Phys 206 — Exam I Formulae

Trigonometry and Vectors:

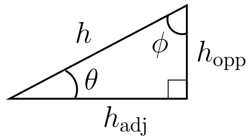
$\sin 30° = \cos 60° = \frac{1}{2}$ $\qquad$ $\sin 36.9° \approx \cos 53.1° \approx \frac{3}{5}$

$\sin 45° = \cos 45° = \frac{1}{\sqrt{2}}$ $\qquad$ $\sin 53.1° \approx \cos 36.9° \approx \frac{4}{5}$

$\sin 60° = \cos 30° = \frac{\sqrt{3}}{2}$

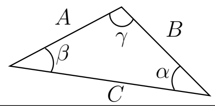
$h_{\text{adj}} = h\cos\theta = h\sin\phi$ $\qquad$ $h^2 = h_{\text{adj}}^2 + h_{\text{opp}}^2$

$h_{\text{opp}} = h\sin\theta = h\cos\phi$ $\qquad$ $\tan\theta = \frac{h_{\text{opp}}}{h_{\text{adj}}}$



Law of cosines: $C^2 = A^2 + B^2 - 2AB\cos\gamma$

Law of sines: $\dfrac{\sin\alpha}{A} = \dfrac{\sin\beta}{B} = \dfrac{\sin\gamma}{C}$



$\vec{A} = A_x\hat{\imath} + A_y\hat{\jmath} + A_z\hat{k} \qquad \hat{A} = \frac{\vec{A}}{|\vec{A}|}$

$\vec{A}\cdot\vec{B} = A_xB_x + A_yB_y + A_zB_z = AB\cos\theta = A_\parallel B = AB_\parallel$

$\vec{A}\times\vec{B} = (A_yB_z - A_zB_y)\hat{\imath} + (A_zB_x - A_xB_z)\hat{\jmath} + (A_xB_y - A_yB_x)\hat{k}$

$|\vec{A}\times\vec{B}| = AB\sin\theta = A_\perp B = AB_\perp$ (direction via right-hand rule)

Kinematics:

$\langle\vec{v}\rangle = \frac{\vec{r}_2 - \vec{r}_1}{t_2 - t_1} \qquad \vec{v} = \frac{d\vec{r}}{dt}$

$\langle\vec{a}\rangle = \frac{\vec{v}_2 - \vec{v}_1}{t_2 - t_1} \qquad \vec{a} = \frac{d\vec{v}}{dt} = \frac{d^2\vec{r}}{dt^2}$

$\vec{r}(t) = \vec{r}_0 + \int_0^t \vec{v}(t')\,dt'$

$\vec{v}(t) = \vec{v}_0 + \int_0^t \vec{a}(t')\,dt'$

— constant acceleration only —

$\vec{r}(t) = \vec{r}_0 + \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$

$\vec{v}(t) = \vec{v}_0 + \vec{a}t$

$v_x^2 = v_{x,0}^2 + 2a_x(x - x_0)$
(and similarly for y and z)

$\vec{r}(t) = \vec{r}_0 + \frac{1}{2}(\vec{v}_i + \vec{v}_f)t$

Quadratic:

$ax^2 + bx + c = 0 \quad\Rightarrow\quad x_{1,2} = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Derivatives:

$\frac{d}{dt}(at^n) = nat^{n-1}$

$\frac{d}{dt}\sin at = a\cos at$

$\frac{d}{dt}\cos at = -a\sin at$

Integrals:

if $f(t) = at^n$, then $\begin{cases} \int_{t_1}^{t_2} f(t)dt = \frac{a}{n+1}(t_2^{n+1} - t_1^{n+1}) \\ \int f(t)dt = \frac{a}{n+1}t^{n+1} + C \end{cases}$
$(n \neq -1)$

$\int \sin at\,dt = \frac{-1}{a}\cos at$

$\int \cos at\,dt = \frac{1}{a}\sin at$

Constants/Conversions:

g = 9.80 m/s^2 = 32.15 ft/s^2 (Earth, sea level)
$\approx$ 10 m/s^2 $\approx$ 33 ft/s^2

1 mi = 1609 m

1 ft = 12 in

1 in = 2.54 cm

1 lb = 4.448 N
$\Leftrightarrow$ 0.454 kg (Earth, sea level)

Circular motion: $\quad a_{\text{rad}} = \dfrac{v^2}{R} \qquad a_{\text{tan}} = \dfrac{d|\vec{v}|}{dt}$

$T = \dfrac{2\pi R}{v}$

Relative velocity: $\quad \vec{v}_{A/C} = \vec{v}_{A/B} + \vec{v}_{B/C}$

$\vec{v}_{A/B} = -\vec{v}_{B/A}$