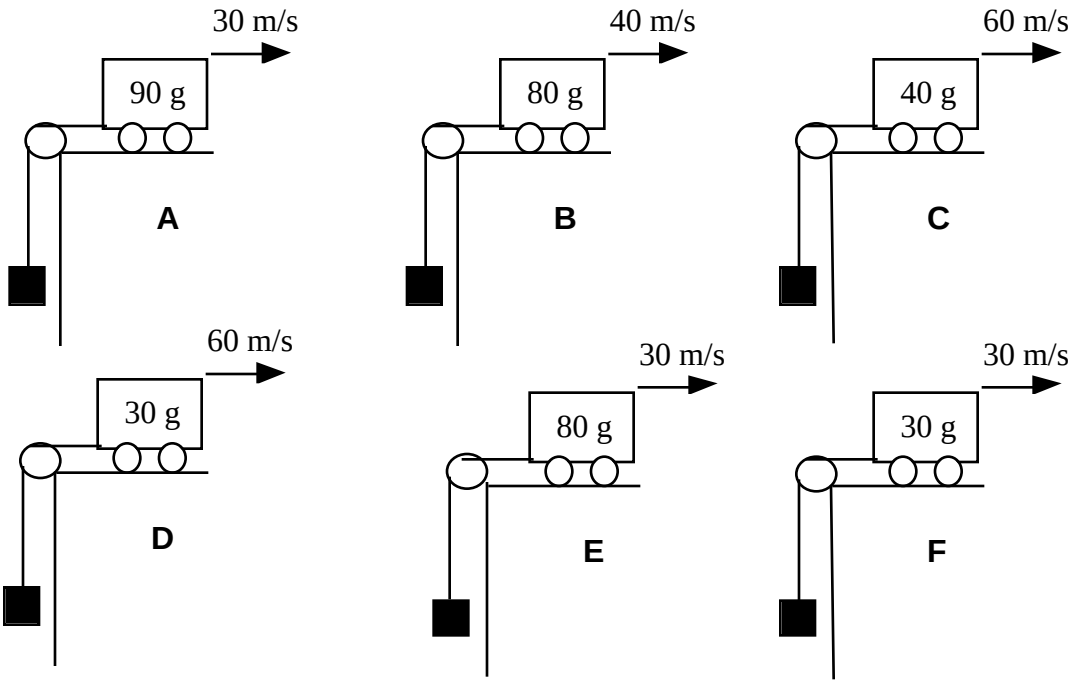
Carts Moving Along Horizontal Surface—String Tension [14]

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_____ 2_____ 3_____ 4_____ 5_____ 6_____ Least

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

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

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

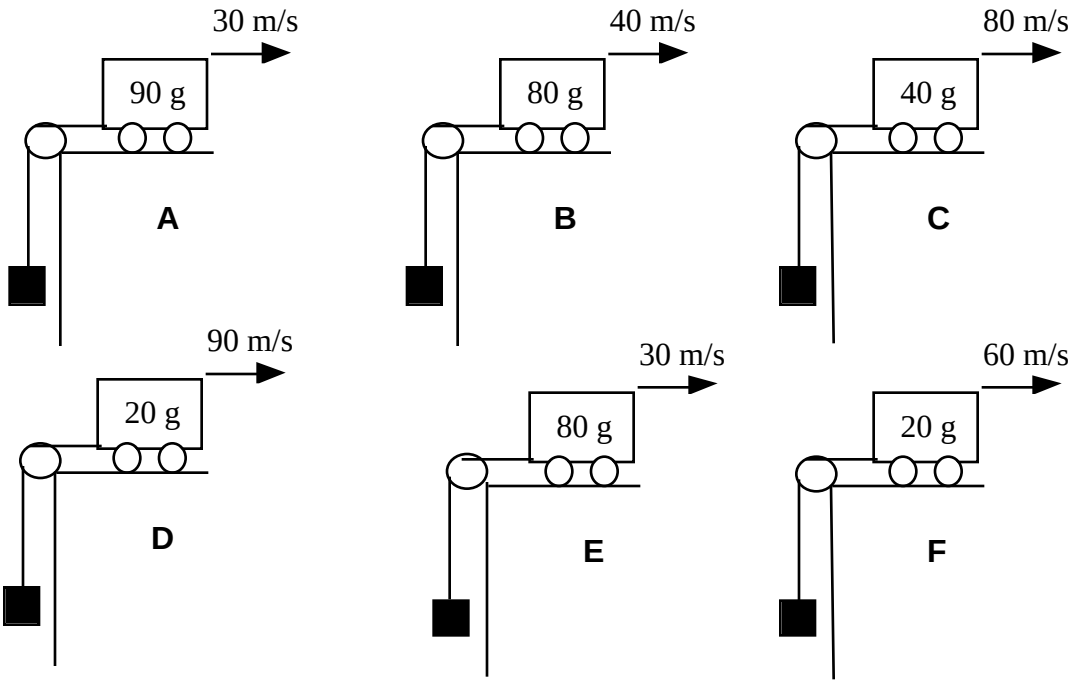
Basically Guessed				Sure				Very Sure	
1	2	3	4	5	6	7	8	9	10

[14] D. Maloney

Carts Moving Along Horizontal Surface—Acceleration [15]

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 string attached, which passes over a 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 will 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 magnitude of the acceleration of the carts. That is, put first the situation where the cart has the greatest acceleration, and put last the situation where the cart has the smallest acceleration.



