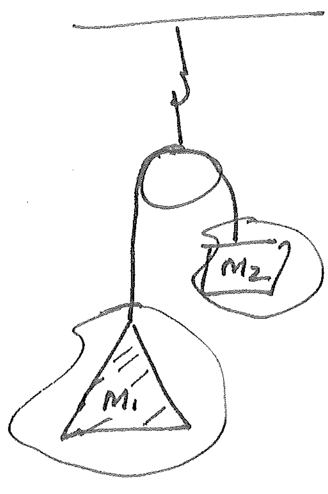
Physics 1100

Extra Credit #15

5.15



$M_1 = 14.4\,kg \quad M_2 = 28\,kg$

$\Rightarrow w_1 = (14.4\,kg)(9.8\,m/s^2) = 141.12\,N$

$w_2 = (28\,kg)(9.8\,m/s^2) = 274.4\,N$

~~Find Acceleration~~

TREAT THE TWO Blocks SEPARATELY

Forces on M_1: $\vec{T}$ up, $\vec{w}_1$ down

$\uparrow \vec{T}$

$\bullet$

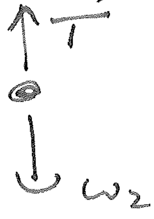
$\downarrow \vec{w}_1$

$\sum F_y = m a_y \Rightarrow T_y + w_{1y} = m_1 a_{1y}$

$\Rightarrow T - 141.12\,N = (14.4\,kg)\, a_{1y}$

Forces on M_2: $\vec{T}$ up $\Leftarrow$ SAME MAGNITUDE SINCE MASSLESS ROPE

$\vec{w}_2$ DOWN



$$\sum F_y = m a_y \Rightarrow T - w_2 = m_2 a_{2y}$$

$$T - 274.4\,\text{N} = 28\,\text{kg}\; a_{2y}$$

$$T - 141.12\,\text{N} = (14.4\,\text{kg})\, a_{1y}$$

$$T - 274.4\,\text{N} = (28\,\text{kg})\, a_{2y}$$

FROM REST M_1 RISES AND M_2 FALLS at SAME RATE

$$\Rightarrow a_{1y} = a \qquad a_{2y} = -a$$

$$\Rightarrow T - 141.12\,\text{N} = (14.4\,\text{kg})(a)$$

$$(-1)\left[T - 274.4\,\text{N} = (28\,\text{kg})(-a)\right] \Rightarrow$$

$$T - 141.12\,\text{N} = (14.4\,\text{kg})\,a$$

$$-T + 274.4\,\text{N} = 28\,\text{kg}\,a$$

$$274.4\,\text{N} - 141.12\,\text{N} = (14.4\,\text{kg} + 28\,\text{kg})\,a$$

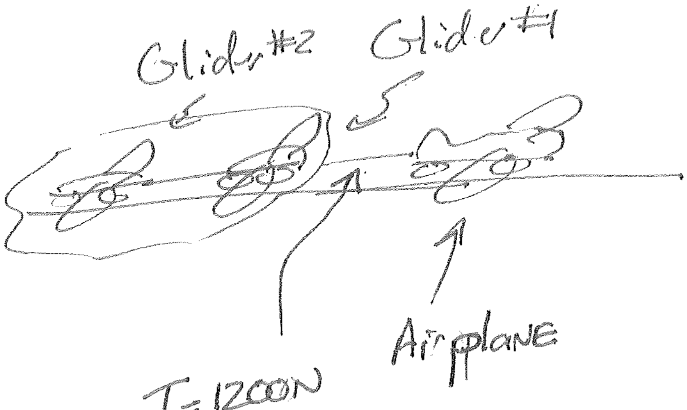
$$133.28\,\text{N} = (42.4\,\text{kg})\,a$$

$$\Rightarrow a = \frac{133.28\,\text{N}}{42.4\,\text{kg}} = 3.14\,\text{m/s}^2$$

