



# Glossary of Key Symbols and Notation

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In this glossary, key symbols and notation are briefly defined.

Symbol	Definition
$\overline{\text{any symbol}}$	average (indicated by a bar over a symbol—e.g., $\overline{v}$ is average velocity)
$^{\circ}\text{C}$	Celsius degree
$^{\circ}\text{F}$	Fahrenheit degree
//	parallel
$\perp$	perpendicular
$\propto$	proportional to
$\pm$	plus or minus
0	zero as a subscript denotes an initial value
$\alpha$	alpha rays
$\alpha$	angular acceleration
$\alpha$	temperature coefficient(s) of resistivity
$\beta$	beta rays
$\beta$	sound level
$\beta$	volume coefficient of expansion
$\beta^{-}$	electron emitted in nuclear beta decay
$\beta^{+}$	positron decay

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Symbol	Definition
$\gamma$	gamma rays
$\gamma$	surface tension
$\gamma = 1 / \sqrt{1 - v^2 / c^2}$	a constant used in relativity
$\Delta$	change in whatever quantity follows
$\delta$	uncertainty in whatever quantity follows
$\Delta E$	change in energy between the initial and final orbits of an electron in an atom
$\Delta E$	uncertainty in energy
$\Delta m$	difference in mass between initial and final products
$\Delta N$	number of decays that occur
$\Delta p$	change in momentum
$\Delta p$	uncertainty in momentum
$\Delta PE_g$	change in gravitational potential energy
$\Delta \theta$	rotation angle
$\Delta s$	distance traveled along a circular path
$\Delta t$	uncertainty in time
$\Delta t_0$	proper time as measured by an observer at rest relative to the process
$\Delta V$	potential difference
$\Delta x$	uncertainty in position
$\epsilon_0$	permittivity of free space
$\eta$	viscosity
$\theta$	angle between the force vector and the displacement vector
$\theta$	angle between two lines
$\theta$	contact angle
$\theta$	direction of the resultant
$\theta_b$	Brewster's angle

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Symbol	Definition
$\theta_c$	critical angle
$\kappa$	dielectric constant
$\lambda$	decay constant of a nuclide
$\lambda$	wavelength
$\lambda_n$	wavelength in a medium
$\mu_0$	permeability of free space
$\mu_k$	coefficient of kinetic friction
$\mu_s$	coefficient of static friction
$\nu_e$	electron neutrino
$\pi^+$	positive pion
$\pi^-$	negative pion
$\pi^0$	neutral pion
$\rho$	density
$\rho_c$	critical density, the density needed to just halt universal expansion
$\rho_{fl}$	fluid density
$\bar{\rho}_{obj}$	average density of an object
$\rho / \rho_w$	specific gravity
$\tau$	characteristic time constant for a resistance and inductance ( $RL$ ) or resistance and capacitance ( $RC$ ) circuit
$\tau$	characteristic time for a resistor and capacitor ( $RC$ ) circuit
$\tau$	torque
$Y$	upsilon meson
$\Phi$	magnetic flux
$\varphi$	phase angle
$\Omega$	ohm (unit)
$\omega$	angular velocity

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Symbol	Definition
A	ampere (current unit)
$A$	area
$A$	cross-sectional area
$A$	total number of nucleons
$a$	acceleration
$a_B$	Bohr radius
$a_c$	centripetal acceleration
$a_t$	tangential acceleration
AC	alternating current
AM	amplitude modulation
atm	atmosphere
$B$	baryon number
$B$	blue quark color
$\bar{B}$	antiblue (yellow) antiquark color
$b$	quark flavor bottom or beauty
$B$	bulk modulus
$B$	magnetic field strength
$B_{\text{int}}$	electron's intrinsic magnetic field
$B_{\text{orb}}$	orbital magnetic field
BE	binding energy of a nucleus—it is the energy required to completely disassemble it into separate protons and neutrons
$BE/A$	binding energy per nucleon
Bq	becquerel—one decay per second
$C$	capacitance (amount of charge stored per volt)
$C$	coulomb (a fundamental SI unit of charge)
$C_p$	total capacitance in parallel
$C_s$	total capacitance in series

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Symbol	Definition
CG	center of gravity
CM	center of mass
$c$	quark flavor charm
$c$	specific heat
$c$	speed of light
Cal	kilocalorie
cal	calorie
$COP_{hp}$	heat pump's coefficient of performance
$COP_{ref}$	coefficient of performance for refrigerators and air conditioners
$\cos \theta$	cosine
$\cot \theta$	cotangent
$\csc \theta$	cosecant
$D$	diffusion constant
$d$	displacement
$d$	quark flavor down
dB	decibel
$d_i$	distance of an image from the center of a lens
$d_o$	distance of an object from the center of a lens
DC	direct current
$E$	electric field strength
$\varepsilon$	emf (voltage) or Hall electromotive force
emf	electromotive force
$E$	energy of a single photon
$E$	nuclear reaction energy
$E$	relativistic total energy
$E$	total energy

