INTERNATIONAL SYSTEM OF UNITS (SI)

SI Base Units

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

SI Prefixes

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

Examples of SI Derived Units

Derived Quantity	SI derived unit	
	Name	Symbol
area	square meter	m^2
volume	cubic meter	m^3
speed, velocity	meter per second	m/s
acceleration	meter per second squared	m/s^2
wave number	reciprocal meter	m^{-1}
mass density	kilogram per cubic meter	kg/m^3
specific volume	cubic meter per kilogram	m^3/kg
current density	ampere per square meter	A/m^2
magnetic field strength	ampere per meter	A/m
amount-of-substance concentration	mole per cubic meter	mol/m^3
luminance	candela per square meter	cd/m^2
mass fraction	kilogram per kilogram, which may be represented by the number 1	kg/kg = 1

SI Derived Units With Special Names and Symbols

Derived Quantity	SI Derived Unit			
	Name	Symbol	Expression in Terms of Other SI Units	Expression in terms of Other SI Base Units
plane angle	radian [a]	rad	-	$m \cdot m^{-1} = 1$ [b]
solid angle	steradian [a]	sr [c]	-	$m^2 \cdot m^{-2} = 1$ [b]
frequency	hertz	Hz	-	s^{-1}
force	newton	N	-	$m \cdot kg \cdot s^{-2}$
pressure, stress	pascal	Pa	N/m^2	$m^{-1} \cdot kg \cdot s^{-2}$
energy, work, quantity of heat	joule	J	$N \cdot m$	$m^2 \cdot kg \cdot s^{-2}$
power, radiant flux	watt	W	J/s	$m^2 \cdot kg \cdot s^{-3}$
electric charge, quantity of electricity	coulomb	C	-	$s \cdot A$
electric potential difference, electromotive force	volt	V	W/A	$m^2 \cdot kg \cdot s^{-3} \cdot A^{-1}$
capacitance	farad	F	C/V	$m^{-2} \cdot kg^{-1} \cdot s^4 \cdot A^2$
electric resistance	ohm	Ω	V/A	$m^2 \cdot kg \cdot s^{-3} \cdot A^{-2}$
electric conductance	siemens	S	A/V	$m^{-2} \cdot kg^{-1} \cdot s^3 \cdot A^2$
magnetic flux	weber	Wb	$V \cdot s$	$m^2 \cdot kg \cdot s^{-2} \cdot A^{-1}$
magnetic flux density	tesla	T	Wb/m^2	$kg \cdot s^{-2} \cdot A^{-1}$
inductance	henry	H	Wb/A	$m^2 \cdot kg \cdot s^{-2} \cdot A^{-2}$
Celsius temperature	degree Celsius	°C	-	K
luminous flux	lumen	lm	$cd \cdot sr$ [c]	$m^2 \cdot m^{-2} \cdot cd = cd$
illuminance	lux	lx	lm/m^2	$m^2 \cdot m^{-4} \cdot cd = m^{-2} \cdot cd$
activity (of a radionuclide)	becquerel	Bq	-	s^{-1}
absorbed dose, specific energy (imparted), kerma	gray	Gy	J/kg	$m^2 \cdot s^{-2}$
dose equivalent [d]	sievert	Sv	J/kg	$m^2 \cdot s^{-2}$
catalytic activity	katal	kat	-	$s^{-1} \cdot mol$

[a] The *radian* and *steradian* may be used advantageously in expressions for derived units to distinguish between quantities of a different nature but of the same dimension; some examples are given in Table 4.

[b] In practice, the symbols *rad* and *sr* are used where appropriate, but the derived unit "1" is generally omitted.

[c] In photometry, the unit name *steradian* and the unit symbol *sr* are usually retained in expressions for derived units.

[d] Other quantities expressed in *sieverts* are *ambient dose equivalent*, *directional dose equivalent*, *personal dose equivalent*, and *organ equivalent dose*.

