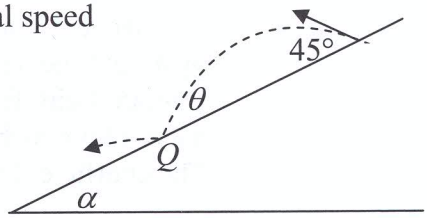
2011

3 **(b)** A plane is inclined at an angle α to the horizontal.
A particle is projected down the plane with initial speed of 10 m s^{-1} at an angle 45° to the inclined plane.
The plane of projection is vertical and contains the line of greatest slope.



The particle strikes the plane at Q with a landing angle θ where $\tan\theta = \frac{1}{4}$.

(i) Find the value of α.

(ii) If the magnitude of the rebound velocity at Q is $5\sqrt{33}$, find the value of e, the coefficient of restitution.

(i)

$r_j = 0$

$0 = 10\sin 45.t - \frac{1}{2}g\cos\alpha.t^2$

$\Rightarrow \quad t = \dfrac{10\sqrt{2}}{g\cos\alpha}$ 5

$v_i = 10\cos 45 + g\sin\alpha\left(\dfrac{10\sqrt{2}}{g\cos\alpha}\right)$ 5

$= 5\sqrt{2} + 10\sqrt{2}\tan\alpha$

$v_j = 10\sin 45 - g\cos\alpha\left(\dfrac{10\sqrt{2}}{g\cos\alpha}\right)$ 5

$= -5\sqrt{2}$

$\tan\theta = \dfrac{-v_j}{v_i}$

$\dfrac{1}{4} = \dfrac{5\sqrt{2}}{5\sqrt{2} + 10\sqrt{2}\tan\alpha}$

$\tan\alpha = 1.5 \quad \Rightarrow \quad \alpha = 56.3°$ 5

(ii)

$v_i = 20\sqrt{2}$

$v_j = 5e\sqrt{2}$

$5\sqrt{33} = \sqrt{\left(20\sqrt{2}\right)^2 + \left(5e\sqrt{2}\right)^2}$

$\Rightarrow e = \dfrac{1}{\sqrt{2}}$ 5 25