Fundamental Physical Constants — Extensive Listing

Quantity	Symbol	Value	Unit	Relative std. uncert. $u_{\rm r}$
		UNIVERSAL		
speed of light in vacuum	c	$299\,792\,458$	m s^{-1}	exact
vacuum magnetic permeability $4\pi\alpha\hbar/e^2c$	μ_0	$1.256\,637\,062\,12(19)\times10^{-6}$	N A^{-2}	1.5×10^{-10}
$\mu_0/(4\pi\times10^{-7})$		$1.000\,000\,000\,55(15)$	N A^{-2}	1.5×10^{-10}
vacuum electric permittivity $1/\mu_0c^2$	ϵ_0	$8.854\,187\,8128(13)\times10^{-12}$	F m^{-1}	1.5×10^{-10}
characteristic impedance of vacuum $\mu_0 c$	Z_0	$376.730\,313\,668(57)$	Ω	1.5×10^{-10}
Newtonian constant of gravitation	G	$6.674\,30(15)\times10^{-11}$	m^3 kg^{-1} s^{-2}	2.2×10^{-5}
	$G/\hbar c$	$6.708\,83(15)\times10^{-39}$	$({\rm GeV}/c^2)^{-2}$	2.2×10^{-5}
Planck constant*	h	$6.626\,070\,15\times10^{-34}$	J Hz^{-1}	exact
		$4.135\,667\,696\ldots\times10^{-15}$	eV Hz^{-1}	exact
	$\hbar$	$1.054\,571\,817\ldots\times10^{-34}$	J s	exact
		$6.582\,119\,569\ldots\times10^{-16}$	eV s	exact
	$\hbar c$	$197.326\,980\,4\ldots$	MeV fm	exact
Planck mass $(\hbar c/G)^{1/2}$	$m_{\rm P}$	$2.176\,434(24)\times10^{-8}$	kg	1.1×10^{-5}
energy equivalent	$m_{\rm P}c^2$	$1.220\,890(14)\times10^{19}$	GeV	1.1×10^{-5}
Planck temperature $(\hbar c^5/G)^{1/2}/k$	$T_{\rm P}$	$1.416\,784(16)\times10^{32}$	K	1.1×10^{-5}
Planck length $\hbar/m_{\rm P}c=(\hbar G/c^3)^{1/2}$	$l_{\rm P}$	$1.616\,255(18)\times10^{-35}$	m	1.1×10^{-5}
Planck time $l_{\rm P}/c=(\hbar G/c^5)^{1/2}$	$t_{\rm P}$	$5.391\,247(60)\times10^{-44}$	s	1.1×10^{-5}
		ELECTROMAGNETIC		
elementary charge	e	$1.602\,176\,634\times10^{-19}$	C	exact
	$e/\hbar$	$1.519\,267\,447\ldots\times10^{15}$	A J^{-1}	exact
magnetic flux quantum $2\pi\hbar/(2e)$	Φ_0	$2.067\,833\,848\ldots\times10^{-15}$	Wb	exact
conductance quantum $2e^2/2\pi\hbar$	G_0	$7.748\,091\,729\ldots\times10^{-5}$	S	exact
inverse of conductance quantum	G_0^{-1}	$12\,906.403\,72\ldots$	Ω	exact
