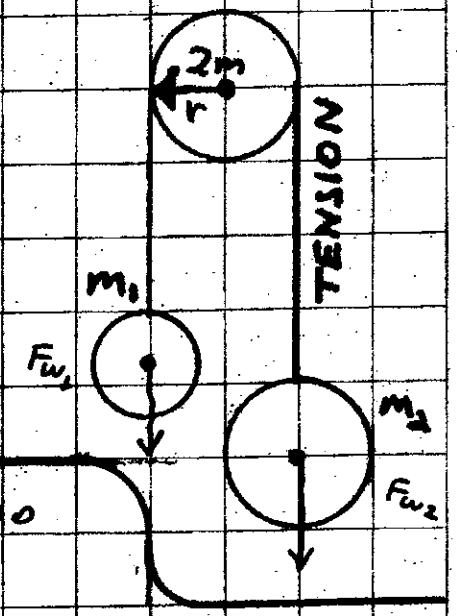
20080307_1455

A mass of 10.00 kg (m_1) is connected to a 20.00 kg mass (m_2) by a thin rope over a frictionless pulley as shown. Find acceleration and tension. (assume the rope has no mass) (assume the pulley has no mass)



Solution: Since m_2 is bigger it will go down and m_2 will go up.

1ST Find weights of each mass.

$F_{w_1} = m_1 g = (10\text{kg})g$ $\quad F_{w_2} = m_2 g = (20\text{kg})g$

Force that can cause acceleration $= F_{w_2} - F_{w_1} = (10\text{kg})g$

This Force must cause both masses to accelerate

$F_{acc} = (m_{TOTAL})(a_{cc_{TOTAL}}) = (m_1 + m_2)\,a = (10\text{kg} + 20\text{kg})\,a$

$(10\text{kg})g = (30\text{kg})a$ so $a_{cc} = a = \frac{(10\text{kg})g}{(30\text{kg})} = \frac{1}{3}g$

→ ∴ Acceleration $= \frac{1}{3}g$

The tension in the rope must be enough to support m_1 and to cause it to accelerate

$T = m_1 g + m_1 a = (10\text{kg})g + (10\text{kg})(\frac{1}{3}g) = (10\text{kg})(g + \frac{1}{3}g)$

$T = (10\text{kg})(\frac{4}{3}g) = (\frac{40\text{kg}}{3})g$

→ ∴ Tension $= (\frac{40\text{kg}}{3})g$

Note: Why not use $9.8\ m/s^2$ for g?

Because we were not told that this happened on Earth. This is why we needed to solve it for the general case.