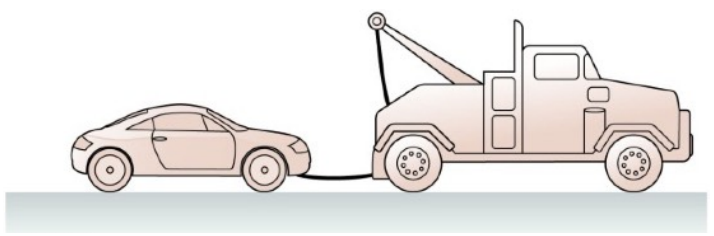
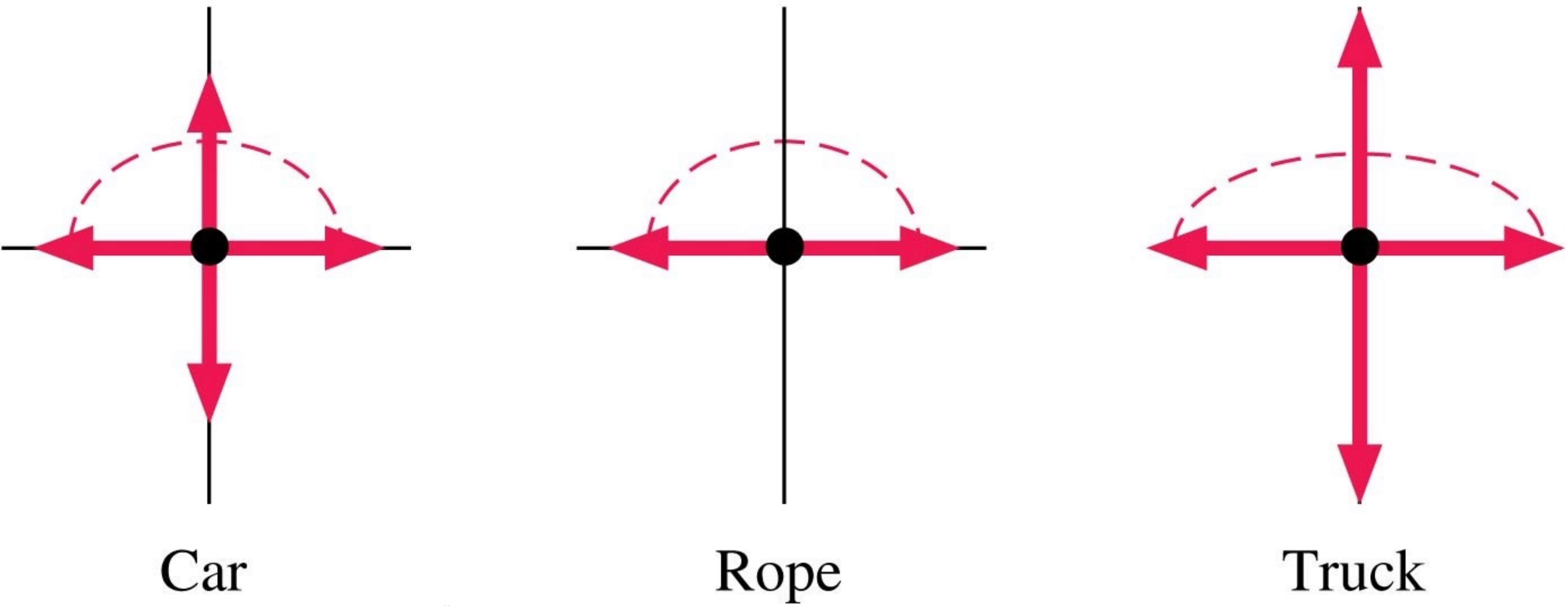
Fun Physic Fact

If Hydrogen bonding was not present in water, it would boil at -90 degrees Celsius and almost no liquid water would exist on earth.

Question #9

What, if anything, is wrong with these free-body diagrams for a truck towing a car at steady speed? The truck is heavier than the car and the rope is massless.



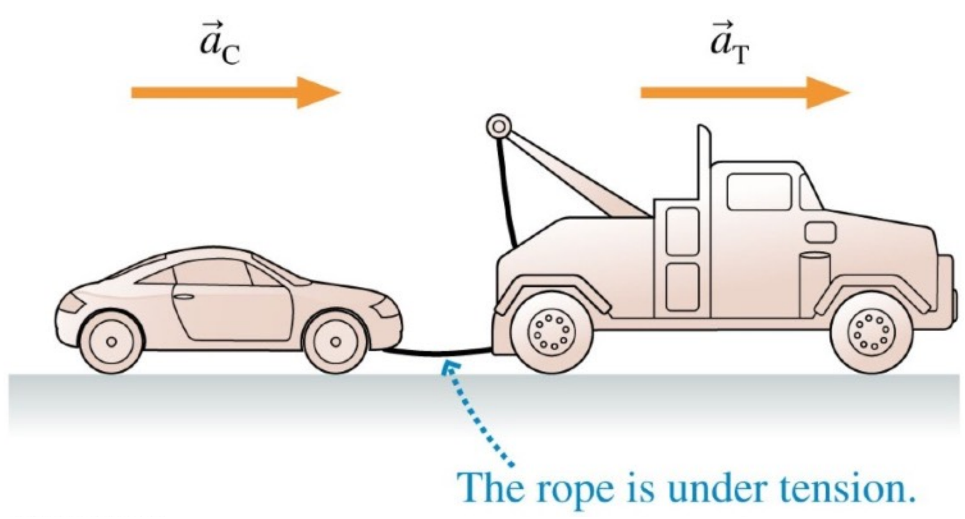


a. Nothing is wrong.
b. One of more forces have the wrong direction.
c. Both D and E.
d. One or more action/reaction pairs are wrong.
e. One or more forces have the wrong length.

