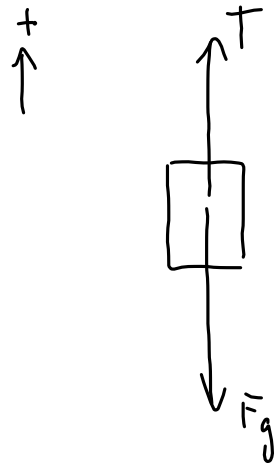
10-2 Multiple Masses

Consider an typical elevator problem:



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

$$T - F_g = ma$$

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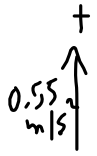
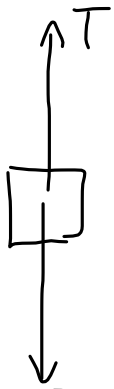
$m = 2245\,kg$

$\vec{a} = 0.55\,m/s^2\,[up]$

$T = ?$





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

$$T - F_g = ma$$

$$T = ma + F_g$$

$F_g = (2245kg)(9.81m/s^2)$

$= 22023.45\,N$

$T = (2245kg)(+0.55m/s^2) + 22023.45N$

$T = \underset{F_{net}}{1234.75N} + \underset{F_g}{22023.45N}$

$T = 23258.2N$

$T = 2.33 \times 10^4\,N$

Multiple Masses → assumptions

- Tension is uniform throughout the string
- mass of the string to be negligible in comparison to the attached masses.
- string does not stretch
- pulley is frictionless.

• both masses have the same acceleration (they are attached)

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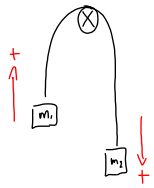
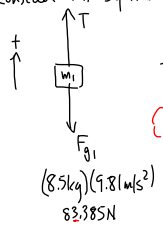
$m_1 = 8.5\,kg$
$m_2 = 17.0\,kg$

a) $a = ?$
b) $T = ?$



Consider m_1 by itself:



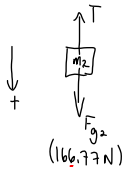
$\vec{F}_{net} = m\vec{a}$

$T - F_{g_1} = m_1 a$

$T - 83.385N = (8.5kg)\,a$

2 unknowns.... need another equation.

Consider m_2 by itself:



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

$F_{g_2} - T = m_2 a$

$166.77N - T = (17.0kg)\,a$

Solve the system of equations:

$T - 83.385N = (8.5kg)\,a$

$-T + 166.77N = (17.0kg)\,a$

$83.385N = (25.5kg)\,a$

$a = \frac{83.385N}{25.5kg}$

$a = 3.3\,m/s^2$

Now sub $a = 3.3 m/s^2$

$T - 83.385N = (8.5kg)\,a$

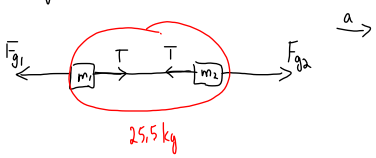
$T = (8.5kg)(3.3\,m/s^2) + 83.385N$

$T = 27.795N + 83.385N$

$T = 110.18N$

$T = 1.10 \times 10^2 N$

Another way to think about it:



TO DO:

PP|478 (elevator)
PP|485 (atwood's machine)