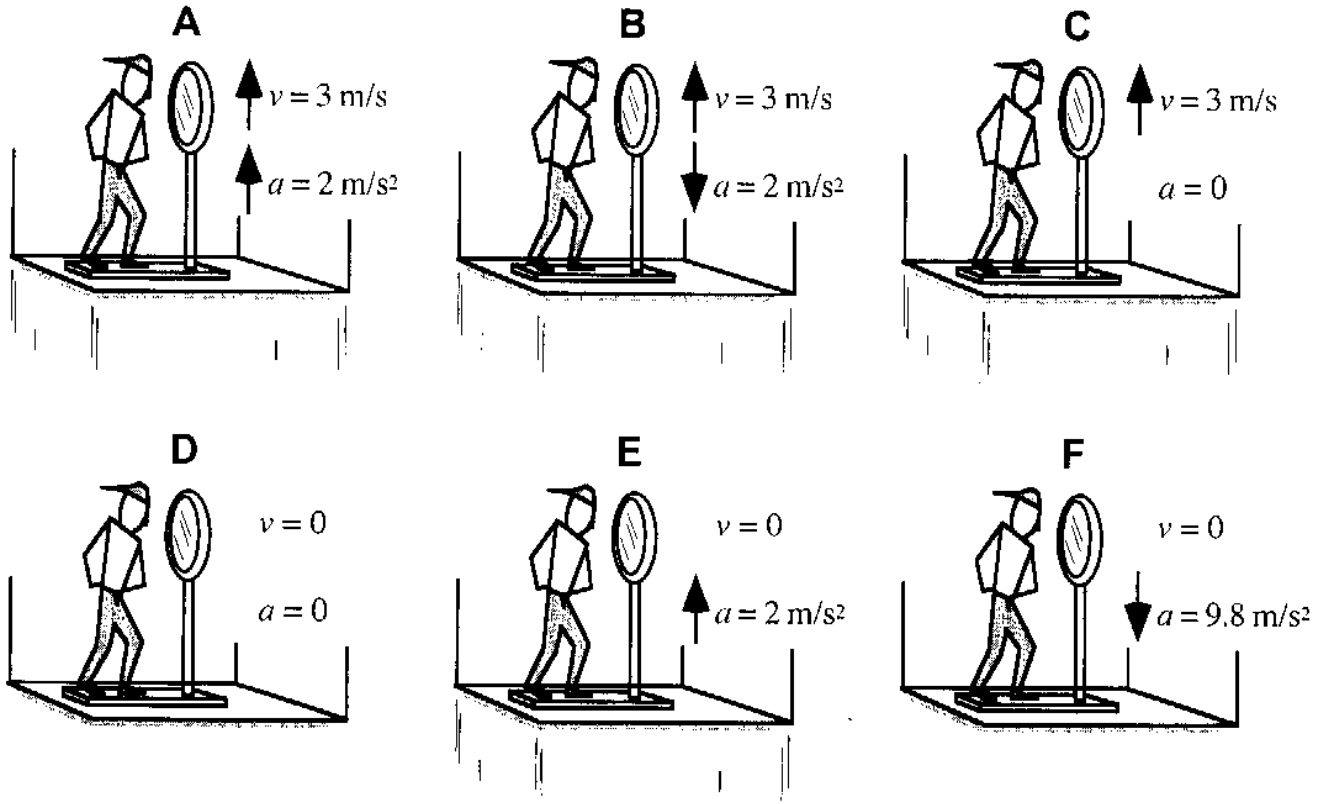
Forces

Ranking Tasks

Person in an Elevator Moving Upward—Scale Weight[38]

The figures below depict situations where a person is standing on a scale in six identical elevators. Each person weighs 600 N when the elevators are stationary. Each elevator now moves (accelerates) according to the specified arrow that is drawn next to it. In all cases where the elevator is moving, it is moving upward.

Rank the figures, from greatest to least, on the basis of the *scale weight* of each person as registered on each scale. (Use $g = 9.8\ \text{m/s}^2$.)



