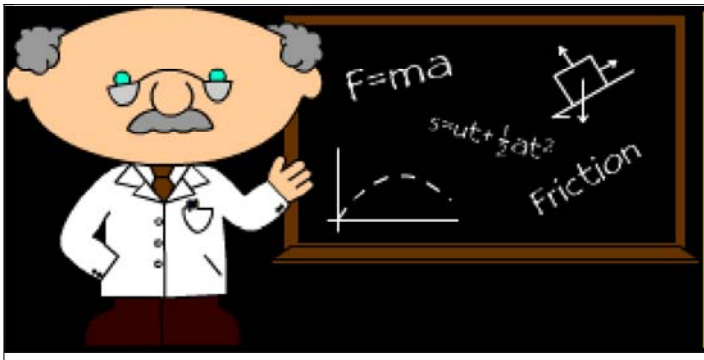
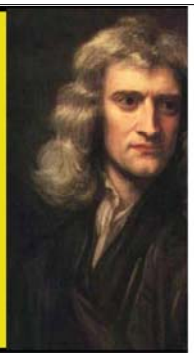


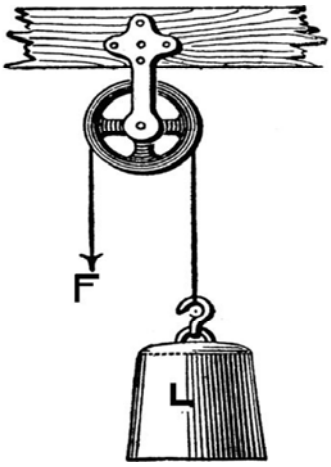
Unit 2: Dynamics



2.5 Pulleys

Things to know about pulleys:

- we assume no friction
- the pulley only changes the direction of the force



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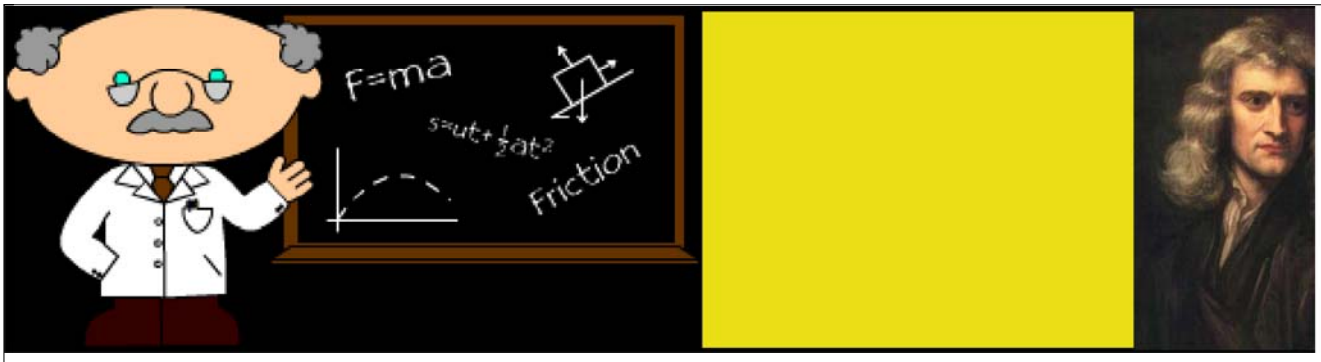


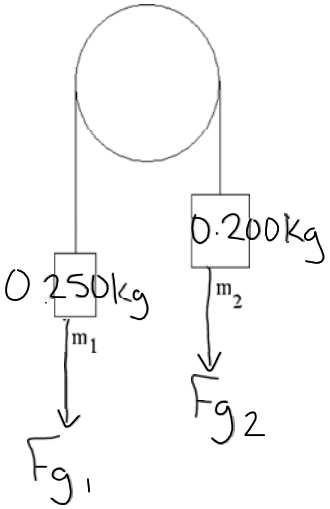
Atwood's Pulley

The Atwood's Pulley is a basic device used to demonstrate the principals of dynamics.

Ex.) If m_1=0.250 kg

m_2=0.200 kg

What is the acceleration of the system?



