8.01L SUMMARY OF EQUATIONS

Note: Quantities shown in **bold** are vectors.

\[ \mathbf{v} = \frac{d\mathbf{r}}{dt} \quad \mathbf{a} = \frac{d\mathbf{v}}{dt} \]

For constant acceleration \( \mathbf{a} \), if at \( t = 0 \) \( \mathbf{v}_0 = 0 \) and \( \mathbf{v}_0 = 0 \): \( \mathbf{v} = \mathbf{v}_0 + \mathbf{a}t \)

\[ \mathbf{r} = \mathbf{r}_0 + \mathbf{v}_0 t + \frac{1}{2} \mathbf{a} t^2 \]

Circular motion at constant speed \( a = \frac{v^2}{r} = \omega^2 r \) (Centripetal acceleration, points towards center of circle, \( \omega \) is angular speed in radians per second)

Adding relative velocities ("wrt" is short for "with respect to"):

\[ \mathbf{v}^w_{\mathbf{A}} + \mathbf{v}^w_{\mathbf{B}} = \mathbf{v}^w_{\mathbf{A}} \]

\[ \sum \mathbf{F} = 0 \iff \mathbf{a} = 0 \quad \text{(Newton’s first law)} \]

\[ \mathbf{F} = m\mathbf{a} \quad \text{or} \quad \mathbf{F} = \frac{d\mathbf{p}}{dt} \quad \text{(Newton’s second law)} \]

\[ \mathbf{F}_{\mathbf{AB}} = -\mathbf{F}_{\mathbf{BA}} \quad \text{(Newton’s third law)} \]

\( \mathbf{F} = -k\mathbf{x} \) (spring force) \( f \leq \mu N \) (Friction force relative to Normal force)

\[ W = \int \mathbf{F} \cdot d\mathbf{r} \quad \text{(work done by force \( \mathbf{F} \))} \]

\[ W_{other} = \Delta E = E_f - E_i \quad E = KE + PE \quad \text{(work-energy theorem)} \]

\[ F_x = -\frac{dU}{dx} \quad \text{(force derived from potential energy)} \]

Potential Energies: \( U = mgh \) (gravitational, near Earth)

Physical Constants:

\( g = 9.8 \text{ m/s}^2 \) Use the approximate value \( g = 10 \text{ m/s}^2 \) where told to do so.

Conversion reminder:

\( \pi \text{ radians} = 180^\circ \)

Lazy Physicist’s Favorite Angle: (to be used when calculators are not allowed):

36.9° and 53.1° are the angles of a 3-4-5 right triangle so:

\( \sin(36.9^\circ) = \cos(53.1^\circ) = 0.60 \quad \cos(36.9^\circ) = \sin(53.1^\circ) = 0.80 \)

\( \tan(36.9^\circ) = 0.75 \quad \tan(53.1^\circ) = 1.33 \)

Solution to a Quadratic Equation: If \( ax^2 + bx + c = 0 \) then

\[ x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \]