

# Mathematical Physics

## MP467

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## Cosmology and Astrophysics

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### Textbooks:

1. A.C. Phillips: The Physics of Stars, 2nd edition, Wiley (1994) 523.8 PHI
2. S.L. Shapiro and S.A. Teukolsky: Black Holes, White Dwarfs and Neutron Stars: the physics of compact objects, Wiley (1983) 523.01 SHA
3. A. Liddle: An Introduction to Modern Cosmology, Wiley (1998) 523.1 LID
4. V. Mukhanov: Physical Foundations of Cosmology, CUP (2005)
5. S. Weinberg: The First Three Minutes, Basic Books (1994) 523.12 WEI
6. B. Carroll and D. Ostlie: An Introduction to Modern Astrophysics, Addison-Wesley (1996) 523.01 CAR
7. R. Bowers and T. Deeming: Astrophysics I+II, Jones and Bartlett (1984) 523.01 BOW

### Topics:

1. Moons and Planets
2. Stellar formation and stellar structure
3. Degenerate Stars: white dwarves, neutron stars, pulsars and black-holes
4. Cosmology and the early Universe

Quantity	Symbol	Value
Speed of light (in vacuum)	$c$	$299\,792\,458\,m\,s^{-1}$ (exact)
Newton's constant	$G$	$6.673 \times 10^{-11}\,kg^{-1}\,m^3\,s^{-2}$
Planck's constant	$h$	$6.626 \times 10^{-34}\,J\,s$
Electron charge (magnitude)	$e$	$1.602 \times 10^{-19}\,C$
Electric permittivity (vacuum)	$\epsilon_0 = \frac{1}{\mu_0 c^2}$	$8.854 \times 10^{-12}\,C^2\,N^{-1}\,m^{-2}$
Magnetic permeability (vacuum)	$\mu_0$	$4\pi \times 10^{-7}\,N\,s^2\,C^{-2}$
Fine structure constant	$\alpha = \frac{e^2}{2\epsilon_0 hc}$	$7.297 \times 10^{-3}$
Thompson cross-section	$\sigma_T$	$6.652 \times 10^{-29}\,m^2$
Electron mass	$m_e$	$9.109 \times 10^{-31}\,kg$
Proton mass	$m_p$	$1.673 \times 10^{-27}\,kg$
Atomic mass unit (mass of $^{12}C$ atom)/12	$a.m.u.$	$1.661 \times 10^{-27}\,kg$
Boltzmann's constant	$k_B$	$1.381 \times 10^{-23}\,J\,K^{-1}$
Stefan-Boltzmann constant	$\sigma_{SB}$	$5.670 \times 10^{-8}\,J\,s^{-1}\,m^{-2}\,K^{-4}$
Avagardo's number	$N_A$	$6.022 \times 10^{23}\,mol^{-1}$
Earth mass	$M_{\oplus}$	$5.97 \times 10^{24}\,kg$
Earth radius (equatorial)	$R_{\oplus}$	$6.38 \times 10^3\,km$
Lunar mass	$M_{\mathfrak{C}}$	$7.35 \times 10^{22}\,kg$
Lunar radius	$R_{\mathfrak{C}}$	$1.74 \times 10^3\,km$
Earth-Moon distance (mean)	$d_{\oplus-\mathfrak{C}}$	$3.84 \times 10^5\,km$
Earth-Sun distance (mean)	$d_{\oplus-\odot}$	$1.50 \times 10^8\,km$
Solar mass	$M_{\odot}$	$1.99 \times 10^{30}\,kg$
Solar radius (equatorial)	$R_{\odot}$	$6.961 \times 10^5\,km$
Solar luminosity	$L_{\odot}$	$3.85 \times 10^{26}\,J\,s^{-1}$
Temperature of microwave background	$T_0$	$2.725 \pm 0.002\,K$
Hubble constant	$H_0$	$72 \pm 5\,km\,s^{-1}\,Mpc^{-1}$
( $H_0 = 100h\,km\,s^{-1}\,Mpc^{-1}$ )	$h$	$0.72 \pm 0.05$
Critical density	$\rho_c = \frac{3H_0^2}{8\pi G}$	$1.88 \times 10^{-26}h^2\,kg\,m^{-3}$
Baryon density	$\Omega_b = \rho_b/\rho_c$	$0.044 \pm 0.004$
Cold dark matter density	$\Omega_m = \rho_m/\rho_c$	$0.27 \pm 0.04$
Total density	$\Omega_{tot}$	$1.02 \pm 0.02$
Age of the Universe	$t_0$	$13.7 \pm 0.2 \times 10^9\,yr$
Electron Volt	$eV$	$1.602 \times 10^{-19}\,J$
parsec	$pc$	$3.086 \times 10^{16}\,m$
year	$yr$	$3.156 \times 10^7\,s$