



THE SI SYSTEM AND UNITS OF MEASUREMENT

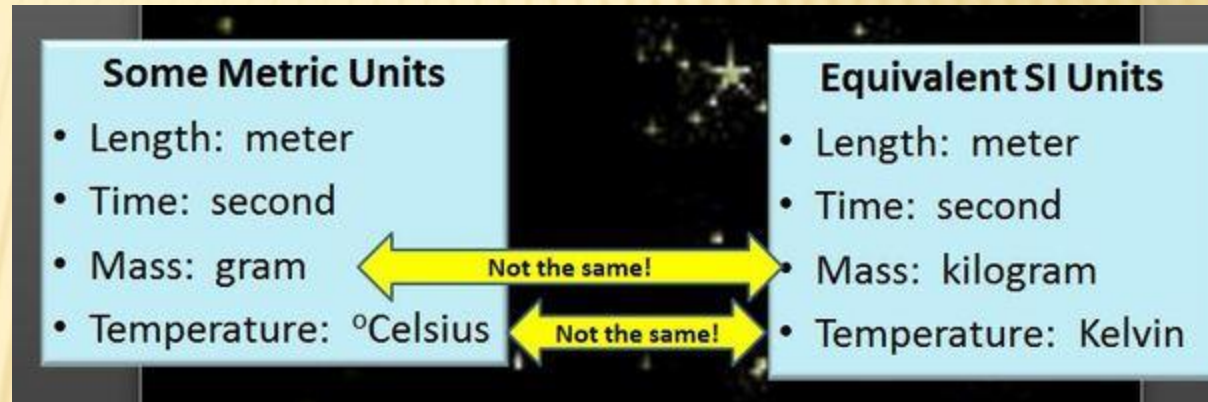
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MEASUREMENT

- ✗ In the late 18th century, scientists used the *metric system*
- ✗ The metric system is a precursor to the *SI System*
- ✗ Scientists all over the world use a single measurement system called *Le Systeme International d'unités*, abbreviated SI