Josephson constant $2e/h$	$K_{\rm J}$	$483\,597.848\,4\ldots\times10^{9}$	Hz V^{-1}	exact
von Klitzing constant $\mu_0c/2\alpha=2\pi\hbar/e^2$	$R_{\rm K}$	$25\,812.807\,45\ldots$	Ω	exact
Bohr magneton $e\hbar/2m_{\rm e}$	$\mu_{\rm B}$	$9.274\,010\,0783(28)\times10^{-24}$	J T^{-1}	3.0×10^{-10}
		$5.788\,381\,8060(17)\times10^{-5}$	eV T^{-1}	3.0×10^{-10}
	$\mu_{\rm B}/h$	$1.399\,624\,493\,61(42)\times10^{10}$	Hz T^{-1}	3.0×10^{-10}
	$\mu_{\rm B}/hc$	$46.686\,447\,783(14)$	[m^{-1} T^{-1}]†	3.0×10^{-10}
	$\mu_{\rm B}/k$	$0.671\,713\,815\,63(20)$	K T^{-1}	3.0×10^{-10}
nuclear magneton $e\hbar/2m_{\rm p}$	$\mu_{\rm N}$	$5.050\,783\,7461(15)\times10^{-27}$	J T^{-1}	3.1×10^{-10}
		$3.152\,451\,258\,44(96)\times10^{-8}$	eV T^{-1}	3.1×10^{-10}
	$\mu_{\rm N}/h$	$7.622\,593\,2291(23)$	MHz T^{-1}	3.1×10^{-10}
	$\mu_{\rm N}/hc$	$2.542\,623\,413\,53(78)\times10^{-2}$	[m^{-1} T^{-1}]†	3.1×10^{-10}
	$\mu_{\rm N}/k$	$3.658\,267\,7756(11)\times10^{-4}$	K T^{-1}	3.1×10^{-10}
		ATOMIC AND NUCLEAR		
		General		
fine-structure constant $e^2/4\pi\epsilon_0\hbar c$	α	$7.297\,352\,5693(11)\times10^{-3}$		1.5×10^{-10}
inverse fine-structure constant	α^{-1}	$137.035\,999\,084(21)$		1.5×10^{-10}
Rydberg frequency $\alpha^2m_{\rm e}c^2/2h=E_{\rm h}/2h$	cR_∞	$3.289\,841\,960\,2508(64)\times10^{15}$	Hz	1.9×10^{-12}
energy equivalent	$hc\,R_\infty$	$2.179\,872\,361\,1035(42)\times10^{-18}$	J	1.9×10^{-12}
		$13.605\,693\,122\,994(26)$	eV	1.9×10^{-12}
Rydberg constant	R_∞	$10\,973\,731.568\,160(21)$	[m^{-1}]†	1.9×10^{-12}
Bohr radius $\hbar/\alpha m_{\rm e}c=4\pi\epsilon_0\hbar^2/m_{\rm e}e^2$	a_0	$5.291\,772\,109\,03(80)\times10^{-11}$	m	1.5×10^{-10}
Hartree energy $\alpha^2m_{\rm e}c^2=e^2/4\pi\epsilon_0a_0=2hcR_\infty$	$E_{\rm h}$	$4.359\,744\,722\,2071(85)\times10^{-18}$	J	1.9×10^{-12}
		$27.211\,386\,245\,988(53)$	eV	1.9×10^{-12}
quantum of circulation	$\pi\hbar/m_{\rm e}$	$3.636\,947\,5516(11)\times10^{-4}$	m^2 s^{-1}	3.0×10^{-10}

