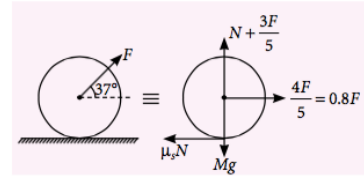


**solid cylindrical wheel of mass  $M$  and radius  $R$  is pulled by a force  $F$  applied to the centre of the wheel at  $37^\circ$  to the horizontal. If the wheel is to roll without slipping, what is the maximum value of  $|F|$ ? The coefficients of static and kinetic friction are  $\mu_s = 0.40$  and  $\mu_k = 0.30$  and  $\sin 37^\circ = 3/5$ .**

**(a)  $0.79 Mg$  (b)  $0.98 Mg$  (c)  $0.6 Mg$  (d)  $0.49 Mg$**

1. (a) :  $N = Mg - \frac{3F}{5} = Mg - 0.6F$



For pure rolling,  $a = R\alpha$

$$\frac{0.8F - \mu_s N}{M} = R \left[ \frac{(\mu_s N)R}{\left(\frac{1}{2}MR^2\right)} \right] \quad \left( \because \alpha = \frac{\tau}{I} \right)$$

$$0.8F = 3\mu_s N = 3(0.4)(Mg - 0.6F)$$

$$F = 0.79 Mg$$

$\therefore$  Maximum value of  $F = 0.79 Mg$

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