Good Day!

- There are answer keys to the homework on either side of the room.
- Look at the answers and write the number of the problem that you would most like to see solved on your whiteboard.

Most Requested Problem

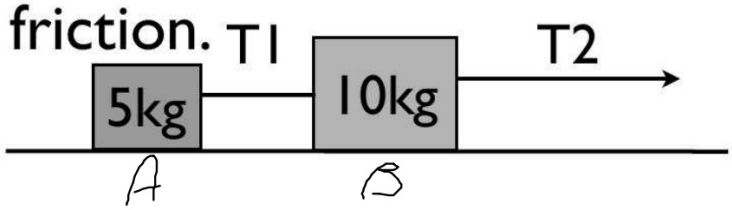
Today

- Problems with multiple tensions.
- Multi-body problems.
- Atwood Machines

Tension

- If a tension is causing the acceleration of an object, we can apply F=ma to find the tension.
- Until now: we have assumed the total tension in a chord/string to be uniform.
- We can use F=ma to find out the individual tensions on each side of a chord/cable.

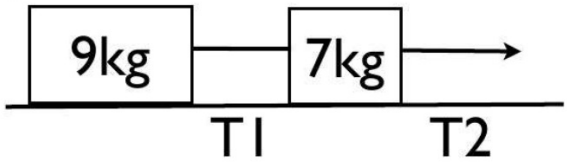
The blocks are accelerating at 2.5m/s^2. Find the tensions on each string. Assume no friction.



$T_1 = m_A \cdot a = 5\,kg \cdot 2.5\,m/s^2 = 12.5\,N$

$T_2 = (m_A + m_B)\,2.5\,m/s^2 = 37.5\,N$

The tension on T1 is 45N. Find the acceleration of the system and T2.



Atwood's Machine

- Two masses hung over a pulley.
- We assume that the pulley is massless and frictionless. The rope is massless.
- Calculate the acceleration in the system and the tension on the rope.
- We need to pick a positive direction.

m1=7kg. m2=5kg. Acceleration of the system and the tension on each rope. How can we rearrange the system to a simpler picture?

(+) (−)

