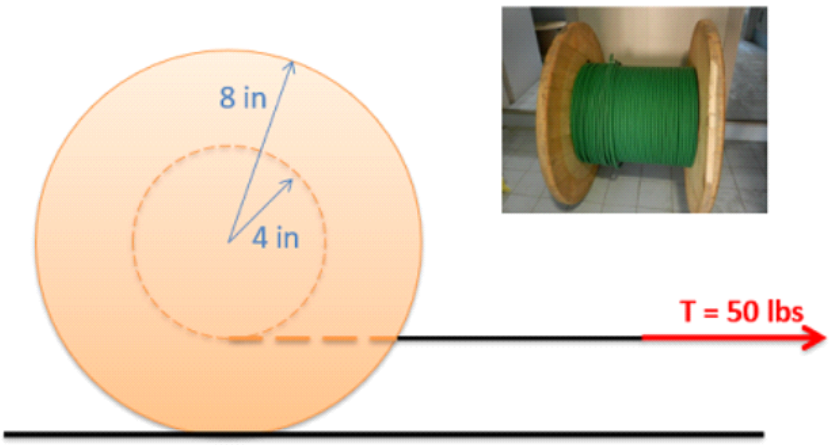
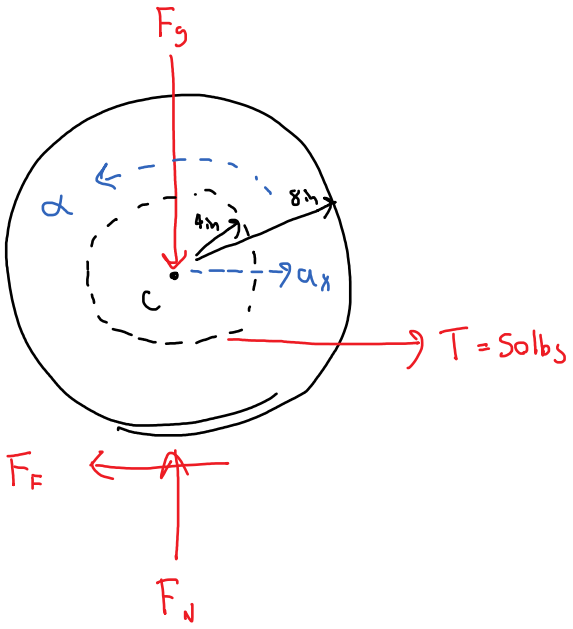
Problem 2

The cable spool shown below has a weight of 50 lbs and has a moment of inertia of .28 slug ft^2. Assume the spool rolls without slipping when we apply a 50 lb tension in the cable.

- What is the friction force between the spool and the ground?
- What is the acceleration of the mass center of the spool?



Spool image by Seeweb CC-BY-SA 2.0



$$\sum F_x = 50 - F_F = \left(\frac{50}{32.2}\right) a_x$$

$$\sum M_c = \left(\frac{4}{12}\right)(50) - \left(\frac{8}{12}\right)(F_F) = .28\,\alpha$$

rolling without slipping

$$a_x = -r\,\alpha$$

r: $\frac{8}{12}$ ft

F_x | $F_F = 50 + 1.0352\alpha$

M_c | $16.667 - .667\left(50 + 1.0352\alpha\right) = .28\alpha$

$-16.667 = .9701\alpha$

$\alpha = -17.18\ rad/s^2$

$$F_F = 50 + 1.0352\alpha = 32.22\ lbs$$

$$a_x = -\frac{8}{12}\alpha = 11.45\ ft/s^2$$