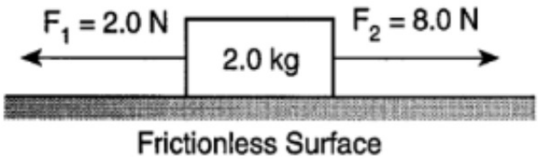
A net force of 25 newtons is applied horizontally to a 10.-kilogram block resting on a table. What is the magnitude of the acceleration of the block?

(1) 0.0 m/s^2
(2) 0.26 m/s^2
(3) 0.40 m/s^2
(4) 2.5 m/s^2

A net force of 10. newtons accelerates an object at 5.0 meters per second^2. What net force would be required to accelerate the same object at 1.0 meter per second^2?

(1) 1.0 N
(2) 2.0 N
(3) 5.0 N
(4) 50. N

Two forces are applied to a 2.0-kilogram block on a frictionless, horizontal surface, as shown in the diagram below.



The acceleration of the block is

(1) 5.0 m/s^2 to the right
(2) 5.0 m/s^2 to the left
(3) 3.0 m/s^2 to the right
(4) 3.0 m/s^2 to the left

What is the magnitude of the net force acting on a 2.0×10^3-kilogram car as it accelerates from rest to a speed of 15 meters per second in 5.0 seconds?

(1) 6.0×10^3 N
(2) 2.0×10^4 N
(3) 3.0×10^4 N
(4) 6.0×10^4 N

If a 30-newton force is required to accelerate a 2-kilogram object at 10 meters per second^2, over a level floor, then the magnitude of the frictional force acting on the object is

(1) 0 N
(2) 10 N
(3) 20 N
(4) 30 N

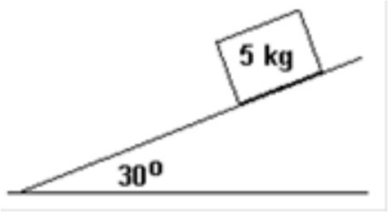
A 35-kg child is climbing a rope to get to a tree fort. What is the tension in the rope if

- the child is climbing the rope at a constant speed?
- the child is accelerating up the rope at 3 ms^{-2}?
- the child is resting on the rope?
- the child is resting on the rope, but the rope is attached to a crane and accelerated upward at 3 ms^{-2}?

What average force is needed to accelerate a 7.00-gram pellet from rest to 125 ms^{-1} over a distance of 0.800 m along the barrel of a rifle?

A freight train has a mass of 1.5×10^7 kg. If the locomotive can exert a constant pull of 7.5×10^5 N, how long does it take to increase the speed of the train from rest to 80 kmh^{-1}?

A 5 kg block rests on a flat plane inclined at an angle of 30 degrees to the horizon as shown in the diagram below.



1. (MC) What would be the acceleration of the block down the plane assuming the force of friction is negligible?

(A) 0.5 m/s^2

(B) 0.87 m/s^2

(C) 5 m/s^2

(D) 8.7 m/s^2

(E) 10 m/s^2

2. (MC) If the block is placed on a second plane (where friction is significant) inclined at the same angle, it will begin to accelerate at 2.0 m/s. What is the force of friction between the block and the second inclined plane?

(A) 10 N

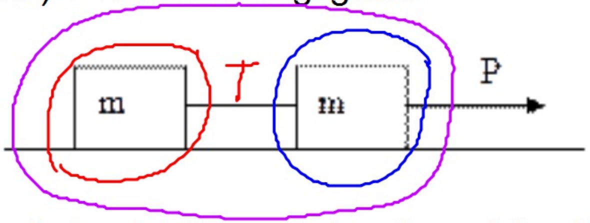
(B) 15 N

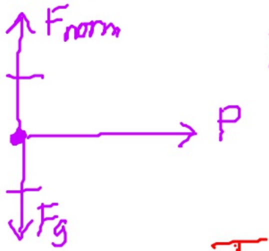
(C) 25 N

(D) 43.3 N

(E) 50 N

Two blocks, each with mass *m*, are connected by a string and accelerated to the right by a single force P (pull). Friction is negligible.





$\Sigma F = F_{net} = P$

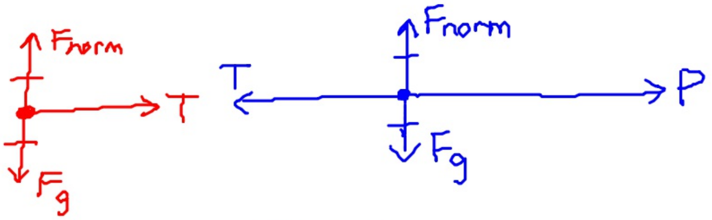
$(2m)a = P$

- Solve for the acceleration of the first mass. Express your answers in terms of *m* and *P* only. $a = \frac{P}{2m}$
- Solve for the tension in the string connecting the blocks in terms of *P* only.

