

STEP III, 2009, Q9

- 9 A particle is projected under gravity from a point P and passes through a point Q . The angles of the trajectory with the positive horizontal direction at P and at Q are θ and ϕ , respectively. The angle of elevation of Q from P is α .
- (i) Show that $\tan \theta + \tan \phi = 2 \tan \alpha$.
- (ii) It is given that there is a second trajectory from P to Q with the same speed of projection. The angles of this trajectory with the positive horizontal direction at P and at Q are θ' and ϕ' , respectively. By considering a quadratic equation satisfied by $\tan \theta$, show that $\tan(\theta + \theta') = -\cot \alpha$. Show also that $\theta + \theta' = \pi + \phi + \phi'$.



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