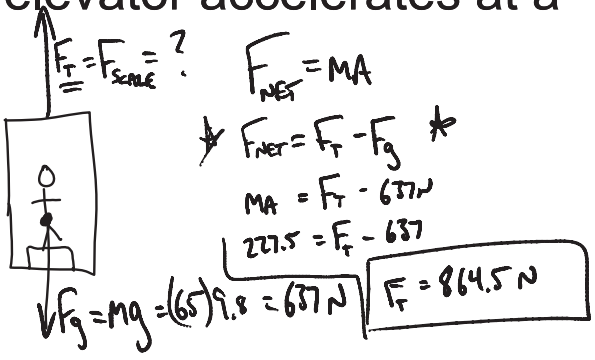
FORCE DIAGRAMS

Sample Problem

- A 65 kg person stands on a scale in an elevator. What weight does the scale register when the elevator accelerates at a rate of 3.5 m/s^2?

UPWARD



Atwood's Machine

- What is the acceleration of the masses?
- What is the tension in the rope?

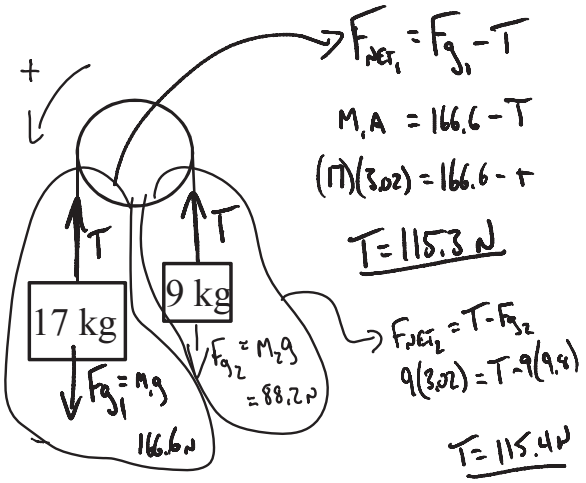
$F_{NET_{SYSTEM}} = F_{g_1} - F_{g_2}$

$F_{NET_{SYSTEM}} = 166.6\text{N} - 88.2\text{N}$

$(M_1 + M_2)A = 78.4\text{N}$

$(17+9)A = 78.4$

$A = 3.02\ \text{m/s}^2$



$F_{NET_1} = F_{g_1} - T$

$M_1 A = 166.6 - T$

$(17)(3.02) = 166.6 - T$

$T = 115.3\ \text{N}$

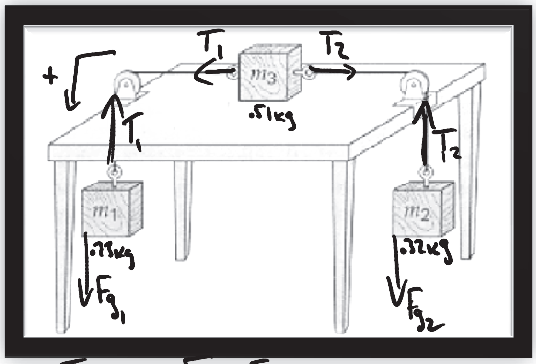
$F_{NET_2} = T - F_{g_2}$

$9(3.02) = T - 9(9.8)$

$T = 115.4\text{N}$

Atwood's Machine 2

- There is no friction in the system.
- m_1= 0.73kg, m_2= 0.32kg, m_3= 0.51kg
- Find the acceleration of the system.
- Find the tension in the string.