Acceleration constraints

If two objects move together, their accelerations are constrained to be equal

$$\vec{a}_{\mathrm{cx}} = \vec{a}_{\mathrm{tx}} = \vec{a}_{\mathrm{x}}$$

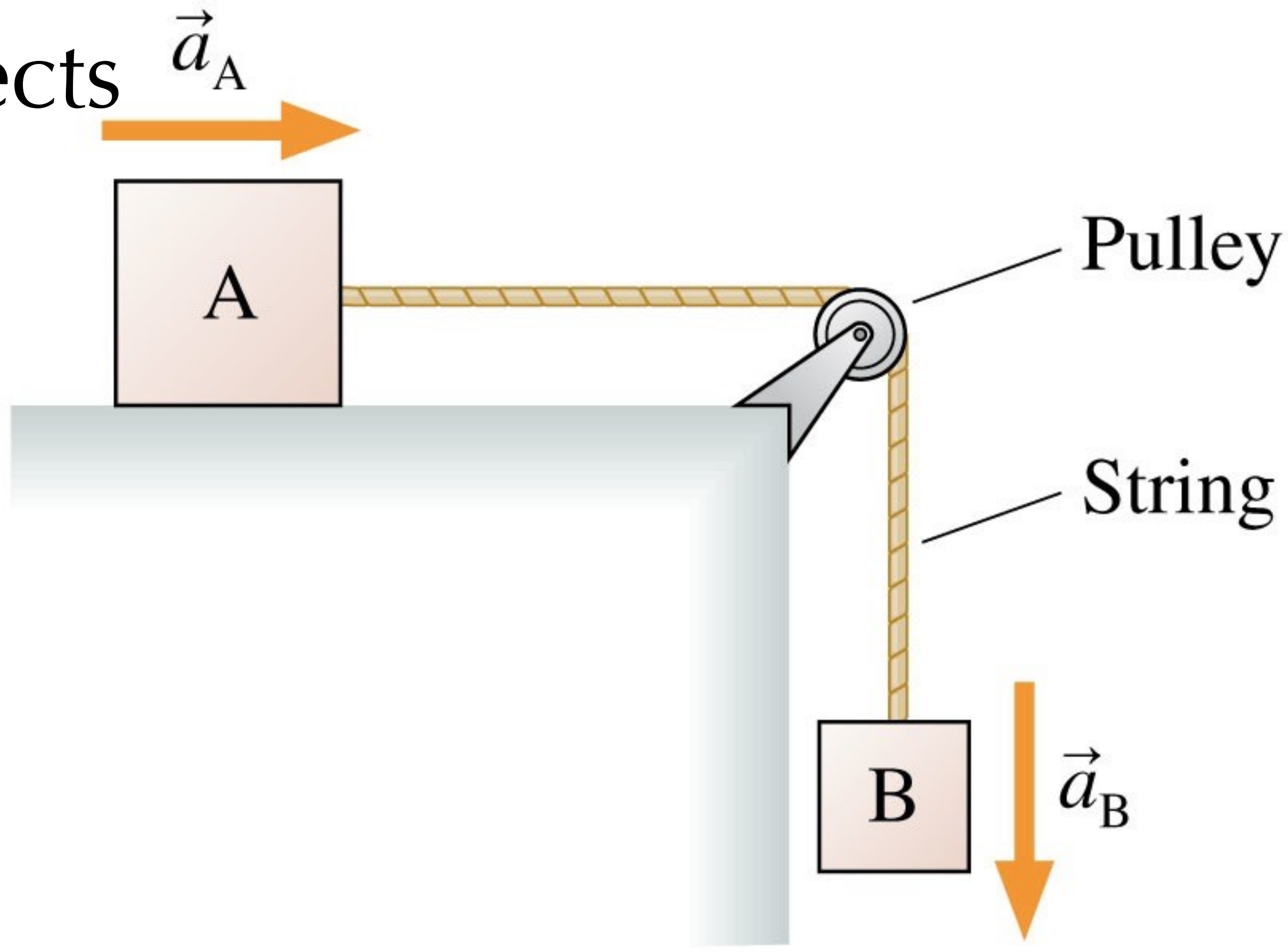


Acceleration constraints

Sometimes the accelerations of two objects may have different signs and they may travel in different directions