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Symbol	Definition
$E_0$	ground state energy for hydrogen
$E_0$	rest energy
EC	electron capture
$E_{\text{cap}}$	energy stored in a capacitor
$Eff$	efficiency—the useful work output divided by the energy input
$Eff_C$	Carnot efficiency
$E_{\text{in}}$	energy consumed (food digested in humans)
$E_{\text{ind}}$	energy stored in an inductor
$E_{\text{out}}$	energy output
$e$	emissivity of an object
$e^+$	antielectron or positron
eV	electron volt
F	farad (unit of capacitance, a coulomb per volt)
F	focal point of a lens
<b>F</b>	force
$F$	magnitude of a force
$F$	restoring force
$F_B$	buoyant force
$F_c$	centripetal force
$F_i$	force input
<b>F</b> <sub>net</sub>	net force
$F_o$	force output
FM	frequency modulation
$f$	focal length
$f$	frequency

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Symbol	Definition
$f_0$	resonant frequency of a resistance, inductance, and capacitance ( <i>RLC</i> ) series circuit
$f_0$	threshold frequency for a particular material (photoelectric effect)
$f_1$	fundamental
$f_2$	first overtone
$f_3$	second overtone
$f_B$	beat frequency
$f_k$	magnitude of kinetic friction
$f_s$	magnitude of static friction
$G$	gravitational constant
$G$	green quark color
$\bar{G}$	antigreen (magenta) antiquark color
$g$	acceleration due to gravity
$g$	gluons (carrier particles for strong nuclear force)
$h$	change in vertical position
$h$	height above some reference point
$h$	maximum height of a projectile
$h$	Planck's constant
$hf$	photon energy
$h_i$	height of the image
$h_o$	height of the object
$I$	electric current
$I$	intensity
$I$	intensity of a transmitted wave
$I$	moment of inertia (also called rotational inertia)
$I_0$	intensity of a polarized wave before passing through a filter

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Symbol	Definition
$I_{\text{ave}}$	average intensity for a continuous sinusoidal electromagnetic wave
$I_{\text{rms}}$	average current
J	joule
$J/\Psi$	Joules/psi meson
K	kelvin
$k$	Boltzmann constant
$k$	force constant of a spring
$K_{\alpha}$	x rays created when an electron falls into an $n = 1$ shell vacancy from the $n = 3$ shell
$K_{\beta}$	x rays created when an electron falls into an $n = 2$ shell vacancy from the $n = 3$ shell
kcal	kilocalorie
KE	translational kinetic energy
KE+PE	mechanical energy
$\text{KE}_e$	kinetic energy of an ejected electron
$\text{KE}_{\text{rel}}$	relativistic kinetic energy
$\text{KE}_{\text{rot}}$	rotational kinetic energy
$\overline{\text{KE}}$	thermal energy
kg	kilogram (a fundamental SI unit of mass)
$L$	angular momentum
L	liter
$L$	magnitude of angular momentum
$L$	self-inductance
$\ell$	angular momentum quantum number
$L_{\alpha}$	x rays created when an electron falls into an $n = 2$ shell from the $n = 3$ shell
$L_e$	electron total family number



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Symbol	Definition
$L_{\mu}$	muon family total number
$L_{\tau}$	tau family total number
$L_f$	heat of fusion
$L_f$ and $L_v$	latent heat coefficients
$L_{orb}$	orbital angular momentum
$L_s$	heat of sublimation
$L_v$	heat of vaporization
$L_z$	$z$ - component of the angular momentum
$M$	angular magnification
$M$	mutual inductance
$m$	indicates metastable state
$m$	magnification
$m$	mass
$m$	mass of an object as measured by a person at rest relative to the object
$m$	meter (a fundamental SI unit of length)
$m$	order of interference
$m$	overall magnification (product of the individual magnifications)
$m(^AX)$	atomic mass of a nuclide
MA	mechanical advantage
$m_e$	magnification of the eyepiece
$m_e$	mass of the electron
$m_{\ell}$	angular momentum projection quantum number
$m_n$	mass of a neutron
$m_o$	magnification of the objective lens
mol	mole