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

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

Or, there is no acceleration in any of these carts. _____

Please carefully explain your reasoning.

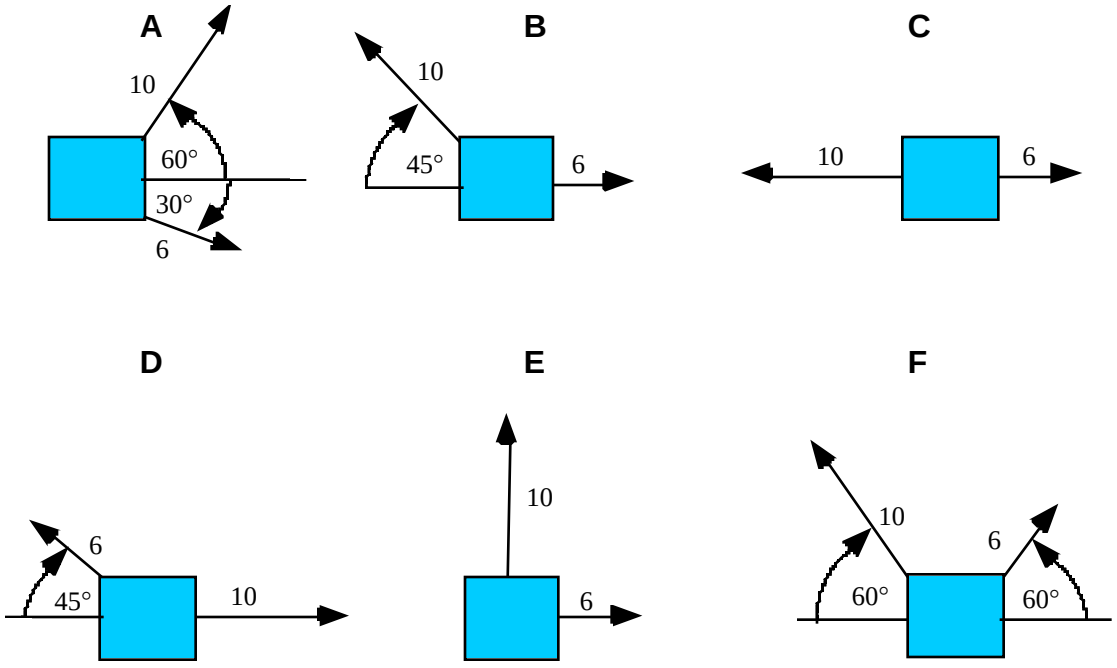
How sure were you of your ranking? (circle one)

Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[15] D. Maloney

Two-Dimensional Forces on a Treasure Chest—Final Speed [17]

The six figures below show treasure chests with two forces acting upon them. The lengths of the force vectors represent the magnitudes of the forces. Rank these situations from greatest to least with regard to the final speed of the treasure chest after 2 seconds. All chests start at rest. If you believe that two of the situations have the same final speed, place both of their letters at the same rank.



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

Or, all of these treasure chests have the same final speed. _____
Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

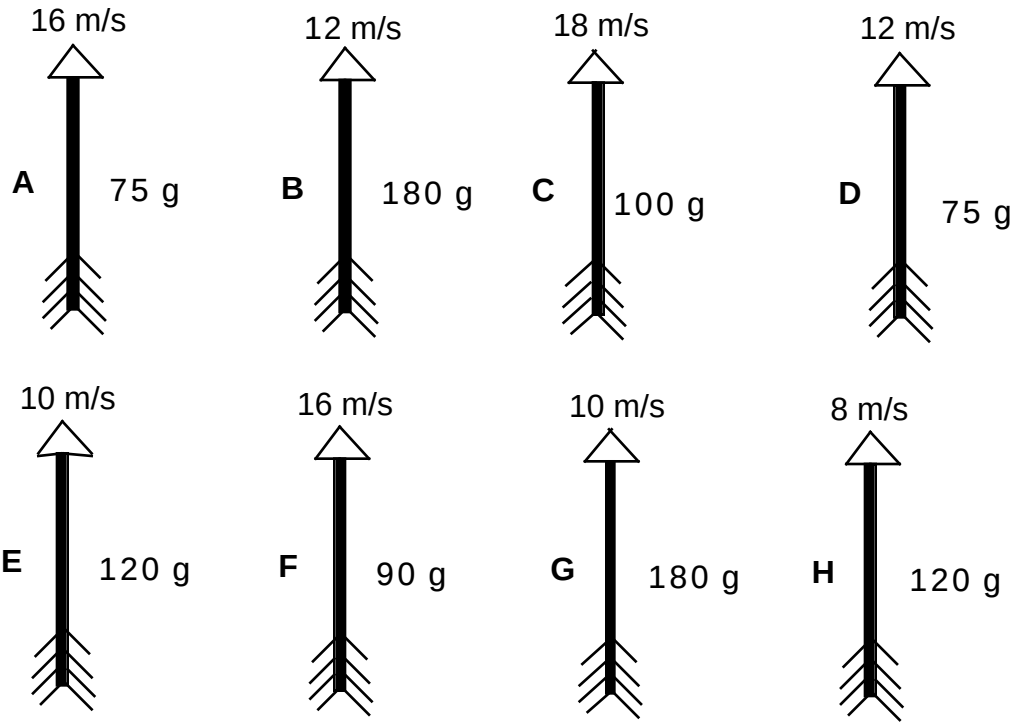
Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[17] K. W. Nicholson, D. Maloney, T. O'Kuma