Examples of Derived Units Whose Names and Symbols Include SI Derived Units with Special Names and Symbols

Derived Quantity	SI derived unit	
	Name	Symbol
dynamic viscosity	pascal second	Pa·s
moment of force	newton meter	N·m
surface tension	newton per meter	N/m
angular velocity	radian per second	rad/s
angular acceleration	radian per second squared	rad/s^2
heat flux density, irradiance	watt per square meter	W/m^2
heat capacity, entropy	joule per kelvin	J/K
specific heat capacity, specific entropy	joule per kilogram kelvin	J/(kg·K)
specific energy	joule per kilogram	J/kg
thermal conductivity	watt per meter kelvin	W/(m·K)
energy density	joule per cubic meter	J/m^3
electric field strength	volt per meter	V/m
electric charge density	coulomb per cubic meter	C/m^3
electric flux density	coulomb per square meter	C/m^2
permittivity	farad per meter	F/m
permeability	henry per meter	H/m
molar energy	joule per mole	J/mol
molar entropy, molar heat capacity	joule per mole kelvin	J/(mol·K)
exposure (x and γ rays)	coulomb per kilogram	C/kg
absorbed dose rate	gray per second	Gy/s
radiant intensity	watt per steradian	W/sr
radiance	watt per square meter steradian	$W/(m^2 \cdot sr)$
catalytic (activity) concentration	katal per cubic meter	kat/m^3

SI Prefixes

Factor	Name	Symbol
10^{24}	yotta	Y
10^{21}	zetta	Z
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10^{1}	deka	da

Factor	Name	Symbol
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a
10^{-21}	zepto	z
10^{-24}	yocto	y

MISCELLANEOUS

Some Physical Constants

standard value for gravity acceleration	g_n	$\stackrel{def}{=}$	9.806 65 m/s^2
light velocity in space	c	=	299.7924 Mm/s
molar gas constant	R	=	8.314 41 J/(mol·K)
triple point for water	T_3	$\stackrel{def}{=}$	273.16 K
Avogadro's constant	N_A	=	$6.022\,045 \cdot 10^{23}$ mol^{-1}
Boltzmann's constant	k	=	$R/N_A = 1.380\,66 \cdot 10^{-23}$ J/K

molar volume for ideal gas at:

ρ_0 = 1 atm
= 101.325 kPa
og T_0 = 273.15 K $\quad V_0 = RT_0/\rho_0 = 22.4138$ dm^3/mol

Mathematic Symbols

=	equal
≠	not equal, different from
≡	identical equal
≈	about/approximate equal
$\stackrel{def}{=}$	per definition equal, defined equal
≙	corresponding to
→	towards
∞	infinity
<	less than
>	greater than
≤	less than or equal
≥	greater than or equal
«	much lesser than
»	much greater than

Mass

kg	lb (pound)	slug	oz (ounce)	cwt (hundred-weight)	ton (UK)	sh cwt (short hundred weight) (US)	sh tn (short ton) (US)
1	2.204 62	$68.521\,8 \cdot 10^{-3}$	35.274 0	$19.684\,1 \cdot 10^{-3}$	$0.984\,207 \cdot 10^{-3}$	$22.046\,2 \cdot 10^{-3}$	$1.102\,31 \cdot 10^{-3}$
0.453 592 37	**1**	$31.081\,0 \cdot 10^{-3}$	**16**	$8.928\,57 \cdot 10^{-3}$	$0.446\,429 \cdot 10^{-3}$	$\mathbf{10 \cdot 10^{-3}}$	$\mathbf{0.5 \cdot 10^{-3}}$
14.593 9	32.174 0	**1**	514.785	0.287 268	$14.363\,4 \cdot 10^{-3}$	0.321 740	$16.086\,9 \cdot 10^{-3}$
$28.349\,5 \cdot 10^{-3}$	$\mathbf{62.5 \cdot 10^{-3}}$	$1.942\,56 \cdot 10^{-3}$	**1**	$0.558\,036 \cdot 10^{-3}$	$27.901\,8 \cdot 10^{-6}$	$\mathbf{0.625 \cdot 10^{-3}}$	$\mathbf{31.25 \cdot 10^{-6}}$
50.802 3	**112**	3.481 07	$\mathbf{1.792 \cdot 10^{3}}$	**1**	$50 \cdot 10^{-3}$	**1.12**	$\mathbf{56 \cdot 10^{-3}}$
$1.016\,05 \cdot 10^{3}$	$\mathbf{2.24 \cdot 10^{3}}$	69.621 3	$\mathbf{35.84 \cdot 10^{3}}$	**20**	**1**	**22.4**	**1.12**
45.359 237	**100**	3.108 10	$\mathbf{1.6 \cdot 10^{3}}$	0.892 857	$44.642\,9 \cdot 10^{-3}$	**1**	$\mathbf{50 \cdot 10^{-3}}$
907.185	$\mathbf{2 \cdot 10^{3}}$	62.161 9	$\mathbf{32 \cdot 10^{3}}$	17.857 1	0.892 857	**20**	**1**

