DETACHABLE FORMULA SHEET

Formulas

Circum. of circle	$C = 2\pi R$	Escape speed	$v_{esc} = \sqrt{2GM/R} = \sqrt{2}v_{circ}$
Area of disk	$A = \pi R^2$	Wave relation	$f = c/\lambda$
Surf. area of sphere	$S = 4\pi R^2$	Photon energy	$E = hf$
Volume of sphere	$V = \frac{4}{3}\pi R^3$	Redshift	$z \equiv (\lambda_{obs} - \lambda_{emit})/\lambda_{emit}$
Density of object	$\rho = M/V$	Doppler shift	$z = v_{rad}/c \; (v_{rad} \ll c)$
Small-angle formula	$\theta \approx D/d$	Wien's law	$\lambda_{max} = (0.002898 \text{ m K})/T$
Force of gravity	$F = Gm_1m_2/d^2$	Steph.-Boltz. law	$F_{emit} = \sigma T^4$
Ideal gas law	$P = nk_BT$	Flux-lumin. relation	$F_{obs} = L/4\pi d^2$
Kepler's 3rd law	$P^2 = a^3$	Stellar luminosity	$L = 4\pi R^2 \sigma T^4$
Newton's form	$P^2 = \frac{4\pi^2}{G(m_1+m_2)}a^3$	Parallax	$d = 1/p$, d in pc, p in arcsec
Convenient form	$\frac{m_1+m_2}{M_\odot} = \left(\frac{a}{AU}\right)^3/\left(\frac{P}{yr}\right)^2$	Magnitude system	$m_2 - m_1 = 2.5\log_{10}(F_1/F_2)$
Mass balance	$m_1r_1 = m_2r_2$	Distance modulus	$m - M = 5\log_{10}(d/10 \text{ pc})$
Momentum balance	$m_1v_1 = m_2v_2$	Jeans mass	$M_J = (5k_BT/Gm_p)^{3/2}(3/4\pi\rho)^{1/2}$
Kinetic energy	$KE = \frac{1}{2}mv^2$	Main seq. lifetime	$\tau \approx 1.0 \times 10^{10}(M/M_\odot)^{-2.5}$ yr
Mass-energy equiv.	$E = mc^2$	Lorentz factor	$\gamma = 1/\sqrt{1 - v^2/c^2}$
Grav. Pot. energy	$GPE = -Gm_1m_2/r$	Special relativity	$t = \gamma t_{prop}$, $l = l_{prop}/\gamma$, $m = \gamma m_{prop}$
Orbital energy	$E = KE + GPE$	Schwarzschild radius	$R_S = 2GM/c^2 \simeq 3(M/M_\odot)$ km
Circular orbit speed	$v_{circ} = \sqrt{GM/R}$	Gravitational redshift	$z = (1 - R_S/r)^{-1/2} - 1 \simeq GM/c^2r$

Units

Astronomical unit	$1 \text{ AU} = 1.496 \times 10^{11}$ m
Light-year	$1 \text{ ly} = 9.461 \times 10^{15} \text{ m} = 6.324 \times 10^4$ AU
Parsec	$1 \text{ pc} = 3.086 \times 10^{16} \text{ m} = 3.262 \text{ ly} = 2.063 \times 10^5$ AU
Year	$1 \text{ yr} = 365.25 \text{ d/yr} \times 24 \text{ h/d} \times 60 \text{ min/h} \times 60 \text{ s/min} = 3.15576 \times 10^7$ s
Degree of arc	$1° = 60'$ (arcmin) $= 3600''$ (arcsec); $180° = \pi$ rad
Electron-Volt	$1 \text{ eV} = 1.602 \times 10^{-19}$ J

Quantities

Mass of Sun	$M_\odot = 1.989 \times 10^{30}$ kg
Radius of Sun	$R_\odot = 6.955 \times 10^8$ m
Effective temperature of Sun	$T_\odot = 5.778 \times 10^3$ K
Luminosity of Sun	$L_\odot = 3.839 \times 10^{26}$ W
Mass of hydrogen atom	$m_H = 1.674 \times 10^{-27}$ kg

Metric Prefixes

n (nano)	10^{-9}
μ (micro)	10^{-6}
m (milli)	10^{-3}
k (kilo)	10^3
M (mega)	10^6
G (giga)	10^9
T (tera)	10^{12}

Constants

Speed of light	$c = 2.998 \times 10^8 \text{ m s}^{-1}$
Gravitational constant	$G = 6.673 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$
Planck's constant	$h = 6.626 \times 10^{-34} \text{ m}^2 \text{ kg s}^{-1}$
Stefan-Boltzmann constant	$\sigma = 5.670 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$
Boltzmann constant	$k_B = 1.381 \times 10^{-23} \text{ J K}^{-1}$