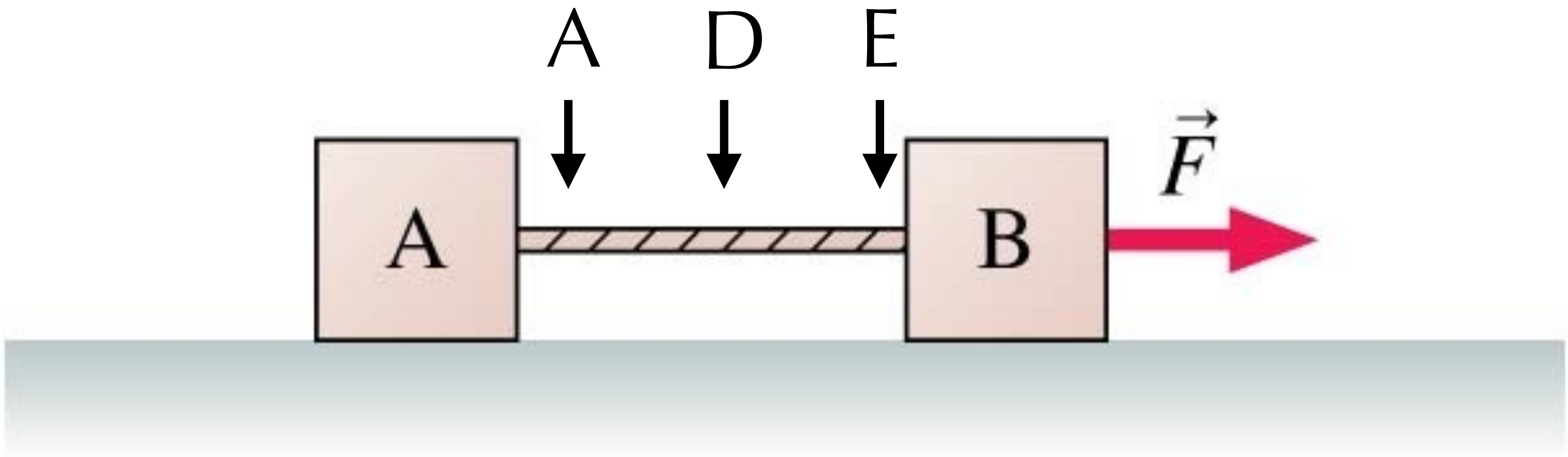
The string constrains the objects to accelerate together