$F_{NET_{SYSTEM}} = F_{g_1} - F_{g_2}$

$(.73 + .51 + .32)A = (.73)(9.8) - (.32)(9.8)$

$A = 2.58\ \text{m/s}^2$

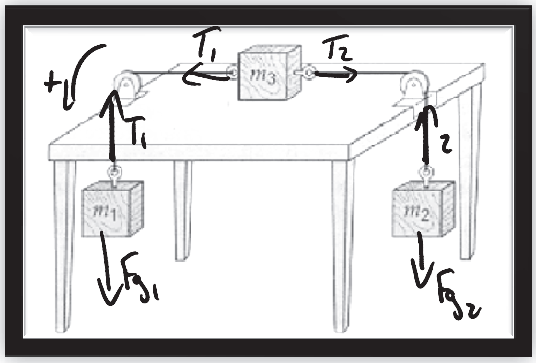
Atwood's Machine 2

$F_{NET_1} = F_{g_1} - T_1$

$m_1 A = m_1 g - T_1$

$(.73)(2.58) = .73(9.8) - T_1$

$T_1 = 5.27\ N$



$F_{NET_2} = T_2 - F_{g_2}$

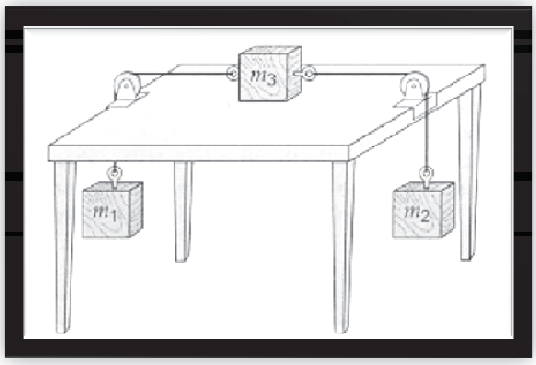
$m_2 A = T_2 - m_2 g$

$(.32)(2.58) = T_2 - (.32)(9.8)$

$T_2 = 3.96\ N$

Atwood's Machine 3

- There is no friction in the system.
- m_1= 0.42 kg, m_3= 0.61kg
- a = 1.89 m/s^2 to the right
- Find m_2, T_1 and T_2.



Atwood's Machine 3

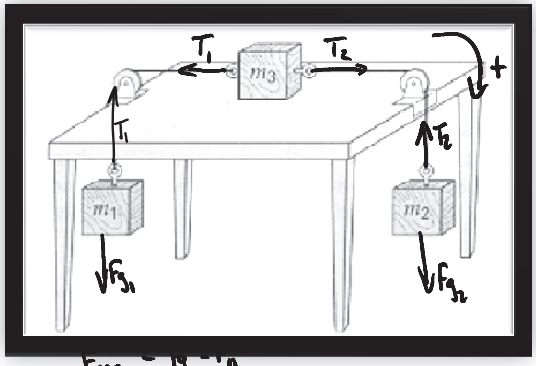
$F_{NET_1} = T_1 - F_{g_1}$

$m_1 A = T_1 - m_1 g$

$(.42)(1.89) = T_1 - (.42)(9.8)$

$.7938 = T_1 - 4.116$

$T_1 = 4.91\ N$



$F_{NET_2} = F_{g_2} - T_2$

$m_2 A = m_2 g - T_2$

$(.77)(1.89) = .77(9.8) - T_2$

$1.46 = 7.55 - T_2$

$T_2 = 6.09\ N$

$F_{NET_{SYSTEM}} = F_{g_2} - F_{g_1}$

$(m_1 + m_2 + m_3) A = m_2 g - m_1 g$

$(.42 + m_2 + .61)(1.89) = m_2(9.8) - (.42)(9.8)$

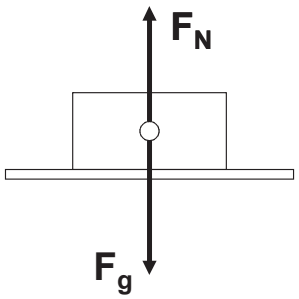
$.7938 + 1.89 m_2 + 1.153 = 9.8 m_2 - 4.116$

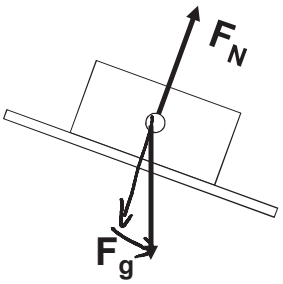
$6.06 = 7.91 m_2$

$m_2 = .77\ kg$

Normal Force

- The force acting perpendicular to the surface that the object is resting on.