Greatest 1 A E 2 _____ 3 C D 4 _____ 5 B 6 F Least

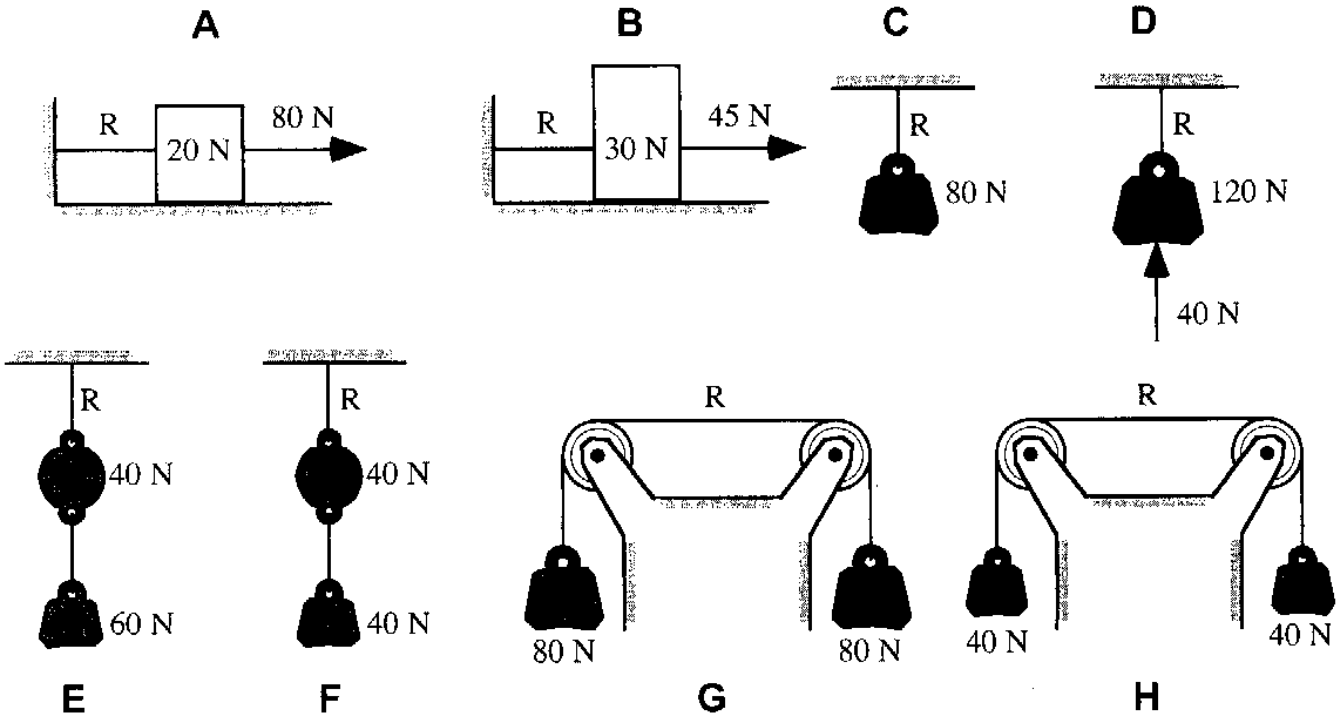
Or, all of the scales read the same weight. _____

Or, all of the scales read zero weight. _____

Blocks Attached to Fixed Objects—Rope Tension[24]

The eight figures below show various situations where blocks of different weights are attached by ropes to rigidly fixed objects or to other blocks, which are attached to fixed objects. The situations differ in a number of ways, as the figures show. The weights of the blocks are given in the figures, as well as the magnitudes and directions of any other forces that may be acting. Our interest is solely in the rope that is designated R in each figure.

Rank these arrangements, from greatest to least, on the basis of the tension in the rope R. That is, put first the arrangement where rope R is under the greatest tension and put last the arrangement where rope R is under the least tension.



Greatest 1 E 2 ____ 3 ACDFG 4 ____ 5 ____ 6 ____ 7 B 8 H Least

Or, all the ropes marked R are under the same tension (but not zero). _____

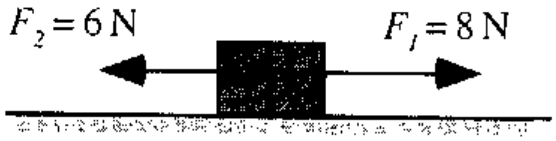
Or, there is no tension in any of these ropes. _____

Forces on Objects on Smooth Surfaces—Velocity Change[34]

Two forces act on an object that is on a frictionless surface, as shown below.

