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Physics Midterm 2   11-21-22

1.) a.

$T \uparrow$
(m)
$f \downarrow$
$mg \downarrow$

b. $F = ma$

$F = T - f - mg \rightarrow ma = T - f - mg \rightarrow a = \dfrac{T - f - mg}{m}$

$a = \dfrac{1.25 \times 10^7 \, N - 4.5 \times 10^6 \, N - (5 \times 10^5 kg)(9.8 \, m/s^2)}{5 \times 10^5 \, kg}$
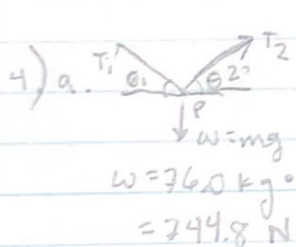
$\boxed{a = 6.20 \, m/s^2}$

2.) $\boxed{a - 700 \, N}$ It's a trick question, right? Because newton's
3rd law is equal + opposite.

3.) $F = ma \rightarrow a = 200 \, m/s^2$, $m = 2000 kg$

$F = 2000 kg \cdot 200 \, m/s^2 + 1000 \, N$

$F = \boxed{401000 \, N}$

4.) a.

$T_1 \nwarrow \quad \theta_1 \quad \theta_2 \quad \nearrow T_2$
$\downarrow^{\, \theta} \, w = mg$
$\theta_1 = 75°, \theta_2 = 10°$

$w = 76.0 \, kg \cdot 9.8 \, m/s^2$
$= 744.8 \, N$

$T_1 \sin\theta_1 \uparrow \quad \uparrow T_2 \sin\theta_2$
$\leftarrow T_1 \cos\theta_1 \quad T_2 \cos\theta_2 \rightarrow$
$wg \downarrow$

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

$\boxed{max = T_2 \cos\theta_2 - T_1 \cos\theta_1}$

c. $F_{net,y} = T_1 \sin\theta_1 + T_2 \sin\theta_2 - mg$

$\boxed{may = T_1 \sin\theta_1 + T_2 \sin\theta_2 - mg}$

d. here.

$T_1 \cos\theta_1 = T_2 \cos\theta_2$
$T_1 \cos(75°) = T_2 \cos(10)$
$\dfrac{T_1 \cdot 0.259}{0.259} = \dfrac{T_2 \cdot 0.985}{0.259}$

$T_1 \sin(75) + T_2 \sin(10) = mg$

$\dfrac{T_2 \cdot 0.985}{0.259}(0.966) +$
$T_2 \cdot 0.174 = 76.0 kg \cdot 9.8 \, m/s^2$
$T_2(3.67) + T_2(0.174) = 744.8$
$T_2(3.67 + 0.174) = 744.8$
$T_2 = \dfrac{744.8}{3.844} = \boxed{193.76 \, N}$

$T_1 = 193.76 \cdot \dfrac{0.985}{0.259} = \boxed{736.87 \, N}$

So $\boxed{T_1 = 736.87 \, N}$ &
$\boxed{T_2 = 193.76 \, N}$

3.1.) a. $F_{max} = \mu_s N$
$= \mu_s \, mg$
$= (0.5)(120 kg)$
$(9.8 \, m/s^2)$
$= \boxed{588 \, N}$

μ_s
$\leftarrow \boxed{} \rightarrow F_{max}$
$\uparrow N$
$\downarrow mg$
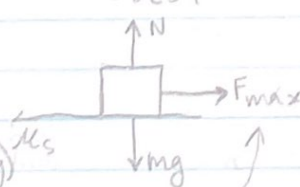
b.) $\dfrac{ma}{m} = \dfrac{600 - \mu_k \, mg}{m} \rightarrow a = \dfrac{600 N - (0.3)(120 kg)(9.8 \, m/s^2)}{120 kg} = \boxed{2.06 \, m/s^2}$

2.) $mg\sin\theta - \mu_k\, mg\cos\theta = ma$ $\theta = 25$ $\mu_k = 0.1$

$g(\sin\theta - \mu_k\cos\theta) = a$

$a = 9.8\frac{m}{s^2}(\sin(25) - 0.1\cos(25))$

$\boxed{a = 3.25\ m/s^2}$
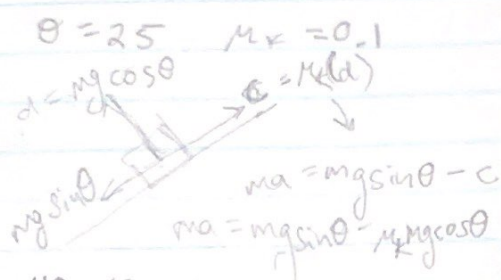
$ma = mg\sin\theta - c$

