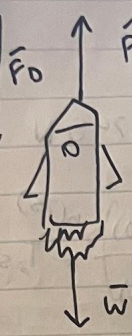
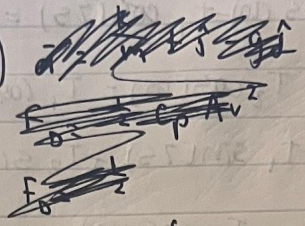
Physics Midterm #2

1. a)



b) 

$m = 5 \cdot 10^5 kg$

$\bar{F} = ma$

$\bar{F}_D = 4.5 \cdot 10^6 N$

$\bar{w} = 5 \cdot 10^5 kg \cdot 9.81 m/s^2 = 4.905 \cdot 10^6 N$

$\bar{F}_{tot} = \bar{F}_t - (\bar{F}_D + \bar{w}) = 3.095 \cdot 10^6 N \quad \bar{F}_t = 1.25 \cdot 10^7 N$

$\frac{3.095 \cdot 10^6 N}{m} = \boxed{6.19 \ m/s^2}$

2. $\boxed{-200 N}$

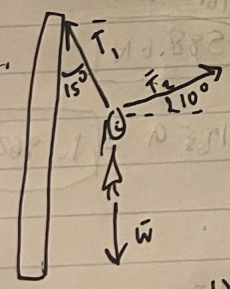
3. $\bar{F}_D = 1000 N \quad m = 2000 kg \quad \bar{a} = -200 m/s^2$

$\bar{F}_{tot} = m\bar{a}$

$\bar{F}_{tot} = 2000 kg \cdot 4200 m/s^2$

$\bar{F}_{tot} = 400,000 N$

$400,000 N - 1000 = \boxed{3.99 \cdot 10^5 N}$

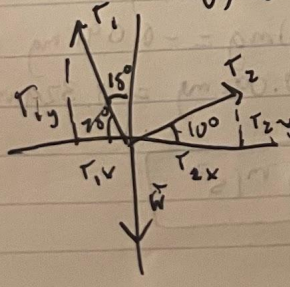
4. 

a)

$\bar{w} = 76 kg \cdot 9.81 m/s^2 = 745 N$

b) $F_{net,x} = T_2 \cos\theta_2 - T_1 \sin\theta_1$

c) $F_{net,y} = T_2 \sin\theta_2 + T_1 \cos\theta_1 - \bar{w}$

d) 

$\cos(75) = \frac{-T_{1x}}{T_1} \quad T_{1x} = -T_1 \cos(75)$

$\sin(75) = \frac{T_{1y}}{T_1} \quad T_{1y} = T_1 \sin(75)$

$\cos(110) = \frac{T_{2x}}{T_2} \quad T_{2x} = T_2 \cos(10)$

$\sin(10) = \frac{T_{2y}}{T_2} \quad T_{2y} = T_2 \sin(10)$

$T_2\cos(10) - T_1\cos(75) = 0$

$T_2\cos(10) = T_1\cos(75)$

$T_1\sin(75) + T_2\sin(10) - 745\,N = 0$

$T_1 = \dfrac{T_2\cos(10)}{\cos(75)}$

$\left(\dfrac{T_2\cos(10)}{\cos(75)}\right)\sin(75) + T_2\sin(10) - 745N = 0$

$0.174\,T_2$

$3.67\,T_2 + T_2\sin(10) = 745\,N$

$3.84\,T_2 = 745\,N$

$\boxed{T_2 = 194\,N}$

$194\,N\cos(10) = T_1\cos(75)$

$191.05\,N = 0.26\,T_1$

$\boxed{T_1 = 738\,N}$

Chap 5:

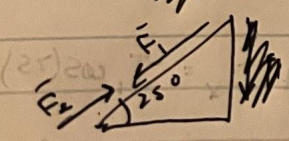
1. $m = 120\,kg$ $\mu_s = 0.5$ $\mu_k = 0.3$

a) $f = 0.5 \cdot mg\hat{j}$ $f = F$ for non accelerating

$f = 0.5 \cdot 120\,kg \cdot 9.81\,m/s^2 = \boxed{588.6\,N}$

b) $\dfrac{588.6\,N}{120\,kg} - 0.3 \cdot 9.81\,m/s^2 = a = \boxed{1.962\,m/s^2}$

2.



$\bar{F}_1 = \sin(25)^*mg = 0.42\,mg$

$\bar{F}_2 = -0.1\cdot\cos(25)mg = -0.091\,mg$

$\bar{F}_{net} = 0.42\,mg - 0.091\,mg = 0.329\,mg$

$a = \dfrac{\bar{F}}{m}$

$a = 0.329g = \boxed{3.23\,m/s^2}$

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

$F_D = \frac{1}{2}(1.225\ kg\,m^{-3})(0.75)(0.75\ m^2)(40\ m/s)^2$

$\boxed{F_D = 551.25\ N}$

4. $3\ mm = 0.003\ m$ $4\ cm = 0.04\ cm$ $\bar{F} = mg$

$m = 2300\ kg$ $r = 0.04\ m$ $\bar{F} = 2300\ kg \cdot 9.81\ m/s^2$

$A = \pi r^2 = 5 \cdot 10^{-3}\ m^2$ $\bar{F} = 22563\ N$

$F/A = Y(\Delta L/L)$

$\frac{F/A}{\Delta L/L} = Y$ $Y = \frac{22563\ N / 5 \cdot 10^{-3}\ m^2}{0.003m / 10m}$

$\boxed{Y = 1.5 \cdot 10^{10}\ N/m^2}$

CHAP 6:

1. $v = 144\ km/h$ $r = 0.5\ m$ $v = r\omega$

$= 40\ m/s$

$\frac{40\ m/s}{0.5\ m} = \boxed{80\ rad/s}$

2. $F_c = \tan\theta = \frac{v^2}{rg}$ $r = 0.9\ km$ $120\ km/h = v$

$r = 900m$ $v = 33.3\ m/s$

$\frac{(33.3\ m/s)^2}{900m \cdot 9.81\ m/s^2} = \tan\theta$

$\boxed{\theta = 7.16^\circ}$

3. a) Path 2

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

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

Path 1: $v = \sqrt{1 \cdot 9.81 m/s^2 \cdot 400m} = 62.6 m/s$

Path 2: $v = \sqrt{1 \cdot 9.81 m/s^2 \cdot 800m} = 88.6 m/s$

4. a) $a_c = \frac{Gm}{r^2}$

$a_c = \frac{(6.673 \cdot 10^{-11} \frac{Nm^2}{kg^2})(1.4 \cdot 10^{22} kg)}{(4.5 \cdot 10^{12} m)^2} = 4.65 \cdot 10^{-14} m/s^2$

b) $a_c = \frac{(6.673 \cdot 10^{-11} \frac{Nm^2}{kg^2})(8.62 \cdot 10^{25} kg)}{(2.5 \cdot 10^{12} m)^2} = 9.2 \cdot 10^{-10} m/s^2$

The acceleration due to gravity is greater at Neptune due to Uranus than at Neptune due to Pluto, due to Uranus's much higher mass.