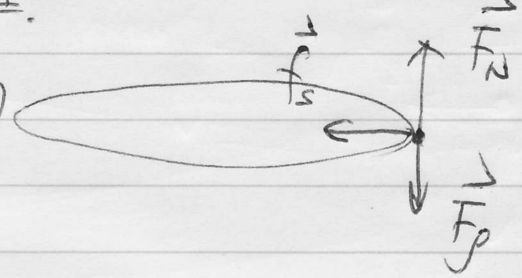
Similar to.

Workout #2

(a)



(b)

$$|f_s| \leq \mu_s m g.$$

$$\Downarrow$$

$$m\frac{v^2}{r}$$

$$\therefore \cancel{m}\frac{v^2}{r} \leq \mu_s \cancel{m} g$$

$$\frac{v^2}{r_{min}} = \mu_s g \qquad \therefore v^2 = r_{min} \cdot \mu_s g$$

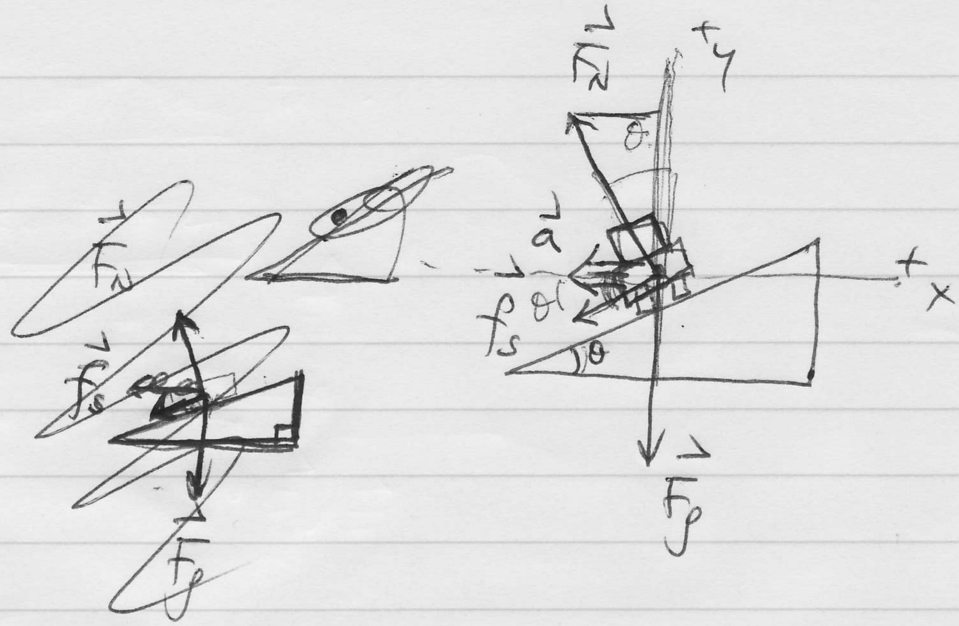
$$\therefore r_{min} = \frac{v^2}{\mu_s g} = \frac{20^2}{0.41 \times 9.8} = 100\,m.$$

(c)

r_{min} is independent of m

$\therefore r_{min}$ doesn't change

(d)



Along x

$$F_{net\text{-}x} = m a_x$$

$$-\left|\vec{f}_s\right|^{max}\cos\theta - \left|\vec{F}_N\right|\sin\theta = m\left(-\frac{v^2}{r_{min}}\right) \quad \ldots ①$$

$$\left|\vec{f}_s\right| = \mu_s\left|\vec{F}_N\right|$$

Along y:

$$F_{net\text{-}y} = m a_y$$

$$\left|\vec{F}_N\right|\cos\theta - \left|\vec{f}_s\right|^{max}\sin\theta - mg = 0. \quad \ldots ②$$

$$\left|\vec{f}_s\right| = \mu_s\left|\vec{F}_N\right|$$

① → $+\mu_s\left|\vec{F}_N\right|\cos\theta + \left|\vec{F}_N\right|\sin\theta = +m\frac{v^2}{r}$

$$\left|\vec{F}_N\right|\left[\mu_s\cos\theta + \sin\theta\right] = m\frac{v^2}{r}$$

② → $\left|\vec{F}_N\right|\left[\cos\theta - \mu_s\sin\theta\right] = mg$

~~$\therefore \left|\vec{F}_N\right| = \frac{mg}{\cos\theta - \mu_s\sin\theta}$~~

~~mg~~

~~$\dfrac{\mu_s \cos\theta + \sin\theta}{\cos\theta - \mu_s \sin\theta} = v^2$~~

$$|\vec{F}_N| = \frac{mg}{\cos\theta - \mu_s \sin\theta}$$

$$\therefore \frac{mg}{\cos\theta - \mu_s \sin\theta}(\mu_s \cos\theta + \sin\theta) = m\frac{v^2}{r_{min}}$$

$$\therefore r_{min} = \frac{v^2}{g} \cdot \frac{\cos\theta - \mu_s \sin\theta}{\mu_s \cos\theta + \sin\theta}$$

$$= \frac{v^2}{\mu_s g}\left[\frac{\cos\theta - \mu_s \sin\theta}{\cos\theta + \frac{\sin\theta}{\mu_s}}\right]$$

$< 1.$

$$< \frac{v^2}{\mu_s g}.$$

$\therefore r_{min}$ ~~[illegible]~~ decreases