

STEP II, 2008, Q11

- 11 A wedge of mass km has the shape (in cross-section) of a right-angled triangle. It stands on a smooth horizontal surface with one face vertical. The inclined face makes an angle θ with the horizontal surface. A particle P , of mass m , is placed on the inclined face and released from rest. The horizontal face of the wedge is smooth, but the inclined face is rough and the coefficient of friction between P and this face is μ .

- (i) When P is released, it slides down the inclined plane at an acceleration a relative to the wedge. Show that the acceleration of the wedge is

$$\frac{a \cos \theta}{k + 1}.$$

To a stationary observer, P appears to descend along a straight line inclined at an angle 45° to the horizontal. Show that

$$\tan \theta = \frac{k}{k + 1}.$$

In the case $k = 3$, find an expression for a in terms of g and μ .

- (ii) What happens when P is released if $\tan \theta \leq \mu$?



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