Arrows—Acceleration[19]

The eight figures below show arrows that have been shot into the air. All of the arrows were shot straight up and are the same size and shape. The arrows are made of different materials so they have different masses, and they have different speeds as they leave the bows. The values for each arrow are given in the figures. (We assume for this situation that the effect of air resistance can be neglected.) All start from same height.

Rank these arrows, from greatest to least, on the basis of the acceleration of the arrows at the top of their flight.



Greatest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ 7_____ 8_____ Least

All arrows have the same acceleration but not zero. _____

The acceleration at the top is zero for all these. _____

Please carefully explain your reasoning.

How sure were you of your ranking?

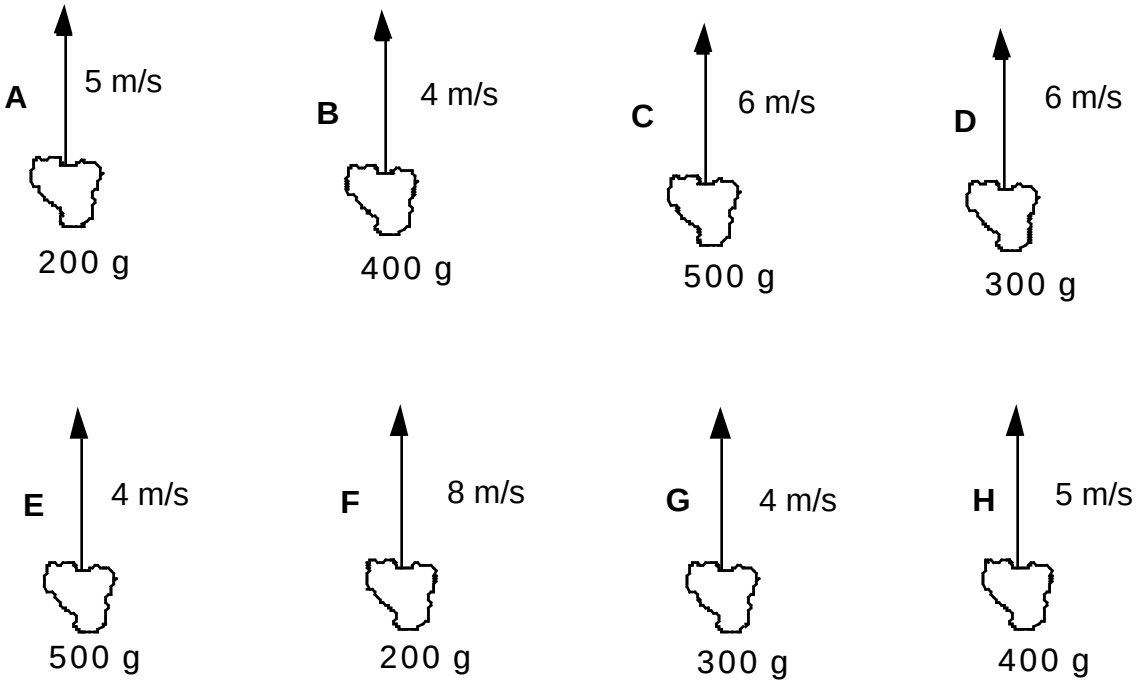
Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[19] T. O'Kuma, D. Maloney

Rocks Thrown Upward—Net Force[20]

Shown below are eight rocks that have been thrown straight up into the air. The rocks all have the same shape, but they have different masses. The rocks are all thrown straight up, but at different speeds. The masses of the rocks and their speeds when released are given in the figures. (We assume for this situation that the effect of air resistance can be ignored.) All start from the same height.

Rank these rocks from greatest to least on the basis of the net force on the rocks after being thrown.