F_{g1} ← [m1] T = T [m2] → F_{g2}

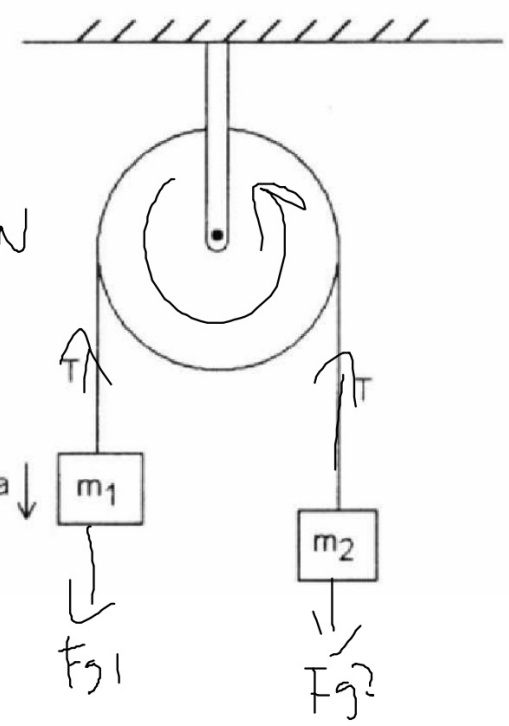
68.6 N 49 N

$\Sigma F = 68.6N - 49N = 19.6N$

$\Sigma m = 12kg$

$\Sigma F = \Sigma m \cdot a$

$a = F/m = 1.63\ m/s^2$

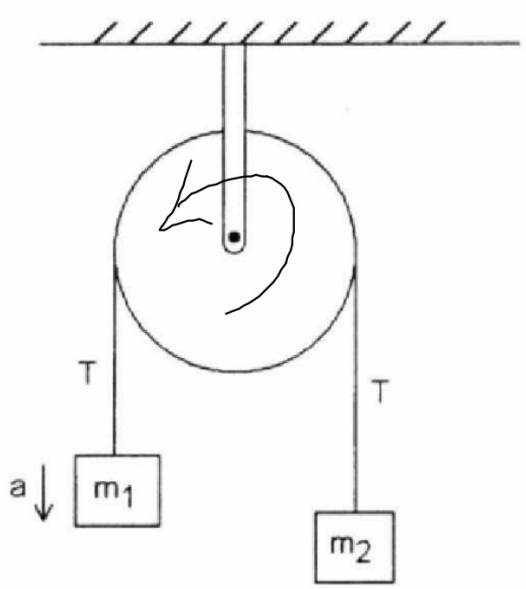


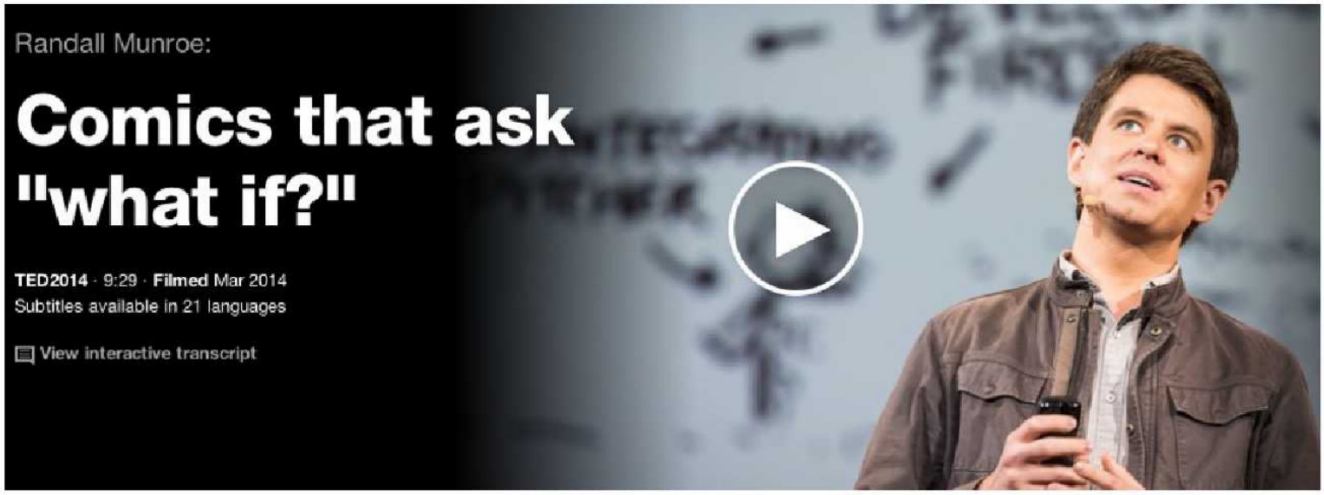
m1=7kg. m2=5kg. Acceleration of the system and the tension on each rope. How can we rearrange the system to a simpler picture?

$\Sigma F = 68.6N - 49N$

$\Sigma m = 12kg$

$a = \frac{F}{m} = 1.63 \, m/s^2$





Serious Force

MIT Physics Demo -- Low Friction Atwood Machine

Video Atwood

Do Now: Solve for the acceleration of the system.

m1=0.55kg. m2=0.56kg. Find the acceleration of the system.

Knowns:

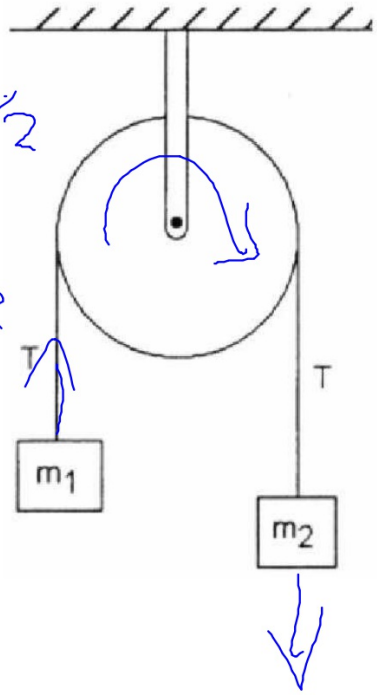
$F_{g1} = m_1 g = 0.55\text{kg} \cdot 9.8\ m/s^2$

5.39 N

$F_{g2} = m_2 g = 0.56\text{kg} \cdot 9.8\ m/s^2$

5.49 N

$a = 0.088\ m/s^2$



Does this agree with the kinematics answer? Vi=0m/s. Δx=1m. t=4.79s. a=?

$$\Delta x = \cancel{v_i t}^{0} + \frac{1}{2} a t^2$$

$$\frac{2\Delta x}{t^2} = \frac{a t^2}{t^2}$$

$$\Rightarrow a = \frac{2\Delta x}{t^2}$$

$$0.087\ m/s^2$$

Multiple Tension on One Rope

- We know that the total tension on a rope is equal to the mass of the **system** times the acceleration of the system.
- The tension on either side of a rope can actually be different.
- That tension is the tension needed to accelerate each object at the same rate.

m1=5kg. m2=3kg. Find the tension of the rope **at** each block. Find the total tension in the chord.