

## WEIGHTS & MEASURES

### Scale of the Metric System and SI

Prefix	Symbol	Power
yotta-	Y	10 <sup>24</sup>
zetta-	Z	10 <sup>21</sup>
exa-	E	10 <sup>18</sup>
peta-	P	10 <sup>15</sup>
tera-	T	10 <sup>12</sup>
giga-	G	10 <sup>9</sup>
mega-	M	10 <sup>6</sup>
kilo-	k	10 <sup>3</sup>
hecto-	h	10 <sup>2</sup>
deca-	da	10 <sup>1</sup>
UNIT		
deci-	d	10 <sup>-1</sup>
centi-	c	10 <sup>-2</sup>
milli-	m	10 <sup>-3</sup>
micro-	mc	10 <sup>-6</sup>
nano-	n	10 <sup>-9</sup>
pico-	p	10 <sup>-12</sup>
femro-	f	10 <sup>-15</sup>
atto-	a	10 <sup>-18</sup>
zepto-	z	10 <sup>-21</sup>
yocto-	y	10 <sup>-24</sup>

### SI Base Units

Quantity	Name	Symbol
length	meter	m
mass*	kilogram†	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	kelvin‡	K
luminous intensity	candela	cd
amount of substance	mole	mol

\* In commercial and everyday use, “weight” usually means mass; *e.g.*, when speaking of a person’s weight, the quantity referred to is mass.

† For historic reasons, kilogram is the only base unit with a prefix. Multiples and submultiples of the kilogram are formed by attaching the appropriate prefix to the stem word “gram” (*e.g.*, milligram) and the appropriate prefix symbol to the symbol “g” (*e.g.*, mg.).

‡ The degree Celsius (°C) is still widely accepted usage for expressing temperature and temperature intervals. Celsius (formerly centigrade) *temperature* is converted to kelvin (K) thermodynamic temperature by adding 273.16 to the Celsius scale. For *temperature interval*, 1°C equals K.

### Some SI Derived Units Expressed in Terms of Base Units

Quantity	Name	Symbol
area	square meter	m <sup>2</sup>
volume*	cubic meter	m <sup>3</sup>
specific volume	cubic meter per kilogram	m <sup>3</sup> /kg
speed, velocity	meter per second	m/s
acceleration	meter per second squared	m/s <sup>2</sup>
mass density	kilogram per cubic meter	kg/m <sup>3</sup>
concentration	mole per cubic meter	mol/m <sup>3</sup>
luminance	candela per square meter	cd/m <sup>2</sup>

\* Liter (L, l). 10<sup>-3</sup> m<sup>3</sup>, is regarded as a special name for the cubic decimeter.

### Some SI Derived Units with Special Names

Quantity	Name	Symbol	Expression
frequency	hertz	Hz	s <sup>-1</sup>
force	newton	N	m kg s <sup>-2</sup>
pressure, stress	pascal	Pa	m <sup>-1</sup> kg s <sup>-2</sup>
energy	joule	J	m <sup>2</sup> kg s <sup>-2</sup>
power	watt	W	m <sup>2</sup> kg s <sup>-3</sup>
quantity of electricity, electric charge	coulomb	C	s A
electric potential, electromotive force	volt	V	m <sup>2</sup> kg s <sup>-3</sup> A <sup>-1</sup>
capacitance	farad	F	m <sup>-2</sup> kg <sup>-1</sup> s <sup>4</sup> A <sup>2</sup>
electrical resistance	ohm	Ω	m <sup>2</sup> kg <sup>-2</sup> A <sup>-2</sup>
electrical conductance	siemens	S	m <sup>-2</sup> kg s <sup>-2</sup> A <sup>-1</sup>
magnetic flux	weber	Wb	m <sup>2</sup> kg s <sup>-2</sup> A <sup>-1</sup>
magnetic flux density	tesla	T	kg s <sup>-2</sup> A <sup>-1</sup>
activity of radionuclide	becquerel*	Bq	s <sup>-1</sup>
absorbed dose of radiation	gray†	Gy	m <sup>2</sup> s <sup>-2</sup>
exposure (x and γ radiation)	coulomb per kilogram‡	C kg	kg <sup>-1</sup> s A

\* Replacing the curie (Ci), 3.7 × 10<sup>10</sup> s<sup>-1</sup>.

† Replacing the rad (rad), 10<sup>-2</sup> J kg<sup>-1</sup>.

‡ Replacing the roentgen (R), 2.58 × 10<sup>-4</sup> C kg<sup>-1</sup>.