Greatest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ 7_____ 8_____ Least

Or, all rocks have the same net force on them but not zero. _____

Or, the net force on all these is zero. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

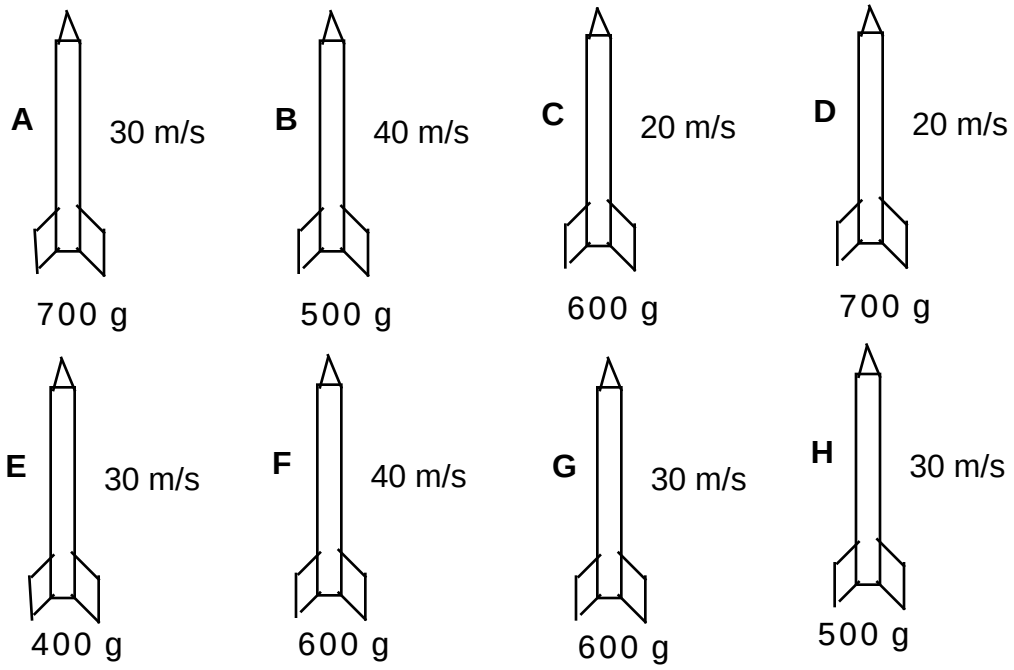
Basically Guessed					Sure				Very Sure
1	2	3	4	5	6	7	8	9	10

[20] T. O'Kuma, D. Maloney

Model Rockets Moving Upward—Net Force [21]

The eight figures below depict eight model rockets that have just had their engines turned off. All of the rockets are aimed straight up, but their speeds differ. All of the rockets are the same size and shape, but they carry different loads, so their masses differ. The specific mass and speed for each rocket is given in each figure. (In this situation, we are going to ignore any effect air resistance may have on the rockets.) At the instant when the engines are turned off, the rockets are all at the same height.

Rank these model rockets, from greatest to least, on the basis of the net force on them after the engines have turned off.



Greatest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ 7_____ 8_____ Least

Or, all rockets have the same net force on them (but not zero). _____

Or, the net force on all of these is zero. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

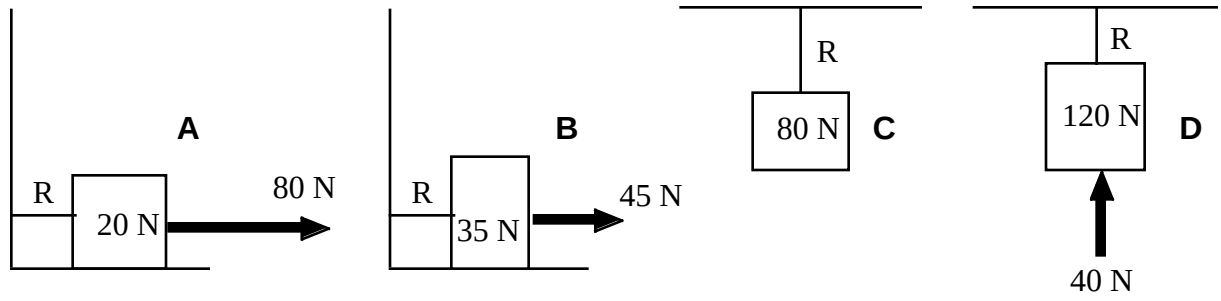
Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

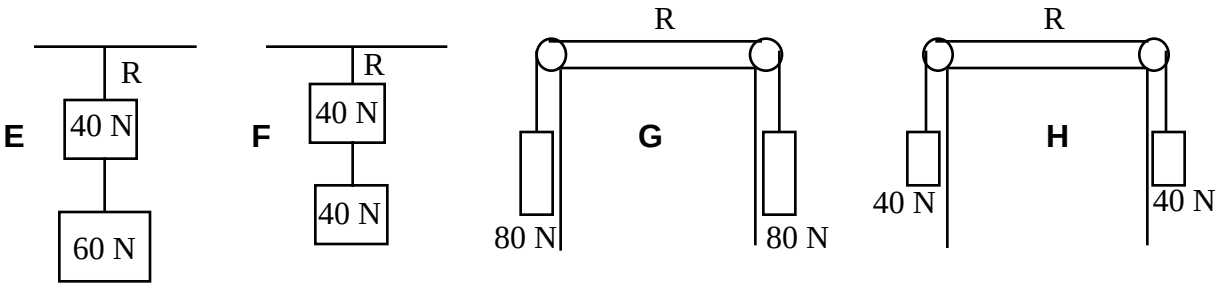
[21] T. O'Kuma

Blocks Attached to Fixed Objects—Rope Tension [22]

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_____ 2_____ 3_____ 4_____ 5_____ 6_____ 7_____ 8_____ 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. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

