

Formula Sheet

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

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

$$T^2 = a^3$$

$$x = vt$$

$$v = at$$

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

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

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

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

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

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

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

$$M_1 r_1 = M_2 r_2$$

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

$$p = mv$$

$$L = p \times r$$

$$L = mvr$$

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

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

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

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

$$\lambda f = c$$

$$\lambda_{\text{max}} = \frac{2.9 \times 10^6}{T}$$

$$\text{Intensity} = \sigma T^4$$

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

$$B = E/c$$

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

$$I(r, \theta) = \frac{\pi^2 p_0^2}{2 \varepsilon_0 c^3} \cdot f^4 \cdot \frac{\sin^2 \theta}{r^2}$$

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

$$M_\gamma = 0$$

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

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

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

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

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

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

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

$$\text{Area}_{\text{sphere}} = 4\pi R^2$$

$$\text{Area}_{\text{disk}} = \pi R^2$$

$$L = M^{3.9}$$

$$E = mc^2$$

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

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

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

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

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

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

$$v = Hd$$

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

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

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

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

$$1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$$

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

$$h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$$

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

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

$$H = 22 \text{ (km/s)}/\text{million-ly}$$

$$1 \text{ ly} = 9.4 \times 10^{12} \text{ km}$$

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

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

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

$$1 \text{ AU} = 149.6 \times 10^6 \text{ km}$$

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

$$R_{\text{Earth}} = 6371 \text{ km}$$

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

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

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

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

$$R_{\text{Moon}} = 1737 \text{ km}$$