$$\vec{a}_{\mathrm{Ax}} = -\vec{a}_{\mathrm{By}}$$



The massless string approximation

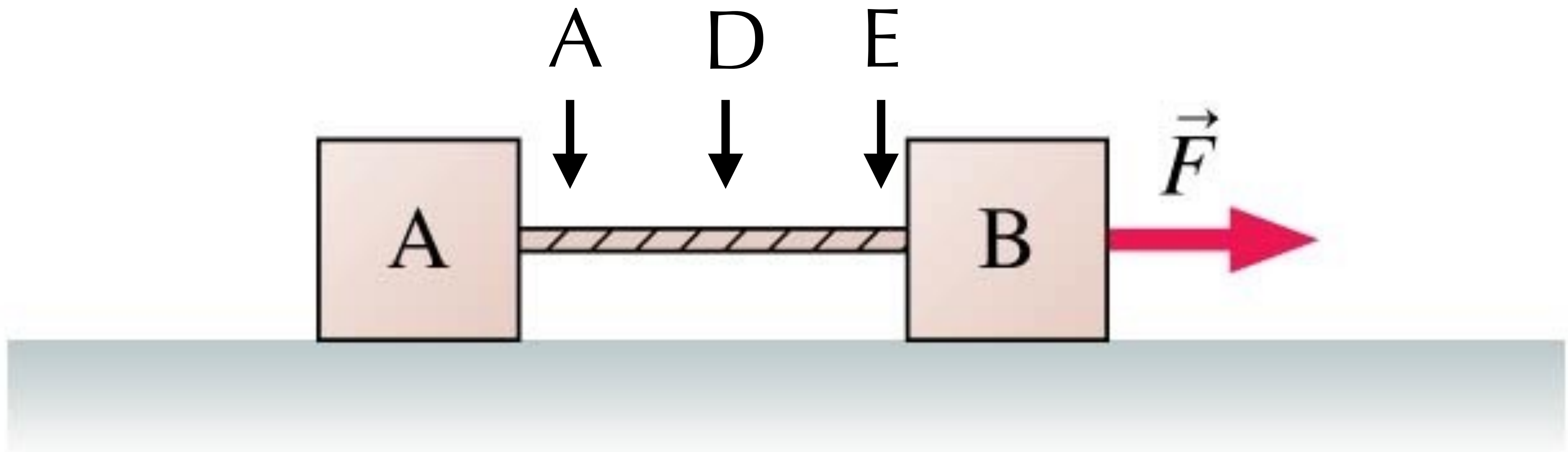
Question #10

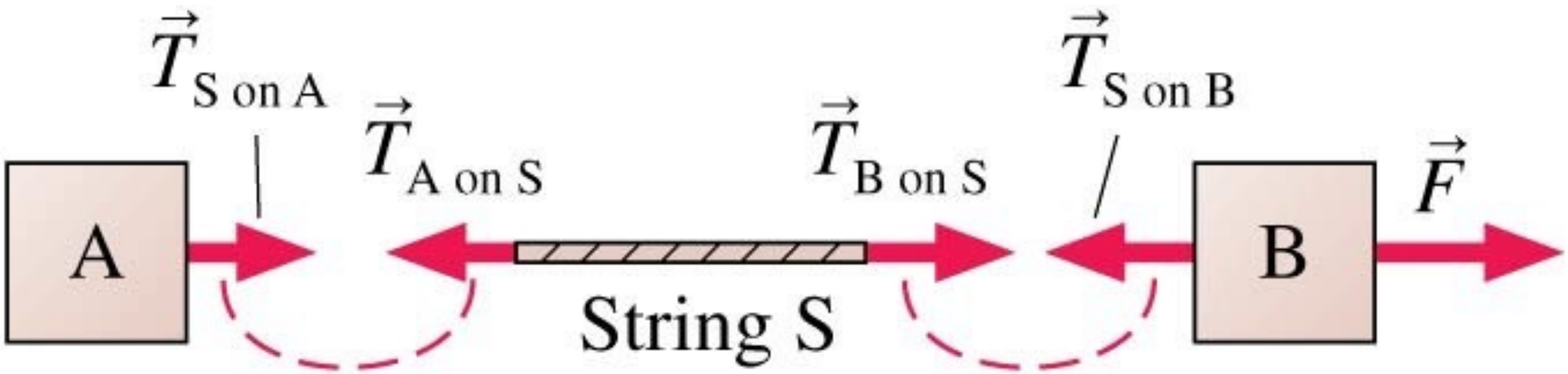


Where is the tension in the rope the greatest?

