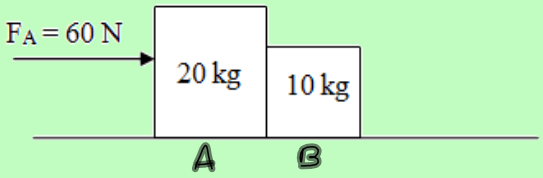
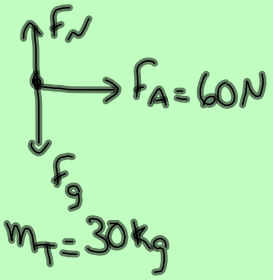
Section 16: Pulleys

1 A force of 60 N [E] acts on a combination of two boxes that are next to each other on a frictionless surface.



A) Find the acceleration of the boxes.



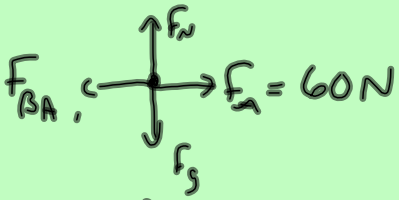
① $F_{net} = F_A = 60N$

② $a = \frac{F_{net}}{m_T} = \frac{60N}{30kg} = 2 m/s^2$

B) Find the force exerted by the 10 kg box on the 20 kg box.

B A

$F_{BA} = ?$



$m_A = 20kg$

$a = 2.0 m/s^2$

$F_{net_A} = ?$

① $F_{net_A} = m_A a$

$= (20kg)(2 m/s^2)$

$= 40N$

② $F_{net_A} = F_A + F_{BA}$

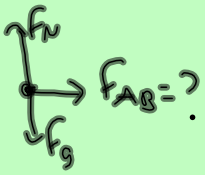
$40N = 60N + F_{BA}$

$-20N = F_{BA}$

C) Find the force exerted by the 20 kg box on the 10 kg box.

A B

$F_{AB} = ?$



$F_{AB} = F_{net_B}$

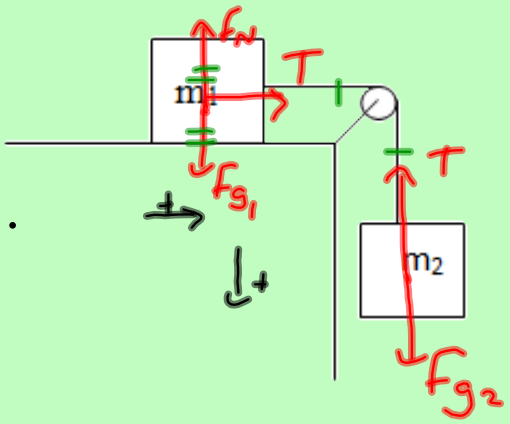
$= m_B a$

$= (10kg)(2 m/s^2)$

$= 20N$

2 A 8.0 kg block (m_1) on a frictionless table is attached by a string to a 2.0 kg block (m_2). The string and the 2.0 kg block is lead over a pulley and hung over the edge of the table.

* To the Right & down is the Positive direction.



A) What would be the acceleration of the system when they are released?

$F_{net_{sys}} = F_{g_2}$

$m_t a = m_2 g$

$(10kg)a = (2kg)(9.8 m/s^2)$

$a = 2.0 m/s^2$

B) What is the tension in the string?

Block on Table

$m = 8.0kg$

$a = 2.0 m/s^2$

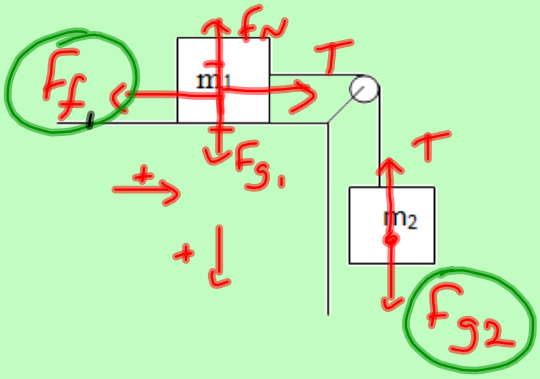
$T = F_{net_1}$

$T = m_1 a$

$= (8kg)(2 m/s^2)$

$= 16N$

3 A 12 kg block (m_1) on a table is attached by a string to a 6.0 kg block (m_2). The string and the 6.0 kg block is lead over a pulley and hung over the edge of the table. The force of friction between the block and the table is 13.8 N.