Mass Inertia Moment

$kg \cdot m^2$	$g \cdot m^2$	$lb \cdot ft^2$	$lb \cdot in^2$	$slug \cdot ft^2$	$oz \cdot in^2$
1	$\mathbf{10 \cdot 10^{6}}$	23.730 4	$3.417\,17 \cdot 10^{3}$	0.737 565	$54.675\,0 \cdot 10^{3}$
$\mathbf{0.1 \cdot 10^{-6}}$	**1**	$2.373\,04 \cdot 10^{-6}$	$0.341\,717 \cdot 10^{-3}$	$73.756\,5 \cdot 10^{-9}$	$5.467\,50 \cdot 10^{-3}$
$42.140\,0 \cdot 10^{-3}$	$421.4 \cdot 10^{3}$	**1**	**144**	$31.081\,0 \cdot 10^{-3}$	$\mathbf{2.304 \cdot 10^{3}}$
$0.292\,640 \cdot 10^{-3}$	$2.926\,40 \cdot 10^{3}$	$6.944\,40 \cdot 10^{-3}$	**1**	$0.215\,839 \cdot 10^{-3}$	**16**
1.355 73	$13.557\,3 \cdot 10^{6}$	32.174 0	$4.633\,06 \cdot 10^{3}$	**1**	$74.128\,9\ 10^{3}$
$18.290\,0 \cdot 10^{-6}$	182.900	$0.434\,028 \cdot 10^{-3}$	$\mathbf{62.5 \cdot 10^{-3}}$	$13.490\,0 \cdot 10^{-6}$	**1**

Force/Power

N	dyn	kp (kilopond)	lbf (pound-force)
1	$\mathbf{0.1 \cdot 10^{6}}$	0.101 972	0.224 809
$\mathbf{10 \cdot 10^{-6}}$	**1**	$1.079\,72 \cdot 10^{-6}$	$2.248\,09 \cdot 10^{-6}$
9.806 65	$\mathbf{0.980\,665 \cdot 10^{6}}$	**1**	2.204 62
4.448 22	$0.444\,822 \cdot 10^{6}$	0.453 592	**1**

1 kgf = 1 kp = 9.80665 N

Force Moment

Nm	kpm	lbf	lbf · ft
1	0.101 972	8.850 75	0.737 562
9.806 65	**1**	86.796 2	7.233 01
0.112 985	$11.521\,2 \cdot 10^{-3}$	**1**	$83.333\,3 \cdot 10^{-3}$
1.355 82	0.138 255	**12**	**1**

Pressure, Tension

N/m^2 Pa	bar	kp/cm^2 at	kp/mm^2	torr	atm (normal-atmosphere)	lbf/in^2
1	$\mathbf{10 \cdot 10^{-6}}$	$10.197\,2 \cdot 10^{-6}$	$0.101\,972 \cdot 10^{-6}$	$7.500\,62 \cdot 10^{-3}$	$9.869\,23 \cdot 10^{-6}$	$0.145\,038 \cdot 10^{-3}$
$\mathbf{100 \cdot 10^{3}}$	**1**	1.019 72	$10.197\,2 \cdot 10^{-3}$	750.062	0.986 923	14.503 8
$\mathbf{98.066\,5 \cdot 10^{3}}$	**0.980 665**	**1**	$\mathbf{10 \cdot 10^{-3}}$	735.559	0.967 841	14.223 3
$\mathbf{9.806\,65 \cdot 10^{6}}$	**98.066 5**	**100**	**1**	$73.555\,9 \cdot 10^{-3}$	96.784 1	$1.422\,33 \cdot 10^{3}$
133.322	$1.333\,22 \cdot 10^{-3}$	$1.359\,51 \cdot 10^{-3}$	$13.595\,1 \cdot 10^{-6}$	**1**	$1.315\,79 \cdot 10^{-3}$	$19.336\,8 \cdot 10^{-3}$
$\mathbf{101.325 \cdot 10^{3}}$	**1.013 25**	1.033 23	$10.332\,3 \cdot 10^{-3}$	**760**	**1**	14.695 9
$6.894\,76 \cdot 10^{3}$	$\mathbf{68.947\,6 \cdot 10^{-3}}$	$70.307\,0 \cdot 10^{-3}$	$0.703\,070 \cdot 10^{-3}$	51.714 9	$68.046\,0 \cdot 10^{-3}$	**1**

