PHYS 172: Stellar Astronomy & Cosmology
Final Exam: Wednesday, May 6, 2026, 9 am – noon, room 110 (regular lecture hall)

Formula Sheet

$$\varepsilon = \frac{d}{2a}$$

$$\frac{v_p}{v_a} = \frac{1+\varepsilon}{1-\varepsilon}$$

$$T^2 = a^3$$

$$x = vt$$

$$v = at$$

$$x = \tfrac{1}{2}at^2$$

$$F_{A\to B} = -F_{B\to A}$$

$$E_k = \frac{1}{2}mv^2$$

$$F_G = \mathrm{G}\frac{M_A M_B}{r^2}$$

$$a_c = \frac{v^2}{r}$$

$$F_c = \frac{mv^2}{r}$$

$$T^2 = \frac{4\pi^2}{G(M_1+M_2)}a^3$$

$$M_1 r_1 = M_2 r_2$$

$$r_2 = a\frac{M_1}{M_1+M_2}$$

$$p = mv$$

$$L = p \times r$$

$$L = mvr$$

$$E_{potential} = -\mathrm{G}\frac{M_1 M_2}{r}$$

$$E_{total} = E_{pot.} + E_{kinetic}$$

$$v_{escape} = \sqrt{\frac{2GM_E}{R_E}}$$

$$f = \frac{1}{T}$$

$$\lambda f = c$$

$$\lambda_{max} = \frac{2.9\times10^6}{T}$$

$$Intensity = \sigma T^4$$

$$I = \frac{1}{2}c\varepsilon_0 E^2$$

$$B = E/c$$

$$P = \frac{I}{c}$$

$$I(r,\theta) = \frac{\pi^2 p_0^2}{2\epsilon_0 c^3}\cdot f^4 \cdot \frac{\sin^2\theta}{r^2}$$

$$p_\gamma = \frac{h}{\lambda} = \frac{E_\gamma}{c}$$

$$M_\gamma = 0$$

$$f' = f + \Delta f$$

$$\frac{\Delta f}{f} = -\frac{\Delta\lambda}{\lambda} = \frac{v_\parallel}{c}$$

$$v_\parallel = v\cos\theta$$

$$\theta_{min} = 1.22\frac{\lambda}{D}$$

$$\theta_{min,\,arcsec} = 0.000252\frac{\lambda_{nm}}{D_m}$$

$$num.\ ang.\ pixels = \frac{\theta_{object}}{\theta_{min}}$$

$$V_{sphere} = \frac{4}{3}\pi R^3$$

$$Area_{sphere} = 4\pi R^2$$

$$Area_{disk} = \pi R^2$$

$$L = M^{3.9}$$

$$E = mc^2$$

$$\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$L = \frac{L_0}{\gamma}\ ,\ \ T = \gamma T_0$$

$$R_S = \frac{2GM}{c^2}$$

$$\frac{\Delta f}{f} = \frac{g\Delta h}{c^2}$$

$$\frac{f_2}{f_1} = \sqrt{\frac{1-\frac{R_s}{R_2}}{1-\frac{R_s}{R_1}}}$$

$$\frac{\lambda_2}{\lambda_1} = \sqrt{\frac{1-\frac{R_s}{R_2}}{1-\frac{R_s}{R_1}}}$$

$$v = Hd$$

$$z = \frac{\Delta\lambda}{\lambda}$$

$$\frac{v}{c} = \frac{(z+1)^2-1}{(z+1)^2+1}$$

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

$G = 6.6743 \times 10^{-11}$ m^3/kg.s^2

1 eV = 1.602×10^{-19} J

$\sigma = 5.67 \times 10^{-8}$ W/(m^2·K^4)

$h = 6.626 \times 10^{-34}$ J·s

$\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/(N·m^2)

$c = 3.0 \times 10^{8}$ m/s

H = 22 (km/s)/million-ly

1 ly = 9.4×10^{12} km

$m_p = 1.67265 \times 10^{-27}$ kg

$m_n = 1.67495 \times 10^{-27}$ kg

$m_e = 9.11 \times 10^{-31}$ kg

1 AU = 149.6×10^{6} km

$M_{Earth} = 5.97 \times 10^{24}$ kg

R_{Earth} = 6371 km

$M_{Sun} = 1.99 \times 10^{30}$ kg

$R_{Sun} = 6.96 \times 10^{5}$ km

$L_{Sun} = 3.8 \times 10^{26}$ W

$M_{Moon} = 7.34 \times 10^{22}$ kg

R_{Moon} = 1737 km