A) What would be the acceleration of the system when they are released?

$$F_{net\,sys} = F_{g2} - F_{f1}$$

$$m_1 a = m_2 g - F_{f1}$$

$$(18\,kg)a = (6\,kg)(9.8\,m/s^2) - 13.8\,N$$

$$a = 2.5\,m/s^2$$

B) What is the tension in the string?

mass 1: F_N, F_f, T, F_g

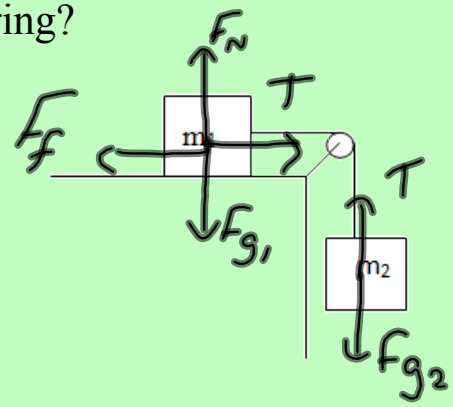
$$F_{net_1} = T - F_f$$

$$m_1 a = T - F_f$$

$$(12\,kg)(2.5\,m/s^2) = T - 13.8\,N$$

$$44\,N = T$$

4 A 10.0 kg mass is attached by a string to a 5.0 kg mass. The string and the 5.0 kg mass is lead over the pulley and hung over the edge of the table. What would be the acceleration of the system when they are released if the coefficient of friction between the table and the 10.0 kg mass is 0.11? What is the tension in the string?



A) What would be the acceleration of the system when they are released?

① $F_{g_2} = m_2 g = (5kg)(9.8 m/s^2)$
$= 49N$

② $f_{f_1} = \mu m_1 g$
$= 0.11(10kg)(9.8 m/s^2)$
$= 10.78N$

③ $F_{net_{sys}} = f_{g_2} - f_{f1}$
$= 49N - 10.78N$
$= 38.22N$

④ $a_{sys} = \frac{f_{net}}{m_T} = \frac{38.22N}{15kg}$
$a = 2.5 m/s^2$

$F_{net} = f_{g_2} - f_{f1}$

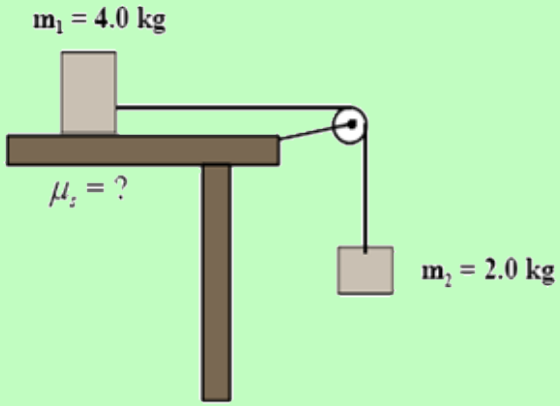
$m_T a = m_2 g - \mu m_1 g$

$(15kg)a = (5kg)(9.8\frac{m}{s^2}) - (0.11)(10kg)(9.8\frac{m}{s^2})$

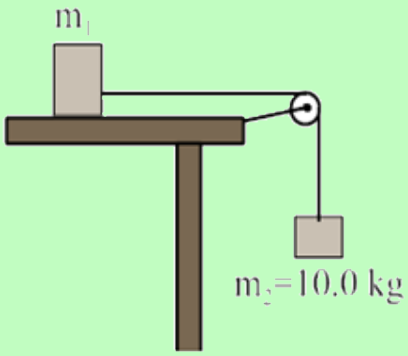
$a = 2.5 m/s^2$

B) What is the tension in the string?

5 In the diagram below, two masses are connected by a light string over a frictionless massless pulley. What coefficient of static friction is required to keep m_1 from slipping?



6 In the diagram below, the tension in the string joining the two masses is 12.0 N. If friction is negligible, what is the mass of m_1?



7 A 3.0 kg mass and a 1.0 kg mass are hanging over a frictionless pulley as shown in the diagram. What is the acceleration of the system? What is the tension in the rope?