1 pascal = 1 N/m^2 1 torr ≈ 1 mmHg

Dynamic Viscosity

N s/m^2 kg/s m	N s/mm^2	P (poise)	cP
1	$\mathbf{10^{-6}}$	**10**	$\mathbf{10^{3}}$
$\mathbf{10^{6}}$	**1**	$\mathbf{10 \cdot 10^{6}}$	$\mathbf{10^{9}}$
0.1	$\mathbf{0.1 \cdot 10^{-6}}$	**1**	**100**
$\mathbf{10^{-3}}$	$\mathbf{10^{-9}}$	$\mathbf{10 \cdot 10^{-3}}$	**1**

Kinematical Viscosity

m^2/s	St (stoke)	mm^2/s cSt
1	$\mathbf{10 \cdot 10^{3}}$	$\mathbf{10^{6}}$
$\mathbf{10^{-6}}$	$\mathbf{10 \cdot 10^{-3}}$	**1**
$\mathbf{0.1 \cdot 10^{-3}}$	**1**	**100**

Time

s	min	h	d (24 hours)	week
1	16.666 7 · 10^{-3}	0.277 778 · 10^{-3}	11.574 1 · 10^{-6}	1.653 44 · 10^{-6}
60	**1**	16.666 7 · 10^{-3}	0.694 444 · 10^{-3}	99.206 3 · 10^{-6}
3.6 · 10^{3}	**60**	**1**	41.666 7 · 10^{-3}	5.952 38 · 10^{-3}
86.4 · 10^{3}	**1.44 · 10^{3}**	**24**	**1**	0.142 857
604.8 · 10^{3}	**10.08 · 10^{3}**	**168**	**7**	**1**

Velocity

m/s	km/h	ft/s	mile/h	kn (knop)
1	**3.6**	3.280 84	2.236 94	1.943 84
0.277 778	**1**	0.911 344	0.621 371	0.539 957
0.304 8	**1.097 28**	**1**	0.681 818	0.592 484
0.447 04	**1.609 344**	1.466 67	**1**	0.868 976
0.514 44	**1.852**	1.687 81	1.150 78	**1**

Energy, Work, Heat

J Nm, Ws	erg	kWh	eV (electrovoltage)	kpm	kcal	hkh (metric horsepower hour)	ft-lbf (foot pound-force)	Btu (British thermal unit)
1	**10 · 10^{6}**	0.277 228 · 10^{-6}	6.242 · 10^{18}	0.101 972	0.238 846 · 10^{-3}	0.377 673 · 10^{-6}	0.737 562	0.947 817 · 10^{-3}
0.1 · 10^{-6}	**1**	27.777 8 · 10^{-15}	0.624 2 · 10^{12}	10.197 2 · 10^{-9}	23.884 6 · 10^{-12}	37.767 3 · 10^{-15}	73.756 2 · 10^{-9}	94.781 7 · 10^{-12}
3.6 10^{6}	**36 · 10^{12}**	**1**	22.47 · 10^{24}	0.367 098 · 10^{6}	859.845	1.359 62	2.655 22 · 10^{6}	3.412 14 · 10^{3}
0.160 2 · 10^{-18}	1.602 · 10^{-12}	44.50 · 10^{-27}	**1**	16.34 · 10^{-21}	38.26 · 10^{-24}	60.50 · 10^{-27}	0.118 2 · 10^{-18}	0.151 8 · 10^{-21}
9.806 65	**98.066 5 · 10^{6}**	2.724 07 · 10^{-6}	61.21 · 10^{18}	**1**	2.342 28 · 10^{-3}	3.703 70 · 10^{-6}	7.233 01	9.294 91 · 10^{-3}
4.186 8 · 10^{3}	**41.868 · 10^{9}**	**1.163 · 10^{-3}**	26.13 · 10^{21}	426.935	**1**	1.581 24 · 10^{-3}	3.088 03 · 10^{3}	3.968 32
2.647 795 5 · 10^{6}	**26.477 955 · 10^{12}**	0.735 499	16.53 · 10^{24}	**0.27 · 10^{6}**	632.415	**1**	1.952 91 · 10^{6}	2.509 63 · 10^{3}
1.355 82	13.558 2 · 10^{6}	0.376 616 · 10^{-6}	8.463 · 10^{18}	0.138 255	0.323 832 · 10^{-3}	0.512 055 · 10^{-6}	**1**	1.285 07 · 10^{-3}
1.055 06 · 10^{3}	10.550 6 · 10^{9}	0.293 071 · 10^{-3}	6.586 · 10^{21}	107.586	0.251 996	0.389 466 · 10^{-3}	778.169	**1**

