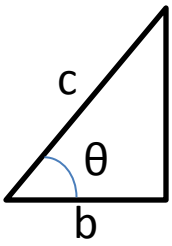
95.141 Fall 2010: Exam I Formula Sheet

- Trig



a

$$\sin\theta = \frac{a}{c} \quad , \quad \cos\theta = \frac{b}{c}$$

$$\tan\theta = \frac{a}{b}$$

$$c^2 = a^2 + b^2$$

- Quadratic Formula

$ax^2 + bx + c = 0$ has solutions:

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

- Misc. Formulas

Circumference of a circle: $2\pi r$

Area of a Circle: πr^2

Surface Area of a Sphere: $4\pi r^2$

Volume of a Sphere: $\frac{4}{3}\pi r^3$

Volume of a Cylinder: $h\pi r^2$

- Derivatives

$$\frac{d}{dx}\left(x^n\right) = nx^{n-1} \ (n \neq 0)$$

$$\frac{d}{dx}\left(\cos ax\right) = -a\sin ax \text{ (ax in radians)}$$

$$\frac{d}{dx}\left(\sin ax\right) = a\cos ax \text{ (ax in radians)}$$

$$\frac{d}{dx}\left(\ln x\right) = \frac{1}{x} \quad , \quad \frac{d}{dx}\left(e^{ax}\right) = ae^{ax}$$

$$\text{Chain Rule}: \frac{d}{dx}\left(f(g(x))\right) = \frac{df(g)}{dg}\frac{dg(x)}{dx}$$

$$\text{Distributive Rule}: \frac{d}{dx}\left(f(x) + g(x)\right) = \frac{df(x)}{dx} + \frac{dg(x)}{dx}$$

- Integrals

$$\int x^n dx = \frac{1}{n+1}x^{n+1} + C$$

$$\int e^{ax} dx = \frac{1}{a}e^{ax} + C$$

$$\int \frac{dx}{x} = \ln x + C$$

$$\int \sin x\, dx = -\cos x + C$$

$$\int \cos x\, dx = \sin x + C$$

- Constants/Conversions

$$g = 9.8\,\tfrac{m}{s^2} \quad , \quad \pi \approx 3.1416$$

$$1\,\text{mile} = 1609m \quad , \quad 1\,\text{ft} = 0.3048m$$

$$1\,\text{mile per hour} = 0.447\,\tfrac{m}{s}$$

- 1D Motion

$$\text{average velocity} = \bar{v} = \frac{\Delta x}{\Delta t} = \frac{x_2 - x_1}{t_2 - t_1}$$

$$\text{average acceleration} = \bar{a} = \frac{\Delta v}{\Delta t} = \frac{v_2 - v_1}{t_2 - t_1}$$

$$v(t) = \frac{dx(t)}{dt} \text{ (instantaneous)}$$

$$a(t) = \frac{dv(t)}{dt} = \frac{d^2x(t)}{dt^2} \text{ (instantaneous)}$$

- Constant a motion (1D)

$$x(t) = x_o + v_{xo}t + \frac{1}{2}at^2$$

$$v(t) = v_{xo} + at \quad , \quad a(t) = \text{constant}$$

$$v^2 = v_{xo}^2 + 2a(x - x_o)$$

- Newton's Laws

$$\sum \vec{F} = m\vec{a}$$

$$\text{if} \quad \sum \vec{F} = 0 \quad \text{then} \quad \frac{d\vec{v}}{dt} = \vec{a} = 0$$