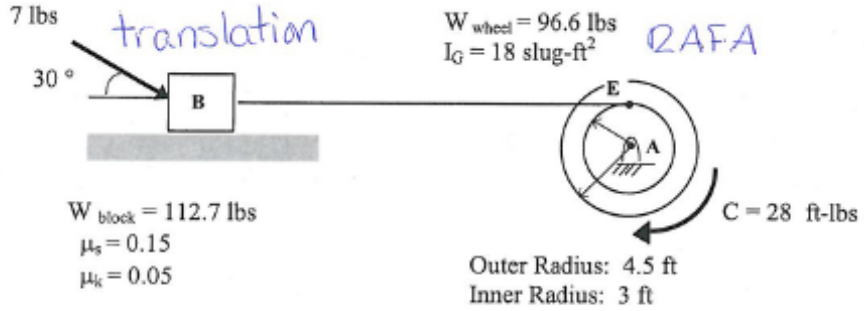
Problem 9. The system shown below is initially at rest. The system is acted upon by an applied couple and an applied force. Assuming the rope connecting block B to wheel A remains taut, what is the velocity of Block B after it has displaced **10 feet** to the right?



translation

RAFA

What works?
- force
- friction
- couple

USE WORK-ENERGY TECHNIQUE

Work from force

$U_p = \int F ds \cos\theta\, ds$

$U_p = 7\cos 30°(10-0)$

$= 60.6$ ft·lbs

Work from friction

$U_{fr} = -\mu_k N d$

$N = 112.7 + 7\sin 30$

$= 116.2$

$U_{fr} = -(.05)(116.2)(10)$

$= -58.1$ ft·lbs

Work from couple

$U_c = c(\theta_2 - \theta_1)$

$\theta_2 = \frac{s_E}{r} = \frac{10}{3} = 3.33$

$U_c = 28(3.33)$

$= 93.3$ ft·lbs

Total Work

$U_{1-2} = \sum U$

$= 60.6 - 58.1 + 93.3$

$= 95.8$ ft·lbs

Energy

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

$T_1 = 0 \quad T_2 = \frac{1}{2} m_B V_B^2 + \frac{1}{2} I_G \omega^2$

from kinematics: $V_B = V_E = \omega r = 3\omega$

$T_2 = \frac{1}{2}\left(\frac{112.7}{32.2}\right)(3\omega)^2 + \frac{1}{2}(18)\omega^2$

$= 24.75\omega^2$

$0 + 95.8 = 24.75\omega^2$

$\omega = 1.967$ rps↻

$V_B = \omega r = (1.967)(3)$

$V_B = 5.90$ fps→

Answer: $v_B = 5.90$ ft/s→