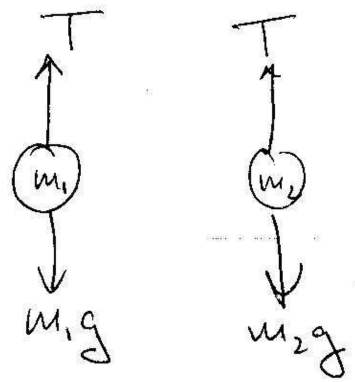
Atwood's Machine – Newton's Second Law



$T - m_1 g = m_1 a \qquad T - m_2 g = -m_2 a$

Eliminate T : ~~ad~~ subtract equation

$$\begin{array}{l} T - m_1 g = m_1 a \\ -\left(T - m_2 g = -m_2 a \right) \\ \hline \end{array}$$

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

$$a = \frac{m_2 - m_1}{m_1 + m_2} g = \frac{10}{310} g = 0.316$$

~~0.032~~

$\Delta x = 1.66\,m \qquad \Delta t = \begin{matrix} 4.2 \\ 3.6 \end{matrix}$ sec

$v = v_0 + at \qquad v^2 = v_0^2 + 2a\Delta x$

$= 0 + a\Delta t \qquad = 2a\Delta x$

$\longrightarrow a^2 (\Delta t)^2 = 2a\Delta x$

$$a = \frac{2\Delta x}{(\Delta t)^2}$$

$a = \cancel{0.132}\ 0.188 \ (\Delta t = 4.2s)$

$\cancel{0.556}\ 0.256 \ (3.6s)$

for $a = 0.316 \quad \Delta t = \sqrt{\frac{2\Delta x}{a}} = 3.24$ sec

Atwood's Machine – Energy

No friction, gravity conservative force

$$W_{NC} = 0 : \quad KE_i + PE_i = KE_f + PE_f$$

$$0 + m_2 g \Delta y = \frac{(m_1+m_2)}{2} v_f^2 + m_1 g \Delta y$$

$$\frac{m_1+m_2}{2} v_f^2 = (m_2 - m_1) g \Delta y$$

$$v_f^2 = \frac{m_2 - m_1}{m_2 + m_1} 2 g \Delta y$$

But from kinematics $v_f^2 = \underset{0}{\underset{\shortparallel}{v_0}}{}^2 + 2 a \Delta y$

$$2 a \Delta y = \frac{m_2 - m_1}{m_2 + m_1} 2 g \Delta y$$

$$\boxed{a = \frac{m_2 - m_1}{m_2 + m_1} g}$$

No information about time Δt

For measurement use kinematics:

$v_f = \underset{0}{\underset{\shortparallel}{v_0}} + a\Delta t$ and $v_f^2 = \underset{0}{\underset{\shortparallel}{v_0}}{}^2 + 2 a \Delta y$

$$(a\Delta t)^2 = 2 a \Delta y$$

$$\cancel{\Delta t = \sqrt{\frac{2\Delta y}{a}}} \quad \cancel{\text{or}} \quad a = \frac{2\Delta y}{(\Delta t)^2}$$