$\vec{F_{g_1}}$ ← 0.450 → $\vec{F_{g_2}}$

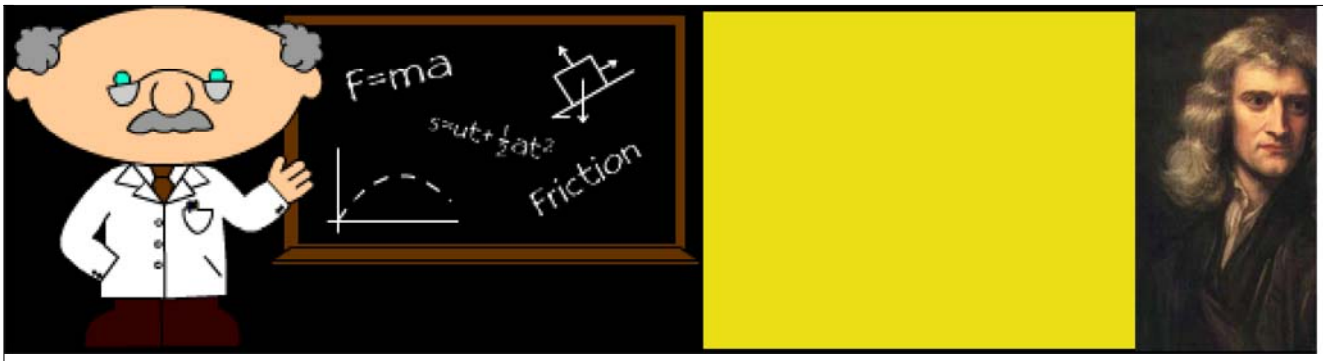
$\vec{F_{net}} = -\vec{F_{g_1}} + \vec{F_{g_2}}$

$m_T\vec{a} = -m_1\vec{g} + m_2\vec{g}$

$$\frac{0.450\,\vec{a}}{0.450} = \frac{-(0.250 \cdot -9.81) + (.20 \cdot -9.81)}{0.450}$$

$|\vec{a}| = 1.09\ m/s^2$

* put negative sign on heavier mass.



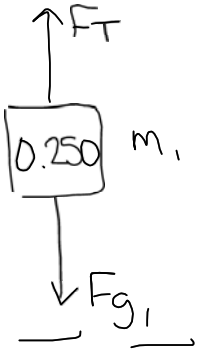
Ex.) Find the tension in the rope in the previous problem.

$\vec{a} = 1.09 m/s^2$

$m_1 = 0.250 kg$

$m_2 = 0.200 kg$

$m_T = 0.450 kg$



$\vec{F_{net}} = \vec{F_{g_1}} + \vec{F_T}$

$\vec{F_T} = \vec{F_{net}} - \vec{F_{g_1}}$

$= m_1\vec{a} - m_1\vec{g}$

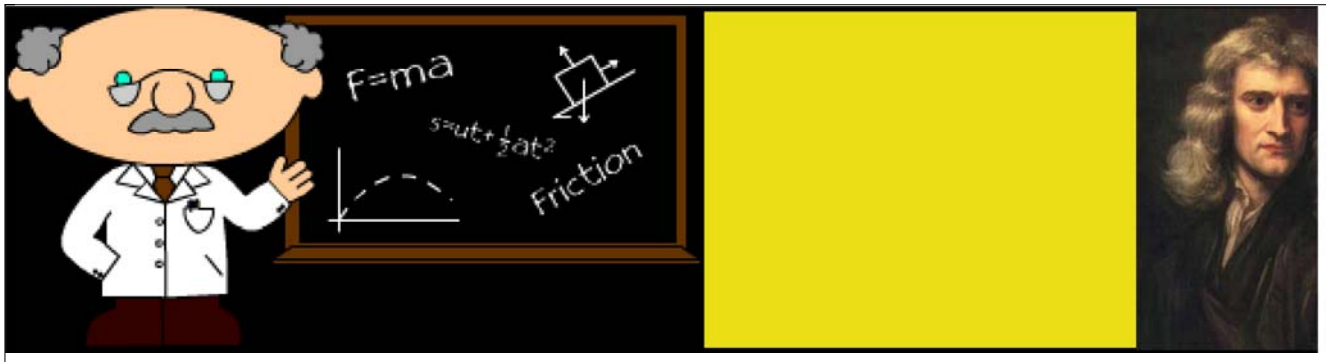
$= (0.250 \cdot 7.09) - (0.250 \cdot -9.81)$

$= \boxed{2.18 N}$

Steps:

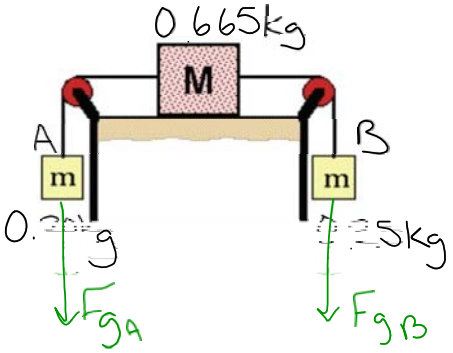
1. Consider only one mass and draw a free-body diagram.
2. For the total force, use the acceleration of the system.
3. For the mass, use the mass of the single pulley.
4. Careful with integers (negatives).

Guided Practice: Pg.155 # 1, 2.



Two-Pulley System

Ex.) A box with a mass of 0.665 kg is on a horizontal table. Attached via pulleys are two masses, one 0.20 kg and one 0.25 kg. What is the acceleration of the system?



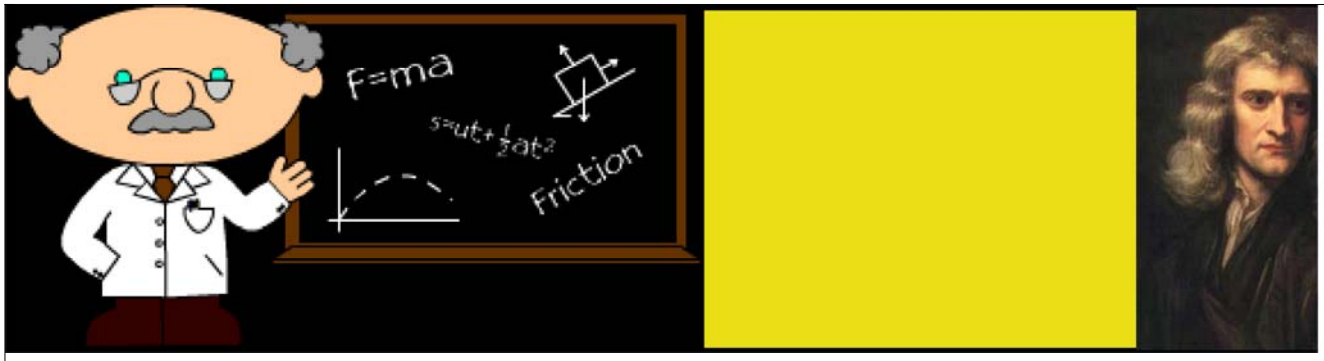
F_{gA} ← 1.115kg → F_{gB}

$\vec{F}_{net} = \vec{F}_{gA} + \vec{F}_{gB}$

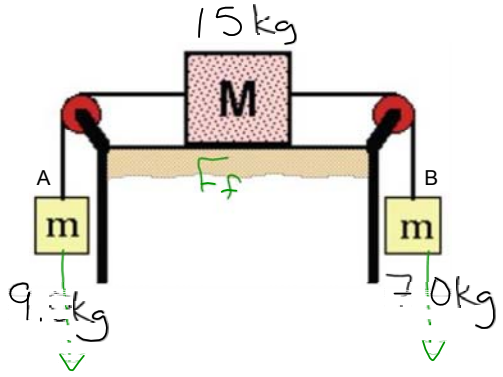
$\frac{m_T\vec{a}}{m_T} = \frac{m_A\vec{g} + m_B\vec{g}}{m_T}$

$\vec{a} = \frac{(0.20 \cdot -9.81) + -(0.25 \cdot -9.81)}{1.115}$

$\vec{a} = 0.44 m/s^2$



Ex.) What is the acceleration of a box if the force friction between the table and the 15 kg box is 10 N? m_A = 9.0 kg, m_B = 7.0 kg



+ direction

− direction

$\vec{F}_{net} = \vec{F}_{gA} + \vec{F}_{gB} + \vec{F}_f$ (+, −, −)

$m_T\vec{a} = -(m_A \cdot \vec{g}) + (m_B \cdot \vec{g}) + 10N$

$\vec{a} = \frac{-(9.0 \cdot 9.81) + (7.0 \cdot 9.81) + 10}{31}$

$\vec{a} = 0.31\ m/s^2\ [left]$

Pg. 158 #7, 9.