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Quantity	Symbol	Value	Unit	Relative std. uncert. u_r
	$2\pi\hbar/m_e$	$7.273\,895\,1032(22) \times 10^{-4}$	$m^2\ s^{-1}$	3.0×10^{-10}
		Electroweak		
Fermi coupling constant‡	$G_F/(\hbar c)^3$	$1.166\,3787(6) \times 10^{-5}$	GeV^{-2}	5.1×10^{-7}
weak mixing angle§ θ_W (on-shell scheme)				
$\sin^2\theta_W = s_W^2 \equiv 1 - (m_W/m_Z)^2$	$\sin^2\theta_W$	$0.222\,90(30)$		1.3×10^{-3}
		Electron, e^-		
electron mass	m_e	$9.109\,383\,7015(28) \times 10^{-31}$	kg	3.0×10^{-10}
		$5.485\,799\,090\,65(16) \times 10^{-4}$	u	2.9×10^{-11}
energy equivalent	$m_e c^2$	$8.187\,105\,7769(25) \times 10^{-14}$	J	3.0×10^{-10}
		$0.510\,998\,950\,00(15)$	MeV	3.0×10^{-10}
electron-muon mass ratio	m_e/m_μ	$4.836\,331\,69(11) \times 10^{-3}$		2.2×10^{-8}
electron-tau mass ratio	m_e/m_τ	$2.875\,85(19) \times 10^{-4}$		6.8×10^{-5}
electron-proton mass ratio	m_e/m_p	$5.446\,170\,214\,87(33) \times 10^{-4}$		6.0×10^{-11}
electron-neutron mass ratio	m_e/m_n	$5.438\,673\,4424(26) \times 10^{-4}$		4.8×10^{-10}
electron-deuteron mass ratio	m_e/m_d	$2.724\,437\,107\,462(96) \times 10^{-4}$		3.5×10^{-11}
electron-triton mass ratio	m_e/m_t	$1.819\,200\,062\,251(90) \times 10^{-4}$		5.0×10^{-11}
electron-helion mass ratio	m_e/m_h	$1.819\,543\,074\,573(79) \times 10^{-4}$		4.3×10^{-11}
electron to alpha particle mass ratio	m_e/m_α	$1.370\,933\,554\,787(45) \times 10^{-4}$		3.3×10^{-11}
electron charge to mass quotient	$-e/m_e$	$-1.758\,820\,010\,76(53) \times 10^{11}$	$C\ kg^{-1}$	3.0×10^{-10}
electron molar mass $N_A m_e$	$M(e), M_e$	$5.485\,799\,0888(17) \times 10^{-7}$	$kg\ mol^{-1}$	3.0×10^{-10}
reduced Compton wavelength $\hbar/m_e c = \alpha a_0$	$\lambda\!\!\!^{-}_C$	$3.861\,592\,6796(12) \times 10^{-13}$	m	3.0×10^{-10}
Compton wavelength	λ_C	$2.426\,310\,238\,67(73) \times 10^{-12}$	[m]†	3.0×10^{-10}
classical electron radius $\alpha^2 a_0$	r_e	$2.817\,940\,3262(13) \times 10^{-15}$	m	4.5×10^{-10}
Thomson cross section $(8\pi/3)r_e^2$	σ_e	$6.652\,458\,7321(60) \times 10^{-29}$	m^2	9.1×10^{-10}
electron magnetic moment	μ_e	$-9.284\,764\,7043(28) \times 10^{-24}$	$J\ T^{-1}$	3.0×10^{-10}
to Bohr magneton ratio	μ_e/μ_B	$-1.001\,159\,652\,181\,28(18)$		1.7×10^{-13}
to nuclear magneton ratio	μ_e/μ_N	$-1838.281\,971\,88(11)$		6.0×10^{-11}
electron magnetic moment				
anomaly $\lvert\mu_e\rvert/\mu_B - 1$	a_e	$1.159\,652\,181\,28(18) \times 10^{-3}$		1.5×10^{-10}
electron g-factor $-2(1 + a_e)$	g_e	$-2.002\,319\,304\,362\,56(35)$		1.7×10^{-13}
electron-muon magnetic moment ratio	μ_e/μ_μ	$206.766\,9883(46)$		2.2×10^{-8}
electron-proton magnetic moment ratio	μ_e/μ_p	$-658.210\,687\,89(20)$		3.0×10^{-10}
electron to shielded proton magnetic				
moment ratio (H_2O, sphere, 25 °C)	μ_e/μ'_p	$-658.227\,5971(72)$		1.1×10^{-8}
electron-neutron magnetic moment ratio	μ_e/μ_n	$960.920\,50(23)$		2.4×10^{-7}
electron-deuteron magnetic moment ratio	μ_e/μ_d	$-2143.923\,4915(56)$		2.6×10^{-9}
electron to shielded helion magnetic				
moment ratio (gas, sphere, 25 °C)	μ_e/μ'_h	$864.058\,257(10)$		1.2×10^{-8}
electron gyromagnetic ratio $2\lvert\mu_e\rvert/\hbar$	γ_e	$1.760\,859\,630\,23(53) \times 10^{11}$	$s^{-1}\ T^{-1}$	3.0×10^{-10}
		$28\,024.951\,4242(85)$	$MHz\ T^{-1}$	3.0×10^{-10}
		Muon, μ^-		
muon mass	m_μ	$1.883\,531\,627(42) \times 10^{-28}$	kg	2.2×10^{-8}
		$0.113\,428\,9259(25)$	u	2.2×10^{-8}
energy equivalent	$m_\mu c^2$	$1.692\,833\,804(38) \times 10^{-11}$	J	2.2×10^{-8}
		$105.658\,3755(23)$	MeV	2.2×10^{-8}
muon-electron mass ratio	m_μ/m_e	$206.768\,2830(46)$		2.2×10^{-8}
muon-tau mass ratio	m_μ/m_τ	$5.946\,35(40) \times 10^{-2}$		6.8×10^{-5}
muon-proton mass ratio	m_μ/m_p	$0.112\,609\,5264(25)$		2.2×10^{-8}