Effect

W Nm/s, J/s	kpm/s	kcal/s	kcal/h	hkh (metric horsepower)	hp (UK, US) horsepower	ft.lbf/s	Btu/h
1	0.101 972	0.238 846 · 10^{-3}	0.859 845	1.359 62 · 10^{-3}	1.341 02 · 10^{-3}	0.737 562	3.412 14
9.806 65	**1**	2.342 28 · 10^{-3}	8.432 20	13.333 3 · 10^{-3}	13.150 9 · 10^{-3}	7.233 01	33.461 7
4.186 8 · 10^{3}	426.935	**1**	**3.6 · 10^{3}**	5.692 46	5.614 59	3.088 03 · 10^{3}	14.286 0 · 10^{3}
1.163	0.118 593	0.277 778 · 10^{-3}	**1**	1.581 24 · 10^{-3}	1.559 61 · 10^{-3}	0.857 785	3.968 32
735.499	**75**	0.175 671	632.415	**1**	0.986 320	542.476	2.509 63 · 10^{3}
745.700	76.040 2	0.178 107	641.186	1.013 87	**1**	**550**	2.544 43 · 10^{3}
1.355 82	0.138 255	0.323 832 · 10^{-3}	1.165 79	1.843 40 · 10^{-3}	**1.818 18 · 10^{-3}**	**1**	4.626 24
0.293 071	29.884 9 · 10^{-3}	69.998 8 · 10^{-6}	0.251 996	0.398 467 · 10^{-3}	0.393 015 · 10^{-3}	0.216 158	**1**

Heat Conduction Ability

W/m K W/m °C	kcal/m h K kcal/m h °C	cal/cm s K cal/cm s °C	Btu in/ft h °F	Btu in/ft² h °F
1	0.859 845	2.388 46 · 10^{-3}	0.577 789	6.933 47
1.163	**1**	2.777 78 · 10^{-3}	0.671 969	8.063 63
418.68	**360**	**1**	241.909	2.902 91 · 10^{3}
1.730 73	1.488 16	4.133 79 · 10^{-3}	**1**	**12**
0.144 228	0.124 014	0.344 482 · 10^{-3}	0.083 333 3	**1**

Heat Passage

W/m² K W/m² °C	kcal/m² h K kcal/m² h °C	cal/cm² s K cal/cm² s °C	Btu in/ft² h °F
1	0.859 845	23.884 6 · 10^{-6}	0.176 110
1.163	**1**	27.777 8 · 10^{-6}	0.204 816
41.868 · 10^{3}	**36 · 10^{3}**	**1**	7.737 38 · 10^{3}
5.678 26	4.882 43	135.623 · 10^{-6}	**1**

Temperature, Temperature Differences

Kelvin-Scale	Celsius-Scale	Rankine-Scale	Fahrenheit-Scale
0 K	**-273.15°C**	**0°R**	**-459.67°F**
255.372 2 K	-17.777 8°C	**459.67°R**	**0°F**
273.15 K	**0°C**	**491.67°R**	**32°F**
273.16 K	**0.01°C**	**491.688°R**	**32.018°F**
1 K	**1°C**	**1.8°R**	**1.8°F**
0.555 556 K	0.555 556°C	**1°R**	**1°F**

Magnetic Sizes

1 Oe (1 örsted) corresponding to $10^{3}/4\pi$ A/m = 79.577 5 A/m
1 A/m corresponding to $4\pi \cdot 10^{-3}$ Oe = 12.566 3 · 10^{-3} Oe
1 Mx (1 maxwell) = 10^{-8} Wb
1 Gs (1 gauss) = 10^{-4} T