The massless string approximation

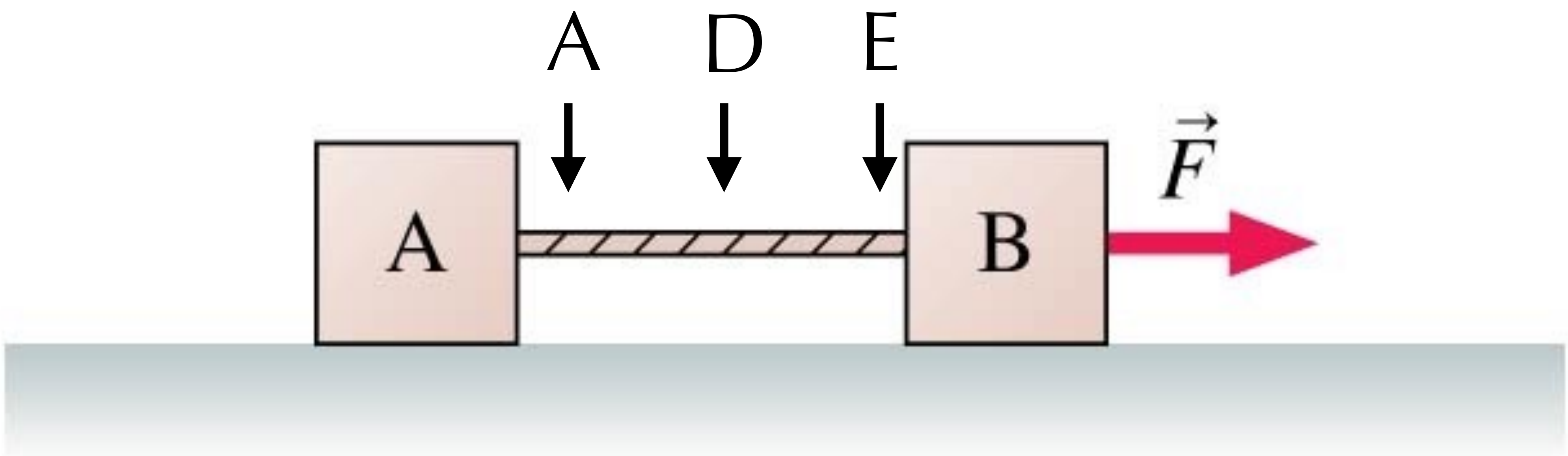
Question #10

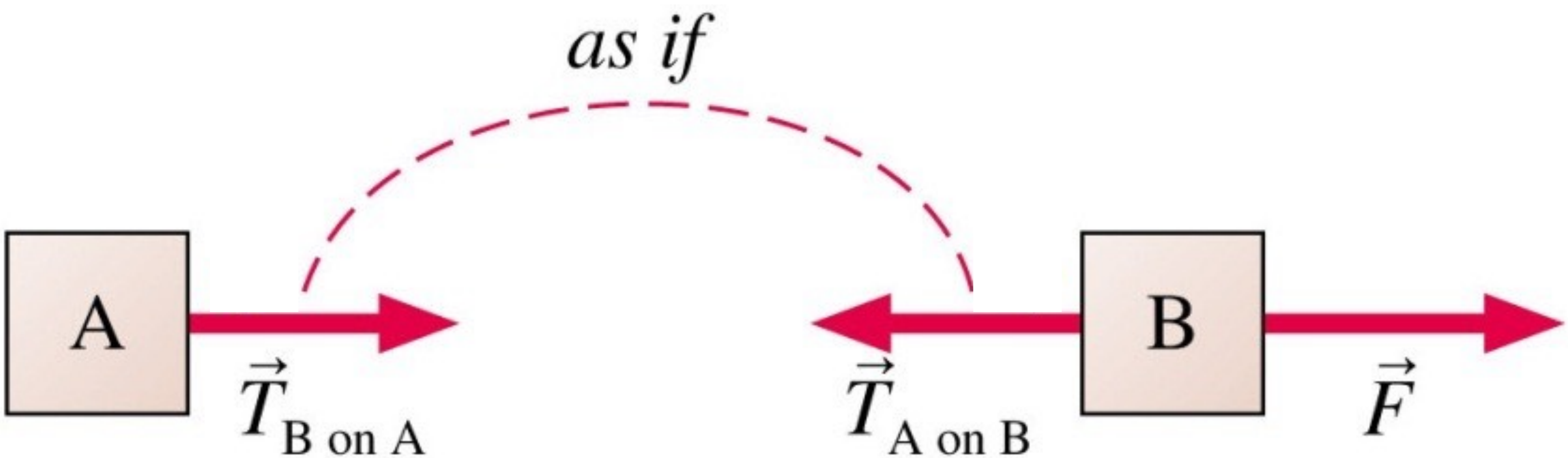




The massless string approximation

Question #10

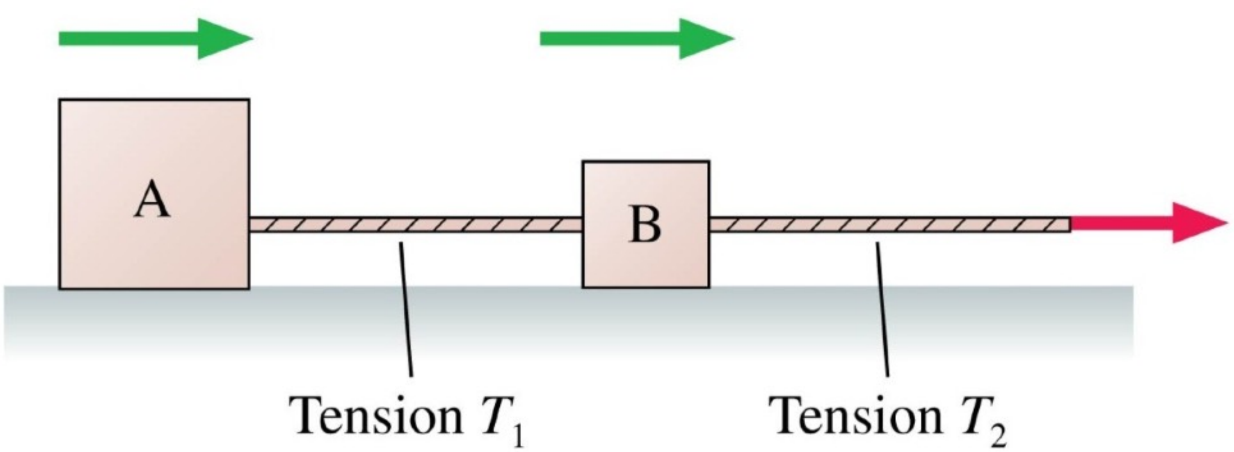




Question #11

Boxes A and B are being pulled to the right on a frictionless surface. Box A has a larger mass than B. How do the two tension forces compare?

a. $T_1 > T_2$
b. $T_1 = T_2$
c. .
d. $T_1 < T_2$
e. Not enough information to tell.



Question #12

Boxes A and B are sliding to the right on a frictionless surface. Hand H is slowing them. Box A has a larger mass than B. Considering only the *horizontal* forces:

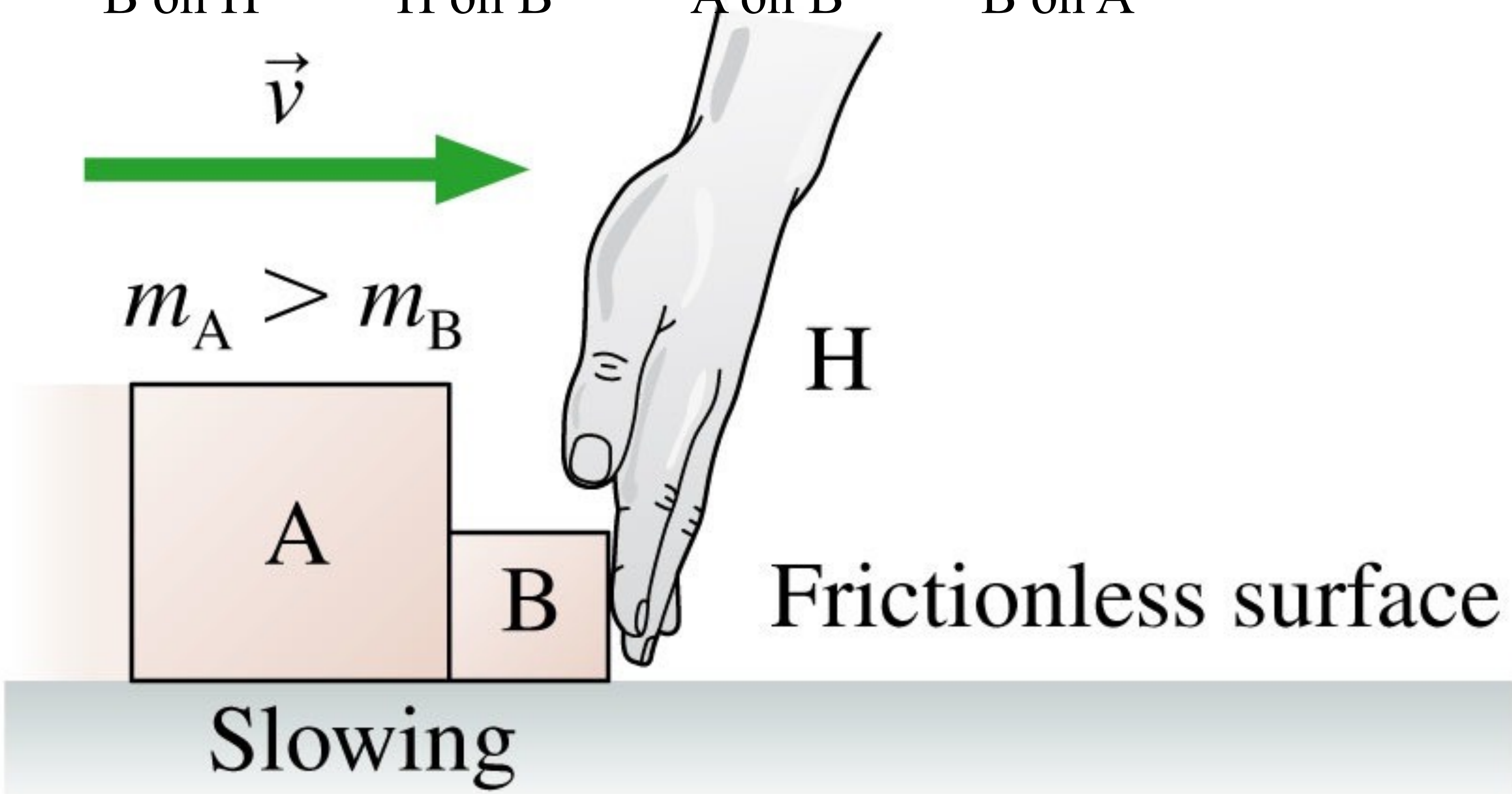
a. $F_{\text{B on H}} = F_{\text{H on B}} = F_{\text{A on B}} = F_{\text{B on A}}$