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Quantity	Symbol	Value	Unit	Relative std. uncert. u_r
muon-neutron mass ratio	m_μ/m_n	$0.112\,454\,5170(25)$		2.2×10^{-8}
muon molar mass $N_A m_\mu$	$M(\mu), M_\mu$	$1.134\,289\,259(25) \times 10^{-4}$	kg mol^{-1}	2.2×10^{-8}
reduced muon Compton wavelength $\hbar/m_\mu c$	$\lambda\!\!\!^-_{C,\mu}$	$1.867\,594\,306(42) \times 10^{-15}$	m	2.2×10^{-8}
muon Compton wavelength	$\lambda_{C,\mu}$	$1.173\,444\,110(26) \times 10^{-14}$	[m]†	2.2×10^{-8}
muon magnetic moment	μ_μ	$-4.490\,448\,30(10) \times 10^{-26}$	J T^{-1}	2.2×10^{-8}
to Bohr magneton ratio	μ_μ/μ_B	$-4.841\,970\,47(11) \times 10^{-3}$		2.2×10^{-8}
to nuclear magneton ratio	μ_μ/μ_N	$-8.890\,597\,03(20)$		2.2×10^{-8}
muon magnetic moment anomaly $\lvert\mu_\mu\rvert/(e\hbar/2m_\mu) - 1$	a_μ	$1.165\,920\,89(63) \times 10^{-3}$		5.4×10^{-7}
muon g-factor $-2(1 + a_\mu)$	g_μ	$-2.002\,331\,8418(13)$		6.3×10^{-10}
muon-proton magnetic moment ratio	μ_μ/μ_p	$-3.183\,345\,142(71)$		2.2×10^{-8}
		Tau, τ^-		
tau mass¶	m_τ	$3.167\,54(21) \times 10^{-27}$	kg	6.8×10^{-5}
		$1.907\,54(13)$	u	6.8×10^{-5}
energy equivalent	$m_\tau c^2$	$2.846\,84(19) \times 10^{-10}$	J	6.8×10^{-5}
		$1776.86(12)$	MeV	6.8×10^{-5}
tau-electron mass ratio	m_τ/m_e	$3477.23(23)$		6.8×10^{-5}
tau-muon mass ratio	m_τ/m_μ	$16.8170(11)$		6.8×10^{-5}
tau-proton mass ratio	m_τ/m_p	$1.893\,76(13)$		6.8×10^{-5}
tau-neutron mass ratio	m_τ/m_n	$1.891\,15(13)$		6.8×10^{-5}
tau molar mass $N_A m_\tau$	$M(\tau), M_\tau$	$1.907\,54(13) \times 10^{-3}$	kg mol^{-1}	6.8×10^{-5}
reduced tau Compton wavelength $\hbar/m_\tau c$	$\lambda\!\!\!^-_{C,\tau}$	$1.110\,538(75) \times 10^{-16}$	m	6.8×10^{-5}
tau Compton wavelength	$\lambda_{C,\tau}$	$6.977\,71(47) \times 10^{-16}$	[m]†	6.8×10^{-5}
		Proton, p		
proton mass	m_p	$1.672\,621\,923\,69(51) \times 10^{-27}$	kg	3.1×10^{-10}
		$1.007\,276\,466\,621(53)$	u	5.3×10^{-11}
energy equivalent	$m_p c^2$	$1.503\,277\,615\,98(46) \times 10^{-10}$	J	3.1×10^{-10}
		$938.272\,088\,16(29)$	MeV	3.1×10^{-10}
proton-electron mass ratio	m_p/m_e	$1836.152\,673\,43(11)$		6.0×10^{-11}
proton-muon mass ratio	m_p/m_μ	$8.880\,243\,37(20)$		2.2×10^{-8}
proton-tau mass ratio	m_p/m_τ	$0.528\,051(36)$		6.8×10^{-5}
proton-neutron mass ratio	m_p/m_n	$0.998\,623\,478\,12(49)$		4.9×10^{-10}
proton charge to mass quotient	e/m_p	$9.578\,833\,1560(29) \times 10^{7}$	C kg^{-1}	3.1×10^{-10}
proton molar mass $N_A m_p$	$M(\text{p}), M_p$	$1.007\,276\,466\,27(31) \times 10^{-3}$	kg mol^{-1}	3.1×10^{-10}
reduced proton Compton wavelength $\hbar/m_p c$	$\lambda\!\!\!^-_{C,p}$	$2.103\,089\,103\,36(64) \times 10^{-16}$	m	3.1×10^{-10}
proton Compton wavelength	$\lambda_{C,p}$	$1.321\,409\,855\,39(40) \times 10^{-15}$	[m]†	3.1×10^{-10}
proton rms charge radius	r_p	$8.414(19) \times 10^{-16}$	m	2.2×10^{-3}
proton magnetic moment	μ_p	$1.410\,606\,797\,36(60) \times 10^{-26}$	J T^{-1}	4.2×10^{-10}
to Bohr magneton ratio	μ_p/μ_B	$1.521\,032\,202\,30(46) \times 10^{-3}$		3.0×10^{-10}
to nuclear magneton ratio	μ_p/μ_N	$2.792\,847\,344\,63(82)$		2.9×10^{-10}
proton g-factor $2\mu_p/\mu_N$	g_p	$5.585\,694\,6893(16)$		2.9×10^{-10}
proton-neutron magnetic moment ratio	μ_p/μ_n	$-1.459\,898\,05(34)$		2.4×10^{-7}
shielded proton magnetic moment (H_2O, sphere, 25 °C)	μ'_p	$1.410\,570\,560(15) \times 10^{-26}$	J T^{-1}	1.1×10^{-8}
to Bohr magneton ratio	μ'_p/μ_B	$1.520\,993\,128(17) \times 10^{-3}$		1.1×10^{-8}
to nuclear magneton ratio	μ'_p/μ_N	$2.792\,775\,599(30)$		1.1×10^{-8}
proton magnetic shielding correction $1 - \mu'_p/\mu_p$ (H_2O, sphere, 25 °C)	σ'_p	$2.5689(11) \times 10^{-5}$		4.2×10^{-4}

