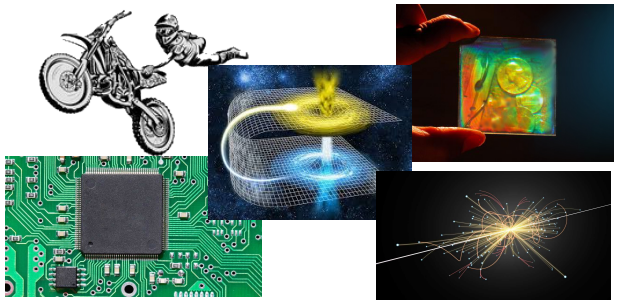
1.1	The Metric System and SI Units
1.2	Scientific Notation and Significant Digits

STANDARDS

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

Length
Mass
Time

Volume
Density
Velocity
Temperature

Charge
Amplitude

Physical Quantities

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

Systems of Units

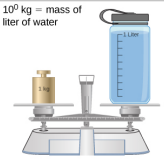
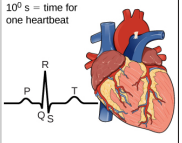
- Imperial System
  - « United States customary units
- International System (SI)
  - « Metric System

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}

2,000,000,000,000

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.

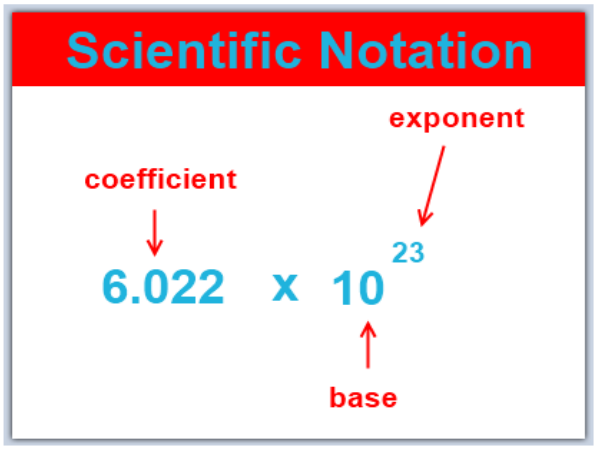
$1.63 \times 10 \times 10 \times 10 \times 10 \ldots$

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
3. 6,926,300,000
4. -392
5. 0.00361

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)