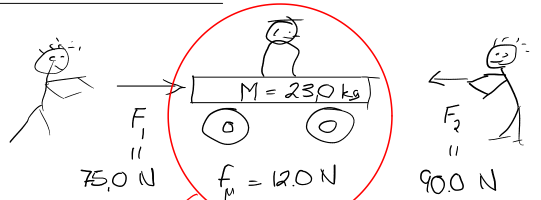
Problem 1: (1-05-32)



a) System of interest if $a_{wagon} = a$ is needed

b) $aM = F_1 - F_2 + f_\mu$

If $v_0 = 0$ and as $F_1 - F_2 < 0$

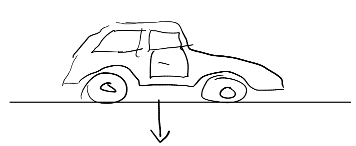
the wagon is accelerated to the Left

$\rightarrow f_\mu = 12.0\ N$ (to the right)

$\rightarrow a = \frac{F_1 - F_2 + F_\mu}{M} = \frac{75.0 - 90.0 + 12.0}{23.0}\ m/s^2 \approx -1.30\ m/s^2$

c) but if $f_\mu = 15.0\ N$ and $v_0 = 0 \rightarrow a = 0$

Problem 2: (1-05-46)



$W = 12500\ N$

$\rightarrow$ accelerates from $v_0 = 0$ at $t_0 = 0$ to $v_1 = 83.0\ km/h$ in $t_1 = 5.00\ s$

$F_\mu = 1350\ N$

Find the force produced by the motor

$v_1 = v_0 + at_1 = at_1 \rightarrow a = \frac{v_1}{t_1}$

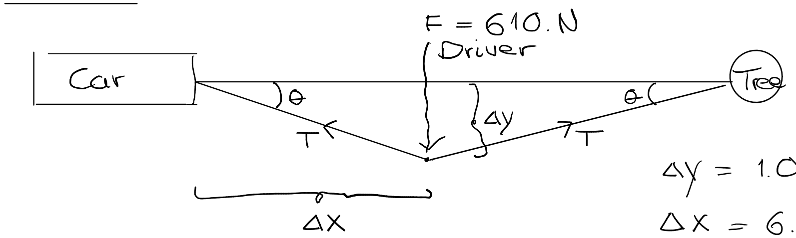
$a = \frac{83.0\ km/h \cdot 1000\ \frac{m}{km} \cdot \frac{h}{3600\ s}}{5.00\ s} \approx 4.61\ m/s^2$

$W = gM \rightarrow M = \frac{W}{g} \rightarrow (F_{motor} - F_\mu) = aM = \frac{v_1}{t_1}\frac{W}{g}$

$\rightarrow F_{motor} = F_\mu + \frac{v_1 W}{t_1 g} = 1350\ N + \left(\frac{83.0}{3.6}\right)\frac{1}{5.00}\left(\frac{12500}{9.81}\right) N$

$\simeq 7.23 \cdot 10^3\ N$

Problem 3: (1-05-62)



$\Delta y = 1.00\ m$

$\Delta x = 6.00\ m$

Find T

$\tan\theta = \frac{\Delta y}{\Delta x}$, Equilibrium when $2T\sin\theta = F$

$\rightarrow T = \frac{F}{2\sin\theta} = \frac{F}{2\sin\left\{\arctan\left(\frac{\Delta y}{\Delta x}\right)\right\}}$

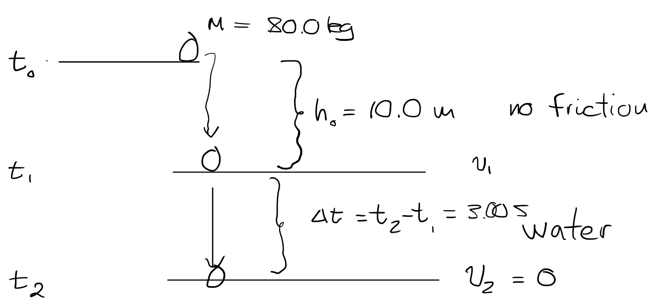
$= \frac{F}{2}\sqrt{\frac{1 - \left(\frac{\Delta y}{\Delta x}\right)^2}{\left(\frac{\Delta y}{\Delta x}\right)}}$

$\simeq 1.80 \cdot 10^3\ N$

$\sin\{\arctan(z)\}$

$= \frac{z}{\sqrt{1 - z^2}}$

Problem 4: (1-05-76)



$v_1 = v_0 - gt_1 = -gt_1$

$h = h_0 - \frac{1}{2}gt_1^2 + v_0 t_1$

$0 = h_0 - \frac{1}{2}gt_1^2 + 0$

$\rightarrow t_1 = \sqrt{\frac{2h_0}{g}}$

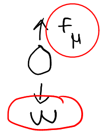
$v_1 = -g\sqrt{\frac{2h_0}{g}} = -\sqrt{2h_0 g}$

Find F acting on the swimmer in the water, that stops her

$v_2 = v_1 + a \cdot \Delta t$

$0 = v_1 + a \cdot \Delta t \rightarrow a = -\frac{v_1}{\Delta t} = \frac{\sqrt{2h_0 g}}{\Delta t}$

In the water two forces work on her



$\rightarrow F_\mu - Mg = Ma = M\frac{\sqrt{2h_0 g}}{\Delta t}$

$\rightarrow F_\mu = M\left\{g + \frac{\sqrt{2h_0 g}}{\Delta t}\right\}$

$\simeq 1.16 \cdot 10^3\ N$