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Quantity	Symbol	Value	Unit	Relative std. uncert. u_r
proton gyromagnetic ratio $2\mu_p/\hbar$	γ_p	$2.675\,221\,8744(11) \times 10^8$	$s^{-1}\ T^{-1}$	4.2×10^{-10}
		$42.577\,478\,518(18)$	MHz T^{-1}	4.2×10^{-10}
shielded proton gyromagnetic ratio $2\mu'_p/\hbar$ (H_2O, sphere, 25 °C)	γ'_p	$2.675\,153\,151(29) \times 10^8$	$s^{-1}\ T^{-1}$	1.1×10^{-8}
		$42.576\,384\,74(46)$	MHz T^{-1}	1.1×10^{-8}
		Neutron, n		
neutron mass	m_n	$1.674\,927\,498\,04(95) \times 10^{-27}$	kg	5.7×10^{-10}
		$1.008\,664\,915\,95(49)$	u	4.8×10^{-10}
energy equivalent	m_nc^2	$1.505\,349\,762\,87(86) \times 10^{-10}$	J	5.7×10^{-10}
		$939.565\,420\,52(54)$	MeV	5.7×10^{-10}
neutron-electron mass ratio	m_n/m_e	$1838.683\,661\,73(89)$		4.8×10^{-10}
neutron-muon mass ratio	m_n/m_μ	$8.892\,484\,06(20)$		2.2×10^{-8}
neutron-tau mass ratio	m_n/m_τ	$0.528\,779(36)$		6.8×10^{-5}
neutron-proton mass ratio	m_n/m_p	$1.001\,378\,419\,31(49)$		4.9×10^{-10}
neutron-proton mass difference	$m_n - m_p$	$2.305\,574\,35(82) \times 10^{-30}$	kg	3.5×10^{-7}
		$1.388\,449\,33(49) \times 10^{-3}$	u	3.5×10^{-7}
energy equivalent	$(m_n - m_p)c^2$	$2.072\,146\,89(74) \times 10^{-13}$	J	3.5×10^{-7}
		$1.293\,332\,36(46)$	MeV	3.5×10^{-7}
neutron molar mass N_Am_n	$M(\mathrm{n}), M_n$	$1.008\,664\,915\,60(57) \times 10^{-3}$	kg mol^{-1}	5.7×10^{-10}
reduced neutron Compton wavelength $\hbar/m_nc$	$\lambda\!\!\!^{-}_{C,n}$	$2.100\,194\,1552(12) \times 10^{-16}$	m	5.7×10^{-10}
neutron Compton wavelength	$\lambda_{C,n}$	$1.319\,590\,905\,81(75) \times 10^{-15}$	[m]†	5.7×10^{-10}
neutron magnetic moment	μ_n	$-9.662\,3651(23) \times 10^{-27}$	J T^{-1}	2.4×10^{-7}
to Bohr magneton ratio	μ_n/μ_B	$-1.041\,875\,63(25) \times 10^{-3}$		2.4×10^{-7}
to nuclear magneton ratio	μ_n/μ_N	$-1.913\,042\,73(45)$		2.4×10^{-7}
neutron g-factor $2\mu_n/\mu_N$	g_n	$-3.826\,085\,45(90)$		2.4×10^{-7}
neutron-electron magnetic moment ratio	μ_n/μ_e	$1.040\,668\,82(25) \times 10^{-3}$		2.4×10^{-7}
neutron-proton magnetic moment ratio	μ_n/μ_p	$-0.684\,979\,34(16)$		2.4×10^{-7}
neutron to shielded proton magnetic moment ratio (H_2O, sphere, 25 °C)	μ_n/μ'_p	$-0.684\,996\,94(16)$		2.4×10^{-7}
neutron gyromagnetic ratio $2\lvert\mu_n\rvert/\hbar$	γ_n	$1.832\,471\,71(43) \times 10^8$	$s^{-1}\ T^{-1}$	2.4×10^{-7}
		$29.164\,6931(69)$	MHz T^{-1}	2.4×10^{-7}
		Deuteron, d		
deuteron mass	m_d	$3.343\,583\,7724(10) \times 10^{-27}$	kg	3.0×10^{-10}
		$2.013\,553\,212\,745(40)$	u	2.0×10^{-11}
energy equivalent	m_dc^2	$3.005\,063\,231\,02(91) \times 10^{-10}$	J	3.0×10^{-10}
		$1875.612\,942\,57(57)$	MeV	3.0×10^{-10}
deuteron-electron mass ratio	m_d/m_e	$3670.482\,967\,88(13)$		3.5×10^{-11}
deuteron-proton mass ratio	m_d/m_p	$1.999\,007\,501\,39(11)$		5.6×10^{-11}
deuteron molar mass N_Am_d	$M(\mathrm{d}), M_d$	$2.013\,553\,212\,05(61) \times 10^{-3}$	kg mol^{-1}	3.0×10^{-10}
deuteron rms charge radius	r_d	$2.127\,99(74) \times 10^{-15}$	m	3.5×10^{-4}
deuteron magnetic moment	μ_d	$4.330\,735\,094(11) \times 10^{-27}$	J T^{-1}	2.6×10^{-9}
to Bohr magneton ratio	μ_d/μ_B	$4.669\,754\,570(12) \times 10^{-4}$		2.6×10^{-9}
to nuclear magneton ratio	μ_d/μ_N	$0.857\,438\,2338(22)$		2.6×10^{-9}
deuteron g-factor μ_d/μ_N	g_d	$0.857\,438\,2338(22)$		2.6×10^{-9}
deuteron-electron magnetic moment ratio	μ_d/μ_e	$-4.664\,345\,551(12) \times 10^{-4}$		2.6×10^{-9}
deuteron-proton magnetic moment ratio	μ_d/μ_p	$0.307\,012\,209\,39(79)$		2.6×10^{-9}
deuteron-neutron magnetic moment ratio	μ_d/μ_n	$-0.448\,206\,53(11)$		2.4×10^{-7}