$T = ma$

$T = \cancel{m}\left(\frac{P}{2\cancel{m}}\right)$

$\boxed{T = \frac{P}{2}}$



$\Sigma F = \underbrace{F_{net}} = T$

$\boxed{ma = T}$

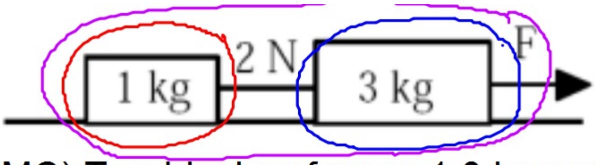
$\Sigma F = \underbrace{F_{net}} = P - T$

$ma = P - T$

$ma = P - ma$

$\underline{+ma \qquad +ma}$ ⇒

$\frac{\cancel{2m}a}{\cancel{2m}} = \boxed{\frac{P}{2m}}$



(MC) Two blocks of mass 1.0 kg and 3.0 kg are connected by a string which has a tension of 2.0 N. A force *F* acts in the direction shown to the right. Assuming friction is negligible, what is the value of *F*?

(A) 1.0 N

(B) 2.0 N

(C) 4.0 N

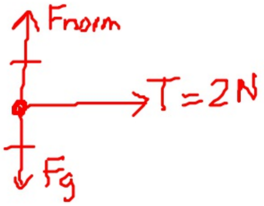
(D) 6.0 N

(E) 8.0 N

$\sum F = \underbrace{F_{net}}_{} = F$

$ma = F$

$(1+3)a = F$

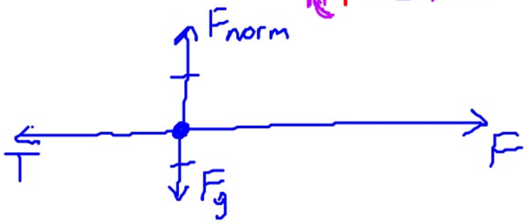


$\sum F = \underbrace{F_{net}}_{} = T = 2N$

$m_1 a = T$

$\frac{(\cancel{1kg})a}{\cancel{1kg}} = \frac{2N}{1Kg}$

$\underline{a = 2ms^{-2}}$



$\sum F = \underbrace{F_{net}}_{} = F - T$

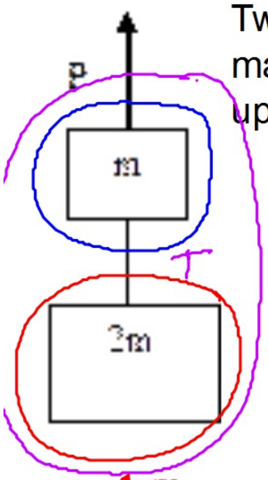
$m_2 a = F \cancel{-T}$

$+T \qquad \cancel{+T}$

$F = m_2 a + T$

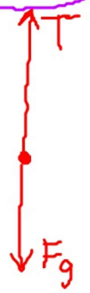
$F = (3kg)(2ms^{-2}) + 2N$

$\boxed{F = 8N}$



Two blocks, one with mass *m* and the other with mass *2m*, are connected by a string and accelerated upwards by a single force P (pull).

- Solve for the acceleration of mass *2m* in terms of *m, P,* and *g.* $a = \frac{P}{3m} - g$
- Solve for the tension in the string connecting the blocks in terms of *P* only.



