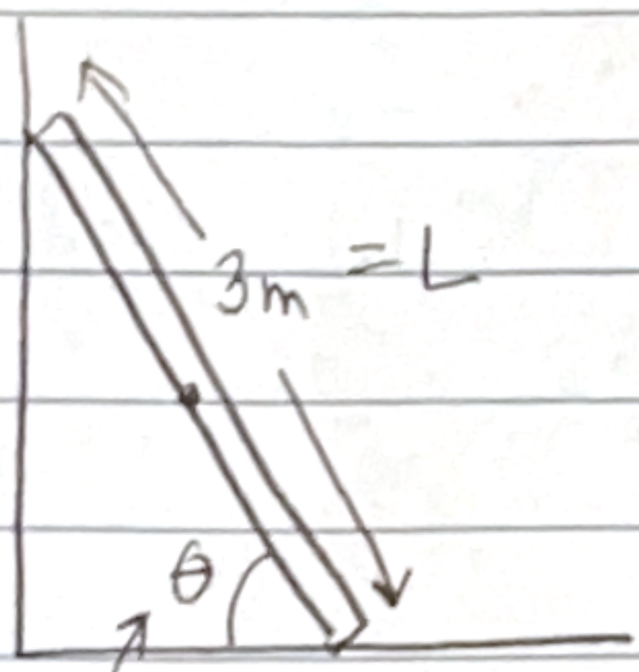
Ch 12 p.333 #58

a)

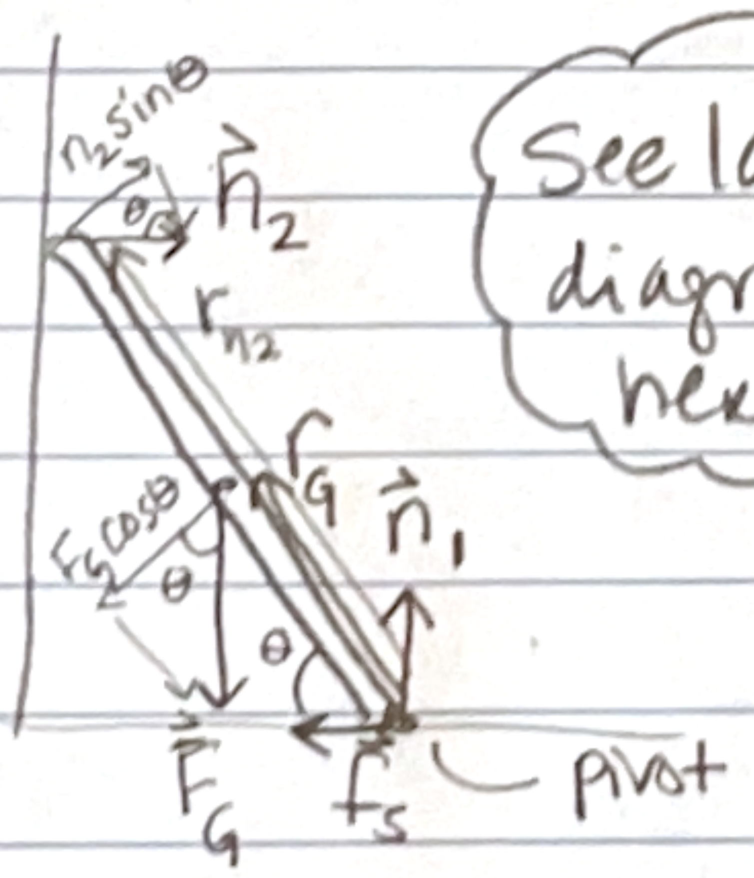


Find min. angle

$\mu_s = .40$

b) System: ladder

models: rigid body, static equilibrium



See larger diagram on next page

When the ladder is at the minimum angle to not slip, the static friction force is a maximum, so the actual value of f_s will be $f_s = \mu_s n_1$

Apply the conditions of Equilibrium:

c) $\boxed{\Sigma F_y = 0}$

$n_1 - mg = 0$

$n_1 = mg$

$\boxed{\Sigma F_x = 0}$

$n_2 - f_s = 0$

$n_2 - \mu_s n_1 = 0$

$n_2 = \mu_s n_1$

$n_2 = \mu_s mg$

$\boxed{\Sigma \vec{\tau} = 0} \Rightarrow -r_{n2} F_{\perp \text{ of } n_2} + r_G F_{\perp \text{ of } F_G}$

