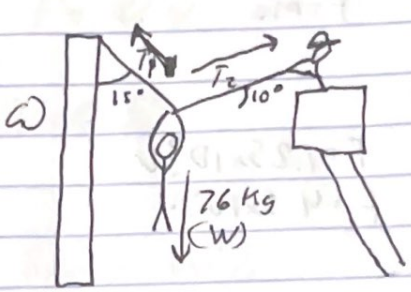
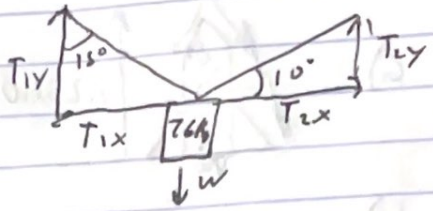
Mid term 2

2) (4)





~~a) $F_{net_x} = \Sigma F_x = 75.5\,kg$~~ b) $F_{net_x} = T_{2x} - T_{1x}$

$F_2 - W$ $F_{net_x} = 0$

$T_1 \cos\theta_1 = T_2 \sin\theta_2$

~~c) $F_{net} = T_1 - W$~~ c) $F_{net} = T_{1y} + T_{2y} - W$

$W = T_{1y} + T_{2y}$

d) $T_2 \cos 10° - T_1 \sin 15° = 0$ (since at rest)

$T_2 = T_1\left(\frac{\sin 15}{\cos 10}\right)$

$T_1 \cos 15° + T_2 \sin 10° - mg = 0$

$T_1 = \frac{mg - T_2 \sin 10°}{\cos 15°}$

$\cos 15 \cdot T_1 = \frac{mg - T_1\left(\frac{\sin 15}{\cos 10°}\right)\sin 10}{\cos 15°} \cdot \cos 15$

$mg = T_1 \cos 15° + T_1\left(\frac{\sin 15}{\cos 10°}\right)\sin 10°$

$T_1 = \frac{mg}{\cos 15° + \left(\frac{\sin 15}{\cos 10}\right)\sin 10}$

$T_1 = \frac{(76\,kg)(9.81\,m/s^2)}{\cos 15 + \left(\frac{\sin 15}{\cos 10}\right)\sin 10}$

$T_1 = 736.33N$

$T_2 = 736.33N\left(\frac{\sin 15}{\cos 10}\right)$

$= 193.51N$

$T_1 = 736.33N$

$T_2 = 193.51N$

Midterm 2

3)

① $f = \mu N = mg$

$\mu = 0.5 \quad m = 120\,kg \quad g = 9.81\,m/s^2$

$f = 0.5(120\,kg)(9.81\,m/s^2)$

a) $\boxed{f = 588\,N}$

b) $f = \mu N$

$\mu = 0.3$

$f = 0.3(120\,kg)(9.81\,m/s^2)$

$f = 353\,N$

$F_{net} = ma$

$a = \frac{F_{net}}{m}$

$a = \frac{588\,N - 353\,N}{120\,kg}$

$\boxed{a = 1.96\,m/s^2}$

② $ma_x = mg\sin\theta \qquad F = ma$

$a_x = g\sin\theta - g\cos\theta\,\mu$

~~$a_x = 4.81\sin(23)^\circ$~~

~~$a_x = 4.15\,m/s^2$~~

$a = g(\sin\theta - \cos\theta\,\mu)$

$= 9.81\,m/s^2(0.42 - 0.91 \cdot \mu)$

0.091

$\boxed{= 3.73\,m/s^2}$

Midterm 2

3)

③ $F_D = \frac{1}{2} C_D \rho A v^2$

$C = 0.75$ $\rho = 1.225 kg\,m^{-3}$

$A = 0.75 m^2$ $V = 40 m/s$

$F_D = \frac{1}{2}(0.75)(1.225)(0.75)(40)^2$

$\boxed{F_D = 551 N}$

④ $\frac{F}{A} = Y(\Delta x / L)$

(4cm) decreased by 0.3cm

$m = 2300 kg$

$A = \pi(r)^2$ $Y = \frac{f \times L}{A \times \Delta x}$

$Y = \frac{2300 kg (9.81) \cdot 10 m}{\pi(4)^2 \cdot 3.7 cm \; 0.037}$

$Y = \frac{225630}{1.86}$

$\boxed{Y = 1.21 \times 10^5 N/m^2}$

Midterm 2

4)

① $V = r\omega$ $\omega = \frac{V}{r}$

$V = 144$ km/h
$r = 0.5$m

$\boxed{\omega = 80 \text{ rad/sec}}$

$\frac{144 \text{ km}}{1 \text{ hr}} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ rad}}{0.5 \text{ m}} \times \frac{1 \text{ hr}}{3600 \text{ s}} = \boxed{80 \text{ rad/sec}}$

② $\tan\theta = \frac{V^2}{rg}$ $\frac{120 \text{ km}}{1 \text{ hr}} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ hr}}{3600 \text{ s}} = 33.3 \text{ m/s}$

$\theta = \tan^{-1}\left(\frac{V^2}{rg}\right)$

$\theta = \tan^{-1}\left(\frac{(33.3 \text{ m/s})^2}{900\text{m}(9.8 \text{ m/s}^2)}\right)$

$\theta = \tan^{-1}(0.126$

$\boxed{\theta = 7.18°}$

③a) path two may be taken at a higher speed, bc the path has a more gradual curve and larger radius. I also like racing so I know that if you take path one at the same speed you will slide off the track.

b) Since the friction force balances the centripetal force

(10) $\omega = 1$ rad/s $V = r\omega$

$V = 400\text{m}(1)$ path 2 = 900 m/s
path 1 = 400 m/s

Midterm 2

4)

(4) distance $= 4.5 \times 10^{12}$ m

a) $m = 1.4 \times 10^{22}$ kg

$$a = \frac{Gm}{r^2} \qquad \frac{6.67 \times 10^{-11} \cdot 1.4 \times 10^{22}}{(4.5 \times 10^{12})^2}$$

$$= 4.61 \times 10^{-14} \text{ m/s}^2$$

b) $m = 8.62 \times 10^{25}$ kg

distance $= 2.5 \times 10^{12}$

$$a = \frac{6.67 \times 10^{-11} \cdot 8.62 \times 10^{25} \text{ kg}}{(2.5 \times 10^{12})^2}$$

$$a = 9.2 \times 10^{-10} \text{ m/s}^2$$

Pluto has slow acceleration, makes sense since pluto is farther away.