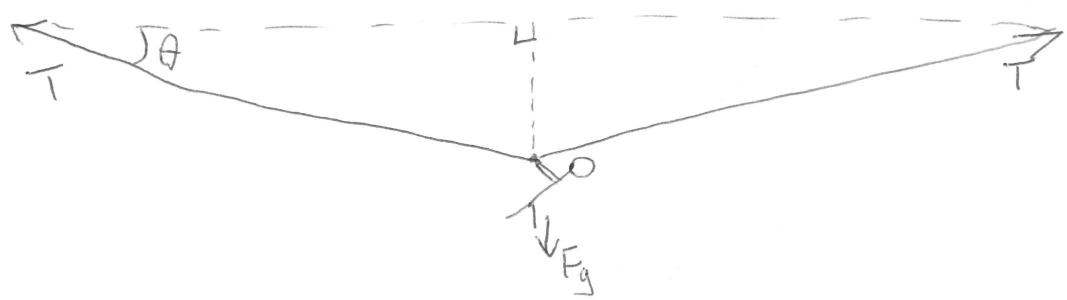
Recitation Week 4

Ch. 5 #4

a) We know y-component of Tension in rope is equal to the man's gravitational force.



$$2T\sin\theta = F_g$$

$$2T\sin 10° = mg = 90(9.8)$$

$$T = \frac{90(9.8)}{2\sin 10} = \boxed{2539\ N}$$

b) $2T\sin\theta = F_g$

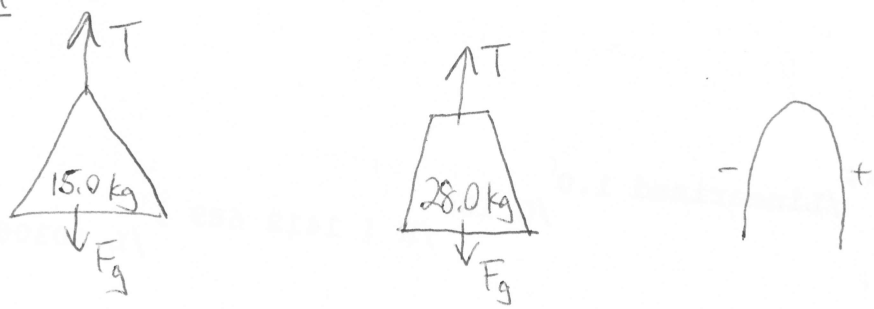
$$\sin\theta = \frac{F_g}{2T_{max}}$$

$$\theta = \sin^{-1}\frac{F_g}{2T_{max}}$$

$$\theta = \sin^{-1}\frac{90(9.8)}{2(2.5\times10^4)} = \boxed{1°}$$

Ch.5 #19

a)



b) $F_{tot} = F_{g\,bricks} + F_{g\,weight}$

$= 15.0(-9.8) + 28.0(9.8)$

$= 127.4\text{ N}$

$127.4\text{ N} = m_{tot}a = (15.0+28.0)a$

$\boxed{a = 2.96\text{ m/s}^2}$

c) $T + F_{g\,bricks} = m_{bricks}a$

$T + 15.0(-9.8) = 15.0(2.96)$

$\boxed{T = 191.4\text{ N}}$

More than bricks, less than counterweight.

Ch. 5 #24

a)

F = force due to movement of elevator

$F_{tot} = F_g + F$

$450\text{ N} = 550\text{ N} + F$

$F = -100\text{ N} = ma$

$m = \frac{550}{9.8} = 56.1\text{ kg}$

$\boxed{a = \frac{-100}{56.1} = -1.78\text{ m/s}^2}$

Student got lighter, so elevator accelerating downwards.

