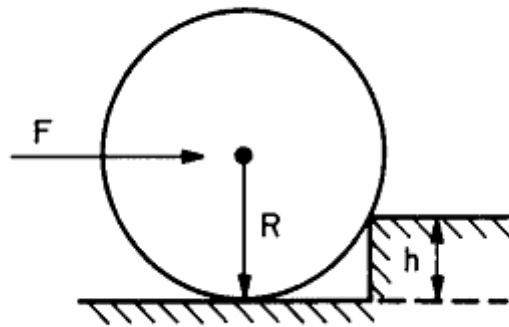


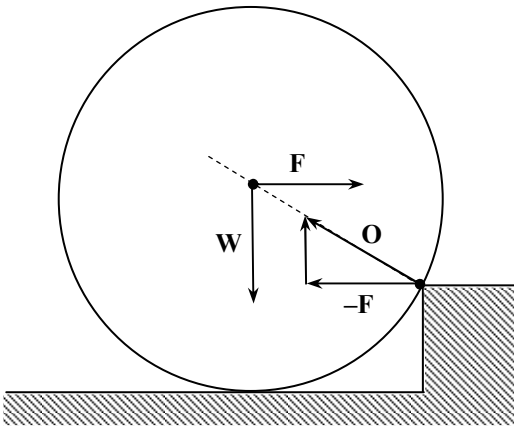
## wheel and block



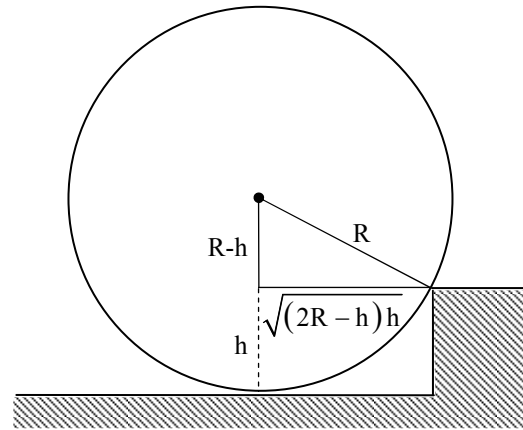
What horizontal force  $F$  (applied at the axle) is required to push a wheel of weight  $W$  and radius  $R$  over a block of height  $h$ ?

### Michael A. Gottlieb's Solution (using forces)

Imagine pushing on the axle with a horizontal force  $F$  that is slowly increasing in magnitude from 0.  $F$  induces a reaction force  $O$  at the corner of the block where it meets the wheel.



While the wheel is not moving, the horizontal component of  $O$  must equal and oppose  $F$ . When the magnitude of the vertical component of  $O$  equals the weight of the wheel, it will be lifted.



By similar triangles we find

$$\frac{F}{W} = \frac{\sqrt{(2R-h)h}}{R-h}$$