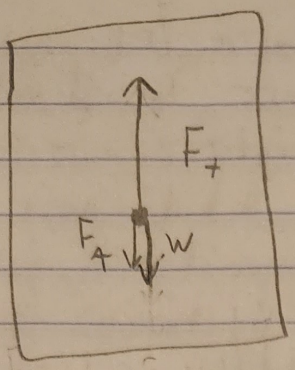
2

1) a)



F_t = Force of Thrusters
F_A = Force of Air resistance
W = weight; Force of Gravity

b) $\Sigma F = ma$ $\quad F_t - (F_A + W) = ma$

$W = mg$

$F_t - (F_A + mg) = ma$

$1.25 \times 10^7 - (9.5 \times 10^6 + 5 \times 10^5 (10)) = ma$

$3,000,000 = ma$

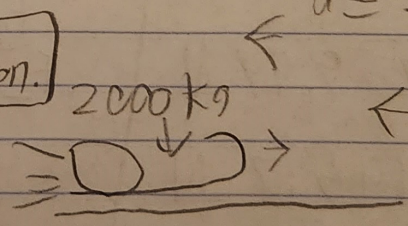
$\frac{3 \times 10^6}{5 \times 10^5} = \frac{5 \times 10^5 (a)}{5 \times 10^5}$

$a = 6\ m/s^2$

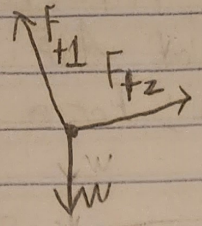
$6\ m/s^2$

2) a) $-700\ N$

3) a) The force of friction.



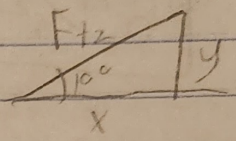
F_{T1} = Force Tension 1
F_{T2} = Force Tension 2
w = weight / Force Gravity

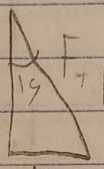
4) A) 

b) $F_{netx} = F_{T2}\cos(10) - F_{T1}\sin(15)$

not on X
$F_{T1} + F_{T2} - w = ma$

$F_{T2} - F_{T1}$





$\cos(10) = \frac{x}{F_{T2}}$

$F_{T2}\cos(10) = x$

$\sin(15) = \frac{x}{F_{T1}}$

$F_{T1}\sin(15)$

c) $F_{noty} = F_{T2}\sin(10) + F_{T1}\cos(15) - W$

$\Sigma F = 0$

d) $F_{T1} = 739.97\ N$
$F_{T2} = 193.7\ N$

$F_1\sin 15 = F_2\cos(10)$
$F_1\frac{\sin 15}{\cos 10} = F_2$

$F_{T1}\cos(15) + F_2(\sin(10)) = W$
$F1(\cos(15) + F1(\frac{\sin 15}{\cos 10})(\sin(10)) = W$
$F1(\cos 15 + \frac{\sin 15}{\cos 10}(\sin 10)) = mg$
$F1(1.012) = 76(9.8)$
$F1 = 735.97\ N$

Proof

$F_1\cos(15) + F_2\sin(10) = W$ $F_1 = F_2\frac{\cos 10}{\sin 15}$

$739.97(\cos(15)) + 193.7\sin(10) = 745.56$ $F2(\frac{\cos 10}{\sin 15}(\cos 15) + (\sin 10)) = W$

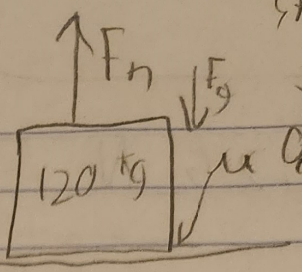
$710.89 + 33.64 \approx 745.56$ $F2(3.849) = 745.56$

