2011

3. (a) A particle is projected from a point P on horizontal ground.
The speed of projection is $35\ \text{m s}^{-1}$ at an angle $\tan^{-1} 2$ to the horizontal.
The particle strikes a target whose position vector relative to P is $x\,\vec{i} + 50\,\vec{j}$.

Find **(i)** the value of x
(ii) a second angle of projection so that the particle strikes the target.

(i)
$$35\cos\alpha.t = x$$
$$t = \frac{x}{7\sqrt{5}}$$ — 5

$$35\sin\alpha.t - 4.9t^2 = 50$$ — 5
$$35\left(\frac{2}{\sqrt{5}}\right)\left(\frac{x}{7\sqrt{5}}\right) - 4.9\left(\frac{x}{7\sqrt{5}}\right)^2 = 50$$
$$x^2 - 100x + 2500 = 0$$
$$x = 50$$ — 5

(ii)
$$35\cos\alpha.t = 50$$
$$t = \frac{10}{7\cos\alpha}$$

$$35\sin\alpha.t - 4.9t^2 = 50$$
$$35\sin\alpha.\left(\frac{10}{7\cos\alpha}\right) - 4.9\left(\frac{10}{7\cos\alpha}\right)^2 = 50$$ — 5
$$50\tan\alpha - 10\left(1 + \tan^2\alpha\right) = 50$$
$$\tan^2\alpha - 5\tan\alpha + 6 = 0$$
$$(\tan\alpha - 2)(\tan\alpha - 3) = 0$$
$$\tan\alpha = 3$$
$$\alpha = 71.6°$$ — 5

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