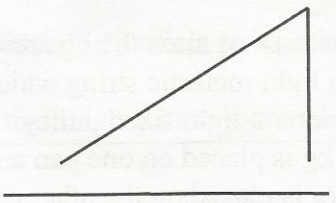
4 (b) A smooth wedge of mass 4m and slope α, is placed on a smooth horizontal surface. A particle of mass m moves down the inclined face of the wedge.



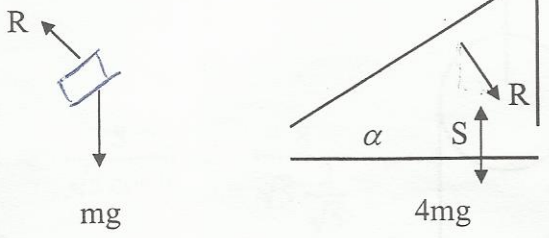
(i) Show on separate diagrams, the forces acting on the wedge and on the particle.

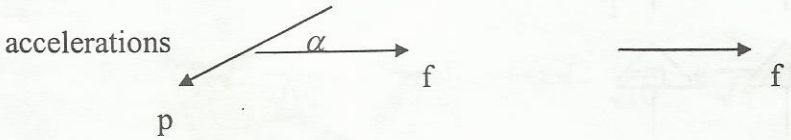
(ii) Prove that the acceleration of the wedge is

$$\frac{g\cos\alpha\sin\alpha}{4+\sin^2\alpha}$$

(iii) If $\alpha = 30°$ find the acceleration of the mass relative to the wedge.

(i)





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(ii) $mg\cos\alpha - R = mf\sin\alpha$ 5

$R\sin\alpha = 4mf$ 5

$mg\cos\alpha\sin\alpha - R\sin\alpha = mf\sin^2\alpha$

$mg\cos\alpha\sin\alpha - 4mf = mf\sin^2\alpha$

$$f = \frac{g\cos\alpha\sin\alpha}{4+\sin^2\alpha}$$ 5

(iii) $\alpha = 30°$ $\qquad f = \frac{g\sqrt{3}}{17}$

$mg\sin\alpha = m(p - f\cos\alpha)$

$$g.\frac{1}{2} = p - \frac{g\sqrt{3}}{17}.\frac{\sqrt{3}}{2}$$

$$\Rightarrow \quad p = \frac{20g}{34} \text{ or } \frac{10g}{17} \text{ or } 5.76$$ 5