$F2 = 193.7$

3

1) a) 588 N

b) The magnitude of acceleration will increase to about 1.97 m/s^2



μ_s is 0.5 and μ_k is 0.3

$F_n = F_g$

$F_f = \mu F_n$

$F_f = 0.5 F_g$

$F_f = 0.5 m g$

$F_f = 0.5(120)(9.8)$

$F_f = 588$

$F = ma$

$F_f = ma$

$589 - 588 = ma$

$589 = 120a$

$a = \frac{1}{120}$

$a = 0.008 \ m/s$

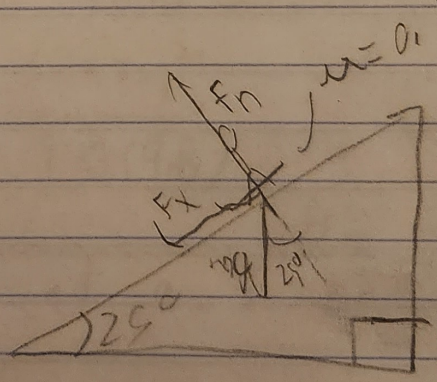
$F_f = 0.3 m g$

$352.8 = 0.3(120)(9.8)$

$588 - 352.8 = ma$

$a = 1.97$

2) $a \approx 4.66 \ m/s^2$



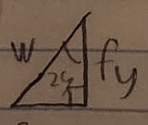
$mg \sin(25) - \mu mg \cos(25) = ma$

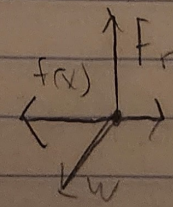
$\frac{mg \sin(25) - \mu mg \cos(25)}{m} = \frac{ma}{m}$

$\Sigma F = ma$

$f(x) = mg \sin(25)$

$W \sin 25 = \frac{f(x)}{W} \cdot W$





$f(x) - f_f = ma$

$f_f = \mu f_n$

$W_\perp = F_n$

$W_\perp - F_n = 0$

$f_n = mg \cos(25)$

$W \cos(22) = \frac{f_y}{W} \cdot W$

3) $F_D \approx 591.25\ N$

$F_D = \frac{1}{2} C_p A v^2$

$F_D = \frac{1}{2} (0.79)(1.225)(0.79)(40)^2$

$F_D = 591.25$

4) $19,130\ \frac{N}{m^2}$

$\frac{F}{A} = Y\left(\frac{\Delta x}{L}\right)$

$\frac{2300\ (9.8)}{2\pi(.04)^2} = Y\left(\frac{0.003}{10}\right)$

$\frac{5.739}{0.0003} = Y\ \frac{(0.0003)}{0.0003}$

$19,130 = Y$

4

1) 288 rad/s

$V = r\omega$

$\frac{144}{0.5} = \frac{0.5\omega}{0.5}$

$\omega = 288$

2) $\theta = 7.18$ degrees

120 km ← 0.9 km

120,000 meters/hr

900 m

$\tan\theta = \frac{v^2}{rg}$

$\frac{120{,}000 \text{ meters}}{1 \text{ hr}} \cdot \frac{1 \text{ hr}}{3600 \text{ seconds}} = 33.33 \text{ m/s}$

$\tan\theta = \frac{(33.33)^2}{400(9.8)}$

$\tan\theta = 0.126$

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

3) a) Path 2 can be taken at a higher speed.

B) Path 1: $V_{tan} = 62.6$ m/s
Path 2: $V_{tan} = 88.54$ m/s

$F_c = ma_c$

$a_c = \frac{v^2}{r}$

$F_c = f_f$

Path 1: $\sqrt{(9.8)(400)} = 62.6$ m/s

Path 2: $\sqrt{9.8 \times 800} = 88.54$ m/s

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

$F_f = \mu F_n$

$F_n = mg$

$\mu mg = m\frac{v^2}{r}$

$\mu g = \frac{v^2}{r} \cdot r$

$\sqrt{\mu g r} = \sqrt{v^2}$

$\mu g r = v$

4) a) The acceleration due to gravity at Neptune due to Pluto is approximately $4.6\,14330\,86 \times 10^{-14}\ m/s^2$.

Force of Attraction due to pluto on neptune

$$F_G = \frac{G m_1 m_2}{r^2}$$

$G = 6.6743 \times 10^{-11}$

$F = m_2 a$

$$m_2 a = \frac{G m_1 m_2}{r^2}$$

$$a = \frac{G m_1}{r^2}$$

$$a = \frac{6.6743 \times 10^{-11} (1.9 \times 10^{22})}{(4.9 \times 10^{12})^2}$$

$a = 4.6 \times 10^{-14}$

b) The acceleration due to gravity at Neptune due to Uranus is approximately $9.20519456 \times 10^{-10}$. This means Uranus has much more of an effect on Neptune than Pluto does.

Uranus

$$a = \frac{G(m_1)}{r^2}$$

$$a = \frac{(6.6743 \times 10^{-11})(8.62 \times 10^{25}\ kg)}{(2.5 \times 10^{12})^2}$$

$a \approx 9.20519456 \times 10^{-10}$