

**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)

$$E = \frac{1}{2} m v^2$$

(Kinetic energy)

$$E = mgh$$

(Potential energy in a uniform gravitational field)

$$F = m v^2 / R$$

(Force needed to keep an object in a circular path.)

$$c = \lambda \nu$$

(speed of light, wavelength, frequency)

$$\lambda_{\max} = 2900000 / T$$

(Wien's Law)

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

(Stefan-Boltzmann law)

$$\frac{(\lambda - \lambda_0)}{\lambda_0} = \frac{\Delta \lambda}{\lambda_0} = \frac{v_r}{c}$$

(Doppler Effect)

$$P = \rho k T$$

(Thermal Pressure)

$$D = \frac{3.26 \text{ LY}}{p} = \frac{1 \text{ pc}}{p}$$

(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)

$$E = m c^2$$

(mass-energy equivalence)

$$V = \frac{(v_1 + v_2)}{(1 + v_1 v_2 / c^2)}$$

(Relativistic velocity addition)