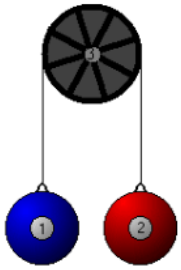
# *Multiple Masses and Finding Net Force*

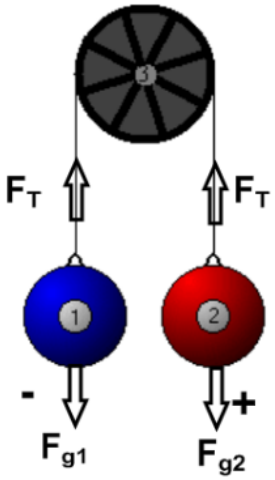
**Chapter 10.2 of MHR:**
**Read Pg 478 - 489**
**Problems Pg 485 #s 19 - 22, Pg 488 #s 24 - 28**



This is an example of a system where there are multiple masses, the Atwood machine.

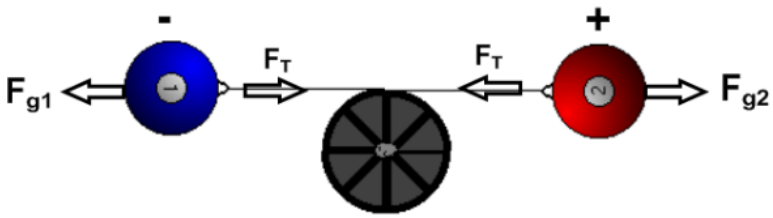
We will apply the concept of forces to determine the resulting acceleration.

***Define the Direction of Forces***



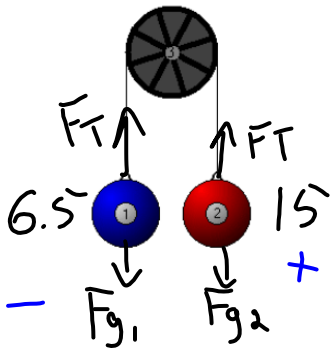

Our problems will not include friction and the pulley will be massless.

You may find it easier to picture, or draw, the system horizontally.



## Atwood Machine Examples

What is the acceleration of an Atwood machine with masses of 6.5 kg and 15 kg on opposite sides of the pulley? What is the magnitude of the force of tension in the rope?




$\sum \text{Forces} = \sum \text{Masses} \times \vec{a}$

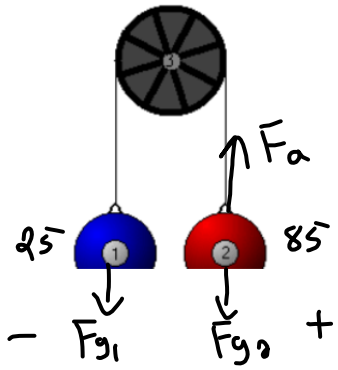
$F_{g_1} + F_{g_2} = (m_1 + m_2)\,a$

$-(6.5)(9.81) + (15)(9.81) = (21.5)\,a$

$83.4 = 21.5\,a$

$3.9\ m/s^2 = a$

A counter weight of 25 kg is used to help a person of mass 85 kg to do chin ups. What is the force applied by the person if he accelerates at 1.2 m/s²?




$\sum \text{Forces} = \sum \text{masses} \times \vec{a}$

$F_{g_1} + F_{g_2} + F_a = (m_1 + m_2)\,a$

Note!

$-(25)(9.81) + (85)(9.81) + F_a = (110)(-1.2)$

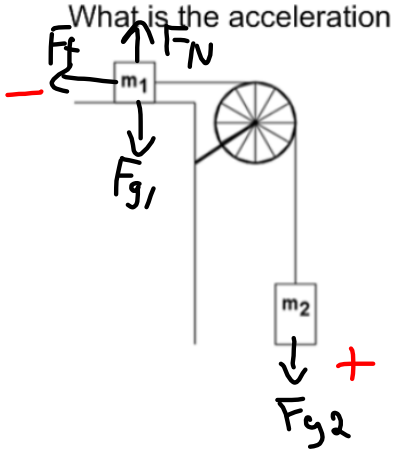
$-245.25 + 833.85 + F_a = -132$

$588.6 + F_a = -132$

$F_a = -720\ N$

A counterbalance is set up to help someone lift an object. The largest mass a person can lift is 33 kg. What must be the minimum mass of the counter weight for a 55 kg object to be lifted with an acceleration of 1.5 m/s$^2$? (mass = 36 kg)

In the diagram below $m_1$ = .425 kg, $m_2$ = .735 kg the coefficient of kinetic friction is 0.34, and there is not friction from the pulley and string. What is the acceleration of the masses?




$\sum F_{forces} = \sum_{masses} \times \vec{a}$

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

$-\mu F_N + F_{g_2} = (m_1 + m_2)\, a$

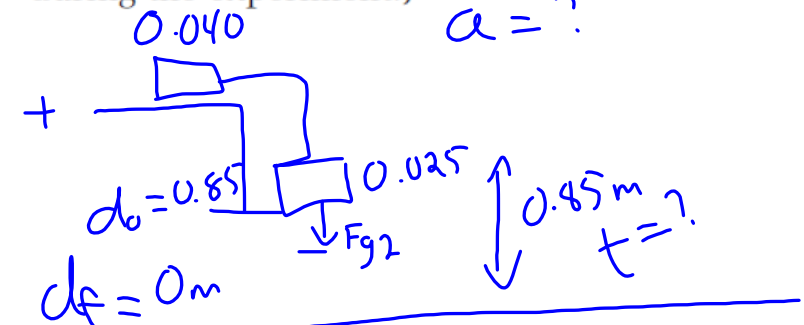
$-\mu F_{g_1} + F_{g_2} = (m_1 + m_2)\, a$

$-(0.34)(0.425)(9.81) + (0.735)(9.81) = 1.16\, a$

$5.793 = 1.16a$

$5.0\ m/s^2 = a$

**25.** A 40.0 g glider on an air track is connected to a 25.0 g mass suspended by a string passing over a frictionless pulley. When the mass is released, how long will it take the glider to travel the 0.85 m to the other end of the track? (Assume the mass does not hit the floor, so there is constant acceleration during the experiment.)




$$\sum \text{Forces} = \sum \text{masses} \times a$$

$$F_{g2} = (m_1 + m_2)a$$

$$-(0.025)(9.81) = (0.04 + 0.025)a$$

$$-0.245 = 0.065a$$

$$-3.8\ m/s^2 = a$$

$$d_f = d_0 + v_0 t + \tfrac{1}{2} a t^2$$

($d_f$ and $v_0 t$ are 0)

$$0 = 0.85 + \tfrac{1}{2}(-3.8)t^2$$

$$-.85 = -1.9t^2$$

$$\sqrt{0.447} = \sqrt{t^2}$$

$$\boxed{0.67\text{s} = t}$$