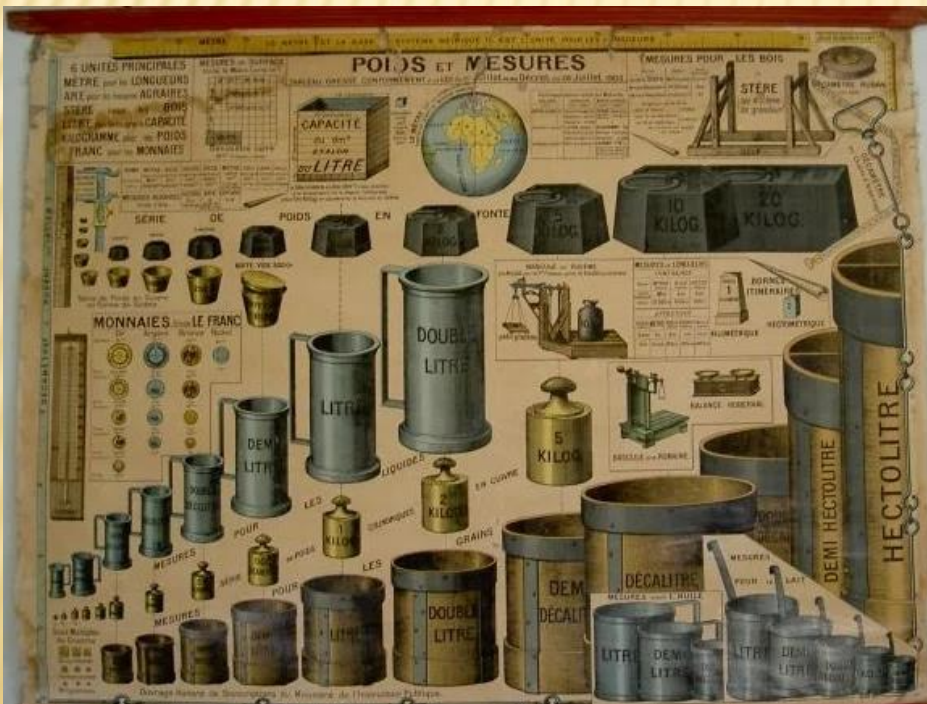


MEASUREMENT SYSTEM COMPARISONS

MEASUREMENT	ENGLISH (US)	SI SYSTEM
LENGTH	Foot / Inch	Meter
MASS	Ounce / Pound	Kilogram
VOLUME	Quart	Cubic meter
TEMPERATURE	Fahrenheit	Kelvin
TIME	Second	Second

SI SYSTEM OF MEASUREMENT

- ✖ This system was presented in 1960 by a *General Conference of Weights and Measures*
- ✖ SI has both base units and derived units



SI SYSTEM OF MEASUREMENT (CONT.)

✗ SI system:

- + based on meter-kilogram-second system (m k s)
- + replaces both the
foot-pound-second system (f p s)
and centimeter-gram-second system (c g s)

- ✗ There are seven SI
base units: meter,
kilogram, second,
mole, ampere, Kelvin and candela

System	Length	Mass	Time
F.P.S.	foot	pound	second
C.G.S.	centimetre	gram	second
M.K.S.	metre	kilogram	second

SI BASE UNITS

✕ The most common base units include:

Quantity	Quantity Symbol	Unit name	Unit abbreviation
Length	l	meter	m
Mass	m	kilogram	kg
Time	t	second	s
Temperature	T	Kelvin	K

UNITS IN THE SI SYSTEM

In the metric and SI systems, *one unit* is used for each type of measurement:

Measurement	Metric	SI
Length	meter (m)	meter (m)
Volume	liter (L)	cubic meter (m ³)
Mass	gram (g)	kilogram (kg)
Time	second (s)	second (s)
Temperature	Celsius (°C)	Kelvin (K)

UNITS IN THE SI SYSTEM (CONT.)

BASE QUANTITIES AND THEIR SYMBOLS IN THE SI SYSTEM

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

SI PREFIXES

- SI Units system includes a set of *prefixes*
- Use of a prefix makes a unit larger or smaller
- Ranges of SI unit prefixes are listed in the tables 1 and 2



SI PREFIXES: TABLE 1

<i>Prefix</i>	<i>Symbol</i>	<i>Function</i>	<i>Divided by</i>
deci	d	10^{-1}	10
centi	c	10^{-2}	100
milli	m	10^{-3}	1000
micro	μ	10^{-6}	1,000,000
nano	n	10^{-9}	1,000,000,000
pico	p	10^{-12}	1,000,000,000,000
femto	f	10^{-15}	1,000,000,000,000,000

SI PREFIXES: TABLE 2

<i>Prefix</i>	<i>Symbol</i>	<i>Function</i>	<i>Multiply by</i>
deca	da	10^1	10
hector	h	10^2	100
kilo	k	10^3	1000
mega	M	10^6	1,000,000
Giga	G	10^9	1,000,000,000
Tera	T	10^{12}	1,000,000,000,000
Peta	P	10^{15}	1,000,000,000,000,000