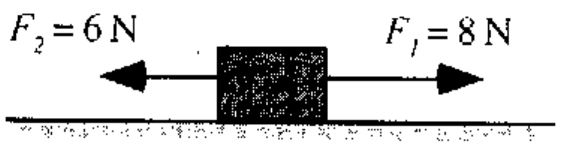
Rank these situations from greatest change in velocity to least change in velocity. (Note: All vectors directed to the right are positive, and those to the left are negative. Also, 0 m/s > -10 m/s.)

A



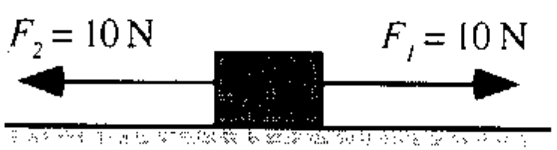
m = 4 kg

B



m = 2 kg

C

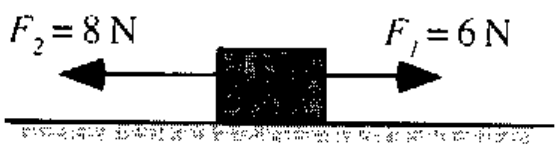


m = 2 kg

D

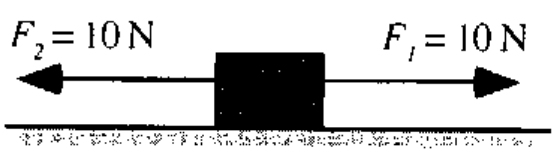
m = 4 kg

E



m = 2 kg

F



m = 4 kg

Greatest 1 B 2 A 3 _____ 4 CF 5 D 6 E Least

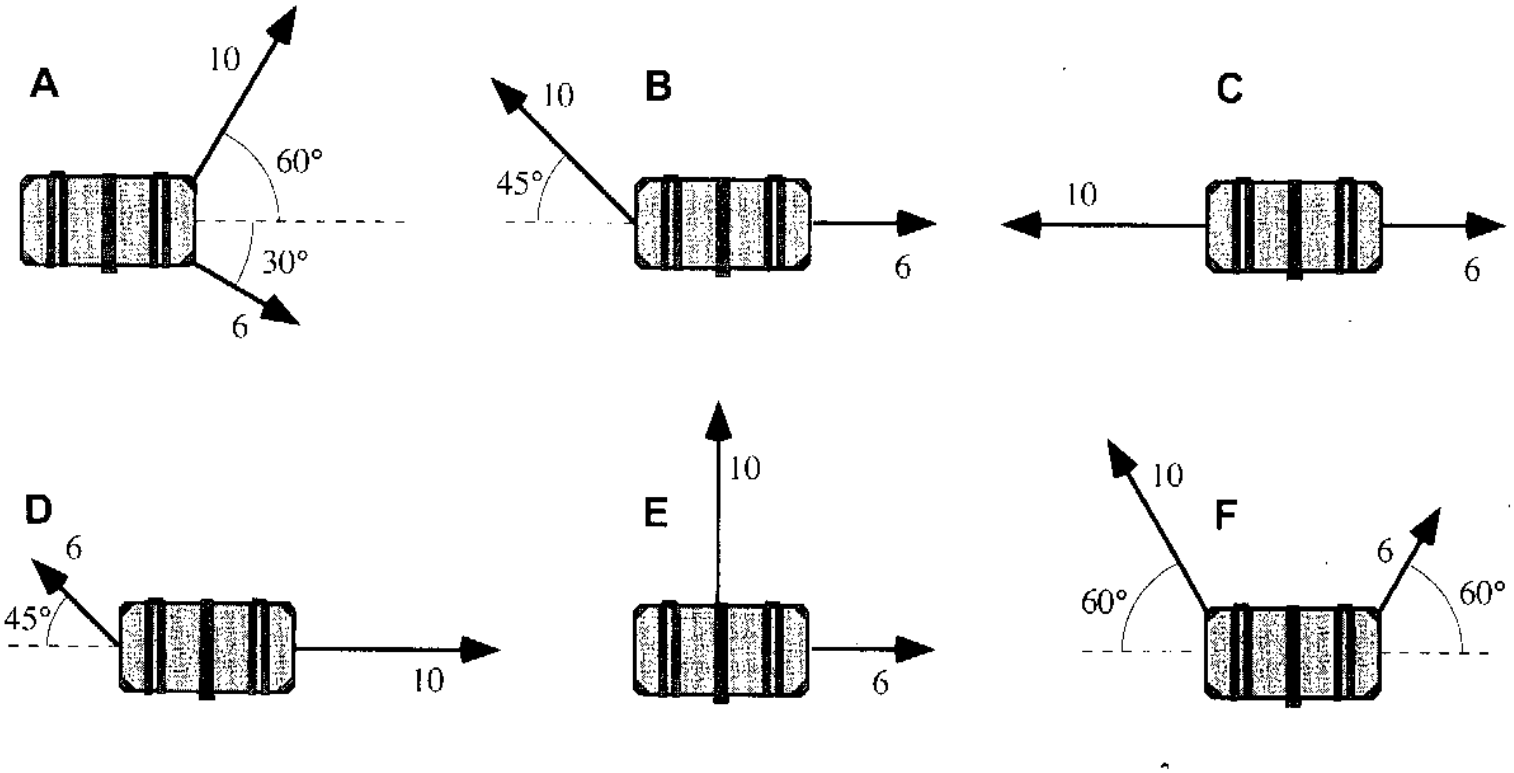
Or, the change in velocity is the same in all cases. _____