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Quantity	Symbol	Value	Unit	Relative std. uncert. u_r
		Triton, t		
triton mass	m_t	$5.007\,356\,7446(15) \times 10^{-27}$	kg	3.0×10^{-10}
		$3.015\,500\,716\,21(12)$	u	4.0×10^{-11}
energy equivalent	$m_t c^2$	$4.500\,387\,8060(14) \times 10^{-10}$	J	3.0×10^{-10}
		$2808.921\,132\,98(85)$	MeV	3.0×10^{-10}
triton-electron mass ratio	m_t/m_e	$5496.921\,535\,73(27)$		5.0×10^{-11}
triton-proton mass ratio	m_t/m_p	$2.993\,717\,034\,14(15)$		5.0×10^{-11}
triton molar mass $N_A m_t$	$M(\mathrm{t}), M_t$	$3.015\,500\,715\,17(92) \times 10^{-3}$	kg mol^{-1}	3.0×10^{-10}
triton magnetic moment	μ_t	$1.504\,609\,5202(30) \times 10^{-26}$	J T^{-1}	2.0×10^{-9}
to Bohr magneton ratio	μ_t/μ_B	$1.622\,393\,6651(32) \times 10^{-3}$		2.0×10^{-9}
to nuclear magneton ratio	μ_t/μ_N	$2.978\,962\,4656(59)$		2.0×10^{-9}
triton g-factor $2\mu_t/\mu_N$	g_t	$5.957\,924\,931(12)$		2.0×10^{-9}
		Helion, h		
helion mass	m_h	$5.006\,412\,7796(15) \times 10^{-27}$	kg	3.0×10^{-10}
		$3.014\,932\,247\,175(97)$	u	3.2×10^{-11}
energy equivalent	$m_h c^2$	$4.499\,539\,4125(14) \times 10^{-10}$	J	3.0×10^{-10}
		$2808.391\,607\,43(85)$	MeV	3.0×10^{-10}
helion-electron mass ratio	m_h/m_e	$5495.885\,280\,07(24)$		4.3×10^{-11}
helion-proton mass ratio	m_h/m_p	$2.993\,152\,671\,67(13)$		4.4×10^{-11}
helion molar mass $N_A m_h$	$M(\mathrm{h}), M_h$	$3.014\,932\,246\,13(91) \times 10^{-3}$	kg mol^{-1}	3.0×10^{-10}
helion magnetic moment	μ_h	$-1.074\,617\,532(13) \times 10^{-26}$	J T^{-1}	1.2×10^{-8}
to Bohr magneton ratio	μ_h/μ_B	$-1.158\,740\,958(14) \times 10^{-3}$		1.2×10^{-8}
to nuclear magneton ratio	μ_h/μ_N	$-2.127\,625\,307(25)$		1.2×10^{-8}
helion g-factor $2\mu_h/\mu_N$	g_h	$-4.255\,250\,615(50)$		1.2×10^{-8}
shielded helion magnetic moment (gas, sphere, 25 °C)	μ'_h	$-1.074\,553\,090(13) \times 10^{-26}$	J T^{-1}	1.2×10^{-8}
to Bohr magneton ratio	μ'_h/μ_B	$-1.158\,671\,471(14) \times 10^{-3}$		1.2×10^{-8}
to nuclear magneton ratio	μ'_h/μ_N	$-2.127\,497\,719(25)$		1.2×10^{-8}
shielded helion to proton magnetic moment ratio (gas, sphere, 25 °C)	μ'_h/μ_p	$-0.761\,766\,5618(89)$		1.2×10^{-8}
shielded helion to shielded proton magnetic moment ratio (gas/H_2O, spheres, 25 °C)	μ'_h/μ'_p	$-0.761\,786\,1313(33)$		4.3×10^{-9}
shielded helion gyromagnetic ratio $2\lvert\mu'_h\rvert/\hbar$ (gas, sphere, 25 °C)	γ'_h	$2.037\,894\,569(24) \times 10^{8}$	s^{-1} T^{-1}	1.2×10^{-8}
		$32.434\,099\,42(38)$	MHz T^{-1}	1.2×10^{-8}
		Alpha particle, α		
alpha particle mass	m_α	$6.644\,657\,3357(20) \times 10^{-27}$	kg	3.0×10^{-10}
		$4.001\,506\,179\,127(63)$	u	1.6×10^{-11}
energy equivalent	$m_\alpha c^2$	$5.971\,920\,1914(18) \times 10^{-10}$	J	3.0×10^{-10}
		$3727.379\,4066(11)$	MeV	3.0×10^{-10}
alpha particle to electron mass ratio	m_α/m_e	$7294.299\,541\,42(24)$		3.3×10^{-11}
alpha particle to proton mass ratio	m_α/m_p	$3.972\,599\,690\,09(22)$		5.5×10^{-11}
alpha particle molar mass $N_A m_\alpha$	$M(\alpha), M_\alpha$	$4.001\,506\,1777(12) \times 10^{-3}$	kg mol^{-1}	3.0×10^{-10}
		PHYSICOCHEMICAL		
Avogadro constant	N_A	$6.022\,140\,76 \times 10^{23}$	mol^{-1}	exact
Boltzmann constant	k	$1.380\,649 \times 10^{-23}$	J K^{-1}	exact
		$8.617\,333\,262\ldots \times 10^{-5}$	eV K^{-1}	exact
	k/h	$2.083\,661\,912\ldots \times 10^{10}$	Hz K^{-1}	exact

