

1998

- 3 (a) A football is kicked from a spot on level ground with a velocity of $\sqrt{8g}$ m/s and strikes a vertical wall 4 m away at a point 2 m above the ground. Find the two possible angles of projection.

$$\vec{r} = (\sqrt{8g} \cos \alpha \cdot t) \vec{i} + (\sqrt{8g} \sin \alpha \cdot t - \frac{1}{2}gt^2) \vec{j}$$

$$r_i = 4 \quad \text{or} \quad \sqrt{8g} \cos \alpha \cdot t = 4$$

$$\Rightarrow t = \frac{4}{\sqrt{8g} \cos \alpha}$$

$$r_j = 2 \quad \text{or} \quad \sqrt{8g} \sin \alpha \cdot t - \frac{1}{2}gt^2 = 2$$

$$\Rightarrow \sqrt{8g} \sin \alpha \cdot \frac{4}{\sqrt{8g} \cos \alpha} - \frac{g}{2} \cdot \frac{16}{8g \cos^2 \alpha} = 2$$

$$4 \tan \alpha - (1 + \tan^2 \alpha) = 2$$

$$\tan^2 \alpha - 4 \tan \alpha + 3 = 0$$

$$\tan \alpha = 1 \quad \text{or} \quad \tan \alpha = 3$$

$$\alpha = 45^\circ / 71^\circ 33'$$

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