

3.6 SI PREFIXES

To signify decimal multiples and submultiples of SI units the following prefixes may be used [3].

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

Prefix symbols should be printed in roman (upright) type with no space between the prefix and the unit symbol.

Example kilometre, km

When a prefix is used with a unit symbol, the combination is taken as a new symbol that can be raised to any power without the use of parentheses.

Examples $1 \text{ cm}^3 = (0.01 \text{ m})^3 = 10^{-6} \text{ m}^3$
 $1 \mu\text{s}^{-1} = (10^{-6} \text{ s})^{-1} = 10^6 \text{ s}^{-1}$
 $1 \text{ V/cm} = 100 \text{ V/m}$
 $1 \text{ mmol/dm}^3 = 1 \text{ mol m}^{-3}$

A prefix should never be used on its own, and prefixes are not to be combined into compound prefixes.

Example pm, not $\mu\mu\text{m}$

The names and symbols of decimal multiples and submultiples of the SI base unit of mass, the kg, which already contains a prefix, are constructed by adding the appropriate prefix to the word gram and symbol g.

Examples mg, not μkg ; Mg, not kkg

The SI prefixes are not to be used with $^{\circ}\text{C}$.

ISO has recommended standard representations of the prefix symbols for use with limited character sets [7].

Ex. Quantities, Units and Symbols in Physical Chemistry
I. Mills et al. IUPAC, Blackwell Science,
2nd Ed, 1995

SI	UNITS	
Length	meter	m
Mass	kilogram	kg
Time	second	s
<i>Thermodynamic</i> Temperature	Kelvin	K
Force	Newton	$N = \text{kg ms}^{-2}$
Pressure	Pascal	$\text{Pa} = \text{Nm}^{-2} = \text{Kg m}^{-1} \text{s}^{-2}$
Energy	Joule	$J = \text{Nm} = \text{Kg m}^2 \text{s}^{-2}$
Volume	liter	$\ell = \text{dm}^3 = 10^{-3} \text{m}^3$

Common non-SI units

- 1 atmosphere (atm) = 101.325 kPa = 760 mm (of Hg)
- 1 bar = 10^5 Pa
- 1 calorie (cal) = 4.184 J
- 1 ångström (Å) = 10^{-10} m

General data and fundamental constants

Quantity	Symbol	Value	Power of ten	Units
Speed of light	c	2.997 924 58*	10^8	m s^{-1}
Elementary charge	e	1.602 176	10^{-19}	C
Faraday constant	$F = N_A e$	9.648 53	10^4	C mol^{-1}
Boltzmann constant	k	1.380 65	10^{-23}	J K^{-1}
Gas constant	$R = N_A k$	8.314 47		$\text{J K}^{-1} \text{mol}^{-1}$
		8.314 47	10^{-2}	$\text{L bar K}^{-1} \text{mol}^{-1}$
		8.205 74	10^{-2}	$\text{L atm K}^{-1} \text{mol}^{-1}$
		6.236 37	10	$\text{L Torr K}^{-1} \text{mol}^{-1}$
Planck constant	h	6.626 08	10^{-34}	J s
	$\hbar = h/2\pi$	1.054 57	10^{-34}	J s
Avogadro constant	N_A	6.022 14	10^{23}	mol^{-1}
Atomic mass unit	u	1.660 54	10^{-27}	kg
Mass				
electron	m_e	9.109 38	10^{-31}	kg
proton	m_p	1.672 62	10^{-27}	kg
neutron	m_n	1.674 93	10^{-27}	kg
Vacuum permittivity	$\epsilon_0 = 1/c^2 \mu_0$	8.854 19	10^{-12}	$\text{J}^{-1} \text{C}^2 \text{m}^{-1}$
	$4\pi\epsilon_0$	1.112 65	10^{-10}	$\text{J}^{-1} \text{C}^2 \text{m}^{-1}$
Vacuum permeability	μ_0	$4\pi^*$	10^{-7}	$\text{J s}^2 \text{C}^{-2} \text{m}^{-1} (= \text{T}^2 \text{J}^{-1} \text{m}^3)$
Magneton				
Bohr	$\mu_B = e\hbar/2m_e$	9.274 01	10^{-24}	J T^{-1}
nuclear	$\mu_N = e\hbar/2m_p$	5.050 78	10^{-27}	J T^{-1}
g value	g_e	2.002 32		
Bohr radius	$a_0 = 4\pi\epsilon_0\hbar^2/m_e e^2$	5.291 77	10^{-11}	m
Fine-structure constant	$\alpha = \mu_0 e^2 c/2h$	7.297 35	10^{-3}	
	α^{-1}	1.370 36	10^2	
Second radiation constant	$c_2 = hc/k$	1.438 78	10^{-2}	m K
Stefan-Boltzmann constant	$\sigma = 2\pi^5 k^4/15h^3 c^2$	5.670 51	10^{-8}	$\text{W m}^{-2} \text{K}^{-4}$
Rydberg constant	$R = m_e e^4/8h^3 c \epsilon_0^2$	1.097 37	10^5	cm^{-1}
Standard acceleration of free fall	g	9.806 65*		m s^{-2}
Gravitational constant	G	6.673	10^{-11}	$\text{N m}^2 \text{kg}^{-2}$

* Exact value

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The Greek alphabet

A, α	alpha	N, ν	nu
B, β	beta	Ξ, ξ	xi
Γ, γ	gamma	O, o	omicron
Δ, δ	delta	Π, π	pi
E, ϵ	epsilon	P, ρ	rho
Z, ζ	zeta	Σ, σ	sigma
H, η	eta	T, τ	tau
Θ, θ	theta	Υ, υ	upsilon
I, ι	iota	Φ, ϕ	phi
K, κ	kappa	χ, χ	chi
Λ, λ	lambda	Ψ, ψ	psi
M, μ	mu	Ω, ω	omega

