

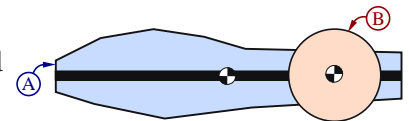
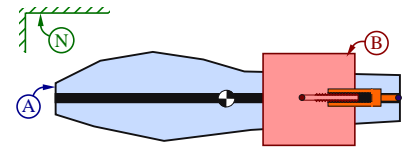
$\vec{F} = m\vec{a}$ FBD, MG road-maps, and concepts for translating mechanical systems.

18.1 Concept: Translational motion? (free-body diagrams)

A rigid body B is connected to a rigid body A with a force actuator (pushes B apart from A). Initially, A and B are **at rest** (stationary) in deep empty space in a Newtonian (inertial) reference frame N .

Using physical intuition, guess if the force actuator can move:

• A 's mass center in N ? Yes/No		<input type="text"/>
• B 's mass center in N ? Yes/No		<input type="text"/>
• System mass center in N ? Yes/No		<input type="text"/>

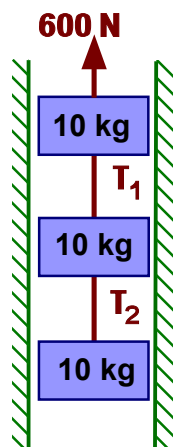


Verify each guess with an equation of motion (3^{rd} -column above).

The previous 3 answers are the **same/different** if B is connected to A with a torque/rotational motor (instead of a force actuator).

18.2 FE/EIT Review – Tension in vertical ropes (free-body diagrams).

$\vec{F} = m\vec{a}$



The figure to the left shows three 10 kg rigid blocks that are in a smooth (**frictionless**) vertical slot. The set of interconnected blocks is pulled vertically-upward with a 600 N force.

Under the figure to the left, circle **True** if the tensions T_i ($i=1,2$) in the light (massless) inextensible ropes are equal. Otherwise, circle **False** and report numerical values for T_1 and T_2 below. Approximate Earth's gravitational acceleration as $g = 10 \frac{m}{s^2}$.

Repeat this analysis when the same set blocks has its bottom-most block fastened to a rigid floor (shown to the right).

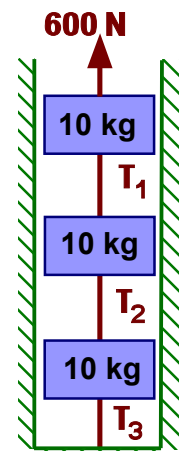
Result:

If False for left system:

$T_1 = \text{[] N}$ $T_2 = \text{[] N}$

If False for right system:

$T_1 = \text{[] N}$ $T_2 = \text{[] N}$



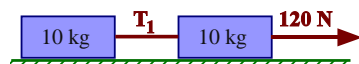
$T_1 = T_2$
True/False

$T_1 = T_2 = T_3$
True/False

18.3 FE/EIT Review – Tension in horizontal ropes (free-body diagrams).

$\vec{F} = m\vec{a}$

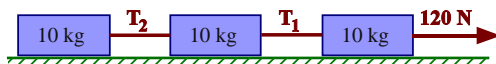
The following figures show rigid blocks, each of mass 10 kg, that are in contact with a smooth (**frictionless**) flat horizontal Newtonian reference frame. Each set of interconnected blocks is pulled horizontally-right with 120 Newtons. Using **free-body diagrams**, determine the tension T_i ($i = 1, 2, \dots$) in each light inextensible ropes connecting the blocks.



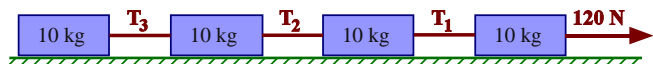
$T_1 = \text{[] Newtons}$



$T_4 = \text{[] N}$ $T_3 = \text{[] N}$ $T_2 = \text{[] N}$ $T_1 = \text{[] N}$



$T_2 = \text{[] N}$ $T_1 = \text{[] N}$



$T_3 = \text{[] N}$ $T_2 = \text{[] N}$ $T_1 = \text{[] N}$

Hint: Consider **MG road-maps** and first calculate system center of mass acceleration, then T_1 , then T_2 , etc.