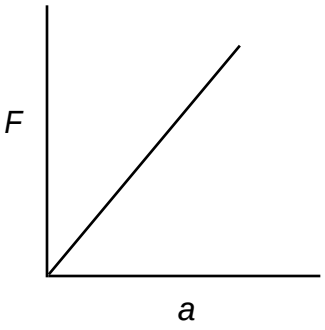
Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[22] D. Maloney

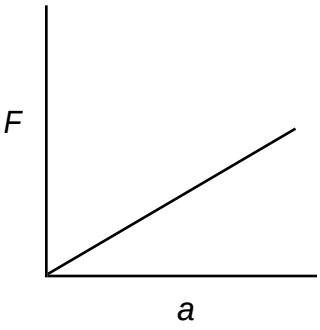
Force Acceleration Graphs—Mass [24]

The following graphs plot force vs. acceleration for several objects. Rank each situation according to mass. That is, order the situations from the largest to the smallest mass that the force is acting upon. All graphs have the same scale for each respective axis.

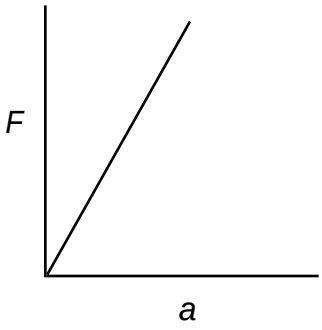
A



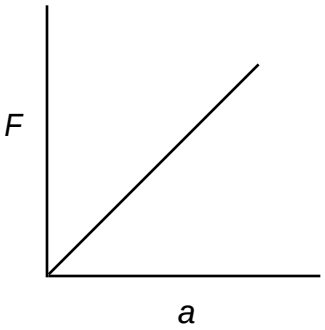
B



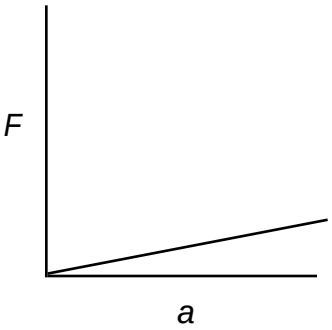
C



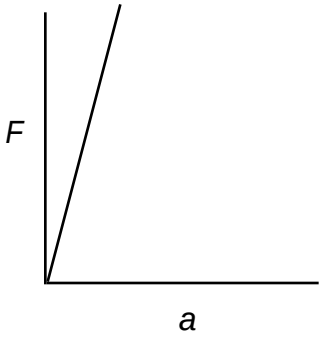
D



E



F



Largest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ Smallest

Or, all the masses are the same. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

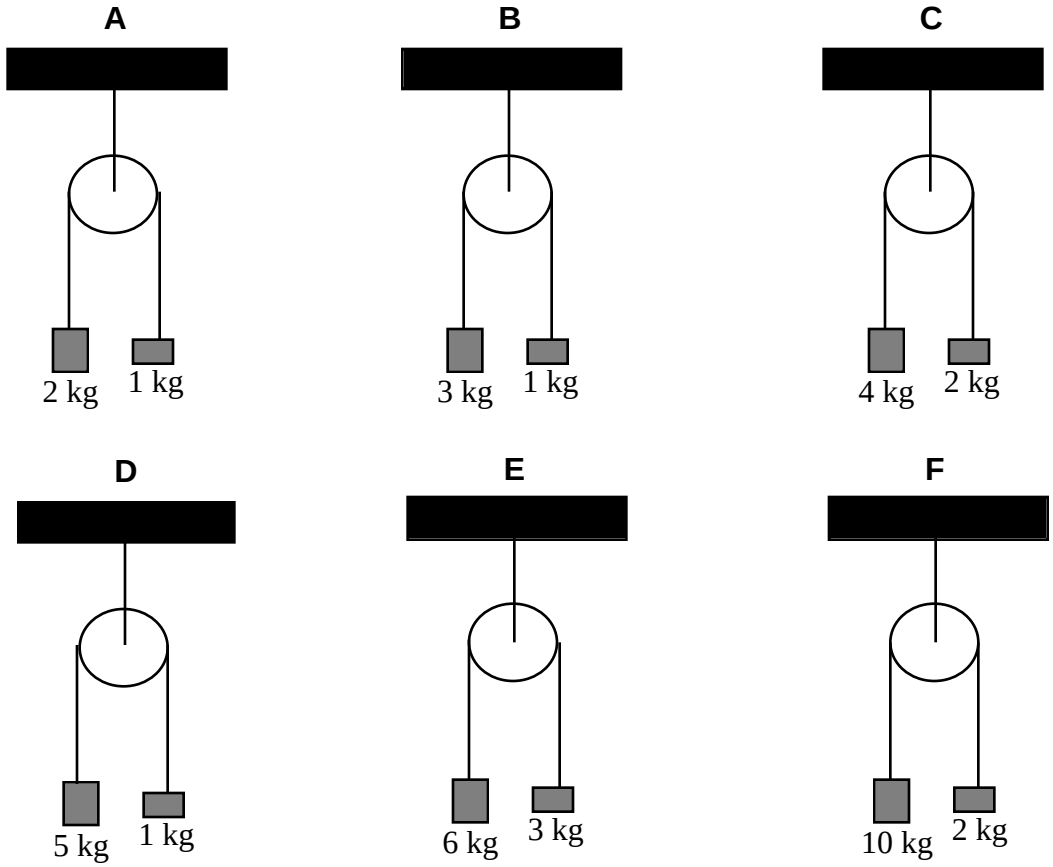
Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[24] D. Schramme, C. Fang, B. Speers

