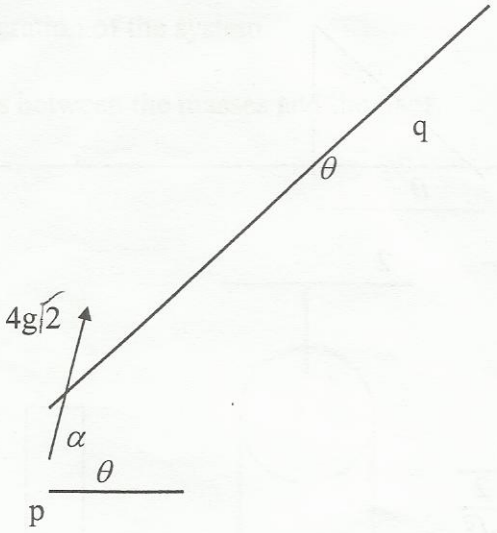
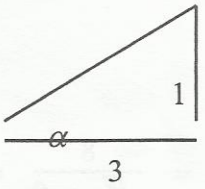
1999 (a)

3. A particle is projected from a point p up an inclined plane with a speed of $4g\sqrt{2}$ m/s at an angle $\tan^{-1}(\frac{1}{3})$ to the inclined plane. The plane is inclined at an angle θ to the horizontal. (The plane of projection is vertical and contains the line of greatest slope). The particle is moving horizontally when it strikes the plane at the point q.

(a) Find the two possible values for θ.





$\vec{r} = (4g\sqrt{2}\cos\alpha.t - \frac{1}{2}g\sin\theta.t^2)\vec{i} + (4g\sqrt{2}\sin\alpha.t - \frac{1}{2}g\cos\theta.t^2)\vec{j}$ 5,5

$\vec{v} = (4g\sqrt{2}\cos\alpha - g\sin\theta.t)\vec{i} + (4g\sqrt{2}\sin\alpha - g\cos\theta.t)\vec{j}$ 5,5

At q: $r\vec{j} = 0$ 5

$\Rightarrow$ $t = \dfrac{8g\sqrt{2}\sin\alpha}{g\cos\theta}$ or $\dfrac{8}{\sqrt{5}\cos\theta}$ 5

$\tan\theta = \dfrac{-V\vec{j}}{V\vec{i}}$ 5

$\tan\theta = \dfrac{g\cos\theta.t - 4g\sqrt{2}\sin\alpha}{4g\sqrt{2}\cos\alpha - g\sin\theta.t}$

$\tan\theta = \dfrac{\frac{8g}{\sqrt{5}} - \frac{4g}{\sqrt{5}}}{\frac{12g}{\sqrt{5}} - \frac{8g}{\sqrt{5}}\tan\theta}$

$2\tan^2\theta - 3\tan\theta + 1 = 0$

$(2\tan\theta - 1)(\tan\theta - 1) = 0$

$\tan\theta = \frac{1}{2}$ or $\tan\theta = 1$ 5

$\Rightarrow$ $\theta = 26°\,34'$ or $45°$