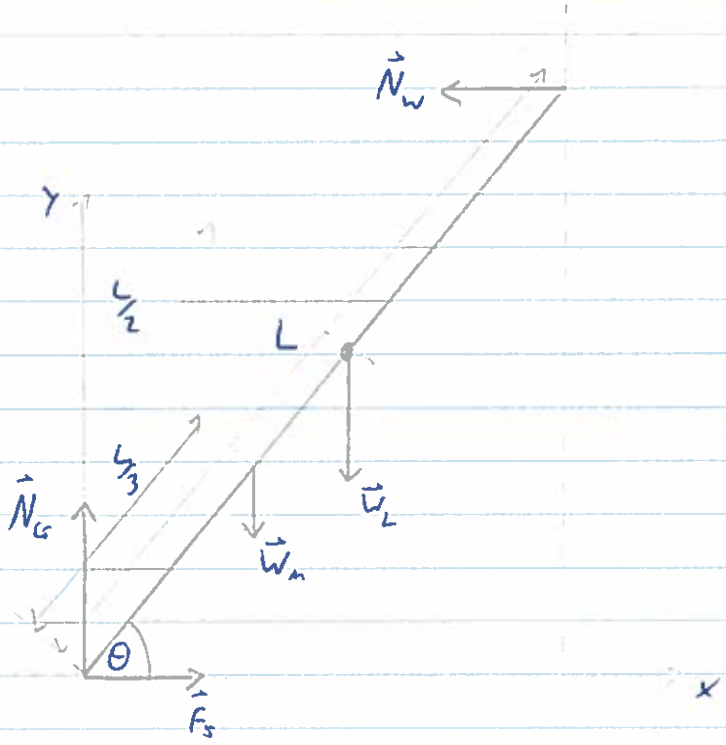
Ex 11.3
p 350

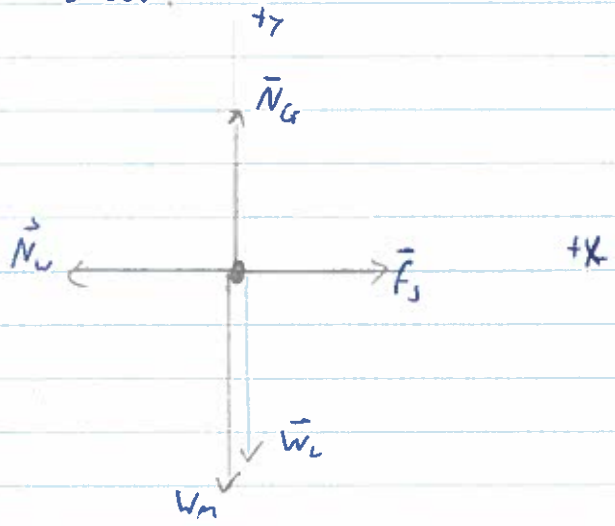
Person on ladder.

Frictionless



a/ Find N_W, N_G, F_S

FBD for ladder:



Static equilibrium in x & y: NI:

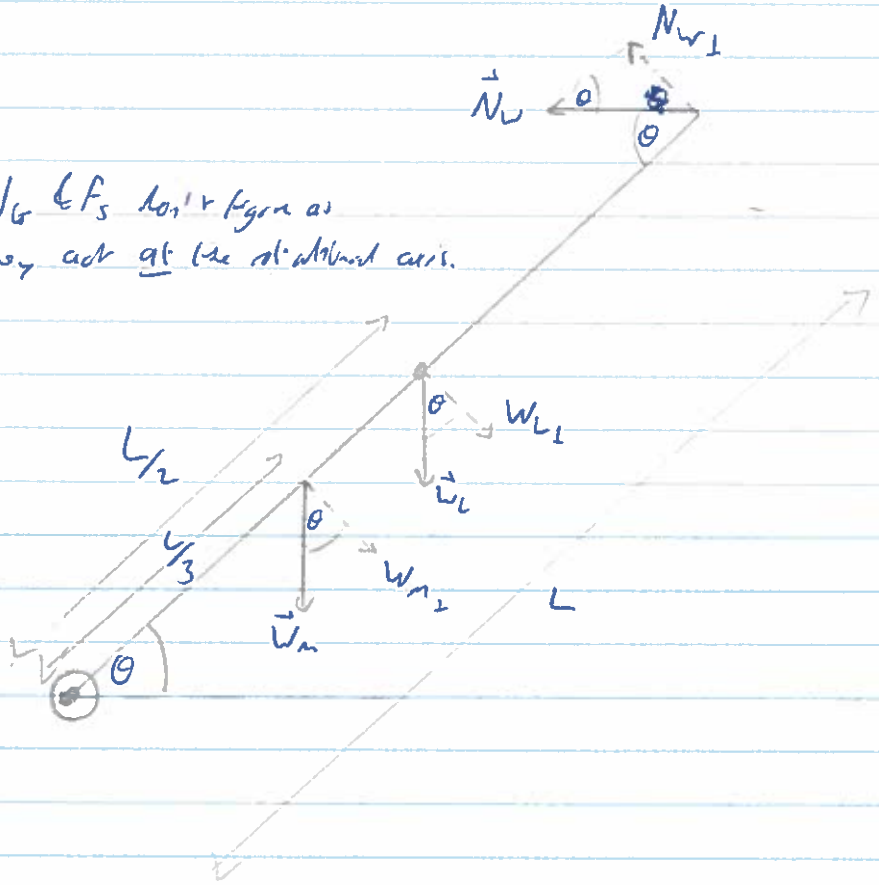
x: $\Sigma F_x = 0 = F_s - N_w \rightarrow F_s = N_w$

y: $\Sigma F_y = 0 = N_G - W_L - W_m \rightarrow \underline{N_G = W_L + W_m}$

$W_L = 180N$, $W_m = 800N$

$\underline{N_G} = 180N + 800N = \underline{980N}$

Rotational diagram around base of ladder.



Rot. equil:

$$\Sigma \tau = 0 = \tau_m + \tau_L + \tau_w$$

Torques: $\tau_m = -\frac{1}{3} W_{m_\perp} = -\frac{1}{3} W_m \cos\theta$

$$\tau_L = -\frac{1}{2} W_{L_\perp} = -\frac{1}{2} W_L \cos\theta$$

$$\tau_w = +L N_{w_\perp} = +L N_w \sin\theta$$

$$\Sigma \tau = 0 = -\frac{1}{3} W_m \cos\theta - \frac{1}{2} W_L \cos\theta + L N_w \sin\theta$$

$$N_w = \frac{\frac{1}{3} W_m + \frac{1}{2} W_L}{\tan\theta}$$

$$= \frac{\frac{1}{3}(800\,N) + \frac{1}{2}(180\,N)}{\tan 53.1^\circ}$$

$$\underline{N_w = 267.8\,N}$$

From Static equil in x: $\underline{F_s} = N_w = \underline{267.8\,N}$

b/ $F_s = \mu_s N_w \qquad \mu_s = \frac{F_s}{N_w} = \frac{267.8\,N}{980\,N}$

$$\underline{\mu_s = 0.273}$$