Or, the velocity will not change in any of these situations. _____

Two-Dimensional Forces on a Treasure Chest—Acceleration[18]

The six figures below represent treasure chests with two forces acting on them. We are looking down on the chests from above. The lengths of the force vectors represent the magnitude of the force. All chests have the same mass.

Rank these situations from greatest to least with regard to the resulting magnitude of acceleration of the treasure chest.



Greatest 1 F 2 AE 3 _____ 4 BD 5 _____ 6 C Least

Or, all of these treasure chests have the same magnitude of acceleration. _____

Moving Car and Boat Trailer—Force Difference[31]

In the six figures below, all the boat trailers and cars are identical but the boat trailers have different loads.

Rank from greatest to least on the basis of the difference between the strength (magnitude) of the force the car exerts on the boat trailer, and the strength of the force the boat trailer exerts on the car.

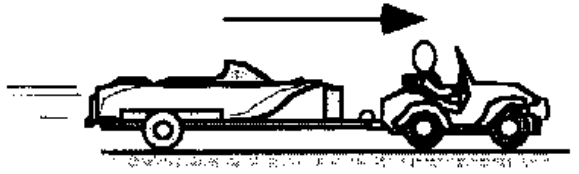
A

$m = 1000$ kg $v_f = 20$ m/s

B

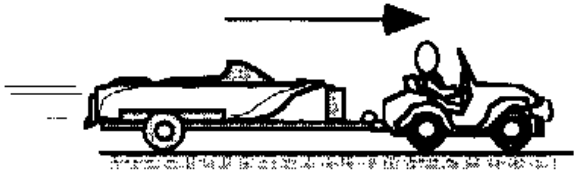
$m = 2000$ kg $v_f = 20$ m/s

C



$m = 1000$ kg $v_f = 40$ m/s

D

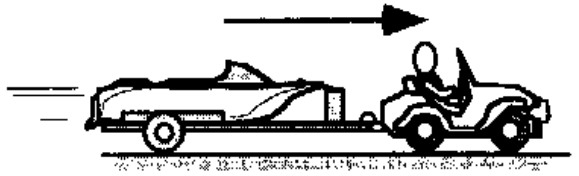


$m = 4000$ kg $v_f = 10$ m/s

E

$m = 2000$ kg $v_f = 10$ m/s

F



$m = 1000$ kg $v_f = 10$ m/s

Greatest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ Least

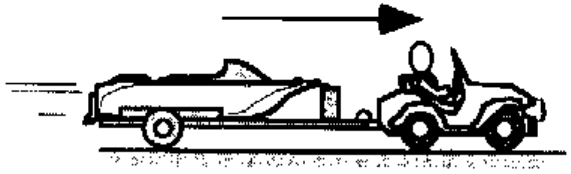
Or, the differences between the two forces are the same in each situation. ABCDEF

Accelerating Car and Boat Trailer—Force Difference[32]

In the six figures below, all the trailers and cars are identical but the boat trailers have different loads.

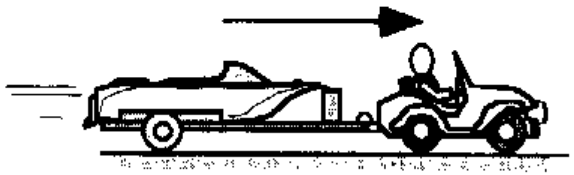
Rank from greatest to least on the basis of the difference between the strength (magnitude) of the force the car exerts on the boat trailer and the strength of the force the trailer exerts on the car during the period when the boat trailers are accelerating from rest to the given final speeds.

