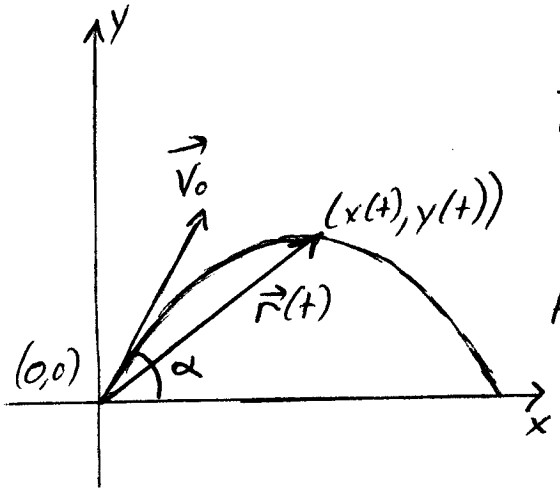
Math 21D
Vogler

Projectile Motion



$\vec{r}(t) = (|\vec{V_0}| \cos\alpha \cdot t)\vec{i} + (|\vec{V_0}| \sin\alpha \cdot t - \frac{1}{2}gt^2)\vec{j}$

where gravity is $g = 32\ ft/sec^2 = 9.8\ m/sec^2$

Hence, $x(t) = |\vec{V_0}| \cos\alpha \cdot t$,

$y(t) = |\vec{V_0}| \sin\alpha \cdot t - \frac{1}{2}gt^2$

I.) Flight time: $t = \dfrac{2|\vec{V_0}| \sin\alpha}{g}$

II.) Maximum height: $y = \dfrac{|\vec{V_0}|^2 \sin^2\alpha}{2g}$

(occurs when $t = \dfrac{|\vec{V_0}| \sin\alpha}{g}$)

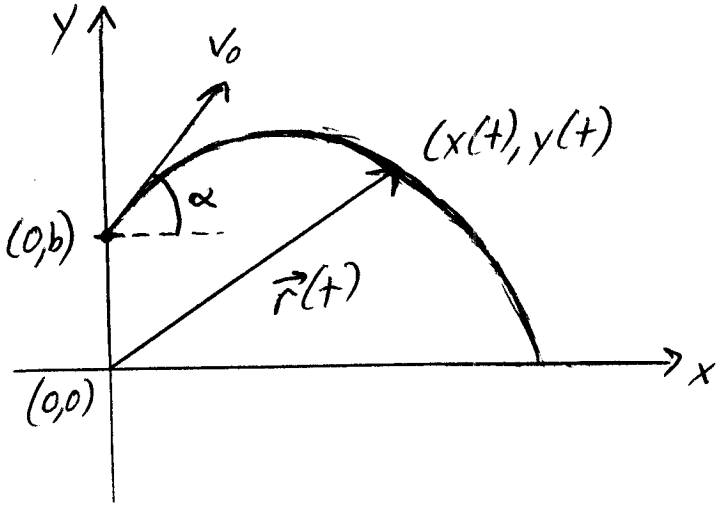
III.) Down range distance $(y(t) = 0)$: $x = \dfrac{2|\vec{V_0}|^2 \cos\alpha \sin\alpha}{g}$

(occurs when $t = \dfrac{2|\vec{V_0}| \sin\alpha}{g}$)

IV.) Maximum down range distance for given $|\vec{V_0}|$:

$x = \dfrac{|\vec{V_0}|^2}{g}$ (Occurs when $\alpha = 45^\circ$ & $t = \dfrac{\sqrt{2}|\vec{V_0}|}{g}$)

New Initial Position



$$\vec{r}(t) = (|\vec{v}_0| \cos\alpha \cdot t)\vec{i} + (b + |\vec{v}_0| \sin\alpha \cdot t - \tfrac{1}{2} g t^2)\vec{j}$$

Hence, $x(t) = |\vec{v}_0| \cos\alpha \cdot t$, $y(t) = b + |\vec{v}_0| \sin\alpha \cdot t - \tfrac{1}{2} g t$

Note: Since the initial point is $(0,b)$ & not the origin, the formulas on the previous page do not apply!