

## STEP III, 2001 Q9

- 9  $B_1$  and  $B_2$  are parallel, thin, horizontal fixed beams.  $B_1$  is a vertical distance  $d \sin \alpha$  above  $B_2$ , and a horizontal distance  $d \cos \alpha$  from  $B_2$ , where  $0 < \alpha < \pi/2$ . A long heavy plank is held so that it rests on the two beams, perpendicular to each, with its centre of gravity at  $B_1$ . The coefficients of friction between the plank and  $B_1$  and  $B_2$  are  $\mu_1$  and  $\mu_2$ , respectively, where  $\mu_1 < \mu_2$  and  $\mu_1 + \mu_2 = 2 \tan \alpha$ .

The plank is released and slips over the beams experiencing a force of resistance from each beam equal to the limiting frictional force (i.e. the product of the appropriate coefficient of friction and the normal reaction). Show that it will come to rest with its centre of gravity over  $B_2$  in a time

$$\pi \left( \frac{d}{g(\mu_2 - \mu_1) \cos \alpha} \right)^{\frac{1}{2}}.$$



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