A



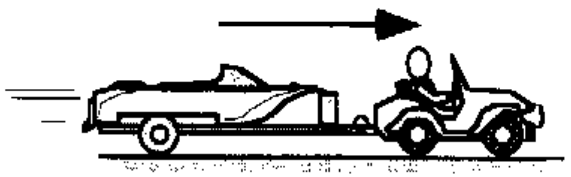
$m = 1000$ kg $v_f = 20$ m/s

B



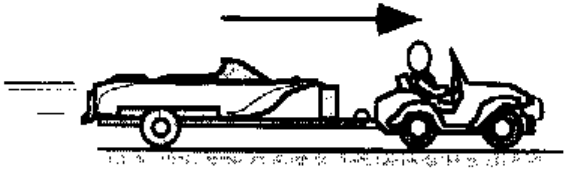
$m = 2000$ kg $v_f = 20$ m/s

C



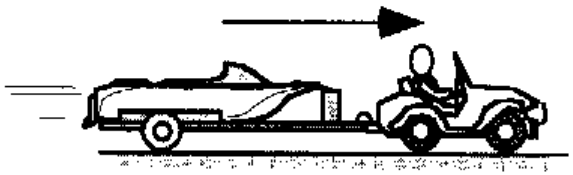
$m = 1000$ kg $v_f = 40$ m/s

D



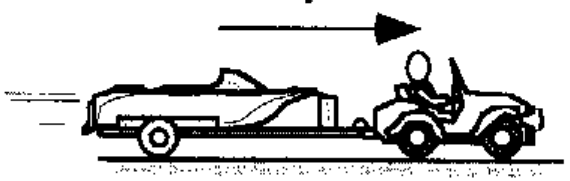
$m = 4000$ kg $v_f = 10$ m/s

E



$m = 2000$ kg $v_f = 10$ m/s

F



$m = 1000$ kg $v_f = 10$ m/s

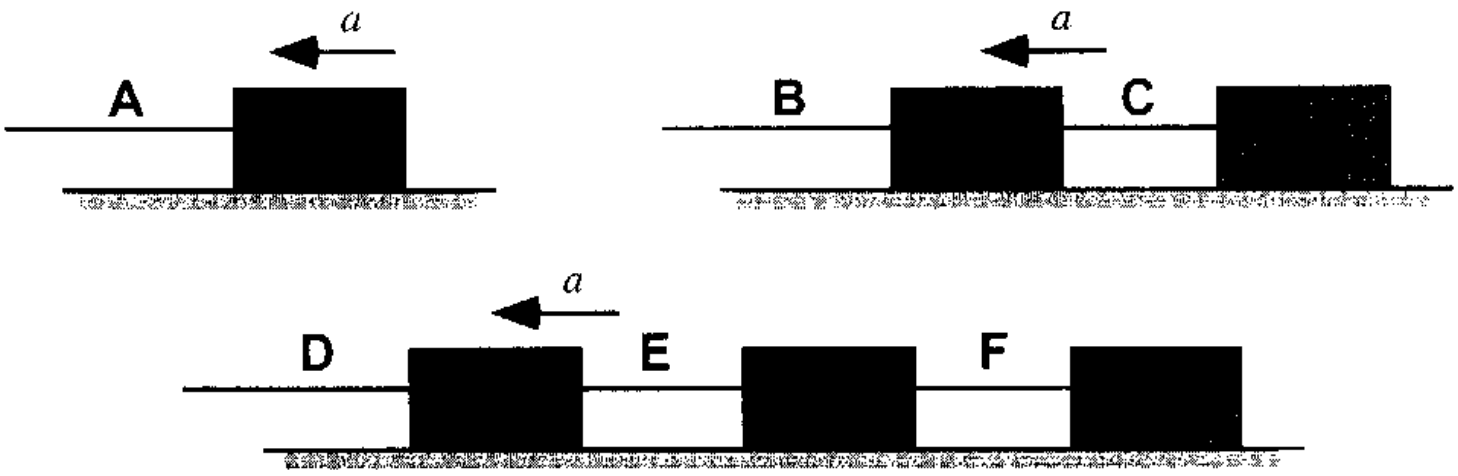
Greatest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ Least

Or, the differences between the two forces are the same in all situations. ABCDEF

Ropes Pulling Boxes—Rope Tension[29]

The figures below show boxes that are being pulled by ropes along frictionless surfaces, accelerating toward the left. All of the boxes are identical, and the acceleration is the same in each figure. As you can see, some of the boxes are pulled by ropes attached to the box in front of them.

