Handout 1

Chapters 1-5

$1\,mile = 1609\,m = 1.609\,km$ $\quad 1\,year = 365\,days = 3.15\ \times 10^7 s$ $\quad 1\,slug = 14.95\,kg$

$1\,m = 39.37\,in = 3.281\,ft$ $\quad 1\,day = 24\,h = 1.44\ \times 10^3 \min = 8.64\ \times 10^4 s$

$1\,u = 1.66 \times 10^{-27} kg$ $\quad 1000\,kg = 1\,t\ (metric\ ton)$

$g = 9.80\,m/s^2$ $\quad \Delta x = x_f - x_i$ $\quad \Delta v = v_f - v_i$

Vectors in 2-D: $x = r\cos\theta$ $\quad \tan\theta = \frac{y}{x}$ $\quad y = r\sin\theta$ $\quad r = \sqrt{x^2 + y^2}$ $\quad \vec{r} = x\,\hat{\imath} + y\,\hat{\jmath}$

Average velocity: $\bar{v} = \frac{\Delta x}{\Delta t}$ $\quad$ Instantaneous velocity: $v = \frac{dx}{dt}$

Average acceleration: $\bar{a} = \frac{\Delta v}{\Delta t}$ $\quad$ Instantaneous acceleration: $a = \frac{dv}{dt}$

Equations of motion 1-D: $v = v_0 + a\,t$ $\quad x = x_0 + \frac{1}{2}(v_0 + v)t$ $\quad x = x_0 + v_0\,t + \frac{1}{2}\,a\,t^2$

$v^2 = v_0^2 + 2\,a\,(x - x_0)$ $\quad a\ must\ be\ constant$

Centripetal acceleration: $a_r = \frac{v_t^2}{r}$

Projectile motion 2-D: (v_0, θ_0) $\quad v_{x0} = v_0\cos\theta_0$ $\quad v_{y0} = v_0\sin\theta_0$

$a_x = 0$ $\quad a_y = -g$ $\quad \vec{a} = 0\,\hat{\imath} - g\,\hat{\jmath}$ $\quad \overrightarrow{v_0} = v_{xo}\,\hat{\imath} + v_{y0}\,\hat{\jmath}$

Newton's 1st law: $\vec{F}_{net} = \sum \vec{F}_{external} = 0$

Newton's 2nd law: $\vec{F}_{net} = \sum \vec{F}_{external} = m\vec{a}$ or $\vec{F}_{net} = \frac{d\vec{p}}{dt}$ $\quad \vec{p} = m\,\vec{v}$

Newton's 3rd law: $\vec{F}_{A\ on\ B} = -\vec{F}_{B\ on\ A}$

Weight: $\vec{w} = m\vec{g}$ $\quad$ Normal is perpendicular to surface

Free body diagram: object represented by a point

Hooke's law: $F_{sp} = -kx$

Uniform circular motion: $F_{net} = m\frac{v_t^2}{r}$ $\quad$ towards center

Static friction: $f_s \le \mu_s n$ $\quad$ Kinetic friction: $f_k = \mu_k n$