Appendix F

Units, Constants, and Notations

This appendix simply lists various fundamental units, physical constants, and notations used throughout the text, for easy reference.

Table F.1 shows the names, abbreviations, and values of the standard order-of-magnitude prefixes for units of measurement.

Table F.2 shows the various base units of measurement referred to in this thesis. Any of these of course may also appear together with any of the prefixes listed in table F.1.

Table F.3 shows the fundamental physical constants we use. The Planck length L_{P} is listed in the units table (table F.2), but it may also be considered to be a fundamental physical constant. It is sometimes hypothesized to be some sort of minimum length scale for physics.

Table F.4 gives our preferred, more mnemonic notation for comparing the asymptotic order of growth of functions.

Name	Sym	Val	Name	Sym	Val
deka-	D	10^1	deci-	d	10^{-1}
hecto-	h	10^2	centi-	c	10^{-2}
kilo-	k	10^3	milli-	m	10^{-3}
mega-	M	10^6	micro-	μ	10^{-6}
giga-	G	10^9	nano-	n	10^{-9}
tera-	T	10^{12}	pico-	p	10^{-12}
peta-	P	10^{15}	femto-	f	10^{-15}
exa-	E	10^{18}	atto-	a	10^{-18}

Table F.1: Unit magnitude prefixes.

Symbol	Name	Measures	Some equivalences
Å	Ångstrom	length	10^{-10} m
B	byte	information	8 b
b	bit	information, entropy	$(\ln 2)$ nat
C	Coulomb	electric charge	
eV	electron Volt	energy	1.60217733×10^{-19} J
g	gram	mass	
Hz	Hertz	frequency	1/s
J	Joule	energy	1 N m
K	Kelvin	temperature	$\sim 1.38\times10^{-23}$ J/nat
kg	kilogram	mass	1000 g
m	meter	length	
N	Newton	force	1 kg m/s^2
nat	nat	entropy	k_B, 1 b/ln 2
L_P	Planck length	length	$\sqrt{G\hbar/c^3} \approx 1.616\times10^{-35}$ m
s	second	time	
V	Volt	electric potential	1 J/C

Table F.2: Some basic units of measurement used in this document.

Symbol	Meaning	Some equivalences	Approximate value
c	Speed of light		299792458 m/s
ϵ_0	Permittivity of free space	$1/\mu_0 c^2$	8.85418782×10^{-12} F/m
h	Planck's constant		6.6260755×10^{-34} J $\cdot$ s
$\hbar$	Reduced Planck's constant	$h/2\pi$	1.05457267×10^{-34} J $\cdot$ s
G	Gravitational constant		6.67259×10^{-11} N m^2/kg
k_B	Boltzmann's constant	1 nat	1.3806513×10^{-23} J/K
σ_SB	Stefan-Boltzmann constant	$\pi^2 k_\mathrm{B}^4/60c^2\hbar^3$	5.6704×10^{-8} J/s-K^4-m^2
q_e	Electron charge magnitude		1.60217733×10^{-19} C

Table F.3: Fundamental physical constants used in this document.

Cryptic standard notation	Our own mnemonic notation	Mathematical definition; English explanation
$f = \mathbf{\Theta}(g)$	$f \sim g$	$\exists c_1, c_2, n_0 > 0\colon\ \forall n \geq n_0\colon\ 0 \leq c_1 g(n) \leq f(n) \leq c_2 g(n)$; f is asymptotically proportional to g
$f = \mathcal{O}(g)$	$f \precsim g$	$\exists c, n_0 > 0\colon\ \forall n \geq n_0\colon\ 0 \leq f(n) \leq cg(n)$; f is asymptotically no more than proportional to g
$f = \mathbf{\Omega}(g)$	$f \succsim g$	$\exists c, n_0 > 0\colon\ \forall n \geq n_0\colon\ 0 \leq cg(n) \leq f(n)$; f is asymptotically no less than proportional to g
$f = \mathbf{o}(g)$	$f \prec g$	$\forall c > 0\colon\ \exists n_0 > 0\colon\ \forall n \geq n_0\colon\ 0 \leq f(n) < cg(n)$; f is asymptotically strictly less than proportional to g
$f = \boldsymbol{\omega}(g)$	$f \succ g$	$\forall c > 0\colon\ \exists n_0 > 0\colon\ \forall n \geq n_0\colon\ 0 \leq cg(n) < f(n)$; f is asymptotically strictly more than proportional to g

Table F.4: Asymptotic order-of-growth notation. In addition to reviewing the standard notation, we introduce a simplified notation that will be useful in some contexts.