The Metric System Prefixes

Prefix	Symbol	Decimal Value	Scientific	Colloquial
quecto	q	0.000 000 000 000 000 000 000 000 000 001	10^{-30}	nonillionth
ronto	r	0.000 000 000 000 000 000 000 000 000 001	10^{-27}	octillionth
yocto	y	0.000 000 000 000 000 000 000 000 001	10^{-24}	septillionth
zepto	z	0.000 000 000 000 000 000 000 001	10^{-21}	sextillionth
atto	a	0.000 000 000 000 000 000 001	10^{-18}	quintillionth
femto	f	0.000 000 000 000 000 001	10^{-15}	quadrillionth
pico	p	0.000 000 000 001	10^{-12}	trillionth
nano	n	0.000 000 001	10^{-9}	billionth
micro	μ	0.000 001	10^{-6}	millionth
milli	m	0.001	10^{-3}	thousandth
centi	c	0.01	10^{-2}	hundredth
deci	d	0.1	10^{-1}	tenth
-	-	1	10^0	one
deka	da	10	10^1	ten
hecto	h	100	10^2	hundred
kilo	k	1 000	10^3	thousand
mega	M	1 000 000	10^6	million
giga	G	1 000 000 000	10^9	billion
tera	T	1 000 000 000 000	10^{12}	trillion
peta	P	1 000 000 000 000 000	10^{15}	quadrillion
exa	E	1 000 000 000 000 000 000	10^{18}	quintillion
zetta	Z	1 000 000 000 000 000 000 000	10^{21}	sextillion
yotta	Y	1 000 000 000 000 000 000 000 000	10^{24}	septillion
ronna	R	1 000 000 000 000 000 000 000 000 000	10^{27}	octillion
quetta	Q	1 000 000 000 000 000 000 000 000 000 000	10^{30}	nonillion

TEMPERATURE

- ✗ The standard unit of measurement for temperature is Kelvins (K)
- ✗ Temperature can also be measured in degrees Celsius ($^{\circ}\text{C}$) and degrees Fahrenheit ($^{\circ}\text{F}$)
- ✗ To convert degrees Celsius ($^{\circ}\text{C}$) to degrees Fahrenheit ($^{\circ}\text{F}$) multiply by 1.8 and then add 32. To convert degrees Fahrenheit to degrees Celsius, subtract 32 and then divide by 1.8
 $[^{\circ}\text{F} = (^{\circ}\text{C} \times 9/5) + 32]$
- ✗ $\text{K} = ^{\circ}\text{C} + 273$

DERIVED UNITS

- ✘ Derived units are *combinations* of base units
- ✘ They are produced by multiplying or dividing standard units

Quantity	Quantity symbol	Unit	Unit abbreviation
Area	A	square meter	m ²
Volume	V	cubic meter	m ³
Density	D	kilograms per cubic meter	kg/m ³

CONVERSIONS

TABLE 3 UNIT CONVERSION FACTORS

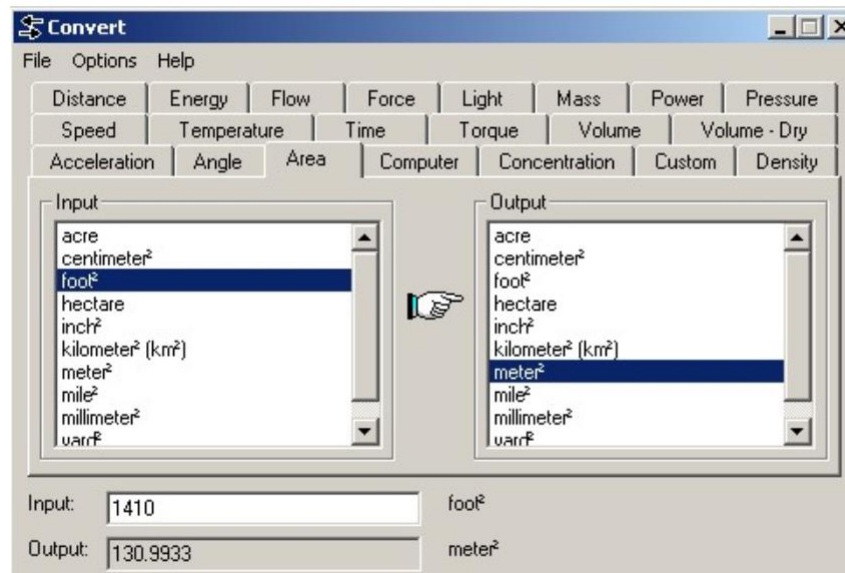
Quantity	To convert from	To	Multiply by
Length	mi	km	1.609 344*
	yd	m	0.9144*
	ft	m	0.304 8*
	ft	mm	304.8*
	in.	mm	25.4*
Area	mi ²	km ²	2.590 00*
	acre	m ²	4 046.87
	acre	ha**	0.404 687
	ft ²	m ²	0.092 903 04*
	in. ²	mm ²	645.16*
Volume	yd ³	m ³	0.764 555
	ft ³	m ³	0.028 3168
	100 board feet	m ³	0.235 974
	gal	L	3.785 41
	in. ³	cm ³	16.387 064
	in. ³	mm ³	16 387.064
Velocity	ft/s	m/s	0.3048
Rate of fluid flow, infiltration	ft ³ /s	m ³ /s	0.028 3168
	gal/h	mL/s	1.051 50
Acceleration	ft/s ²	m/s ²	0.3048
Mass	lb	kg	0.453 59
Mass per unit area	psf	kg/m ²	4.882 43
Mass density	pcf	kg/m ³	16.018 5
Force	lb	N	4.448 22
Force per unit length	plf	N/m	14.593 9
Pressure, stress	psf	Pa	47.880 26
	psi	kPa	6.894 76
	in. of mercury (in. Hg)	kPa	3.386 38
	in. of Hg (in. Hg)	psf	70.72
	atm***	kPa	101.325

