Phys 150 Midterm 2

Score: 22/20

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Nov 21 Mon
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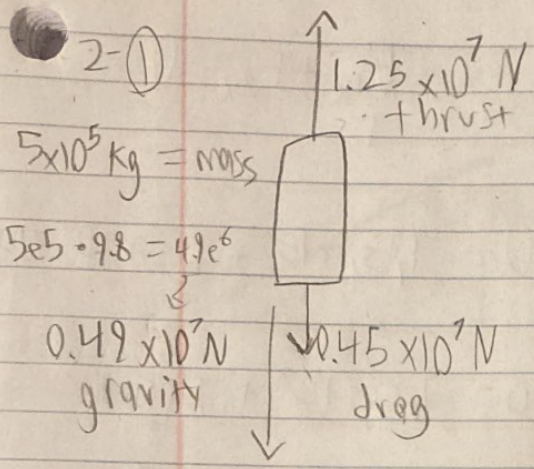
2-①

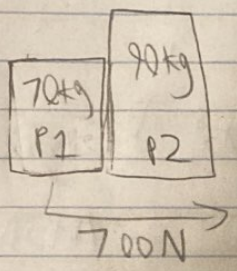


$F_{net} = 1.25e7 - (0.45e7 + 0.49e7)$

$= 0.31e7 = 3.10 \times 10^6$ N

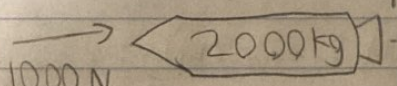
$a = \frac{3.10 \times 10^6 \text{ N}}{0.5 \times 10^6 \text{ kg}} = 6.22 \text{ m/s}^2$

2-②



P2 exerts -700N (or 700N opposite to the direction of P2 force) on P1

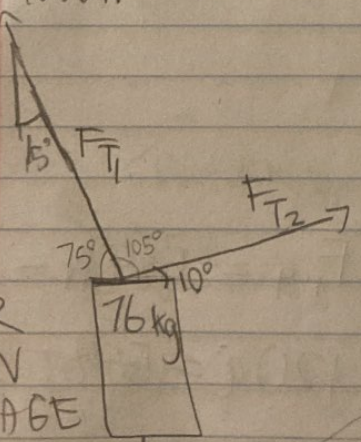
2-③



Additional force needed to decelerate at +200 m/s²:

400000 − 1000 = 399000 N

2-④



BETTER FBD ON NEXT PAGE

⑥ $F_{net\,X} = 745 \times \cos 10° + 745 \times \cos 105°$

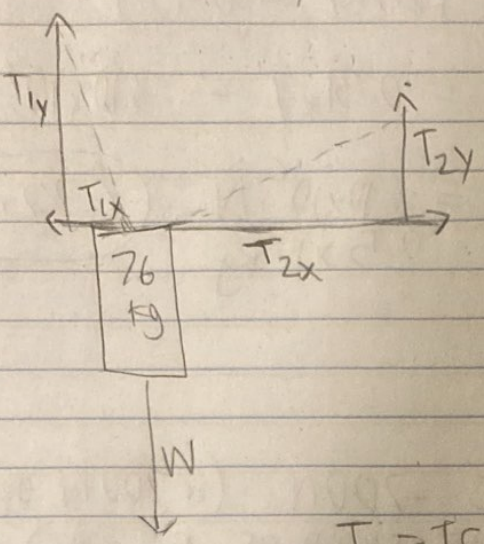
$= 541.2$ N (x)

⑤ $F_{net\,Y} = 745 \times \sin 10° + 745 \times \sin 105° - 745.5_W = 104.05$ N ↑

⑦ $\vec{F}_{net} = 0$, next page

Find T

2-(4) $F_{net}=0$, $F_{1y}+F_{2y}-W=0$ $\quad F_{1x}+F_{2x}=0$



$F_y=0=T_1\sin 15^\circ+T_2\sin 10^\circ-745$

$F_x=0=T_1\cos 15^\circ+T_2\cos 10$

2 variables. 2 equations. 1 system.

$T_1=\frac{T_2\cos 10^\circ}{\sin 15^\circ}=\frac{T_2\cos 10^\circ}{\cos 75^\circ}$ ≠

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

$3.68T_2+0.174T_2=745$

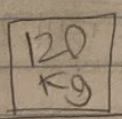
$3.84T_2=745$ $\quad T_2=194N$

$T_1=194\cdot\frac{\cos 10}{\cos 75}$

$T_1=738N$

Well done!

