

## STEP II, 2007, Q10

- 10 A solid figure is composed of a uniform solid cylinder of density  $\rho$  and a uniform solid hemisphere of density  $3\rho$ . The cylinder has circular cross-section, with radius  $r$ , and height  $3r$ , and the hemisphere has radius  $r$ . The flat face of the hemisphere is joined to one end of the cylinder, so that their centres coincide.

The figure is held in equilibrium by a force  $P$  so that one point of its flat base is in contact with a rough horizontal plane and its base is inclined at an angle  $\alpha$  to the horizontal. The force  $P$  is horizontal and acts through the highest point of the base. The coefficient of friction between the solid and the plane is  $\mu$ . Show that

$$\mu \geq \left| \frac{9}{8} - \frac{1}{2} \cot \alpha \right| .$$



# NextStepMaths.com

To view mark schemes, fully worked solutions and examiner's comments, and for more details about tutoring and other services offered, go to [NextStepMaths.com](https://www.NextStepMaths.com)