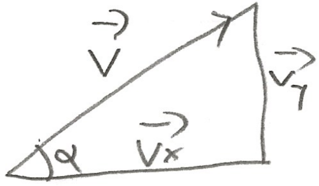

$\vec{V_x} = \vec{V}\cos\alpha$

$\vec{V_y} = \vec{V}\sin\alpha$

$F = ma = -mg$

$a = -g$

$v(t) = -g\cdot t + \vec{V}\sin\alpha$

Height $= h(t) = V\sin\alpha \cdot t - \frac{1}{2}gt^2$

Land: $h(t) = 0$: $V\sin\alpha - \frac{1}{2}gt = 0$

$\frac{1}{2}gt = V\sin\alpha$

$$\boxed{t = \frac{2V\sin\alpha}{g}}$$ landing time

1

distance $= d(t) = V(\cos\alpha)t$

$= V\cos\alpha \cdot \frac{2V\sin\alpha}{g}$

$= \frac{2V^2}{g}\cos\alpha\cdot\sin\alpha$

$= \frac{2V^2}{g}\frac{\sin 2\alpha}{2} = \boxed{\frac{V^2}{g}\sin 2\alpha}$

distance at landing

2

Max distance: $\frac{dh}{d\alpha} = 0$

$\frac{2V^2}{g}\cos 2\alpha = 0$

3

$\cos 2\alpha = 0$

$2\alpha = \frac{\pi}{2}$

$$\boxed{\alpha = \frac{\pi}{4}}$$ max $d = 45°$ angle

4 initial V:

$\frac{V^2}{g}\sin\left(\frac{\pi}{2}\right) = 100$

$V^2 = 100g$

$$\boxed{V = 10\sqrt{g}}$$ initial V

5 $\alpha \in \left[0, \frac{\pi}{2}\right]$ random uniform

$d = \frac{100g}{g}\sin 2\alpha$

$$\boxed{d = 100\sin(2\alpha)}$$

$E[d] = \frac{100}{\frac{\pi}{2}}\int_0^{\pi/2}\sin 2\alpha$

$= \frac{200}{\pi}\left[-\frac{1}{2}\cos(2\alpha)\right]_0^{\pi/2}$

$= \frac{200}{\pi} \simeq 63.66$

$\Rightarrow$ Choose row

64

Expected Value