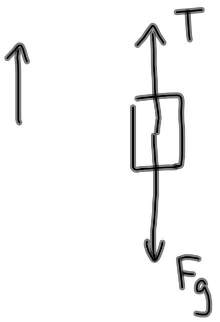
§10-2 Multiple Masses

Recall a basic elevator problem from last year:



If the acceleration is upward,
then $T > F_g$

- going up + speeding up
- going down + slowing down

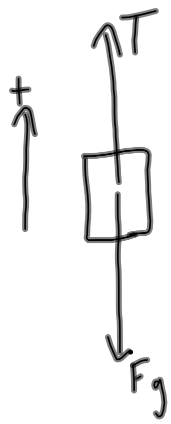
$$\vec{F}_{net} = m\vec{a}$$
$$T - F_g = ma$$

MP|477

$m = 2245\,kg$

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

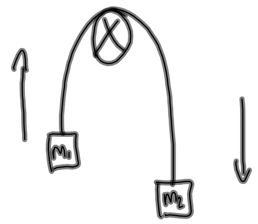
$T = ?$



$$\vec{F}_{net} = m\vec{a}$$
$$T - F_g = ma$$
$$T = ma + mg$$
$$T = m(a + g)$$
$$T = 2245\,kg\,(+0.55\,m/s^2 + 9.81\,m/s^2)$$
(10.36)
$$\boxed{T \doteq 2.326 \times 10^4\ N}$$

Motion of Connected Masses

Atwood's Machine

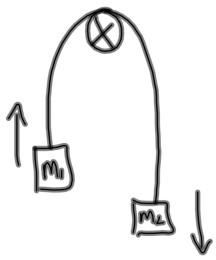


if $m_2 > m_1$

Assumptions:
- string's mass is negligible
- string does not stretch
- tension is uniform
- pulley is frictionless
- pulley acts to change direction of the force.
- masses have same acceleration since they are connected.

mp|483

$m_1 = 8.5\,kg$
$m_2 = 17.0\,kg$
$a = ?$
$T = ?$



Consider m_1:

83.385N

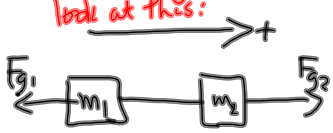
$\vec{F}_{net} = m\vec{a}$

$T - F_{g_1} = m_1 a$

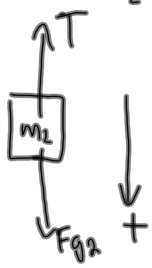
$T - 83.385\,N = (8.5\,kg)a$

T and a are unknowns.

Another way to look at this:



Consider m_2:



166.77N

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

$F_{g_2} - T = m_2 a$

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

Solve the system of equations:

① $T - 83.385\,N = (8.5\,kg)a$

② $166.77\,N - T = (17.0\,kg)a$

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

$a = \dfrac{83.385\,N}{25.5\,kg}$

$a \doteq 3.3\ m/s^2$

sub into ①

$T = (8.5\,kg)a + 83.385$

$T = (8.5\,kg)(3.27\,m/s^2) + 83.385$

$T \doteq 1.1 \times 10^2\,N$

TO DO: PP|478 (elevator)
PP|485 (connected)