b. $F_{\text{B on H}} = F_{\text{H on B}} < F_{\text{A on B}} = F_{\text{B on A}}$

c.

d. $F_{\text{H on B}} = F_{\text{H on A}} > F_{\text{A on B}}$

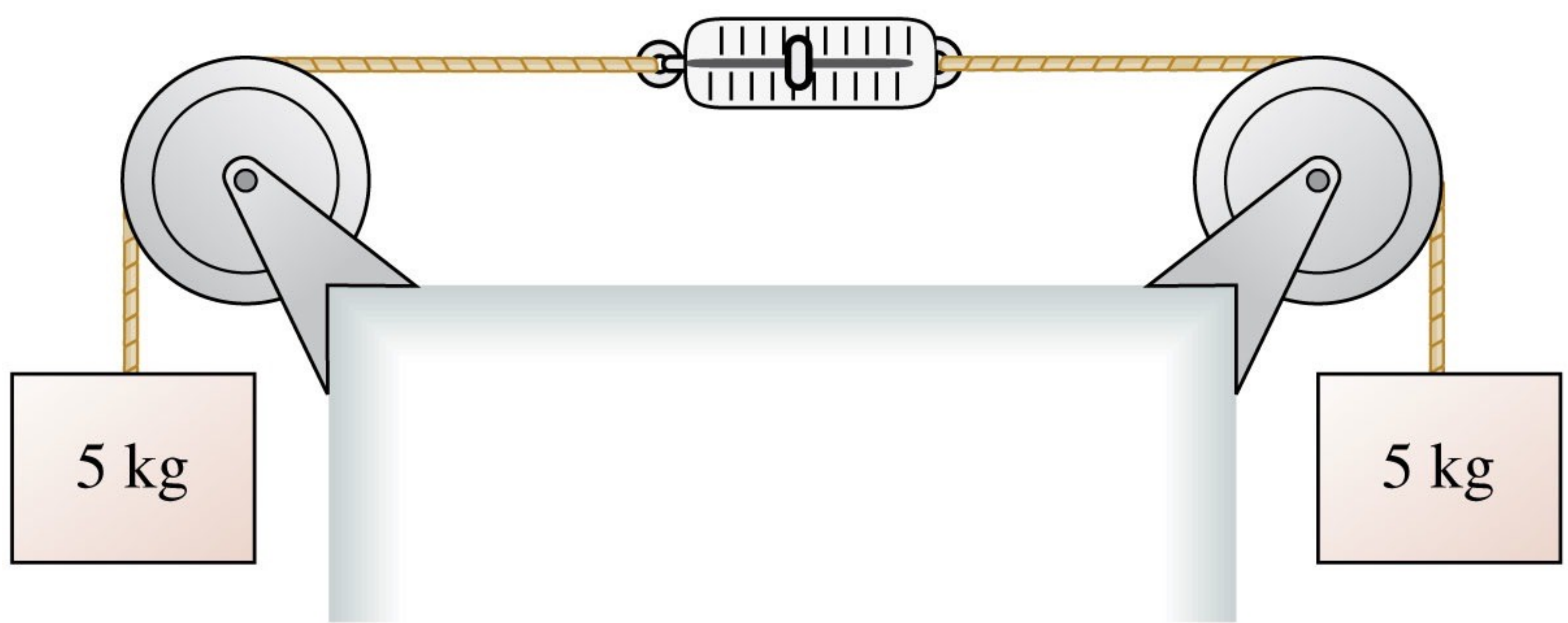
e. $F_{\text{B on H}} = F_{\text{H on B}} > F_{\text{A on B}} = F_{\text{B on A}}$