Fundamental Physical Constants — Extensive Listing

Quantity	Symbol	Value	Unit	Relative std. uncert. $u_{\rm r}$
	k/hc	$69.503\,480\,04\ldots$	$[\mathrm{m}^{-1}\ \mathrm{K}^{-1}]^{\dagger}$	exact
atomic mass constant‖				
$m_{\rm u} = \frac{1}{12}m(^{12}\mathrm{C}) = 2hc\,R_\infty/\alpha^2c^2A_{\rm r}(\mathrm{e})$	$m_{\rm u}$	$1.660\,539\,066\,60(50)\times10^{-27}$	kg	3.0×10^{-10}
energy equivalent	$m_{\rm u}c^2$	$1.492\,418\,085\,60(45)\times10^{-10}$	J	3.0×10^{-10}
		$931.494\,102\,42(28)$	MeV	3.0×10^{-10}
molar mass constant‖	$M_{\rm u}$	$0.999\,999\,999\,65(30)\times10^{-3}$	kg mol^{-1}	3.0×10^{-10}
molar mass‖ of carbon-12 $A_{\rm r}(^{12}\mathrm{C})M_{\rm u}$	$M(^{12}\mathrm{C})$	$11.999\,999\,9958(36)\times10^{-3}$	kg mol^{-1}	3.0×10^{-10}
molar Planck constant	$N_{\rm A}h$	$3.990\,312\,712\ldots\times10^{-10}$	J Hz^{-1} mol^{-1}	exact
molar gas constant $N_{\rm A}k$	R	$8.314\,462\,618\ldots$	J mol^{-1} K^{-1}	exact
Faraday constant $N_{\rm A}e$	F	$96\,485.332\,12\ldots$	C mol^{-1}	exact
standard-state pressure		100 000	Pa	exact
standard atmosphere		101 325	Pa	exact
molar volume of ideal gas RT/p				
$T = 273.15$ K, $p = 100$ kPa or standard-state pressure	$V_{\rm m}$	$22.710\,954\,64\ldots\times10^{-3}$	m^3 mol^{-1}	exact
Loschmidt constant $N_{\rm A}/V_{\rm m}$	n_0	$2.651\,645\,804\ldots\times10^{25}$	m^{-3}	exact
molar volume of ideal gas RT/p				
$T = 273.15$ K, $p = 101.325$ kPa or standard atmosphere	$V_{\rm m}$	$22.413\,969\,54\ldots\times10^{-3}$	m^3 mol^{-1}	exact
Loschmidt constant $N_{\rm A}/V_{\rm m}$	n_0	$2.686\,780\,111\ldots\times10^{25}$	m^{-3}	exact
Sackur-Tetrode (absolute entropy) constant**				
$\frac{5}{2}+\ln[(m_{\rm u}kT_1/2\pi\hbar^2)^{3/2}kT_1/p_0]$				
$T_1 = 1$ K, $p_0 = 100$ kPa or standard-state pressure	S_0/R	$-1.151\,707\,537\,06(45)$		3.9×10^{-10}
$T_1 = 1$ K, $p_0 = 101.325$ kPa or standard atmosphere		$-1.164\,870\,523\,58(45)$		3.9×10^{-10}
Stefan-Boltzmann constant				
$(\pi^2/60)k^4/\hbar^3c^2$	σ	$5.670\,374\,419\ldots\times10^{-8}$	W m^{-2} K^{-4}	exact
first radiation constant for spectral radiance $2hc^2\ \mathrm{sr}^{-1}$	$c_{\rm 1L}$	$1.191\,042\,972\ldots\times10^{-16}$	[W m^2 sr^{-1}]††	exact
first radiation constant $2\pi hc^2 = \pi\,\mathrm{sr}\,c_{\rm 1L}$	c_1	$3.741\,771\,852\ldots\times10^{-16}$	[W m^2]††	exact