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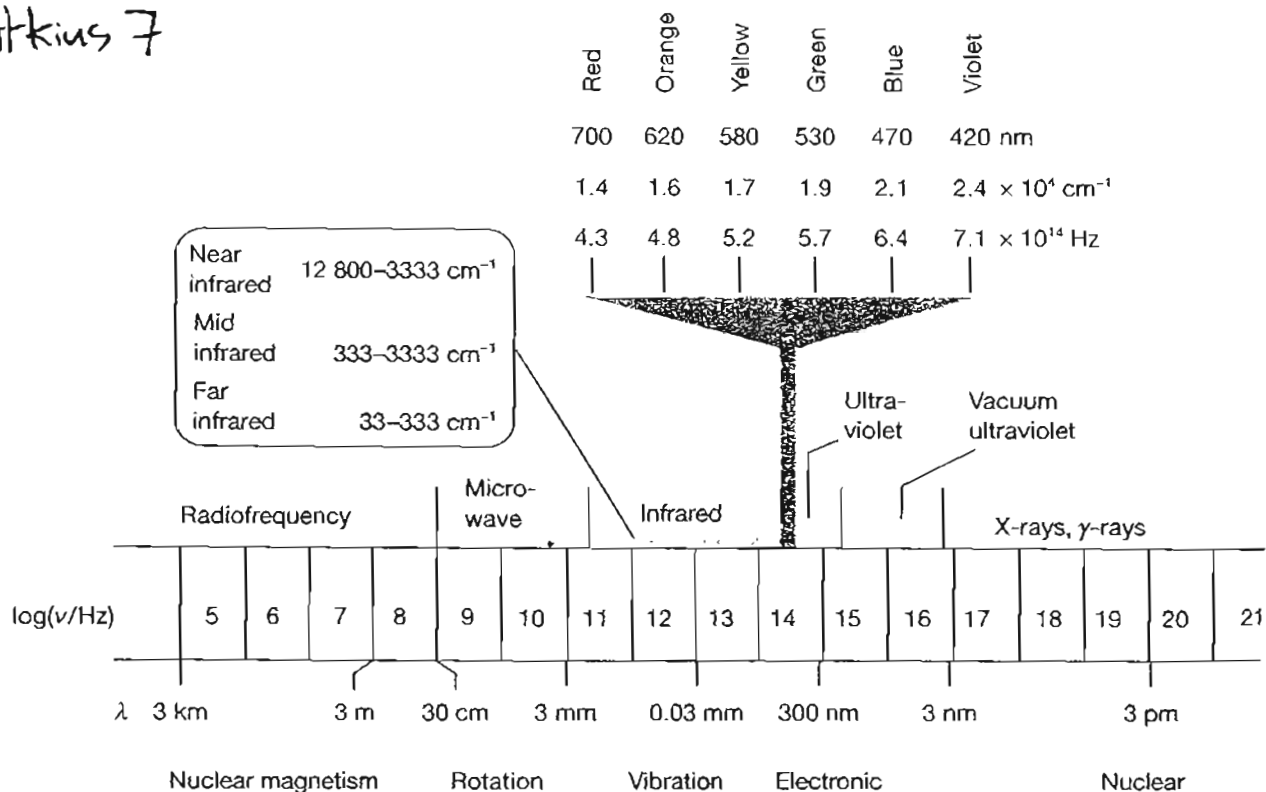


Table 13.1 Regions of the Electromagnetic Spectrum

	Wavelengths in vacuo, λ_0	Wavenumber in vacuo, $\bar{\nu}$	Frequency, ν	Photon energy, $h\nu$	Molar energy, $N_A h\nu$
γ rays	10 pm	10^9 cm^{-1}	30.0 EHz	$19.9 \times 10^{-15} \text{ J}$	12.0 GJ/mol
X rays	10 nm	10^6 cm^{-1}	30.0 PHz	$19.9 \times 10^{-18} \text{ J}$	12.0 MJ/mol
Vacuum UV	200 nm	$50.0 \times 10^3 \text{ cm}^{-1}$	1.50 PHz	$993 \times 10^{-21} \text{ J}$	598 kJ/mol
Near UV	380 nm	$26.3 \times 10^3 \text{ cm}^{-1}$	789 THz	$523 \times 10^{-21} \text{ J}$	315 kJ/mol
Visible	780 nm	$12.8 \times 10^3 \text{ cm}^{-1}$	384 THz	$255 \times 10^{-21} \text{ J}$	153 kJ/mol
Near IR	2.5 μm	$4.00 \times 10^3 \text{ cm}^{-1}$	120 THz	$79.5 \times 10^{-21} \text{ J}$	47.9 kJ/mol
Mid IR	50 μm	200 cm^{-1}	6.00 THz	$3.98 \times 10^{-21} \text{ J}$	2.40 kJ/mol
Far IR	1 mm	10 cm^{-1}	300 GHz	$199 \times 10^{-24} \text{ J}$	120 J/mol
Microwaves	100 mm	0.1 cm^{-1}	3.00 GHz	$1.99 \times 10^{-24} \text{ J}$	12.0 J/mol
Radio waves	1000 mm	0.01 cm^{-1}	300 MHz	$0.199 \times 10^{-24} \text{ J}$	1.2 J/mol

Source: IUPAC Report, "Names, Symbols, Definitions, and Units for Quantities in Optical Spectroscopy," 1984. IR, infrared; UV, ultraviolet. The abbreviations for powers of 10 are given inside the back cover of the book.