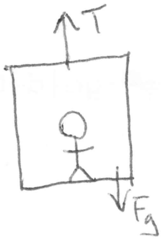
b) $670\text{ N} = 550\text{ N} + F$

$F = 120\text{ N} = ma$

$\boxed{a = \frac{120}{56.1} = 2.14\text{ m/s}^2}$

upwards.

c) If scale reads 0, the elevator is in a free fall, student should worry.

d) 

for ⓐ $F_{Tot} = T + F_g = m_{tot} a$

$T + m_{tot} g = m_{tot} a$

$T = m_{tot}(a-g) = (850+56.1)(1.78-9.8)$

$\boxed{T = -7{,}267\ N}$

for ⓒ free fall, no tension

$\boxed{T = 0}$

Ch.5 #37

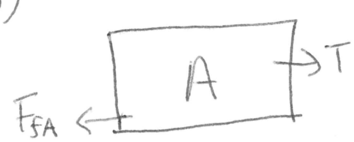
a) traveling at constant velocity, so $F_{tot} = 0$

$F_{tot} = F + F_{fA} + F_{fB} = 0$

$F - \mu_k m_A g - \mu_k m_B g = 0$

$\boxed{F = \mu_k g (m_A + m_B)}$

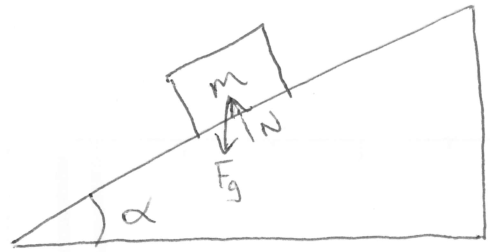
b)



$F_{tot} = 0 = F_{fA} + T$

$T = -F_{fA} = \boxed{-\mu_k m_A g}$

Ch.5 #42



$\mu_s = 0.35$
$\mu_k = 0.25$
$m = 25.0$ kg

a) Normal force $N = F_g \cos\alpha$

$F_f = \mu_s N = \mu_s F_g \cos\alpha$

Force of gravity down ramp $= F_g \sin\alpha$

Point of slippage happens when

$\mu_s F_g \cos\alpha = F_g \sin\alpha$

$\mu_s \cos\alpha = \sin\alpha$

$\mu_s = \tan\alpha$

$\alpha = \tan^{-1}\mu_s = \tan^{-1}(0.35) = \boxed{19.3°}$

b) $F_{tot} = F_g \sin\alpha - \mu_k F_g \cos\alpha$

$= 25.0(9.8)\sin 19.3 - 0.25(25.0)(9.8)\cos 19.3$

$= 81.0 - 57.8$ N

$= 23.2$ N $= ma$

$a = \frac{23.2}{25.0} = \boxed{0.93 \text{ m/s}^2}$

c) $v_f^2 = v_0^2 + 2a(\Delta x)$

$v_f^2 = 0^2 + 2(0.93)(5.0)$

$v_f^2 = 9.3$

$\boxed{v_f = 3.05 \text{ m/s}}$

Ch.5 #50

$v = 25.0$ m/s
$r = 220.0$ m

a) $F_{cent} = \frac{mv^2}{r}$

$F_f = \mu_k mg$

$F_{cent} = F_f \Rightarrow \frac{mv^2}{r} = \mu_k mg$

$\mu_k = \frac{v^2}{gr} = \frac{(25.0)^2}{9.8(220.0)} = \boxed{0.29}$

b) $\mu_k = \frac{0.29}{3} = 0.096$

$\frac{mv^2}{r} = \mu_k mg$

$v^2 = \mu_k gr = 0.096(9.8)(220.0)$

$v^2 = 208$

$\boxed{v = 14.4 \text{ m/s}}$

Ch.5 #118

a)

$r = 5.00$ m
$v = 12.0$ m/s
$m = 1.60$ kg

To keep in circular motion,
$F_{Tot} = F_{cent} = \frac{mv^2}{r}$ to the center.

$\frac{mv^2}{r} = N - mg$

$N = \frac{mv^2}{r} + mg$

$= \frac{1.60(12.0)^2}{5.0} + 1.60(9.8)$

$= 46.08 + 15.68$

$\boxed{N = 61.76 \text{ Newtons}}$

b)

$\frac{mv^2}{r} = N + mg$

$N = \frac{mv^2}{r} - mg$

$= \frac{1.60(12.0)^2}{5.0} - 1.60(9.8)$

$= 46.08 - 15.68$

$\boxed{N = 30.40 \text{ Newtons}}$