

STEP II, 2011 Q10

- 10** A particle is projected from a point on a horizontal plane, at speed u and at an angle θ above the horizontal. Let H be the maximum height of the particle above the plane. Derive an expression for H in terms of u , g and θ .

A particle P is projected from a point O on a smooth horizontal plane, at speed u and at an angle θ above the horizontal. At the same instant, a second particle R is projected horizontally from O in such a way that R is vertically below P in the ensuing motion. A light inextensible string of length $\frac{1}{2}H$ connects P and R . Show that the time that elapses before the string becomes taut is

$$(\sqrt{2} - 1)\sqrt{H/g}.$$

When the string becomes taut, R leaves the plane, the string remaining taut. Given that P and R have equal masses, determine the total horizontal distance, D , travelled by R from the moment its motion begins to the moment it lands on the plane again, giving your answer in terms of u , g and θ .

Given that $D = H$, find the value of $\tan \theta$.



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