics

Length in Meters (m)	Masses in Kilograms (kg)	Time in Seconds (s)
10^{-15} m = diameter of proton	10^{-30} kg = mass of electron	10^{-22} s = mean lifetime of very unstable nucleus
10^{-14} m = diameter of large nucleus	10^{-27} kg = mass of proton	10^{-17} s = time for single floating-point operation in a supercomputer
10^{-10} m = diameter of hydrogen atom	10^{-15} kg = mass of bacterium	10^{-15} s = time for one oscillation of visible light
10^{-7} m = diameter of typical virus	10^{-5} kg = mass of mosquito	10^{-13} s = time for one vibration of an atom in a solid
10^{-2} m = pinky fingernail width	10^{-2} kg = mass of hummingbird	10^{-3} s = duration of a nerve impulse
10^{0} m = height of 4 year old child 	10^{0} kg = mass of liter of water 	10^{0} s = time for one heartbeat 
10^{2} m = length of football field	10^{2} kg = mass of person	10^{5} s = one day
10^{7} m = diameter of Earth	10^{19} kg = mass of atmosphere	10^{7} s = one year
10^{13} m = diameter of solar system	10^{22} kg = mass of Moon	10^{9} s = human lifetime
10^{16} m = distance light travels in a year (one light-year)	10^{25} kg = mass of Earth	10^{11} s = recorded human history
10^{21} m = Milky Way diameter	10^{30} kg = mass of Sun	10^{17} s = age of Earth
10^{26} m = distance to edge of observable universe	10^{53} kg = upper limit on mass of known universe	10^{18} s = age of the universe

Fill In The Blank

1 kilometer = 1000 meters

Metric Prefixes for Powers of 10 and Their Symbols

Prefix	Symbol	Meaning	Prefix	Symbol	Meaning
yotta-	Y	10^{24}	yocto-	y	10^{-24}
zetta-	Z	10^{21}	zepto-	z	10^{-21}
exa-	E	10^{18}	atto-	a	10^{-18}
peta-	P	10^{15}	femto-	f	10^{-15}
tera-	T	10^{12}	pico-	p	10^{-12}
giga-	G	10^{9}	nano-	n	10^{-9}
mega-	M	10^{6}	micro-	μ	10^{-6}
kilo-	k	10^{3}	milli-	m	10^{-3}
hecto-	h	10^{2}	centi-	c	10^{-2}
deka-	da	10^{1}	deci-	d	10^{-1}

1,000,000 dollars

1 M.d

Converting Units

The following time is given using metric prefixes on the base SI unit of time: the second. Convert 577μs to seconds.

577×10^{-6} s

Converting Units

The following length is given in meters. Use metric prefixes to rewrite 1.63×10^{13}m so the numerical value is bigger than one but less than 1000. For example, 7.9×10^{-2}m could be written either as 7.9 cm or 79 mm.

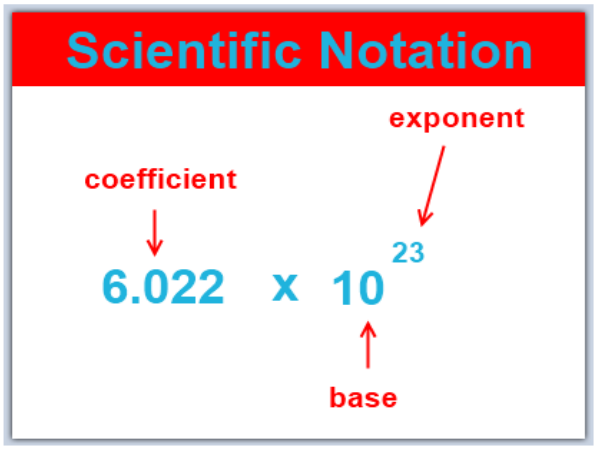
x10 x10 x10 x10 ...

16.3×10^{12} m.

16.3 Tm.

SCIENTIFIC NOTATION

- **Scientific notation** is a way of writing numbers that are too big or too small in a convenient and standard form.
- Scientific notation has a number of useful properties and is commonly used in calculators and by scientists, mathematicians and engineers.



EXAMPLES

Write the following numbers in scientific notation.

1. 1,001 1.001×10^3
2. 53 5.3×10^1
3. 6,926,300,000 6.9263×10^9
4. -392 -3.92×10^2
5. 0.00361 3.61×10^{-3}

$10^{-1} = \frac{1}{10}$

EXAMPLES

Write the following numbers in scientific notation.

1. 1,001 1.001×10^3
2. 53 5.3×10^1
3. 6,926,300,000 6.9263×10^9
4. -392 -3.92×10^2
5. 0.00361 3.61×10^{-3}

EXAMPLES

Write the following numbers in standard notation.

1. 1.92×10^3
2. 3.051×10^1
3. -4.29×10^2
4. -6.5×10^{-4}
5. 8.317×10^{-3}

EXAMPLES

Write the following numbers in standard notation.

1. 1.92×10^3 1,920
2. 3.051×10^1 30.51
3. -4.29×10^2 -429
4. -6.5×10^{-4} -0.00065
5. 8.317×10^{-3} 0.008317

HOMEWORK

UNIT 1 PROBLEMS (1-5)