Two Different Blocks and a Pulley—Tension [25]

Each figure below shows two blocks hanging from the ends of a strong but massless string that passes over a frictionless pulley. In each figure, the block on the left is more massive than the block on the right, so the block on the left accelerates down, and the block on the right accelerates up. The mass of each block is given in the figures.

Rank the figures from greatest to least on the basis of the tension in the string for the system of blocks.



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

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

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

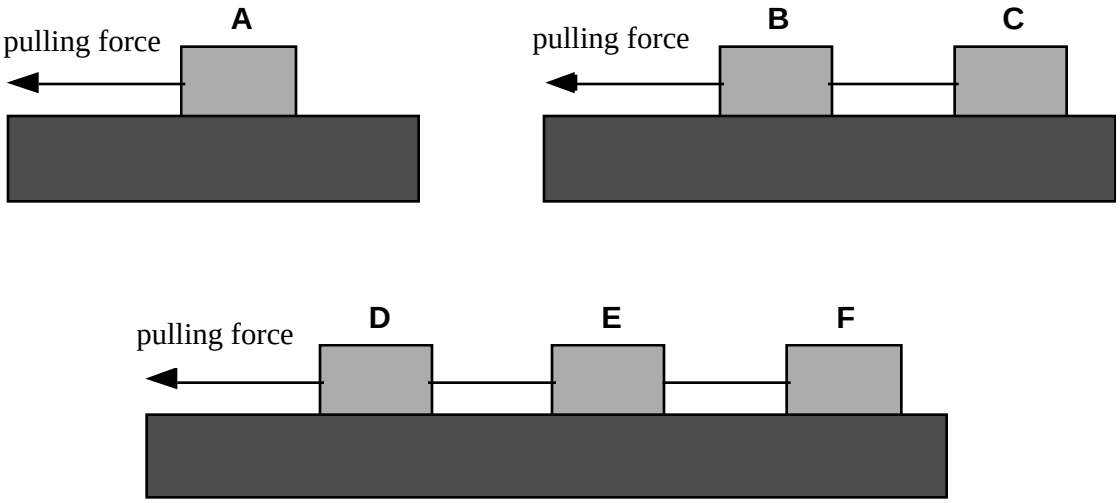
Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[25] S. Loucks, D. Maloney, T. O'Kuma

Ropes Pulling Boxes—Acceleration [26]

The figures below show boxes that are being pulled by ropes along frictionless surfaces, accelerating toward the left. All of the boxes are identical. The pulling force applied to the left-most rope 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 masses from greatest to least on the basis of the acceleration of the masses.



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

Or, all of the accelerations will be the same (but not zero). _____

Or, the acceleration will be zero for all of these blocks._____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

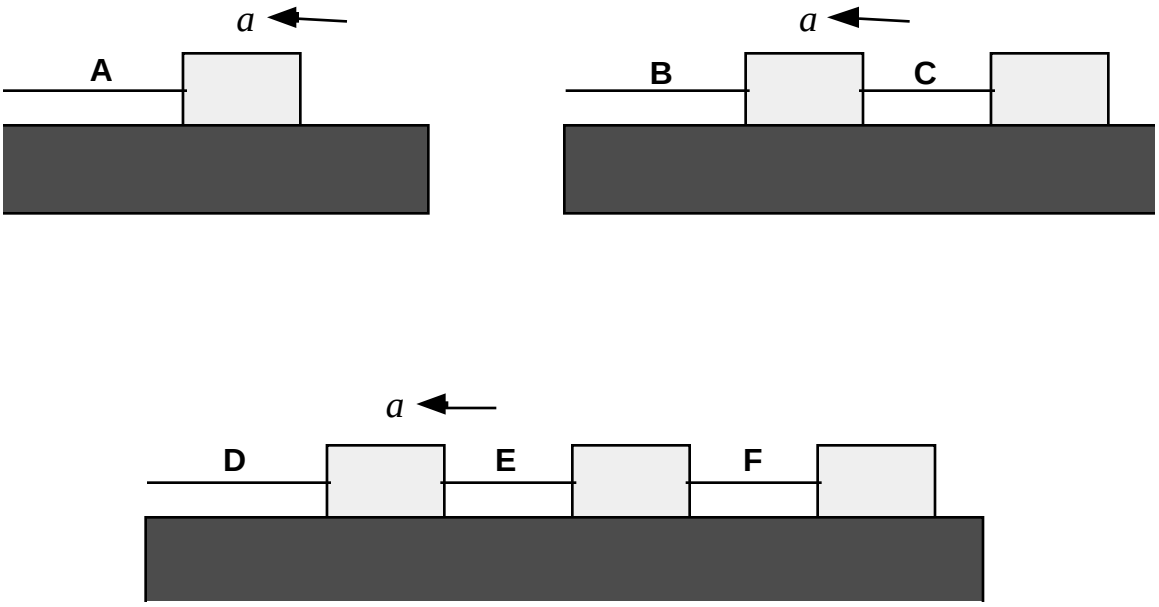
Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[26] S. Loucks

