

STEP II, 2012 Q9

- 9 A tennis ball is projected from a height of $2h$ above horizontal ground with speed u and at an angle of α below the horizontal. It travels in a plane perpendicular to a vertical net of height h which is a horizontal distance of a from the point of projection. Given that the ball passes over the net, show that

$$\frac{1}{u^2} < \frac{2(h - a \tan \alpha)}{ga^2 \sec^2 \alpha}.$$

The ball lands before it has travelled a horizontal distance of b from the point of projection. Show that

$$\sqrt{u^2 \sin^2 \alpha + 4gh} < \frac{bg}{u \cos \alpha} + u \sin \alpha.$$

Hence show that

$$\tan \alpha < \frac{h(b^2 - 2a^2)}{ab(b - a)}.$$



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