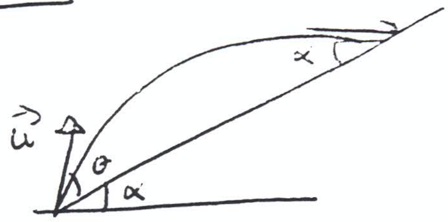
1986



$\vec{g}$: $-g\cos\alpha = -\frac{2g}{\sqrt{5}}$, $-g\sin\alpha = -\frac{g}{\sqrt{5}}$

$\sin\alpha = \frac{1}{\sqrt{5}}$, $\cos\alpha = \frac{2}{\sqrt{5}}$

$$\vec{u} = u\cos\theta\,\vec{i} + u\sin\theta\,\vec{j}$$

$$\vec{g} = -\frac{g}{\sqrt{5}}\vec{i} - \frac{2g}{\sqrt{5}}\vec{j}.$$

$$\vec{r}(t) = \left(u\cos\theta\, t - \frac{g}{2\sqrt{5}}t^2\right)\vec{i} + \left(u\sin\theta\, t - \frac{g}{\sqrt{5}}t^2\right)$$

$$\vec{v}(t) = \left(u\cos\theta - \frac{g}{\sqrt{5}}t\right)\vec{i} + \left(u\sin\theta - \frac{2g}{\sqrt{5}}t\right)\vec{i}$$

Strikes plane when $(\vec{r}(T))_{\vec{j}} = 0$.

$$u\sin\theta\, T - \frac{g}{\sqrt{5}}T^2 = 0$$

$$\Rightarrow T = 0 \text{ or } T = \frac{\sqrt{5}\,u\sin\theta}{g}$$

$\therefore$ speed when strikes plane is.

$$\vec{v}(T) = \left(u\cos\theta - \frac{g}{\sqrt{5}}T\right)\vec{i} + \left(u\sin\theta - \frac{2g}{\sqrt{5}}T\right)\vec{i}$$

$$\vec{v}(T) = (u\cos\theta - u\sin\theta)\vec{i} + (u\sin\theta - 2u\sin\theta)\vec{j}.$$

$$\vec{v}(T) = u(\cos\theta - \sin\theta)\vec{i} - u\sin\theta\,\vec{j}.$$

Lands horizontally $\Rightarrow \frac{|(\vec{v}(T))_{\vec{j}}|}{(\vec{v}(T))_{\vec{i}}} = \tan\alpha.$

$(2) \div (1)$

$$\frac{1}{2} = \frac{u\sin\theta}{u(\cos\theta - \sin\theta)}$$

$$\Rightarrow \tan\alpha = \frac{\sin\theta}{\cos\theta - \sin\theta}$$

$$\Rightarrow \tan\alpha = \frac{\tan\theta}{1 - \tan\theta}$$

$$\Rightarrow \frac{1}{2} = \frac{\tan\theta}{1 - \tan\theta}.$$

$$\Rightarrow 1 - \tan\theta = 2\tan\theta$$

$$\Rightarrow 1 = 3\tan\theta \Rightarrow \boxed{\tan\theta = \frac{1}{3}}$$

RANGE. $\tan\theta = \frac{1}{3} \Rightarrow \cos\theta = \frac{3}{\sqrt{10}}$ $\sin\theta = \frac{1}{\sqrt{10}}$.

$$\Rightarrow T = \frac{\sqrt{5}\,u\frac{1}{\sqrt{10}}}{g} = \frac{u}{\sqrt{2}g}$$

$$\text{Range} = (\vec{r}(T))_{\vec{i}} = u\cos\theta\, T - \frac{g}{2\sqrt{5}}T^2$$

$$= \frac{3u}{\sqrt{10}}\cdot\left(\frac{u}{\sqrt{2}g}\right) - \frac{g}{2\sqrt{5}}\left(\frac{u^2}{2g^2}\right)$$

$$= \frac{3u^2}{\sqrt{20}g} - \frac{\frac{1}{2}u^2}{\sqrt{20}g}$$

$$= \frac{2.5u^2}{}$$