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Symbol	Definition
$m_p$	mass of a proton
$m_s$	spin projection quantum number
$N$	magnitude of the normal force
N	newton
<b>N</b>	normal force
$N$	number of neutrons
$n$	index of refraction
$n$	number of free charges per unit volume
$N_A$	Avogadro's number
$N_r$	Reynolds number
$N \cdot m$	newton-meter (work-energy unit)
$N \cdot m$	newtons times meters (SI unit of torque)
OE	other energy
$P$	power
$P$	power of a lens
$P$	pressure
<b>p</b>	momentum
$p$	momentum magnitude
$p$	relativistic momentum
<b>p</b> <sub>tot</sub>	total momentum
<b>p</b> ' <sub>tot</sub>	total momentum some time later
$P_{abs}$	absolute pressure
$P_{atm}$	atmospheric pressure
$P_{atm}$	standard atmospheric pressure
PE	potential energy
PE <sub>el</sub>	elastic potential energy

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Symbol	Definition
$PE_{\text{elec}}$	electric potential energy
$PE_s$	potential energy of a spring
$P_g$	gauge pressure
$P_{\text{in}}$	power consumption or input
$P_{\text{out}}$	useful power output going into useful work or a desired, form of energy
$Q$	latent heat
$Q$	net heat transferred into a system
$Q$	flow rate—volume per unit time flowing past a point
$+Q$	positive charge
$-Q$	negative charge
$q$	electron charge
$q_p$	charge of a proton
$q$	test charge
QF	quality factor
$R$	activity, the rate of decay
$R$	radius of curvature of a spherical mirror
$R$	red quark color
$\bar{R}$	antired (cyan) quark color
$R$	resistance
R	resultant or total displacement
$R$	Rydberg constant
$R$	universal gas constant
$r$	distance from pivot point to the point where a force is applied
$r$	internal resistance
$r_{\perp}$	perpendicular lever arm
$r$	radius of a nucleus

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Symbol	Definition
$r$	radius of curvature
$r$	resistivity
r or rad	radiation dose unit
rem	roentgen equivalent man
rad	radian
RBE	relative biological effectiveness
$RC$	resistor and capacitor circuit
rms	root mean square
$r_n$	radius of the $n$ th H-atom orbit
$R_p$	total resistance of a parallel connection
$R_s$	total resistance of a series connection
$R_s$	Schwarzschild radius
$S$	entropy
<b>S</b>	intrinsic spin (intrinsic angular momentum)
$S$	magnitude of the intrinsic (internal) spin angular momentum
$S$	shear modulus
$S$	strangeness quantum number
$s$	quark flavor strange
s	second (fundamental SI unit of time)
$s$	spin quantum number
<b>s</b>	total displacement
$\sec \theta$	secant
$\sin \theta$	sine
$s_z$	$z$ -component of spin angular momentum
$T$	period—time to complete one oscillation
$T$	temperature

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Symbol	Definition
$T_c$	critical temperature—temperature below which a material becomes a superconductor
$T$	tension
T	tesla (magnetic field strength $B$ )
$t$	quark flavor top or truth
$t$	time
$t_{1/2}$	half-life—the time in which half of the original nuclei decay
$\tan \theta$	tangent
$U$	internal energy
$u$	quark flavor up
u	unified atomic mass unit
$\mathbf{u}$	velocity of an object relative to an observer
$\mathbf{u}'$	velocity relative to another observer
$V$	electric potential
$V$	terminal voltage
V	volt (unit)
$V$	volume
$\mathbf{v}$	relative velocity between two observers
$v$	speed of light in a material
$\mathbf{v}$	velocity
$\bar{\mathbf{v}}$	average fluid velocity
$V_B - V_A$	change in potential
$\mathbf{v}_d$	drift velocity
$V_p$	transformer input voltage
$V_{\text{rms}}$	rms voltage
$V_s$	transformer output voltage
$\mathbf{v}_{\text{tot}}$	total velocity

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Symbol	Definition
$v_w$	propagation speed of sound or other wave
$\mathbf{v}_w$	wave velocity
$W$	work
$W$	net work done by a system
W	watt
$w$	weight
$w_{fl}$	weight of the fluid displaced by an object
$W_c$	total work done by all conservative forces
$W_{nc}$	total work done by all nonconservative forces
$W_{out}$	useful work output
$X$	amplitude
X	symbol for an element
${}^3\text{children in msup}X_N$	notation for a particular nuclide
$x$	deformation or displacement from equilibrium
$x$	displacement of a spring from its undeformed position
$x$	horizontal axis
$X_C$	capacitive reactance
$X_L$	inductive reactance
$x_{rms}$	root mean square diffusion distance
$y$	vertical axis
$Y$	elastic modulus or Young's modulus
$Z$	atomic number (number of protons in a nucleus)
$Z$	impedance