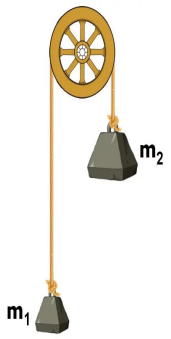
§10-2 Multiple Masses

Atwood's Machine



Assumptions

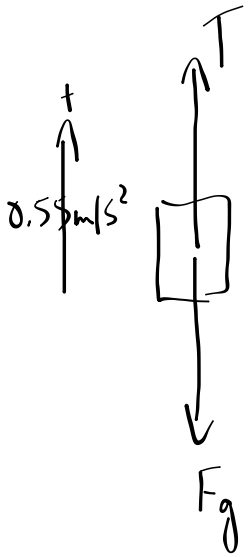
- string has negligible mass
- string does not stretch
- tension is uniform throughout the string
- masses have same magnitude of acceleration.
- pulley is frictionless

MP 4.77

$m = 2245\,kg$

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

$T = ?$



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

$$T - F_g = ma$$

$$T = ma + mg$$

$$T = m(a + g)$$

$$T = 2245\,kg\left(+0.55\,m/s^2 + 9.81\,m/s^2\right)$$

$$T = 2245\,kg\left(10.36\,m/s^2\right)$$

$$T = 2.326 \times 10^4\,N$$

$$(2.3 \times 10^4\,N)$$

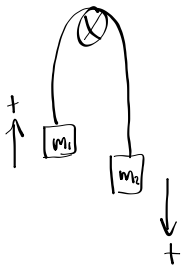
PP/483

$m_1 = 8.5\,kg$

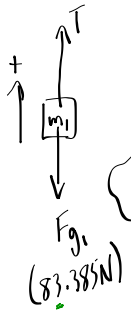
$m_2 = 17\,kg$

$a = ?$

$T = ?$



Consider only m_1

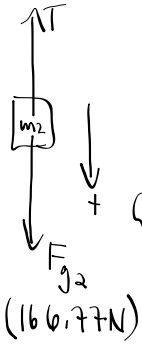


$\vec{F}_{net} = m\vec{a}$

$T - F_{g_1} = m_1 a$

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

Consider m_2 alone:



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

$F_{g_2} - T = m_2 a$

$166.77N - T = (17kg)a$

$T - 83.385 = 8.5a$

$+(-T + 166.77 = 17a)$

$83.385 = 25.5a$

$T - 83.385 = 8.5(3.3)$

$T - 83.385 = 27.795$

$T = 111.18\,N$

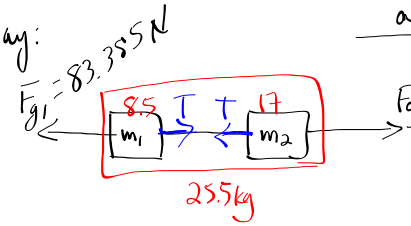
$T = 1.1 \times 10^2\,N$

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

$a = 3.27\,m/s^2$

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

Another way:



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

$F_{g_2} - F_{g_1} = (m_1 + m_2)a$

$m_2 g - m_1 g = (m_1 + m_2)a$

$g(m_2 - m_1) = (m_1 + m_2)a$

find a

Choose m_1

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

$T - F_{g_1} = m_1 a$

solve for T

MP/477 & PP/478

MP/483 & PP/485