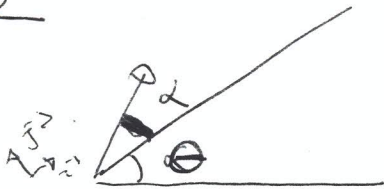


1490 Q3

$$\tan \theta = \frac{1}{6} \Rightarrow \frac{\sqrt{37}}{6} \quad \cos \theta = \frac{6}{\sqrt{37}}$$

$$\sin \theta = \frac{1}{\sqrt{37}}$$

1490 Q3



$$\tan \theta = \frac{1}{6} \Rightarrow \frac{\sqrt{37}}{6} \Rightarrow \cos \theta = \frac{6}{\sqrt{37}} \text{ and } \sin \theta = \frac{1}{\sqrt{37}}$$

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

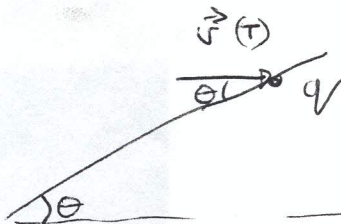
$$\vec{g} = -g \sin \theta \vec{i} - g \cos \theta \vec{j}$$

$$\vec{v}(t) = (u \cos \alpha - g \sin \theta t) \vec{i} + (u \sin \alpha - g \cos \theta t) \vec{j}$$

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

Find T: $\vec{r}(T) \vec{j} = 0 \Rightarrow u \sin \alpha t - \frac{g \cos \theta t^2}{2} = 0$
 $\rightarrow t = 0 \quad \text{or} \quad T = \frac{2u \sin \alpha}{g \cos \theta}$

(i) Strikes horizontally:



$$\Rightarrow \tan \theta = \frac{|(\vec{v}(T))_{\vec{j}}|}{(\vec{v}(T))_{\vec{i}}} = \frac{|u \sin \alpha - g \cos \theta \left(\frac{2u \sin \alpha}{g \cos \theta} \right)|}{u \cos \alpha - g \sin \theta \left(\frac{2u \sin \alpha}{g \cos \theta} \right)}$$

$$\Rightarrow \tan \theta = \frac{|-u \sin \alpha|}{u \cos \alpha - 2u \sin \alpha \tan \theta}$$

$$\Rightarrow \tan \theta = \frac{\sin \alpha}{\cos \alpha - 2 \sin \alpha \tan \theta}$$

GIVEN

$$\tan \theta = \frac{1}{6}$$

$$\frac{1}{6} = \frac{\sin \alpha}{\cos \alpha - 2 \sin \alpha \left(\frac{1}{6} \right)}$$

$$\Rightarrow \cos \alpha - \frac{1}{3} \sin \alpha = 6 \sin \alpha$$

$$\Rightarrow \cos \alpha = 6 \sin \alpha + \frac{1}{3} \sin \alpha$$

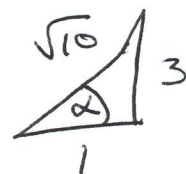
$$\Rightarrow \cos \alpha = \frac{19}{3} \sin \alpha$$

$$\Rightarrow \frac{3}{19} = \frac{\sin \alpha}{\cos \alpha}$$

$$\Rightarrow \boxed{\tan \alpha = \frac{3}{19}} \quad \text{qed}$$

(ii) $\alpha = \tan^{-1} 3$ → show strikes at right angles to plane
 → show $(\vec{v}(T))_{\vec{n}} = 0$

$$\begin{aligned} (\vec{v}(T))_{\vec{n}} &= u \cos \alpha - g \sin \theta \left(\frac{2u \sin \alpha}{g \cos \theta} \right) \\ &= u \cos \alpha - 2u \sin \alpha \tan \theta \\ &= u \frac{1}{\sqrt{10}} - 2u \frac{3}{\sqrt{10}} \left(\frac{1}{6} \right) \\ &= \frac{u}{\sqrt{10}} - \frac{u}{\sqrt{10}} = 0 \end{aligned}$$



$\Rightarrow (\vec{v}(T))_{\vec{n}} = 0 \Rightarrow$ strikes \perp to plane.