Rank the ropes from greatest to least on the basis of the tension in the rope.



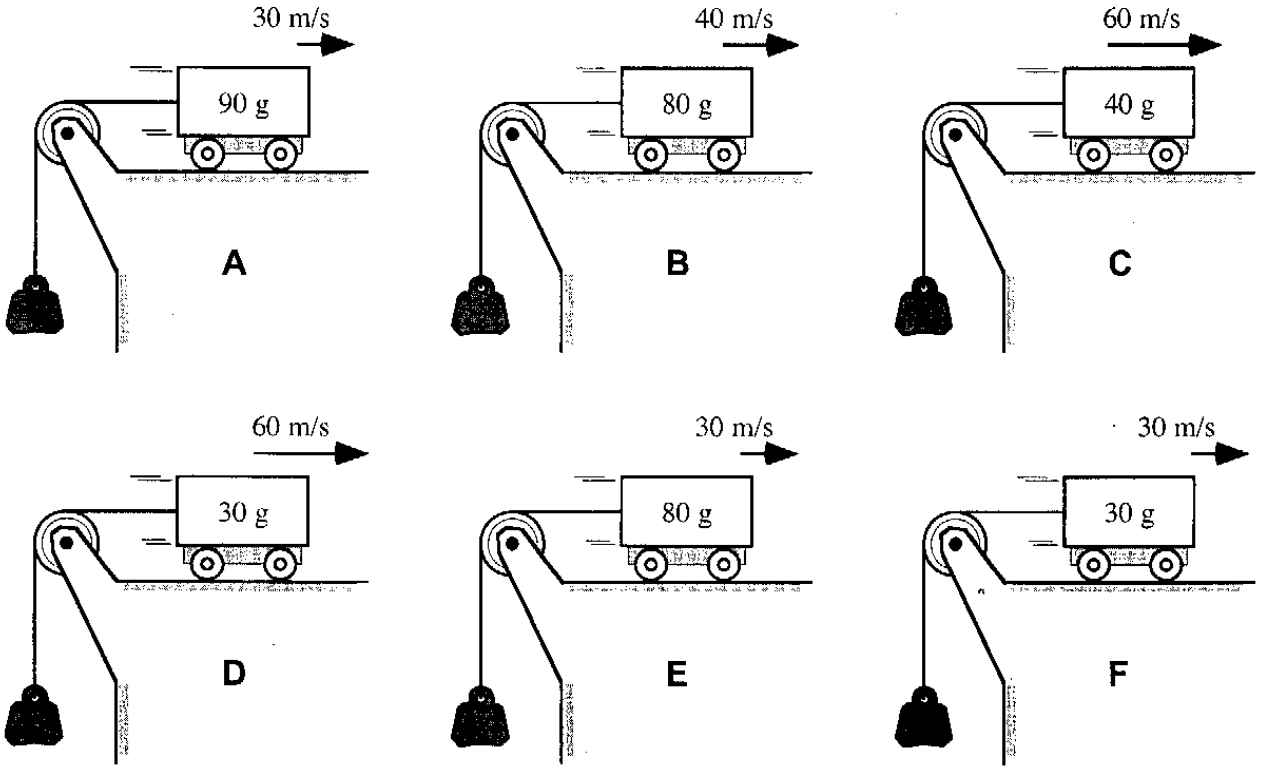
Greatest 1 D 2 _____ 3 B E 4 _____ 5 _____ 6 A C F Least

Or, all of the tensions will be the same. _____

Carts Moving Along Horizontal Surface—String Tension[14]

The six figures below show carts that are moving along horizontal surfaces at various speeds. The carts are the same size and shape but carry different loads, so their masses differ. All of the carts have a massless string attached, which passes over a frictionless massless pulley and is tied to a metal block that is hanging free. All of the metal blocks are identical. As the carts move to the right they pull the blocks up toward the horizontal surface, which is the top of the table.

Rank these situations, from greatest to least, on the basis of the tension in the strings at the instant shown. That is, put first the situation where the string is under the greatest tension, and put last the situation where the string is under the least tension at that instant.



Greatest 1 A 2 _____ 3 BE 4 C 5 _____ 6 DF Least

Or, all of these strings are under the same tension. _____

Or, there is no tension in any of these strings. _____