$\Sigma F = \underbrace{F_{net}} = T - F_g$

$2ma = T - \cancel{2mg}$

$+2mg \quad +\cancel{2mg}$

$\boxed{T = 2ma + 2mg}$

$ma = P - (2ma + 2mg) - mg$

$ma = P - 2ma - 2mg - mg$

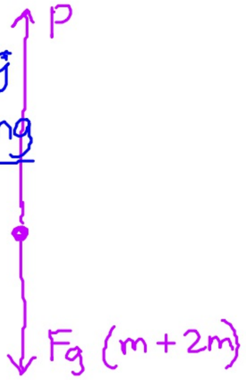
$ma = P - 2\cancel{ma} - 3mg$

$+2ma \quad +\cancel{2ma}$

$3ma = P - 3mg$

$\Sigma F = \underbrace{F_{net}} = P - T - F_g$

$ma = P - T - mg$



$\Sigma F = \underbrace{F_{net}} = P - F_g$

$\frac{\cancel{3m}a}{\cancel{3m}} = \boxed{\frac{P - 3mg}{3m}}$

$$T = 2ma + 2mg$$

$$\boxed{a = \frac{P-3mg}{3m}}$$

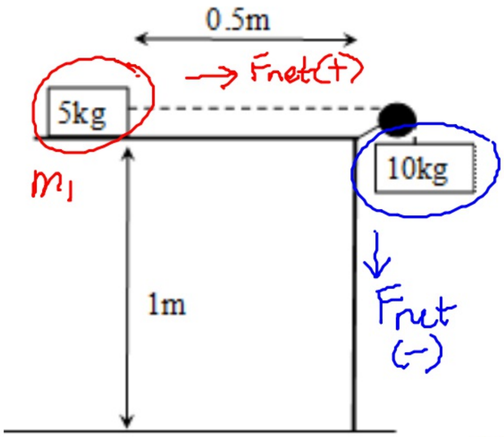
$$T = 2\cancel{m}\left(\frac{P-3mg}{3\cancel{m}}\right) + 2mg$$

$$T = 2\left(\frac{P-3mg}{3}\right) + 2mg$$

$$T = \left(\frac{2P-6mg}{3}\right) + 2mg$$

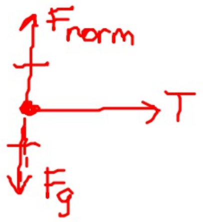
$$T = \frac{2P}{3} - \cancel{2mg} + \cancel{2mg}$$

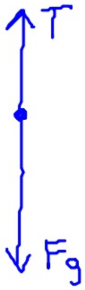
$$\boxed{T = \frac{2}{3}P}$$



A 5 kg block is initially held at rest on a frictionless table. It is connected by a string to a 10 kg mass over a frictionless pulley. The 5 kg mass is released and accelerates 0.5 m towards the edge of the table. When it reaches the end of the table the string detaches and the 5 kg block leaves the 1 m tall table with no initial vertical motion.

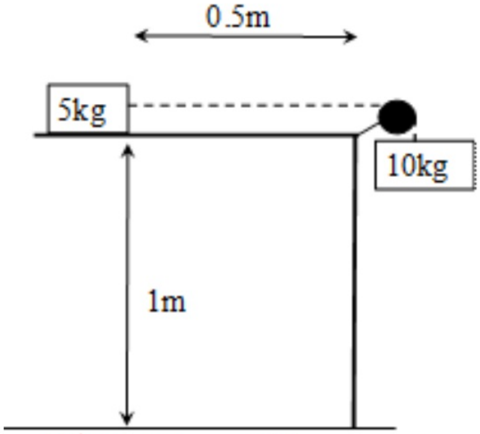
- Draw a FBD for each block just after they are released.





$$\sum F = \underbrace{F_{net}}_{} = T$$
$$+m_1 a = T$$

$$\sum F = \underbrace{F_{net}}_{} = T - F_g$$
$$-m_2 a = T - m_2 g$$



A 5 kg block is initially held at rest on a frictionless table. It is connected by a string to a 10 kg mass over a frictionless pulley. The 5 kg mass is released and accelerates 0.5 m towards the edge of the table. When it reaches the end of the table the string detaches and the 5 kg block leaves the 1 m tall table with no initial vertical motion.

- What is the acceleration of the 5 kg block?

$\sum F = F_{net} = T$

$\boxed{+m_1 a = T}$

$\sum F = F_{net} = T - F_g$

$-m_2 a = T - m_2 g$

$-m_2 a = (m_1 \cancel{a}) - m_2 g$

$- m_1 a \quad \cancel{-m_1 a}$

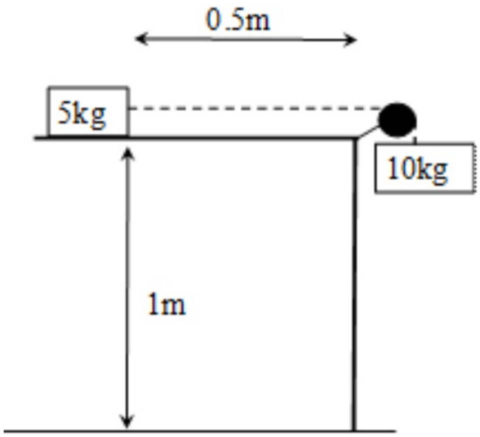
$-m_1 a - m_2 a = -m_2 g$

$\frac{\cancel{(-m_1 - m_2)} a}{\cancel{(-m_1 - m_2)}} = \frac{-m_2 g}{(-m_1 - m_2)}$

$a = \frac{-m_2 g}{(-m_1 - m_2)}$

$a = \frac{-10 \cdot 9.8}{(-5 - 10)}$

$\boxed{a = 6.53 ms^{-2}}$



A 5 kg block is initially held at rest on a frictionless table. It is connected by a string to a 10 kg mass over a frictionless pulley. The 5 kg mass is released and accelerates 0.5 m towards the edge of the table. When it reaches the end of the table the string detaches and the 5 kg block leaves the 1 m tall table with no initial vertical motion.

