## [mex141] Reel of thread I: statics

A reel of thread of weight W whose spindle and rim have radii a and b, respectively, rests on a horizontal table. The loose end of the thread passes under the spindle and leads off at an angle  $\alpha$  above the horizontal as shown. The static frictional force between the reel and the table is  $f \leq \mu_s N$ , where N is the normal force and  $\mu_s$  is the coefficient of static friction. When a tension  $\vartheta$  is applied to the thread, the reel starts rolling to the left for angles  $\alpha > \alpha_c$  or to the right for  $\alpha < \alpha_c$ .

(a) Find the angle  $\alpha_c$  at which a balancing of forces and torques exists for nonzero tension  $\vartheta$  in the thread, which will thus keep the reel at rest.

(b) Find the maximum tension  $\vartheta_{max}$  for which the frictional force can sustain the static state.



Solution: