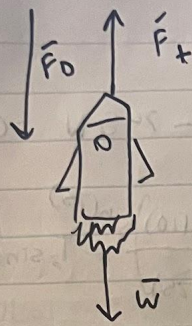


Physics Midterm #2

1. a)

$$m = 5 \cdot 10^5 \text{ kg}$$

$$\vec{F} = m\vec{a}$$



b)

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

$$\vec{W} = 5 \cdot 10^5 \text{ kg} \cdot 9.81 \text{ m/s}^2 = 4.905 \cdot 10^6 \text{ N}$$

$$\vec{F}_{\text{tot}} = \vec{F}_T - (\vec{F}_D + \vec{W}) = 3.095 \cdot 10^6 \text{ N}$$

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

2. ~~1000 N~~

$$-200 \text{ N}$$

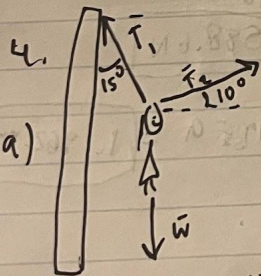
$$3. \vec{F}_D = 1000 \text{ N} \quad m = 2000 \text{ kg} \quad \vec{a} = -200 \text{ m/s}^2$$

$$\vec{F}_{\text{tot}} = m\vec{a}$$

$$\vec{F}_{\text{tot}} = 2000 \text{ kg} \cdot -200 \text{ m/s}^2$$

$$\vec{F}_{\text{tot}} = -400,000 \text{ N}$$

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



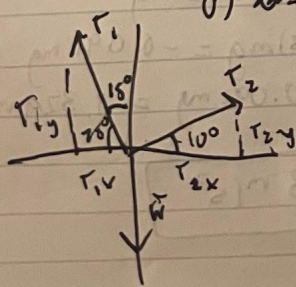
a)

$$\vec{W} = 26 \text{ kg} \cdot 9.81 \text{ m/s}^2 = 254.86 \text{ N}$$

$$b) F_{\text{net},x} = T_2 \cos(210) + T_1 \sin(15)$$

$$c) F_{\text{net},y} = T_2 \sin(210) + T_1 \cos(15) - \vec{W}$$

d)



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

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

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

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

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

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

$$T_1 \sin(75) + T_2 \sin(10) - 745 \text{ N} = 0$$

$$T_1 = \frac{T_2 \cos(10)}{\cos(75)} \quad \left(\frac{T_2 \cos(10) \sin(75)}{\cos(75)} + T_2 \sin(10) - 745 \text{ N} = 0 \right)$$

$$3.67 T_2 + 194 T_2 = 745 \text{ N}$$

$$3.84 T_2 = 745 \text{ N}$$

$$T_2 = 194 \text{ N}$$

194 N

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

$$191.05 \text{ N} = 0.26 T_1$$

$$T_1 = 738 \text{ N}$$

Chap 5:

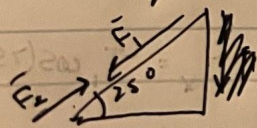
$$1. m = 120 \text{ kg} \quad \mu_s = 0.5 \quad \mu_k = 0.3$$

$$a) f = 0.5 \cdot mg \quad f = \bar{F} \text{ for normal}$$

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

$$b) \frac{588.6 \text{ N}}{120 \text{ kg}} - 0.3 \cdot 9.81 \text{ m/s}^2 = 1.962 \text{ m/s}^2$$

2. ~~Diagram~~



$$F_1 = \sin(25) \cdot mg = 0.42 \text{ mg}$$

$$F_2 = -0.1 \cdot \cos(25) \cdot mg = -0.091 \text{ mg}$$

$$F_{\text{net}} = 0.42 \text{ mg} - 0.091 \text{ mg} = 0.329 \text{ mg}$$

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

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

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

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

$$F_D = 551.25 \text{ N}$$

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

$$m = 2300 \text{ kg} \quad r = 0.04 \text{ m}$$

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

$$A = \pi r^2 = 5 \cdot 10^{-3} \text{ m}^2$$

$$\bar{F} = 22563 \text{ N}$$

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

$$\frac{F/A}{\Delta L/L} = Y$$

$$Y = \frac{22563 \text{ N} / 5 \cdot 10^{-3} \text{ m}^2}{0.003 \text{ m} / 10 \text{ m}}$$

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

CHAP 6:

$$1. v = 144 \text{ km/h} \quad r = 0.5 \text{ m} \quad v = r\omega$$

$$= 40 \text{ m/s}$$

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

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

$$r = 0.9 \text{ km} \quad 120 \text{ km/h} = v$$

$$r = 900 \text{ m}$$

$$v = 33.3 \text{ m/s}$$

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

$$\theta = 7.16^\circ$$

3. a) Path 2

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

$$\frac{v^2}{r} = Mg \quad v = \sqrt{rMg}$$

$$\text{Path 1: } v = \sqrt{1.9.81 \text{ m/s}^2 \cdot 400 \text{ m}} = \boxed{62.6 \text{ m/s}}$$

$$\text{Path 2: } v = \sqrt{1.9.81 \text{ m/s}^2 \cdot 800 \text{ m}} = \boxed{88.6 \text{ m/s}}$$

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

$$a_c = \frac{(6.673 \cdot 10^{-11} \frac{\text{Nm}^2}{\text{kg}^2}) (1.4 \cdot 10^{22} \text{ kg})}{(4.5 \cdot 10^{12} \text{ m})^2} = \boxed{4.61 \cdot 10^{-14} \text{ m/s}^2}$$

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

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

Great work!