Connected Masses

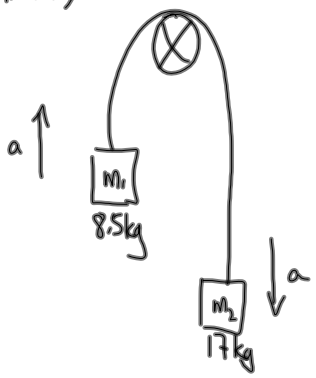
MP|483 (Atwood's Machine)

$m_1 = 8.5\,kg$

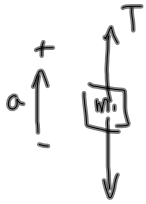
$m_2 = 17\,kg$

$a = ?$

$T = ?$



Consider m_1 alone:



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

$T - F_{g1} = ma$

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

$F_{g_1} = (8.5kg)(9.81 m/s^2)$

$F_{g_1} = 83.385N$

Consider m_2 alone:

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

$F_{g_2} - T = m_2 a$

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

$F_{g_2} = (17kg)(9.81 m/s^2)$

$F_{g_2} = 166.77N$

$T - 83.385 = 8.5a$

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

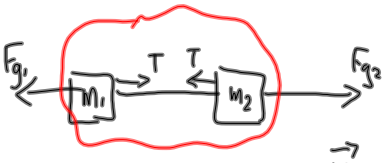
$T = 1.1 \times 10^2 N$

$-T + 166.77 = 17a$

$83.385 = 25.5a$

$a = 3.3 m/s^2$

Another way

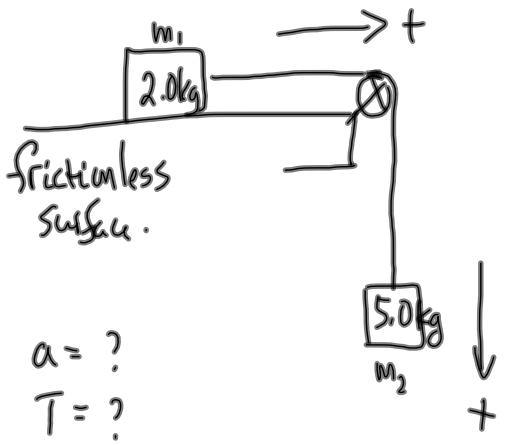


$m_1 + m_2$

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

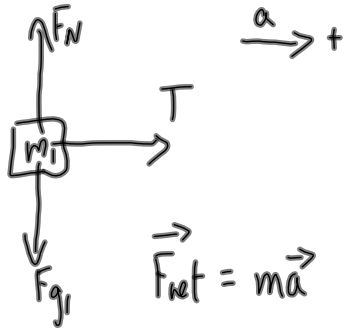
$F_{g_2} - F_{g_1} = (m_1 + m_2)a$

Example (Fletcher's Trolley)



$a = ?$
$T = ?$

Consider m_1:



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

$T = m_1 a$

$T = (2.0kg)a$

Using Substitution:

$49.05N - (2.0kg)a = (5.0kg)a$

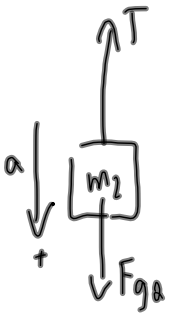
$49.05N = (7.0kg)a$

$a = 7.0 m/s^2$

$T = (2.0kg)(7.0 m/s^2)$

$T = 14N$

Consider m_2:



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

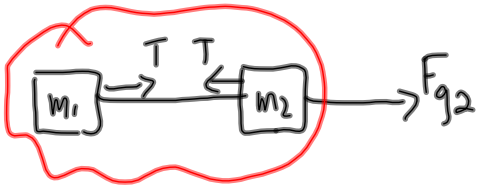
$F_{g_2} - T = m_2 a$

$49.05N - T = (5.0kg)a$

$(5.0kg)(9.8 m/s^2)$

$49.05N$

Another way:



$m_1 + m_2$

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

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

MP|488

$m_1 = 615g$

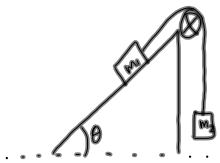
$\theta = 33°$

$m_2 = 525g$

$a = ?$

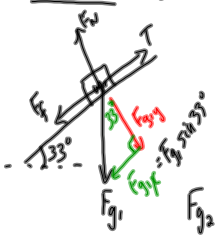
$T = ?$

$\mu = 0.19$



* If this system were moving so that m_1 goes uphill, the biggest value that the tension could be is F_{g_2} (this would give you $a = 0$)

Consider m_1: a ↗ *



We want to see how $F_f + F_{g_1 x}$ compare to F_{g_2}

If $F_{g_2} > F_f + F_{g_1 x}$, then m_1 goes uphill.

$F_{g_2} = (0.525\,kg)(9.8\,m/s^2) = 5.15\,N$

$F_{g_1 x} = (0.615\,kg)(9.8\,m/s^2)\sin 33° = 3.26\,N$

$F_f = \mu F_N = \mu F_{g_1 y}$

$\hookrightarrow (0.19)(0.615\,kg)(9.8\,m/s^2)\cos 33° = 0.96\,N$

$4.22\,N$

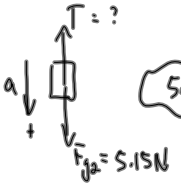
Since $F_{g_2} > F_{g_1 x} + F_f$ → m_1 goes uphill

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

$T - (F_{g_1 x} + F_f) = m_1 a$

$T - 4.22\,N = (0.615\,kg)a$

Consider m_2:



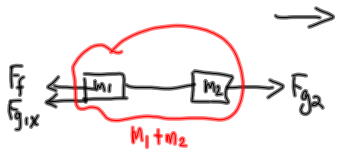
$\vec{F}_{net} = m\vec{a}$

$F_{g_2} - T = ma$

$5.15\,N - T = (0.525\,kg)a$

You can finish!

Another way



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

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

To DO:

① Finish MP (above)

② PP|485

③ PP|488-489 (#26 optional)