Question #13

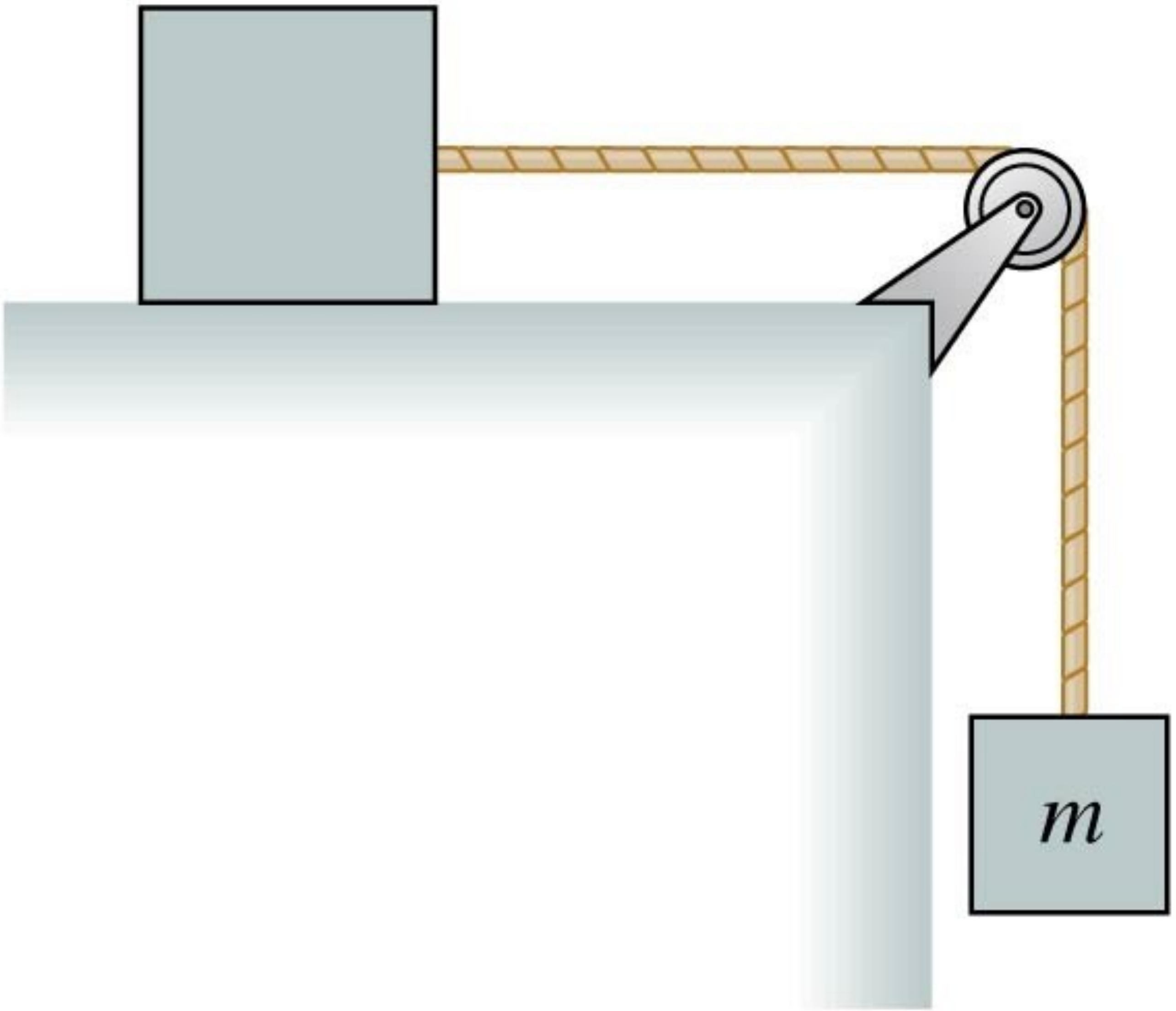
The two masses are at rest. The pulleys are frictionless. The scale is in kg. The scale reads

A. 0 kg.
B. 5 kg.
C. 10 kg.



Question #14

The top block is accelerated across a frictionless table by the falling mass *m*. The string is massless, and the pulley is both massless and frictionless. The tension in the string is



a..
b. $T = mg$.
c. $T > mg$.
d. $T < mg$.

Question #15

Block A is accelerated across a frictionless table. The string is massless, and the pulley is both massless and frictionless. Which is true?