Ropes Pulling Boxes—Rope Tension [27]

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_____ 2_____ 3_____ 4_____ 5_____ 6_____ Least

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

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

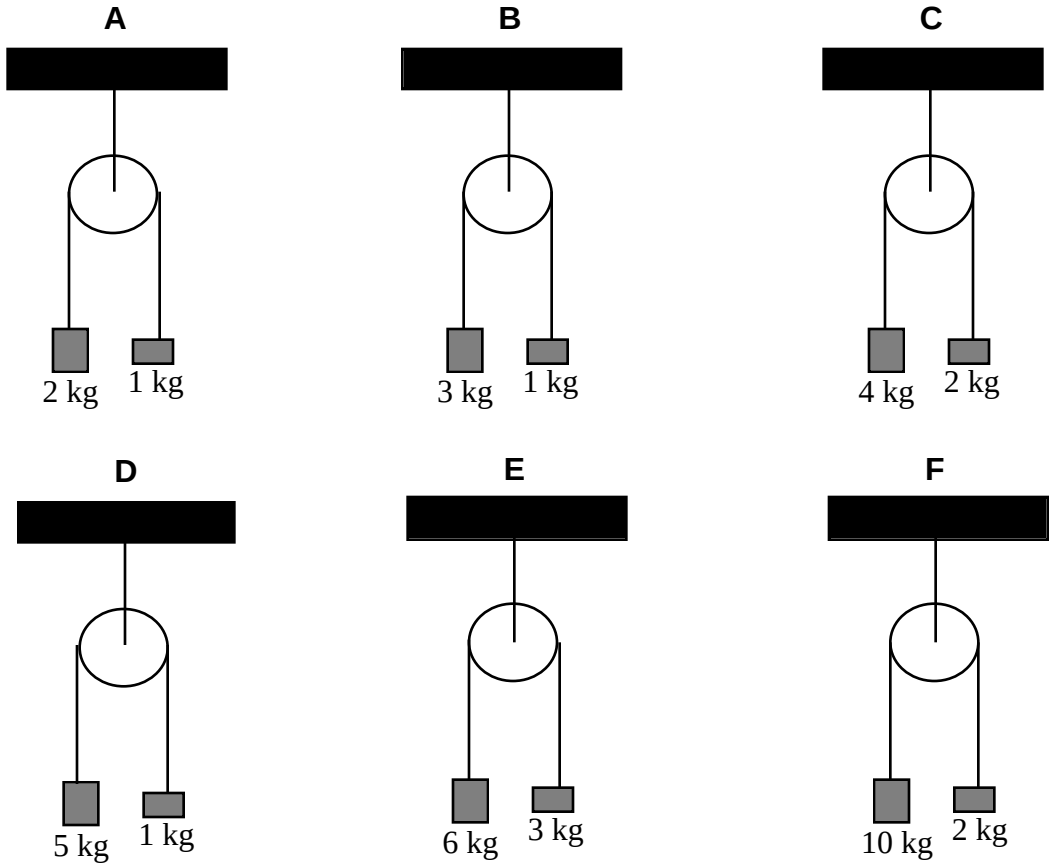
Basically Guessed				Sure				Very Sure	
1	2	3	4	5	6	7	8	9	10

[27] S. Loucks

Two Different Blocks and a Pulley—Net Force [28]

Each figure below shows two blocks hanging from the ends of a strong but massless string, which passes over a frictionless pulley. In each figure, the block on the left is more massive than the block on the right, so the block on the left accelerates down, and the block on the right accelerates up. The mass of each block is given in the figures.

Rank the figures from greatest to least on the basis of the net force that accelerates the system of blocks.



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

Or, all of the net forces will be the same (but not zero). ___

Or, the net force is zero for all of these. ____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

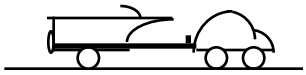
Basically Guessed				Sure				Very Sure	
1	2	3	4	5	6	7	8	9	10

[28] S. Loucks

Moving Car and Boat Trailer—Force Difference [29]

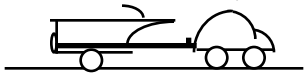
Rank, from greatest to least, on the basis of the difference between the strength (magnitude) of the force the car exerts on the boat trailer, and the strength of the force the boat trailer exerts on the car. All the boat trailers and cars are identical, but the boat trailers have different loads, so the boat trailers masses vary.