$ma = mg\sin\theta - \mu_k mg\cos\theta$

3.) $F_D = \frac{1}{2}C\rho A v^2$ $v = 40\ m/s$

$= \frac{1}{2}(0.75)(1.225\,kg\,m^{-3})(0.75m^2)$ $A = 0.75\,m^2$ $\rho = 1.225\,kg\,m^{-3}$

$(40\,m/s)^2$ $C = 0.75$

$= \boxed{551.25\ N}$

4.) $\boxed{2300}$ 0.4cm $\frac{F}{A} = Y(\Delta x/L) \rightarrow$ $L = 10\ m$

10.0m - 3mm $Y = \dfrac{F/A}{\Delta x/L}$ $\Delta x = 3mm$

$\dfrac{F}{A} = \dfrac{(2300kg)(9.81m/s^2)}{}$ $F = 2300\,kg \cdot 9.8\,m/s^2$

$Y = \dfrac{((2300kg)\cdot(9.8m/s^2))/(2.5m^2)}{(0.003m)/(10m)}$ $= \boxed{3.01\times 10^7\ N}$ $A = 2\pi rh + 2\pi r^2$

area of a cylinder $= 2.5\,m^2$

4.1) linear vel. $= 144\,km/hr \cdot \dfrac{1000m}{1km} \cdot \dfrac{1\,hr}{3600s} = 40\,m/s$ $r = 0.5m$

$v = r\omega$

$\omega = \dfrac{v}{r} \rightarrow \dfrac{40m/s}{0.5m} = \boxed{80\ rad/sec}$

2.) $v = \sqrt{rg\tan\theta}$ $g = 9.8$ $\dfrac{120\,km}{1\,hr} \cdot \dfrac{1000m}{1\,km} \cdot \dfrac{1\,hr}{3600s} = 33.33\,m/s$

$\tan\theta = \dfrac{v^2}{rg}$ $0.9\,km \cdot \dfrac{1000m}{1\,km} = 900\,m$

$\tan\theta = \dfrac{(33.33\ m/s)^2}{(900m \cdot 9.8\,m/s^2)}$

$= \dfrac{1110.89}{8820}\ m$

$\tan\theta = 0.12595\ m$

$\tan^{-1}(0.12595) = \boxed{7.18°}$

3.)a. path 2 because path 1 will have a greater angular velocity.

b. $F_s = \mu_s mg$

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

$\mu = \dfrac{v^2}{g\,r}$

$0.1 = \dfrac{v^2}{(9.8\,m/s^2)(400m)}$

$\sqrt{v^2} = \sqrt{(0.1)(5920\,m/s)}$

$\sqrt{v^2} = \sqrt{392}$

$\boxed{v_1 = 20\,m/s}$

$\sqrt{v^2} = \sqrt{(0.1)(9.8\,m/s^2)(800m)}$

$\boxed{v_2 = 28\,m/s}$

4.) a. $\vec{F_g} = \dfrac{GM}{r^2}$ $G = 6.67430 \times 10^{-11} \ \dfrac{N \cdot m^2}{kg^2}$

$M = 1.4 \times 10^{22} \ kg$

$r = 4.5 \times 10^{12} \ d$

$\vec{F_g} = \dfrac{(6.67430 \times 10^{-11} \ N \cdot m^2 / kg^2)(1.4 \times 10^{22} \ kg)}{(4.5 \times 10^{12} \ kg)^2}$

$\vec{F_g} = \boxed{4.61 \times 10^{-14} \ m/s^2}$

b. $\vec{F_g} = \dfrac{GM}{r^2}$ $G = 6.67430 \times 10^{-11} \ \dfrac{N \cdot m^2}{kg^2}$

$M = 8.62 \times 10^{25} \ kg$

$r = 2.5 \times 10^{12} \ m$

$= \dfrac{(6.67430 \times 10^{-11} \ \frac{N \cdot m^2}{kg^2})(8.62 \times 10^{25} \ kg)}{(2.5 \times 10^{12} \ kg)^2}$

$= \boxed{9.21 \times 10^{-10} \ m/s^2}$

compare:

$\dfrac{g}{g} = \dfrac{9.21 \times 10^{-10} \ m/s^2}{4.61 \times 10^{-14} \ m/s^2} = \boxed{2.0 \times 10^4}$

(+2) Bonus! Well done.