

STEP II, 2002, Q6

- 6 The lines l_1 , l_2 and l_3 lie in an inclined plane P and pass through a common point A . The line l_2 is a line of greatest slope in P . The line l_1 is perpendicular to l_3 and makes an acute angle α with l_2 . The angles between the horizontal and l_1 , l_2 and l_3 are $\pi/6$, β and $\pi/4$, respectively. Show that $\cos \alpha \sin \beta = \frac{1}{2}$ and find the value of $\sin \alpha \sin \beta$. Deduce that $\beta = \pi/3$.

The lines l_1 and l_3 are rotated in P about A so that l_1 and l_3 remain perpendicular to each other. The new acute angle between l_1 and l_2 is θ . The new angles which l_1 and l_3 make with the horizontal are ϕ and 2ϕ , respectively. Show that

$$\tan^2 \theta = \frac{3 + \sqrt{13}}{2}.$$



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