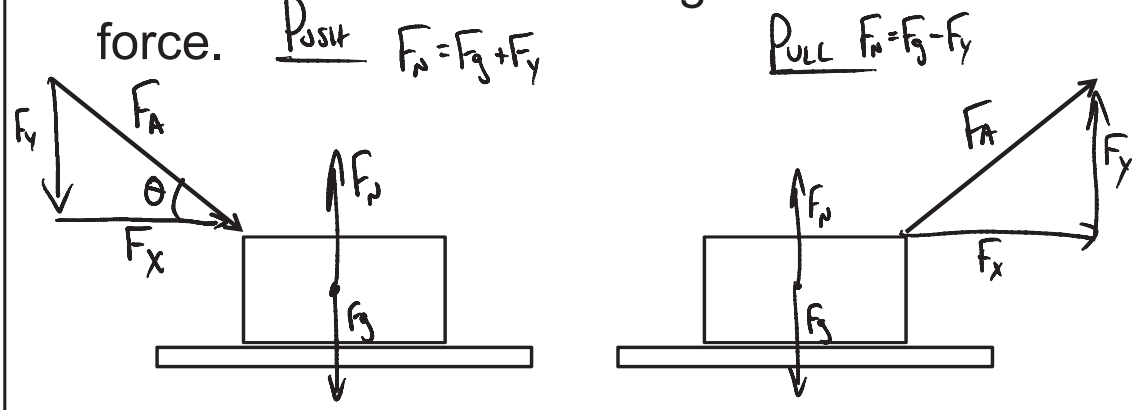




- On a flat surface, the normal force, F_N, is equal to weight of the object. * WITH NO OTHER FORCES

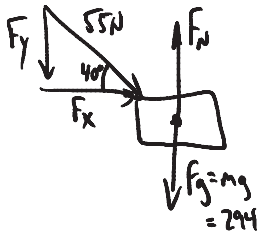
Forces Applied at Angles

- When applying a force at an angle, some of the applied force is used to move the object and some is used to change the normal force.



Forces Applied at Angles Example 1

- A 30 kg lawnmower is pushed with a force of 55 N. If the handle of the mower makes an angle of 40^0 to the horizontal, what is the acceleration of the lawn mower and the normal force that the ground is supplying to the mower?



$F_x = 55\cos 40^0 = 42.1\ N$

$F_y = 55\sin 40^0 = 35.4\ N$

$F_{NET} = F_x = ma$

$42.1 = (30kg)a$

$a = 1.4\ m/s^2$

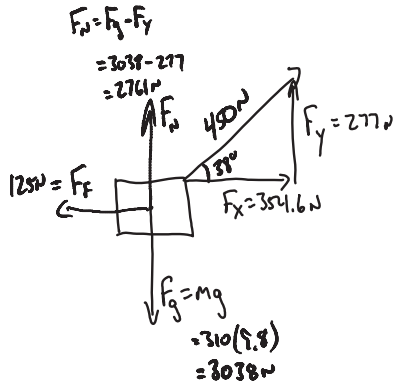
$F_N = F_g + F_y = 294 + 35.4 = 329.4$

Forces Applied at Angles Example 1

Forces Applied at Angles Example 2

- A worker drags a 310 kg crate across a factory floor by pulling on a rope attached to the crate. The worker applies a 450 N force on the rope which is at a 38° to the horizontal. The floor exerts a horizontal force of 125 N that opposes the motion. Calculate the acceleration of the crate and the normal force supplied by the floor?

Forces Applied at Angles Example 2



$F_{NET} = F_x - F_F$

$= 354.6 - 125 N$

$= 229.6 N$

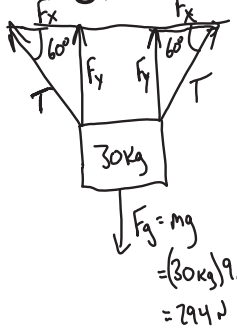
$F_{NET} = MA$

$229.6 N = 310(A)$

$A = .74 m/s^2$

Forces Applied at Angles Example 3

- You hang a 30 kg sign from the ceiling using 2 cables. If each of the cables make a 60^0 angle with the ceiling, what is the tension in each cable?



$2F_y = 294$

$F_y = 147$

$F_y = T \sin 60°$

$147 = T \sin 60°$

$T = \frac{147}{\sin 60°}$

$T = 169.7 N$