- How long does it take the 5 kg block to reach the edge of the table?

$t = \underline{\ ?\ }\ s$

$u = 0\ ms^{-1}$

$a = 6.53\ ms^{-2}$

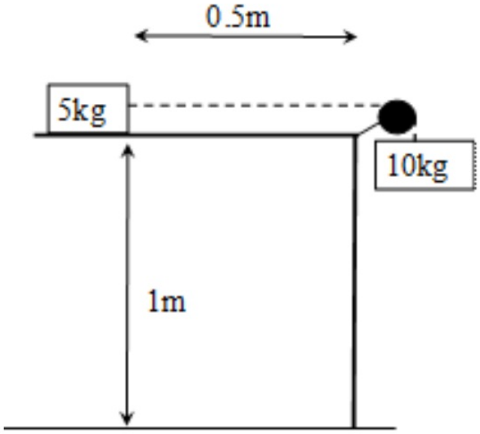
$S = .5\ m$

$$s = \cancel{ut}^{0} + \frac{1}{2}at^2$$

$$s = \frac{1}{2}at^2 \Rightarrow (.5) = \frac{1}{2}(6.53)t^2$$

$$\therefore t = \sqrt{\frac{2s}{a}} = \sqrt{\frac{2(.5)}{(6.53)}}$$

$$\boxed{t = .391\ s}$$



A 5 kg block is initially held at rest on a frictionless table. It is connected by a string to a 10 kg mass over a frictionless pulley. The 5 kg mass is released and accelerates 0.5 m towards the edge of the table. When it reaches the end of the table the string detaches and the 5 kg block leaves the 1 m tall table with no initial vertical motion.

- How fast is the 5 kg block moving when it reaches the edge of the table?

$v = \underline{?}\ ms^{-1}$

$u = 0 ms^{-1}$

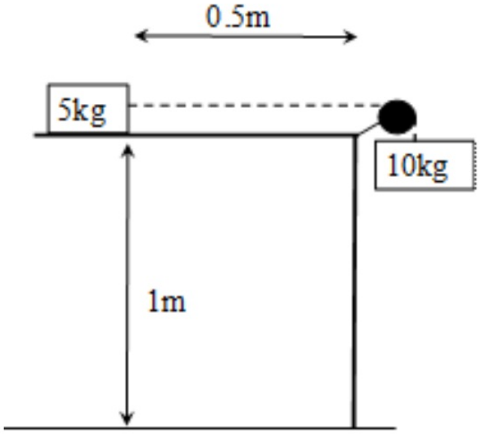
$a = 6.53\ ms^{-2}$

$t = .391 s$

$v = u + at$

$v = (0) + (6.53)(.391)$

$\boxed{v = 2.56\ ms^{-1}}$



A 5 kg block is initially held at rest on a frictionless table. It is connected by a string to a 10 kg mass over a frictionless pulley. The 5 kg mass is released and accelerates 0.5 m towards the edge of the table. When it reaches the end of the table the string detaches and the 5 kg block leaves the 1 m tall table with no initial vertical motion.

- How far does the 5 kg block land from the base of the table?

$S_x = u_x \boxed{t}$ → solve for t!

$S_x = (2.56)(.452)$

$\boxed{S_x = \underline{1.16}\ m}$

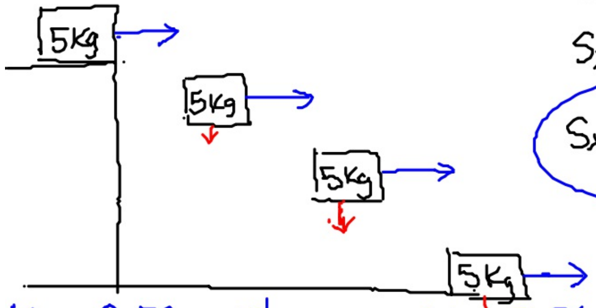
$S_y = u_y t + \frac{1}{2} a_y t^2$

$(-1) = (0)t + \frac{1}{2}(-9.8)t^2$

$\frac{-1}{-4.9} = \frac{-4.\cancel{9} t^2}{-\cancel{4}.9}$

$\sqrt{\frac{1}{4.9}} = \sqrt{t^{\cancel{2}}}$

$\boxed{t = .452\ s}$



$u_x = 2.56\ ms^{-1}$

$u_y = 0\ ms^{-1}$

$a_y = -9.8\ ms^{-2}$

$V_x = 2.56\ ms^{-1}$ $t = \_\_\_ s$

$V_y = \_\_\_ ms^{-1}$

$S_y = -1 m$

$S_x = \_\_\_ m$