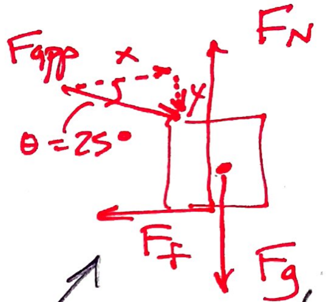
6.62

From table in book: $\mu_{static} = 0.1$, $\mu_{kinetic} = 0.03$

$m = 45.0\,kg$



a) To get block moving we need to overcome static friction. Free-body

$\Sigma F_x = ma = 0$

$F_{app\,x} - F_f = 0$

$F_{app} \cos 25 = \mu F_N$ ← Not $\neq mg$!

$\Sigma F_y = ma = 0$

$F_N - F_g - F_{app\,y} = 0$

$F_N = mg + F_{app} \sin 25$

$F_{app} \cos 25 = \mu(mg + F_{app} \sin 25)$

$F_{app}(0.9063) = (0.1)(45 \cdot 9.8 + F_{app}(0.4226))$

$F_{app}(0.9063) = 44.1 + 0.04226\, F_{app}$

$F_{app}(0.8640) = 44.1$

$F_{app} = \boxed{51.0\,N}$

b)

$\Sigma F_x = ma$

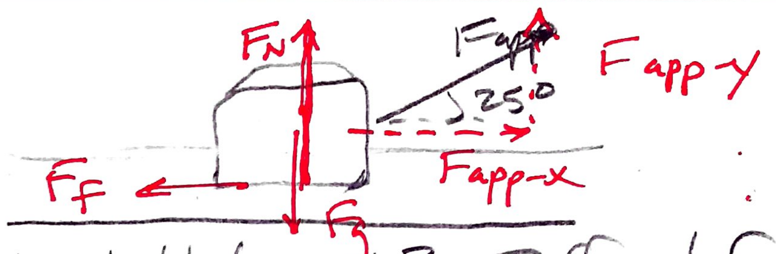
$F_{app\,x} - F_f = ma$

$51 \cos 25 - \mu F_N = 45\, a$

$46.22 - (0.03)(462.6) = 45\, a$ → $F_N = mg + F_{app} \sin 25 = 462.6$

$a = \boxed{0.719\, m/s^2}$

6.63



a) Fapp to get block moving? Different from 6.62 — why?!

$\Sigma F_x = ma_x$

$F_{appx} - F_f = ma = 0$

$F_{appx} - \mu F_N = 0$

(FNormal is different so $F_f = \mu F_N$ is different)

$\Sigma F_y = ma = 0$

$F_{app-y} + F_N - F_g = 0$

$F_N = mg - F_{app-y}$

$F_N = 45 \cdot 9.8 - F_{app} \sin 25$

$F_{app} \cos 25 = (0.1)(441 - 0.4226\, F_{app})$

$F_{app}(0.9486) = 44.1$

$F_{app} = \boxed{46.5\,N}$ ← Less than it was before in problem 62. Lifting up on the box a little reduces the FNormal, & thus the Ffriction acting on the box.

b) Once it's moving, if we continue to apply the same force:

$\Sigma F_x = ma$

$F_{app-x} - F_f = ma$

$46.5 \cos 25 - \mu F_N = ma$

$46.5 \cos 25 - (0.03)(45 \cdot 9.8 - 46.5 \sin 25) = 45a$

$a = \dfrac{42.14 - (0.03)(441 - 19.65)}{45} = \boxed{0.65\, m/s^2}$

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6.65

a) Centripetal force to keep child moving in a circle?

$$\Sigma F_c = \frac{mv^2}{r} = \frac{(22\,kg)\,v^2}{1.25\,m}$$

$$F_c = \frac{(22)(5.236)^2}{1.25}$$

$$= \boxed{483\ N}$$

This is about twice as much as the child's weight of $mg = 216\,N$

$$v = \frac{(2\pi r)\,40\ rev/min}{t} = \frac{2\pi(1.25)\,40}{60\,s} = 5.236\ m/s$$

b)

$$F_c = \frac{mv^2}{r} = \frac{(22)\,v^2}{8\,m}$$

$$v = \frac{(2\pi r)\cdot 3\ rev/min}{t} = \frac{(2\pi 8)(3)}{60\,s} = 2.51\ m/s$$

$$F_c = \frac{(22)(2.51)^2}{8}$$

$$= \boxed{17.3\ N}$$

This is less than a tenth of his weight.