second radiation constant hc/k	c_2	$1.438\,776\,877\ldots\times10^{-2}$	[m K]†	exact
Wien displacement law constants				
$b = \lambda_{\rm max}T = c_2/4.965\,114\,231...$	b	$2.897\,771\,955\ldots\times10^{-3}$	[m K]†	exact
$b' = \nu_{\rm max}/T = 2.821\,439\,372...\,c/c_2$	b'	$5.878\,925\,757\ldots\times10^{10}$	Hz K^{-1}	exact

* The energy of a photon with frequency ν expressed in unit Hz is $E = h\nu$ in J. Unitary time evolution of the state of this photon is given by $\exp(-iEt/\hbar)|\varphi\rangle$, where $|\varphi\rangle$ is the photon state at time $t = 0$ and time is expressed in unit s. The ratio $Et/\hbar$ is a phase.

† The full description of m^{-1} is cycles or periods per meter and that of m is meter per cycle (m/cycle). The scientific community is aware of the implied use of these units. It traces back to the conventions for phase and angle and the use of unit Hz versus cycles/s. No solution has been agreed upon.

‡ Value recommended by the Particle Data Group (Tanabashi, *et al.*, 2018).

§ Based on the ratio of the masses of the W and Z bosons $m_{\rm W}/m_{\rm Z}$ recommended by the Particle Data Group (Tanabashi, *et al.*, 2018). The value for $\sin^2\theta_{\rm W}$ they recommend, which is based on a variant of the modified minimal subtraction ($\overline{\rm MS}$) scheme, is $\sin^2\hat{\theta}_{\rm W}(M_{\rm Z}) = 0.231\,22(4)$.

¶ This and other constants involving m_τ are based on $m_\tau c^2$ in MeV recommended by the Particle Data Group (Tanabashi, *et al.*, 2018).

‖ The relative atomic mass $A_{\rm r}(X)$ of particle X with mass $m(X)$ is defined by $A_{\rm r}(X) = m(X)/m_{\rm u}$, where $m_{\rm u} = m(^{12}\mathrm{C})/12 = 1$ u is the atomic mass constant and u is the unified atomic mass unit. Moreover, the mass of particle X is $m(X) = A_{\rm r}(X)$ u and the molar mass of X is $M(X) = A_{\rm r}(X)M_{\rm u}$, where $M_{\rm u} = N_{\rm A}$ u is the molar mass constant and $N_{\rm A}$ is the Avogadro constant.

** The entropy of an ideal monoatomic gas of relative atomic mass $A_{\rm r}$ is given by $S = S_0 + \frac{3}{2}R\ln A_{\rm r} - R\ln(p/p_0) + \frac{5}{2}R\ln(T/\mathrm{K})$.

†† The full description of m^2 is $\mathrm{m}^{-2}\times(\mathrm{m/cycle})^4$. See also footnote for m^{-1}.