A weight is attached to a massless string. The string is wrapped around a cylinder on a frictionless axle whose radius is 5.00 cm, and whose mass $M$ is 12.00 kg. The weight has a mass $m$ of 4.75 kg. The coefficients of friction between the weight and plane are $\mu_s = 0.45$, and $\mu_k = 0.40$.

(a) Calculate the linear acceleration of the weight.
(b) Calculate the angular acceleration of the cylinder.
(c) Calculate the tension in the string.

$$A = \frac{mg \sin \theta - f_k - T}{m} \quad \theta = 55^\circ$$

$$\alpha = \frac{TR}{I} \quad (N=TR)$$

$$A = \alpha R$$

$$f_k = \mu_N = \mu_k mg \cos 55^\circ$$

$$f_k = \mu_k mg \cos 55^\circ = \frac{\alpha I}{R}$$

$$A = g \sin 55^\circ - \mu_k g \cos 55^\circ - \frac{I \alpha}{mR^2} \quad (\text{using } \alpha = \frac{a}{R})$$

$$a + \frac{a I}{mR^2} = g (\sin 55^\circ - \mu_k \cos 55^\circ)$$

$$a \left(1 + \frac{I}{mR^2}\right) = g (\sin 55^\circ - \mu_k \cos 55^\circ)$$

$$\alpha = \frac{g (\sin 55^\circ - \mu_k \cos 55^\circ)}{1 + \frac{I}{mR^2}}$$

$$A = 2.55 \text{ m/s}^2$$

$$\alpha = \frac{a}{R} = 51.1 \text{ rad/s}^2$$

$$T = \frac{\alpha I}{R} = 15.32 \text{ N}$$