Now: $T - 141.12\,\text{N} = (14.4\,\text{kg})\,a_{1y} \Rightarrow T - 141.12\,\text{N} = (14.4\,\text{kg})(3.14\,\text{m/s}^2)$

$$\Rightarrow T = 186\,\text{N}$$

5.18



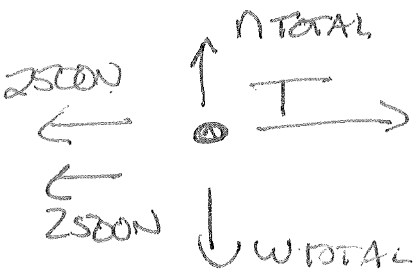
$M_1 = M_2 = 700kg$

$F_{TOTAL} = 2500N$ ON EACH glider

a) LENGTH OF RUNWAY = ? ⇒ NEED Acceleration

If we TREAT THE TWO gliders AS A single Object

Forces are: Tension from plane's Rope. Two Friction forces, NORMAL AND weight



$\sum_i F_x = ma_x \Rightarrow T - 2500N - 2500N = M_{TOTAL}\, a_x$

↑ BOTH MASSES have SAME ACC.

$\Rightarrow T - 5000N = (1400kg)\, a_x$

⇒ LARGEST ACCELERATION WITH $T = 12000N$

$12000N - 5000N = (1400kg)\, a_x$

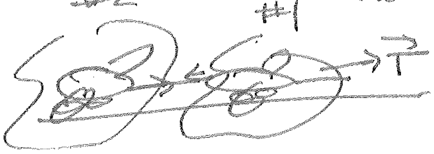
$\Rightarrow a_x = \frac{7000N}{1400kg} = 5 m/s^2$

$V^2 = V_0^2 + 2a(x - x_0)$. Let $x_0 = 0$ ⇒ $x = ?$

$V_0 = 0$, $V = 40\,m/s$

⇒ $V^2 = 2ax$ ⇒ $x = \frac{V^2}{2a} = \frac{(40\,m/s)^2}{2(5\,m/s^2)} = 160\,m$

b) Tension in Tow Rope?

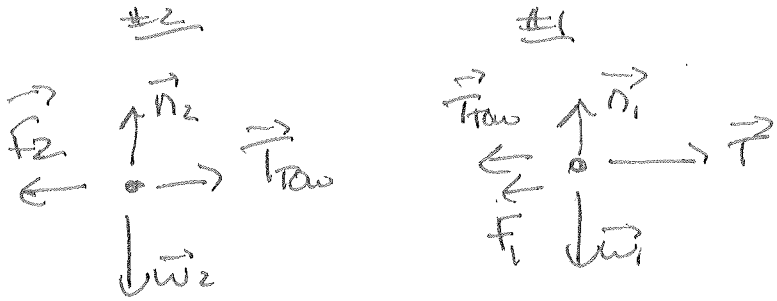


Now split apart. On Glider #2, $\vec{T}_{TOW}$ to Right, $\vec{f}_2$, $\vec{n}_2$, $\vec{w}_2$

On Glider #1 $\vec{T}_{TOW}$ to left, $\vec{f}_1$, $\vec{n}_1$, $\vec{w}_1$

$\vec{T}$ Right

↳ $f_1 = f_2 = 2500\,N$



$\sum F_{2x} = M_2 a_{2x}$ ⇒ $T_{TOW} - f_2 = M_2 a_{2x}$ ⇒ $T_{TOW} - 2500\,N = (700\,kg)(5\,m/s^2)$

⇒ $T_{TOW} = 2500\,N + 3500\,N = 6000\,N$

OR $\sum_1 F_{1x} = M_1 a_{1x}$ ⇒ $T - T_{TOW} - f_1 = M_1 a_{1x}$ ⇒ $12000\,N - T_{TOW} - 2500\,N = (700\,kg)(5\,m/s^2)$

⇒ $9500\,N - T_{TOW} = 3500\,N$ ⇒ $T_{TOW} = 9500\,N - 3500\,N = 6000\,N$