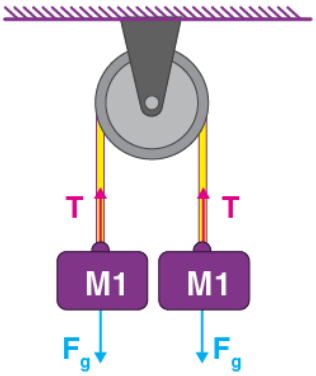
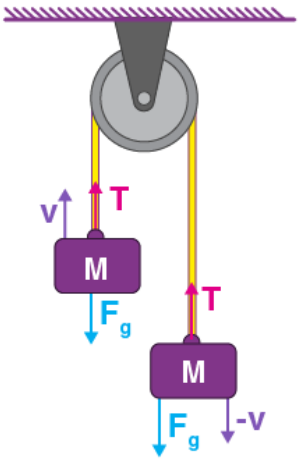
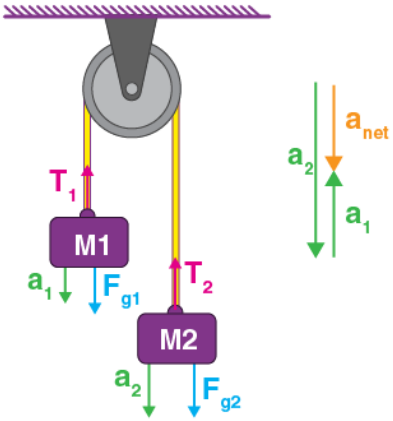
Harold's Physics Attwood Machine
Cheat Sheet

3 November 2025

Two Masses on a Pully

Diagram			
Scenario	$\boldsymbol{v} = 0$	$\boldsymbol{v} = constant$	$\boldsymbol{a} = constant$
Givens	$\mu_{pully} = 0$ $m_{string} = 0\ kg$		
	$M_1 = 0.20\ kg$ $\boldsymbol{v} = 0\frac{m}{s}$ or $= constant\ \frac{m}{s}$		$M_1 = 0.20\ kg$ $M_2 = 0.50\ kg$
Unknowns	$\boldsymbol{T} = ?\ N$		$\lvert\boldsymbol{T}_1\rvert = ?\ N$ $\boldsymbol{a_{net}} = ?\ \frac{m}{s^2}$
Observations	$\lvert\boldsymbol{T}\rvert = \lvert-\boldsymbol{T}\rvert$ $\boldsymbol{a} = 0\ \frac{m}{s^2}$		$\lvert\boldsymbol{T}_1\rvert = \lvert-\boldsymbol{T}_2\rvert = \lvert\boldsymbol{T}\rvert$ $\boldsymbol{a} = constant\ \frac{m}{s^2}$
	$\boldsymbol{g} = 9.81\frac{m}{s^2}$		
Equations	$\sum \boldsymbol{F} = \boldsymbol{F}_a = M\boldsymbol{a}$ $\boldsymbol{T}_1 - \boldsymbol{T}_2 = 0$		
	$\boldsymbol{F_{net}} = 2\boldsymbol{F_g} - \boldsymbol{T} = 0$		$\boldsymbol{F_{g1}} = M_1\boldsymbol{g}$ $\boldsymbol{F_{g2}} = M_2\boldsymbol{g}$ $\boldsymbol{F_{g2}} - \boldsymbol{F_{g1}} = \boldsymbol{F_a}$ $M = M_1 + M_2$ $\boldsymbol{a_2} - \boldsymbol{a_1} = \boldsymbol{a_{net}}$ $\boldsymbol{T} - \boldsymbol{F_{g1}} = M_1\boldsymbol{a_{net}}$ $\boldsymbol{T} - \boldsymbol{F_{g2}} = M_2\boldsymbol{a_{net}}$

Solve	$\boldsymbol{F_g = M_1 g}$ $\boldsymbol{T = 2F_g}$	$\boldsymbol{(T - M_1 g = M_1 a_{net})}$ $\boldsymbol{-(T - M_2 g = -M_2 a_{net})}$ $\boldsymbol{(-M_1 g + M_2 g = M_1 a_{net} + M_2 a)}$ $\boldsymbol{(M_2 - M_1) g = (M_1 + M_2) a_{net}}$ $\boldsymbol{a_{net} = \frac{(M_2 - M_1)}{(M_2 + M_1)} g}$
Substitute	$\boldsymbol{F_g} = (0.20\ kg)\left(9.81 \frac{m}{s^2}\right)$ $\boldsymbol{F_g} = 1.96\ N$ $\boldsymbol{T = 2F_g} = 3.92\ N$	$\boldsymbol{F_{g1}} = (0.20\ kg)\left(9.81 \frac{m}{s^2}\right) = 1.96\ N$ $\boldsymbol{F_{g2}} = (0.50\ kg)\left(9.81 \frac{m}{s^2}\right) = 4.91\ N$ $\boldsymbol{F_a = F_{g2} - F_{g1}} = 4.91\ N - 1.96\ N = 2.94\ N$ $M = M_1 + M_2 = 0.20\ kg + 0.50\ kg = 0.70\ kg$ $\boldsymbol{F_a = M a_{net}}$ $\boldsymbol{a_{net} = \frac{F_a}{M}} = \frac{2.94\ N}{0.70\ kg} = 4.20 \frac{m}{s^2}$ $\boldsymbol{T_1 - T_2 = 0}$ $\boldsymbol{\lvert T_1 \rvert = \lvert T_2 \rvert = \lvert M g \rvert}$ $\boldsymbol{\lvert T_1 \rvert} = (0.70\ kg)\left(9.81 \frac{m}{s^2}\right) = 6.87\ N$ $\boldsymbol{a_{net} = \frac{(M_2 - M_1)}{(M_2 + M_1)} g} = \frac{(0.50 - 0.20)}{(0.50 + 0.20)} \boldsymbol{g} = \frac{3}{7} \boldsymbol{g} = 4.20 \frac{m}{s^2}$

Sources

- Attwood Machine (2025). https://ucscphysicsdemo.wordpress.com/atwood-machine/
- BYJU's (2025). What is Atwood's Machine? https://byjus.com/physics/atwood-machine/