CONVERSIONS (CONT.)

Temperature	°F	°C	$5/[9(°F - 32)]$
	°F	K	$(°F + 459.7)/1.8$
Quantity of heat	Btu	J	1055.056
Power	ton (refrigeration)	kW	3.517
	Btu/h	W	0.293 07
	hp	W	745.7
	Btu/(h·ft ²)	W/m ²	3.154 59
Thermal conductivity	Btu-in/(ft ² -h-°F)	W/(m·°C)	0.144 2
Thermal conductance, or thermal transmittance, U	Btu/(ft ² -h-°F)	W/(m ² ·°C)	5.678 263
Thermal resistance	(ft ² -h-°F)/Btu	(m ² ·°C)/W	0.176 110
Thermal capacity	Btu/(ft ² -°F)	kJ/(m ² ·°C)	20.44
Specific heat	Btu/(lb-°F)	J/(kg·°C)	4.186 8
Vapor permeability	perm-in	ng/(Pa·m·s)	1.459 29
Vapor permeance	perm	ng/(Pa·m ² ·s)	57.213 5
Angle	degree	radian	0.017 453

CONVERSIONS (CONT.)

Convert.exe is a very handy conversion utility. Download and give it a try!



[Download Now](#)

DECIMAL AND THOUSANDS SEPARATORS

- ✗ UK and US are 2 places that use the period (.) to indicate decimal place
 - ✗ Other countries use a comma instead (,)
 - ✗ *Decimal separator* aka “radix character”

Commas in Numbers

commas make numbers easier to read period (full stop) for the decimal point

7,213.6 ✓ 

7.213,6 ✓ 

 Ve do it z' other way around.

DECIMAL AND THOUSANDS SEPARATORS

- ✗ Using comma to separate groups of thousands
 - ✗ Used in U.K. and U.S.
 - ✗ Many other countries use a period instead
 - ✗ Some countries separate thousands groups with a thin space
- ✗ See next slide for some commonly used numeric formats



10 000,00
10.000,00
10,000.00

DECIMAL AND THOUSANDS SEPARATORS

Region	Large Number
Canadian (English and French)	4 294 967 295,000
Danish	4 294 967 295,000
Finnish	4 294 967 295,000
French	4 294 967 295,000
German	4 294 967.295,000
Italian	4.294.967.295,000
Norwegian	4.294.967.295,000
Spanish	4.294.967.295,000
Swedish	4 294 967 295,000
UK-English	4,294,967,295.00
US-English	4,294,967,295.00