Physics 215 – Elementary Modern Physics

Units and Constants

Fundamental SI Units

Measures	Name	Abbr.
Length	meter	m
Time	second	s
Mass	kilogram	kg
Temperature	Kelvin	K
Charge	Coulomb	C

Derived SI Units

Measures	Name	Abbr.	Equiv.
Force	Newton	N	$kg{\cdot}m/s^2$
Energy	Joule	J	N·m
Power	Watt	W	J/s
Frequency	Hertz	Hz	s^{-1}
Pressure	Pascal	Pa	N/m^2
Current	Ampere	A	C/s
Elec. Potential	Volt	V	J/C
Mag. Field	Tesla	T	N·s/m/C

Metric Prefixes

Name	Abbr.	Mult.
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}

Physical Constants

Name	Symbol	Value
Speed of light	c	2.9979×10^{8} m/s
Fundamental Charge	e	1.6022×10^{-19} C
Avogadro's number	N_A	6.0221×10^{23} /mol
Electron mass	m_e	9.1094×10^{-31} kg
		$= 511.00$ keV/c^2
Proton mass	m_p	1.6726×10^{-27} kg
		$= 938.27$ MeV/c^2
Neutron mass	m_n	1.6749×10^{-27} kg
		$= 939.56$ MeV/c^2
Boltzmann's Constant	k_B	1.3807×10^{-23} J/K
		$= 8.6173\times10^{-5}$ eV/K
Planck Constant	h	6.6261×10^{-34} J·s
		$= 4.1357\times10^{-15}$ eV·s
Reduced Planck Constant	$\hbar$	1.0546×10^{-34} J·s
		$= 6.5821\times10^{-16}$ eV·s
Coulomb's Constant	k	8.9876×10^{9} $N{\cdot}m^2/C^2$
Newton's Constant	G	6.674×10^{-11} $N{\cdot}m^2/kg^2$

Non SI Units and Constants

Name	Abbr.	Value
Minute	m	60 s
Hour	h	3600 s
Day	d	86,400 s
Year	y	3.1558×10^{7} s
Light year (c·y)	ly	9.4607×10^{15} m
Electron volt	eV	1.6022×10^{-19} J
Unified mass unit	u	1.6605×10^{-27} kg
		$= 931.49$ MeV/c^2
Helium-4 mass	M_{He}	4.002602 u
Two electrons	$2m_ec^2$	1.022 MeV

Useful Combinations

Combination	Value
hc	1.9864×10^{-25} J·m
	$= 1239.8$ eV·nm
$\hbar c$	3.1615×10^{-26} J·m
	$= 197.33$ eV·nm
$\lambda_c \equiv \frac{h}{m_e c}$	2.4263 pm
$a_0 \equiv \frac{\hbar^2}{k m_e e^2}$	0.052918 nm
$\alpha \equiv \frac{k e^2}{\hbar c}$	0.00729735
	$= 1/137.036$
MeV/c	5.344×10^{-22} kg·m/s
MeV/c^2	1.78266×10^{-30} kg

Astrophysical

Name	Abbr.	Value
Parsec	pc	3.0857×10^{16} m
Solar luminosity	$L_\odot$	3.828×10^{26} W
Solar mass	$M_\odot$	1.989×10^{30} kg
Solar radius	$R_\odot$	6.957×10^{5} km
Solar Temperature	$T_\odot$	5778 K
Hubble's Constant	H_0	67.8 km/s/Mpc
Background Temp.	T_0	2.7255 K