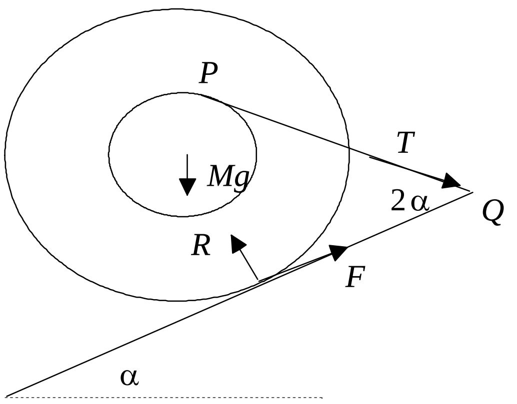
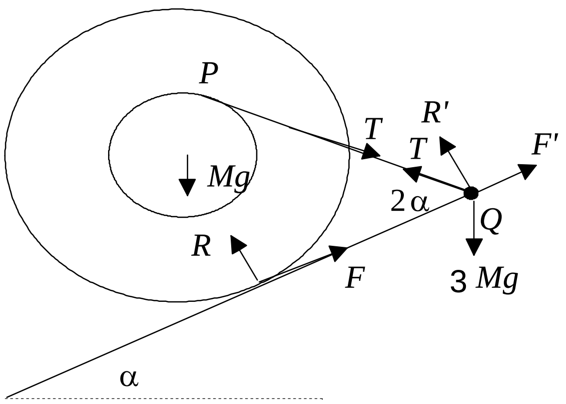
11. Taking moments about axis of cylinder we have
$aT = 2aF$
Resolving horizontally $T\cos\alpha + F\cos\alpha = R\sin\alpha$
$\Rightarrow T + F = R\tan\alpha$
$\Rightarrow F = R\tan\alpha - 2F \Rightarrow \frac{F}{R} = \frac{1}{3}\tan\alpha$
i.e. $\mu \geq \frac{1}{3}\tan\alpha$ as required.





If Q is now fastened to a particle of mass $3M$
Resolving along and perpendicular to plane at Q
$F' = 3Mg\sin\alpha + T\cos 2\alpha$ and
$R' = 3Mg\cos\alpha - T\sin 2\alpha$
so $\frac{F'}{R'} = \frac{3Mg\sin\alpha + T\cos 2\alpha}{3Mg\cos\alpha - T\sin 2\alpha}$

Resolving along and perpendicular to plane for cylinder, we have
$F + T\cos 2\alpha = Mg\sin\alpha$ and $R = Mg\cos\alpha + T\sin 2\alpha$, also $T = 2F$
so $T(1 + 2\cos 2\alpha) = 2Mg\sin\alpha \Rightarrow T = \frac{2Mg\sin\alpha}{1+2\cos 2\alpha}$
$\alpha = \tan^{-1}\frac{1}{2} \Rightarrow \sin\alpha = \frac{1}{\sqrt{5}}, \cos\alpha = \frac{2}{\sqrt{5}}, \sin 2\alpha = \frac{4}{5}$ and $\cos 2\alpha = \frac{3}{5}$
so $T = \frac{2Mg}{\sqrt{5}\left(1+\frac{6}{5}\right)} = \frac{10Mg}{11\sqrt{5}}$ and so $\frac{F'}{R'} = \frac{\frac{3}{\sqrt{5}} + \frac{30}{55\sqrt{5}}}{\frac{6}{\sqrt{5}} - \frac{40}{55\sqrt{5}}} = \frac{165+30}{330-40} = \frac{195}{290} = \frac{49}{58}$
so minimum coefficient of friction at Q is $\frac{49}{58}$.
