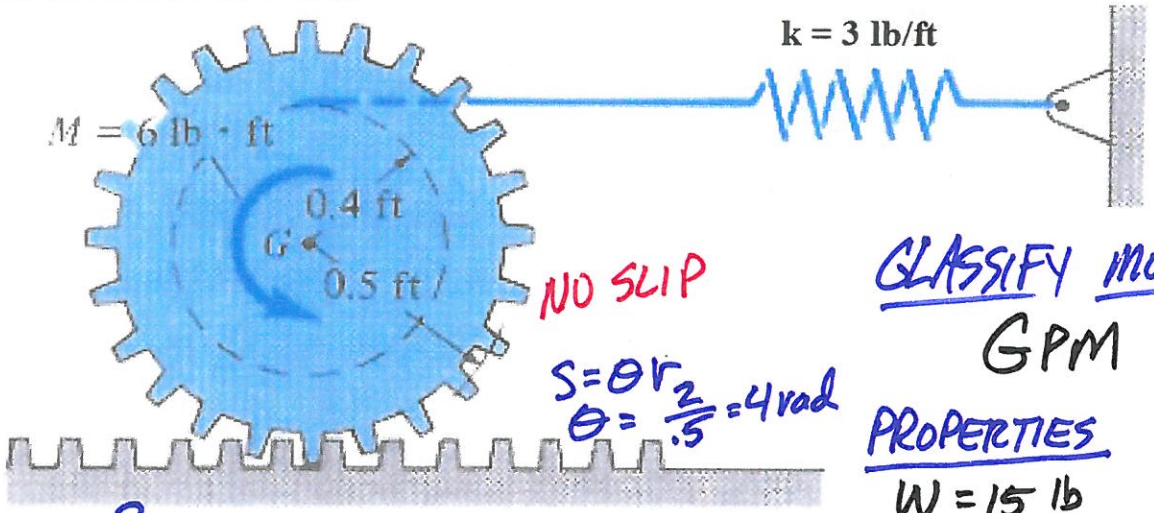
Work Energy II Problem 4:
The gear has a weight of 15 lb and a radius of gyration $k_G = 0.375$ ft. If the spring is unstretched when the torque M = 6 ft*lb is applied, determine the gear's angular velocity after its mass center G has moved to the left s = 2 ft.



NO SLIP

$S = \theta r_2$

$\theta = \frac{2}{.5} = 4$ rad

CLASSIFY MOTION

GPM

PROPERTIES

$W = 15$ lb

$m = \frac{15}{32.2} = 0.466$ slug

$I_G = mK^2 = 0.466(.375)^2$

$= 0.0655$ slug·ft^2

WORK?

MOMENT-COUPLE

$U_M = m\theta = 6\theta = 6(4) = 24$ Ft·lb

SPRING

$U_{sp} = -\frac{1}{2}K(S_2^2 - S_1^2)$

$S_1 = l_1 - l_0 = 0$

$S_2 = 2' + \theta r = 2 + 4(.5) = 3.6'$

$U_{sp} = -\frac{1}{2}(3)(3.6^2 - 0) = -19.44$ Ft·lb

ENERGY

NO SLIP $V_2 = \omega_2 r = .5\omega_2$

$T_1 = 0$

$T_2 = \frac{1}{2}mv_2^2 + \frac{1}{2}I_G\omega_2^2 = \frac{1}{2}(0.466)(.5\omega_2)^2 + \frac{1}{2}(0.0655)\omega_2^2$

$= 0.091\omega_2^2$

WORK ENERGY

$T_1 + U_{1-2} = T_2$

$0 + 24 - 19.44 = 0.091\omega_2^2$

$\omega_2 = 7.07$ rps ↻