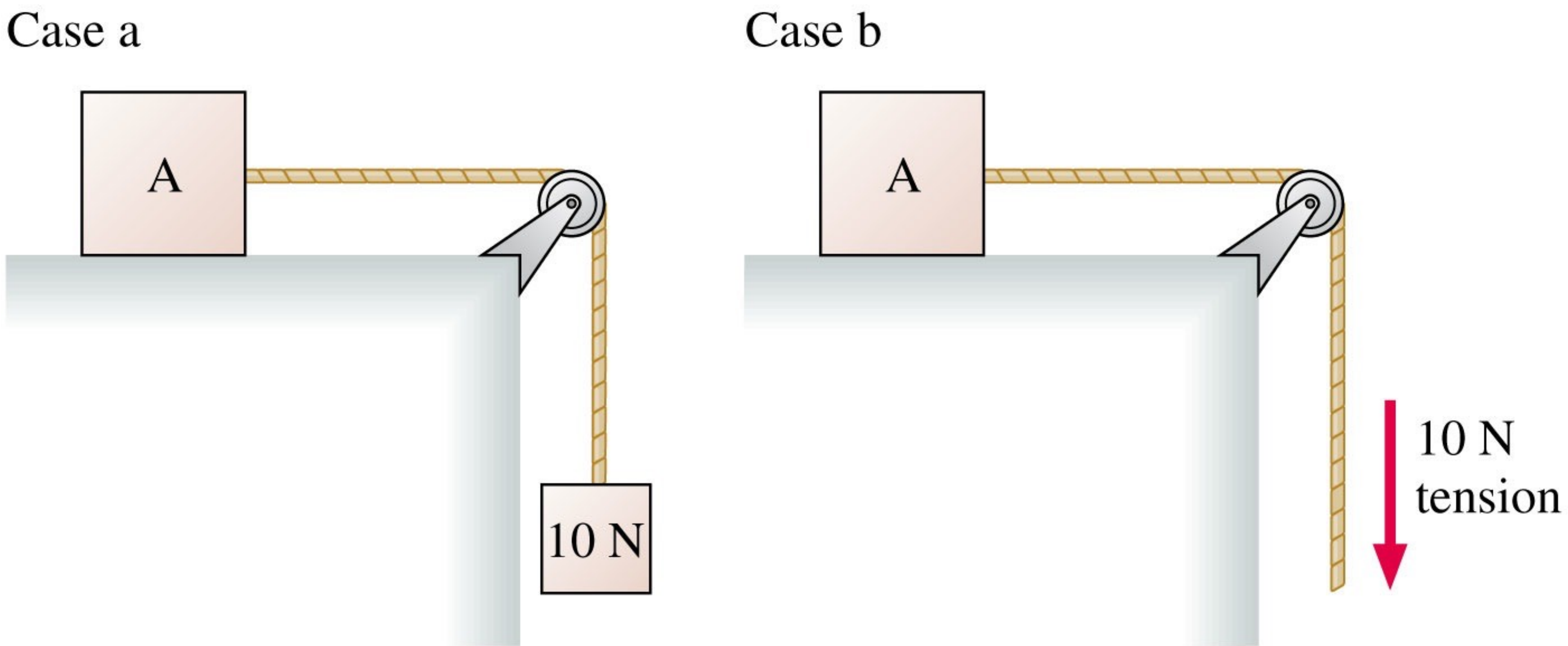
A. .

B. .

C. Block A has the same acceleration in case a and case b.

D. Block A accelerates faster in case b than in case a.

E. Block A accelerates faster in case a than in case b.

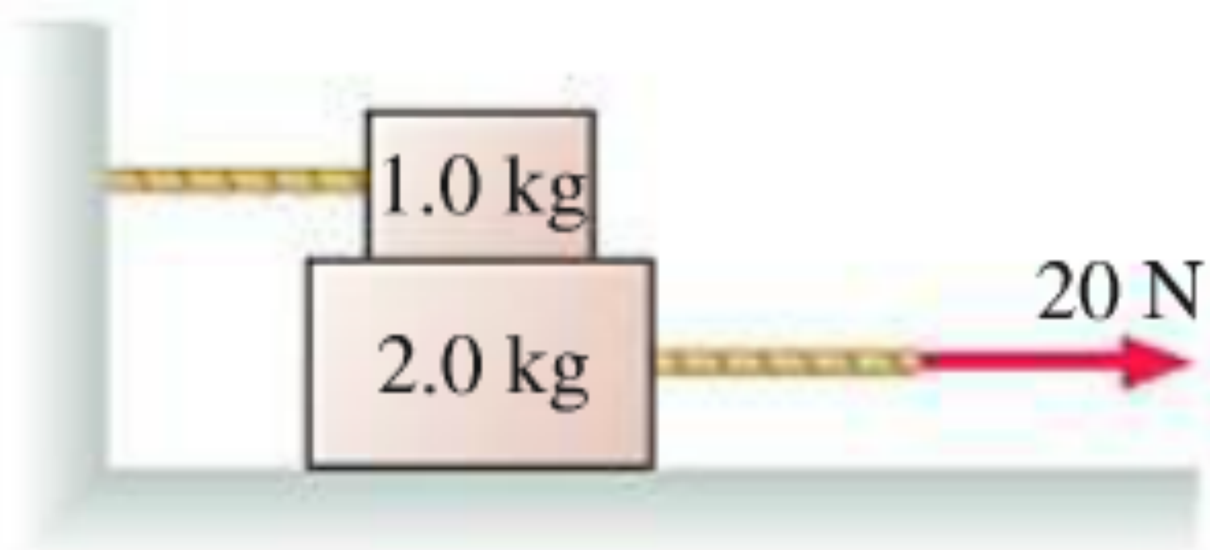


Harder Problem

The 1.0 kg block in the figure is tied to the wall with a rope. It sits on top of a 2.0 kg block. The lower block is pulled to the right with a 20 N tension force. The coefficient of kinetic friction between all surfaces is 0.40.

a) What is the tension in the rope holding the 1.0 kg block?
b) What is the acceleration of the 2.0 kg block?

a) Draw the free body diagrams for both blocks (6 forces for bottom block and 4 forces on the top)
b) Identify the action/reaction pairs
c) Write down Newton's second law in the x and y directions for both blocks (4 equations)
d) Work on the math to solve the system of equations.



Example Problem with Pulleys

The 10.2 kg block is held in place by a force applied to the rope. Find the tensions T_1 to T_5 and the magnitude of F.