ASTR 101 — Midterm 1 Equation Sheet

Spring 2026 | Dr. Anna Rosen

Light & Radiation

$$c = \lambda\nu$$

$$E = h\nu = \frac{hc}{\lambda}$$

$$\lambda(\text{nm}) = \frac{1240}{E(\text{eV})}$$

$$\lambda_{\text{peak}} = \frac{2.90 \times 10^{6}\ \text{nm}\cdot\text{K}}{T}$$

$$L = 4\pi R^2 \sigma T^4$$

$$\text{Power per unit area} = \sigma T^4$$

$$F = \frac{L}{4\pi d^2}$$

Gravity & Motion

$$\vec{F}_{\text{net}} = m\vec{a}$$

$$F_g = \frac{GMm}{r^2}$$

$$g = \frac{GM}{r^2} \qquad W = mg$$

$$a_c = \frac{v^2}{r} \qquad F_c = \frac{mv^2}{r}$$

$$v_{\text{orb}} = \sqrt{\frac{GM}{r}}$$

$$P^2 = \frac{4\pi^2}{GM}a^3$$

$$r_p = a(1-e) \qquad r_a = a(1+e)$$

Measurement & Geometry

$$\frac{\Delta\lambda}{\lambda_0} = \frac{v}{c} \qquad \Delta\lambda = \lambda_{\text{obs}} - \lambda_0$$

$$\theta \approx \frac{D}{d} \quad (\theta \text{ in radians})$$

$$T_K = T_C + 273$$

$$E_n = -\frac{13.6\ \text{eV}}{n^2} \quad (n = 1, 2, 3, \ldots)$$

$$\theta \approx 1.22\frac{\lambda}{D} \quad \text{(angular resolution)}$$

$$\text{Light-gathering power} \propto D^2$$

$$h_{\text{noon}} = 90° - |\varphi - \delta|$$

$$\text{distance} = \text{speed} \times \text{time}$$

Constants

Constant	Symbol	Value
Speed of light	c	3.00×10^{8} m/s
Gravitational const.	G	6.67×10^{-11} N m² kg⁻²
Stefan-Boltzmann	σ	5.67×10^{-8} W m⁻² K⁻⁴
Planck's constant	h	6.63×10^{-34} J s
Surface gravity	$g_\oplus$	9.8 m/s²

Astrophysical Values

Quantity	Symbol	Value
Solar luminosity	$L_\odot$	3.8×10^{26} W
Solar radius	$R_\odot$	7.0×10^{8} m
Solar mass	$M_\odot$	2.0×10^{30} kg
Solar surface temp.	$T_\odot$	5800 K
Earth–Sun distance	1 AU	1.50×10^{11} m
1 light-year	ly	9.46×10^{15} m
1 parsec	pc	3.09×10^{16} m
Earth radius	$R_\oplus$	6.4×10^{6} m
Earth mass	$M_\oplus$	6.0×10^{24} kg

Exponent Rules

Rule	Example
$10^a \times 10^b = 10^{a+b}$	$10^3 \times 10^5 = 10^8$
$10^a / 10^b = 10^{a-b}$	$10^8 / 10^5 = 10^3$
$(10^a)^b = 10^{ab}$	$(10^3)^2 = 10^6$
$10^{1/2} = \sqrt{10}$	$4^{3/2} = \left(\sqrt{4}\right)^3 = 8$
$10^{-n} = 1/10^n$	$10^{-3} = 0.001$

Conversions

$1° = 60' = 3600''$	1 rad ≈ 57.3°
1 nm = 10^{-9} m	1 km = 10^3 m
1 eV = 1.6×10^{-19} J	1 pc ≈ 3.26 ly
1 yr ≈ 3.15×10^7 s	1 day = 86,400 s

Scaling: $A = kB^n \rightarrow A \propto B^n$, then $\dfrac{A_2}{A_1} = \left(\dfrac{B_2}{B_1}\right)^n$