$-L(n_2 \sin\theta) + \left(\frac{L}{2}\right) F_G \cos\theta = 0$

$\cancel{-L}\, n_2 \sin\theta = \cancel{-}\frac{\cancel{L}}{2} F_G \cos\theta$

$n_2 \sin\theta = \frac{mg\cos\theta}{2}$

$n_2 \tan\theta = \frac{mg}{2}$

$\tan\theta = \frac{mg}{2n_2}$

$\tan\theta = \frac{\cancel{mg}}{2\mu_s \cancel{mg}}$

$\tan\theta = \frac{1}{2\mu_s}$

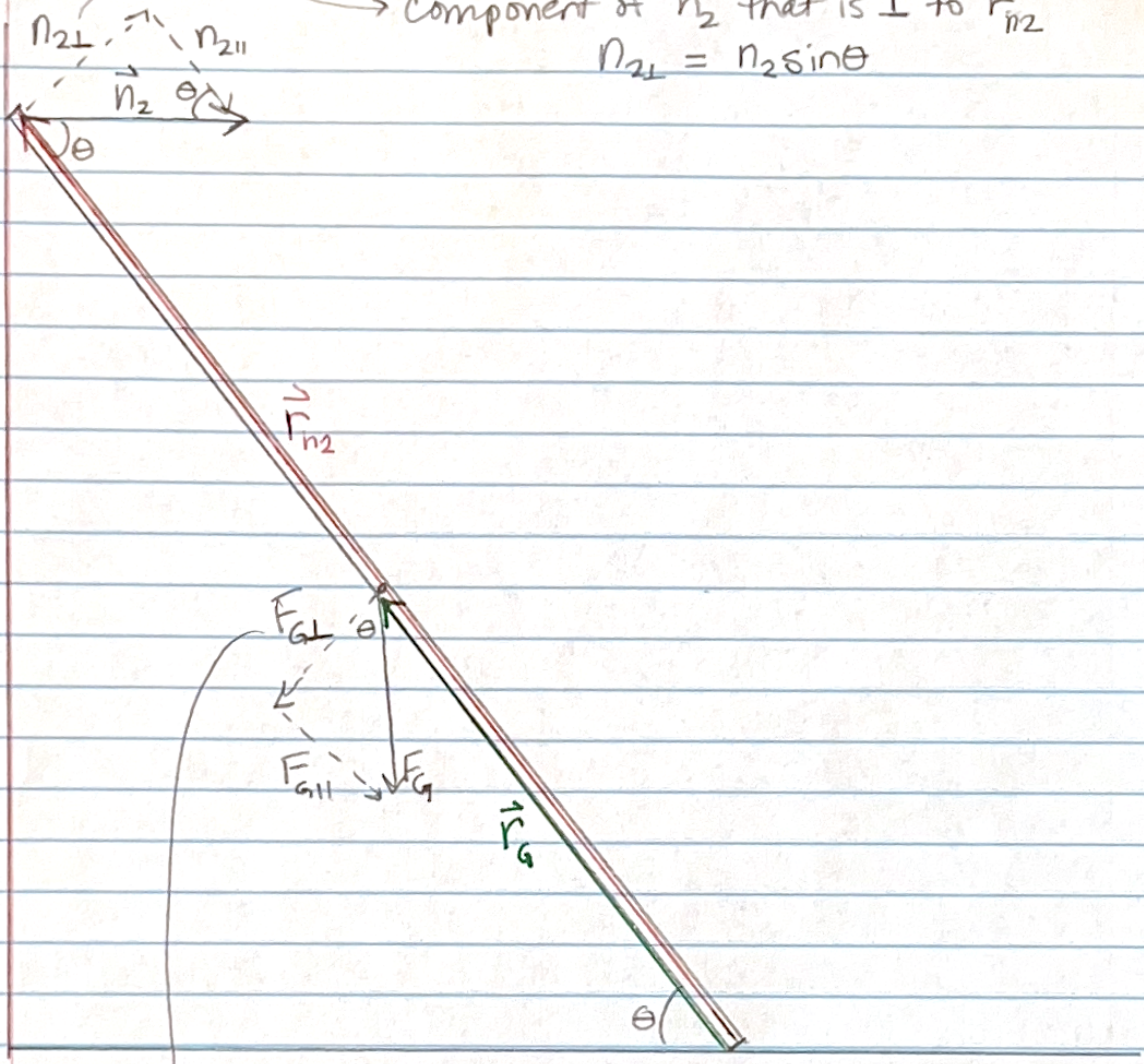
d) $\tan\theta = \frac{1}{2(.40)}$

$\theta = \boxed{51°}$

e) 51° seems reasonable because it is a medium angle and the μ_s value was a medium sort of value.

Component of $\vec{n}_2$ that is $\perp$ to $\vec{r}_{n2}$

$n_{2\perp} = n_2 \sin\theta$



This is the component of $\vec{F}_G$ that is $\perp$ to $\vec{r}_G$

$F_{G\perp} = F_G \cos\theta$