## WEIGHTS AND MEASURES

APP 5

**Measures of Length**

Micrometers	Millimeters	Centimeters	Meters	Kilometers	Miles	Yards	Feet	Inches
<b>1</b>	0.001	10 <sup>-4</sup>						0.000039
10 <sup>3</sup>	<b>1</b>	10 <sup>-1</sup>					0.00328	0.03937
10 <sup>4</sup>	10	<b>1</b>	0.01			0.0109	0.03281	0.3937
254,000	25.4	2.54	0.0254			0.0278	0.0833	<b>1</b>
	304.8	30.48	0.3048			0.333	<b>1</b>	12
10 <sup>6</sup>	10 <sup>3</sup>	10 <sup>2</sup>	<b>1</b>	0.001	0.0006213	1.0936	3.2808	39.37
914,400	914.40	91.44	0.9144	0.009	0.0005681	<b>1</b>	3	36
10 <sup>9</sup>	10 <sup>6</sup>	10 <sup>5</sup>	10 <sup>3</sup>	<b>1</b>	0.6215	1093.6121	3280.8	
			1609.0	1.609	<b>1</b>	1760.0	5280.0	

To convert:

Millimeters to inches: divide by 25.4

Inches to millimeters: multiply by 25.4

Centimeters to feet: divide by 30.7

Feet to centimeters: multiply by 30.7

Meters to yards: multiply by 1.09375

Yards to meters: multiply by 0.9143

Kilometers to miles: multiply by 0.625

Miles to kilometers: multiply by 1.6

**Measures of Mass (Weight)***Avoirdupois*

Grains	Drams	Ounces	Pounds	Metric Equivalents		
				Milligrams	Grams	Kilograms
<b>1</b>	0.0366	0.0023	0.00014	64.8	0.0648	0.000065
27.34	<b>1</b>	0.0625	0.0039		1.772	0.001772
437.5	16	<b>1</b>	0.0625		28.350	0.028350
7,000	256	16	<b>1</b>		453.5924	0.453592
0.0154				<b>1</b>	0.001	
15.4324	0.5648	0.0353	0.002205	1000	<b>1</b>	0.001
15,432.358	564.32	35.27	2.2046		1000	<b>1</b>

To convert (approximately):

Kilograms to pounds: multiply by 2.2

Pounds to kilograms: multiply by 0.454

Grams to ounces: multiply by 0.03527

Ounces to grams: multiply by 28.35

*Apothecaries' Measures*

Grains	Scruples	Drams	Ounces	Pounds	Metric Equivalents		
					Milligrams	Grams	Kilograms
<b>1</b>	0.05	0.0167	0.0021	0.00017	64.8	0.0648	0.000065
20	<b>1</b>	0.333	0.042	0.0035		1.296	0.001296
60	3	<b>1</b>	0.125	0.0104		3.888	0.000389
480	24	8	<b>1</b>	0.0833		31.103	0.031103
5,760	288	96	12	<b>1</b>		373.2418	0.373242
0.0154					<b>1</b>	0.001	
15.4324		0.2572	0.0322	0.0027	1000	<b>1</b>	0.001
15,432.358		257.2	32.15	2.6792		1000	<b>1</b>

**Measures of Capacity***Apothecaries' Measures*

Minims	Fluid Drams	Fluid Ounces	Pints	Quarts	Gallons	Metric Equivalents	
						Liters	Milliliters
<b>1</b>	0.0166	0.002	0.00013			0.0006	0.06161
60	<b>1</b>	0.125	0.0078	0.0039		0.0037	3.6967
480	8	<b>1</b>	0.0625	0.0312	0.0078	0.0296	29.5737
7,680	128	16	<b>1</b>	0.5	0.125	0.4732	473.166
15,360	256	32	2	<b>1</b>	0.25	0.9464	946.358
61,440	1024	128	8	4	<b>1</b>	3.7854	3785.434
16,230	270.52	33.8418	2.1134	1.0567	0.2642	<b>1</b>	1000
16.23	0.2705	0.0338	0.00212	0.00106	0.000265	0.001	<b>1</b>

To convert (approximately):

1 British imperial gallon = 1.201 U.S. gallon

1 U.S. gallon = 0.8327 British imperial gallon

Liters to gallons: multiply by 0.264

Gallons to liters: multiply by 3.788

Liters to pints: multiply by 2.1

Pints to liters: multiply by 0.4762

**Approximate Household Measures and Weights\***

Teaspoons	Tablespoons	Cups or Glasses	Drams	Fluid Ounces	Milliliters	Grams
<b>1</b>			<b>1</b>	0.125	5	5
3	<b>1</b>		4	0.50	15	15
48	16***	1	64	8	237	240

\* A drop is a measure of uncertain quantity, depending on the nature of the liquid as well as the shape of the container and of the opening from which the liquid falls. One drop of water is roughly equivalent to 1 minim.

\*\* Tumbler or glass is generally intended to mean 8 fl. oz.

\*\*\* For dry measure, 12 tablespoons equals 1 cup.