Astronomy 25
Useful Equations
First half of semester

\[ L^2 = \Delta x^2 + \Delta y^2 + \Delta z^2 \]
(The spatial distance (L) between two points, separated by \( \Delta x \), \( \Delta y \), and \( \Delta z \))

\[ v = \Delta x / \Delta t \]
(Linear velocity)

\[ v = v_1 + v_2 \]
(Newtonian velocity addition)

\[ a = \Delta v / \Delta t \]
(Linear acceleration)

\[ \Delta x = \frac{1}{2} a \Delta t^2 \]
(displacement from an acceleration)

\[ R = (v^2 / g) \sin 2\theta \]
(Range of a missile)

\[ F = ma \]
(Newton’s Second Law)

\[ F = GM_1 M_2 / R^2 \]
(Newton’s Law of Gravity)

\[ E = \frac{1}{2} mv^2 \]
(Kinetic energy)

\[ E = mgh \]
(Potential energy in a uniform gravitational field)

\[ F = mv^2 / R \]
(Force needed to keep an object in a circular path.)

\[ c = \lambda v \]
(speed of light, wavelength, frequency)

\[ \lambda_{\text{max}} = 2900000 / T \]
(Wien’s Law)

\[ E = 4\pi R^2 \sigma T^4 \]
(Stefan-Boltzmann law)

\[ \frac{\lambda - \lambda_o}{\lambda_o} = \frac{\Delta \lambda}{\lambda_o} = \frac{v_r}{c} \]
(Doppler Effect)

\[ P = \rho k T \]
(Thermal Pressure)

\[ D = 3.26 \text{ LY} = 1 \text{ pc} \]
(Distance from trigonometric parallax)

Schwarzschild radius
\[ R_s = 2.96 \times (M/M_\odot) \text{ km} \]
\( (M_\odot = 1 \text{ solar mass}) \)

\[ V = H d \]
(Hubble’s Law)

\[ \beta = v / c \]
(Simple relativistic parameter)

\[ \gamma = 1 / \sqrt{1 - v^2 / c^2} \]
(Lorentz factor)

\[ \Delta t = \gamma \Delta t' \]
(Time dilation)

\[ L = L_0 / \gamma \]
(Lorentz contraction)

\[ E = mc^2 \]
(mass-energy equivalence)

\[ V = \frac{(v_1 + v_2)}{\left(1 + v_1 v_2 / c^2\right)} \]
(Relativistic velocity addition)