3-(1) $\mu_k=0.3$ $\mu_s=0.5$



(a) $N\mu_s=0.5\cdot 120\cdot 9.8=588N$

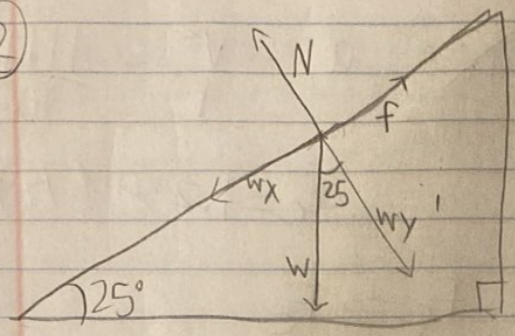
(b) $F_{net}=588N-0.3\cdot 9.8\cdot 120$

$120a=588-353$ (353)

$\frac{120a=235}{120}$

$a=1.958\ m/s^2$

3-(2)



$\mu_k = 0.1$

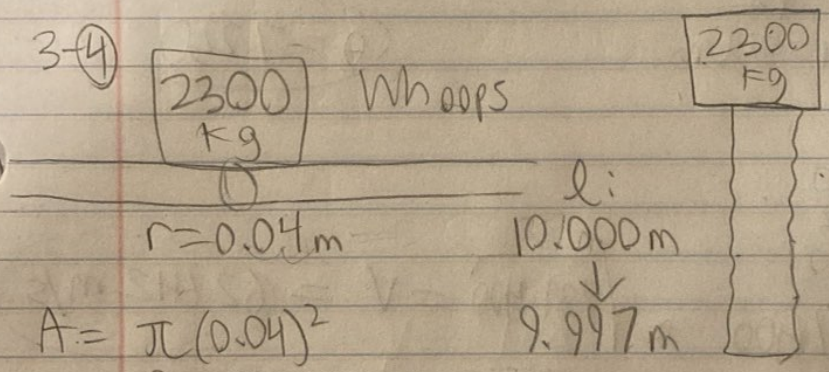
$ma = mg\sin 25° - 0.1mg$

$a = 9.81 \cdot 0.4226 - 0.981$

$a = 4.146 - 0.981$ $\quad a = 3.165\ m/s^2$

3-(3) $F_D = 0.5 \cdot 0.75 \cdot 1.225 \cdot 0.75 \cdot 40 \cdot 40 =$ 551.25 N Drag

3-(4)



$A = \pi(0.04)^2$

$= 0.00502655 m^2$

$\frac{F}{A} = \frac{Y\,\Delta X}{L}$

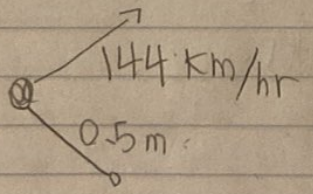
$\frac{22563}{0.00502655} = \frac{Y \cdot 0.003}{10}$

$4488766 = 0.0003Y$

$Y = 1.496 \times 10^{10}$

Nice!

4-(1)



$\frac{144}{3.6} = 40$ m/s linear

$a_c = \frac{1600}{0.5} = 3200\ m/s^2$ $\quad = 0.5\,\omega^2$

$6400 = \omega^2$

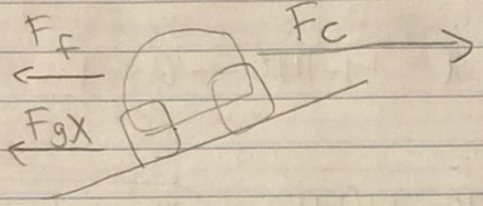
$\omega = 80$ rads/sec

4-2) 900 m = r

120 km/hr = 33.3 m/s

$F_c = a_c = \frac{v^2}{r} = \frac{1111}{900}$

$a_c = 1.23456789 \text{ m/s}^2$



$F_f = F_c$

$\frac{g \sin\theta}{9.81} = \frac{a_c}{9.81} = \frac{1.2346}{9.81}$

$\sin\theta = 0.1258848$

$\theta = 7.230°$

4-3) P1 $\mu = 1.0$ P2

$r = 400$m $r = 800$m

$F_f = F_c$

$mg\mu = mrv^2$

P1 $= 9.81 \cdot 1.0 = v^2/400$ $\sqrt{981 \cdot 400} = v = 62.642$ m/s P1

b) P2 $= 9.81 \cdot 1.0 = v^2/800$ $\sqrt{981 \cdot 800} = v = 88.589$ m/s P2

a) Path 2 can be taken faster.

(+2) Bonus, great work

BONUS $F_G = \frac{Gm_1m_2}{r \cdot r} = \frac{6.674 \times 10^{-11} \text{ m m m}}{\text{kg s s}} \cdot \frac{m_{Nep} \cdot 1.4 \times 10^{22}}{4.5 \times 10^{12} \cdot 4.5 \times 10^{12}}$

$= \frac{9.344 \times 10^{11} (m_{Nep})}{2.025 \times 10^{25}} = 4.614 \times 10^{-14}$ m/s² Pluto on Neptune

Uranus on Neptune: 9.205×10^{-10} m/s²