A



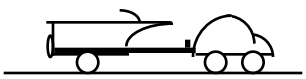
m = 1000 kg v_f = 20 m/s

B



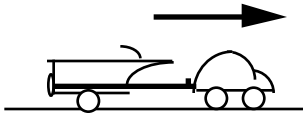
m = 2000 kg v_f = 20 m/s

C



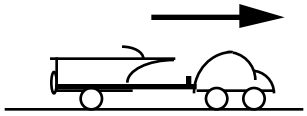
m = 1000 kg v_f = 40 m/s

D



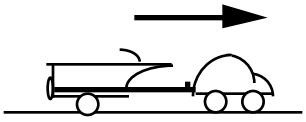
m = 4000 kg v_f = 10 m/s

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. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

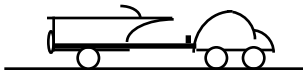
Basically Guessed				Sure				Very Sure	
1	2	3	4	5	6	7	8	9	10

[29] P. Golden, A. Dickison, D. Maloney, T. O'Kuma, C. Hieggelke

Accelerating Car and Boat Trailer—Force Difference [30]

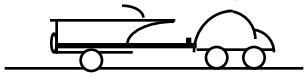
Rank from greatest to least on the basis of the difference between the strength (magnitude) of the force the car exerts on the boat trailer and the strength of the force the trailer exerts on the car during the period when the boat trailers are accelerating from rest to the given final speeds. All the trailers and cabs are identical, but the boat trailers have different loads, so the boat trailer masses vary.

A



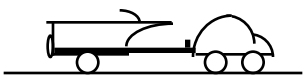
m = 1000 kg v_f = 20 m/s

B



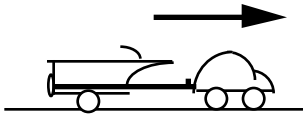
m = 2000 kg v_f = 20 m/s

C



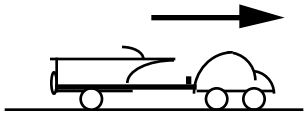
m = 1000 kg v_f = 40 m/s

D



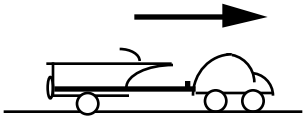
m = 4000 kg v_f = 10 m/s

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. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

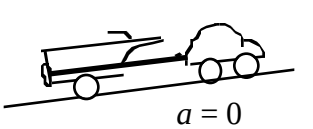
Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[30] P. Golden, A. Dickison, D. Maloney, T. O'Kuma, C. Hieggelke

Car and Boat Trailer on an Incline—Force Difference [31]

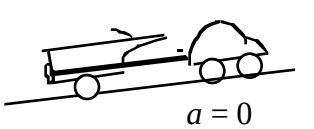
Rank from greatest to least on the basis of the difference between the strength (magnitude) of the force the car exerts on the boat trailer and the strength of the force the boat trailer exerts on the car. All the cars are identical, but the boat trailers have different loads, so the boat trailer masses vary as specified on the diagram. All inclines are the same.

A



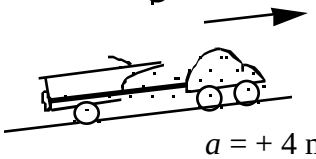
$a = 0$
m = 1000 kg v = +10 m/s

B



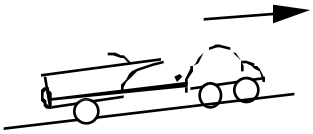
$a = 0$
m = 2000 kg v = +10 m/s

C



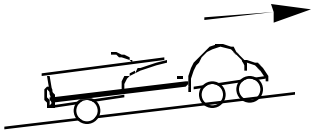
a = + 4 m/s/s
m = 2000 kg v = +20 m/s

D



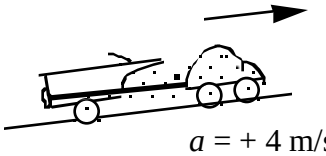
$a = 0$
m = 4000 kg v = +20 m/s

E



$a = 0$
m = 1000 kg v = +20 m/s

F



a = + 4 m/s/s
m = 1000 kg v = +20 m/s

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

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

Please carefully explain your reasoning.

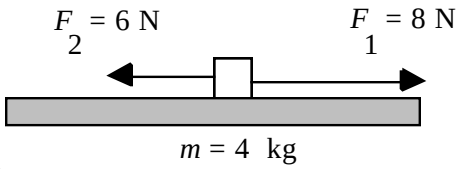
How sure were you of your ranking? (circle one)

Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

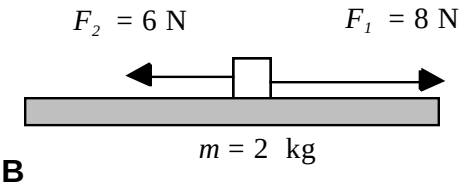
[31] P. Golden, A. Dickison, D. Maloney, T. O'Kuma, C. Hieggelke

Forces on Objects on Smooth Surfaces—Velocity Change [32]

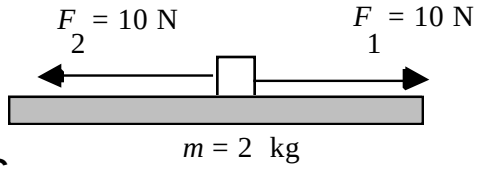
Two forces act on an object that is on a frictionless surface, as shown below. Rank these situations from greatest change in velocity to least change in velocity. (Note: All vectors directed to the right are positive, and those to the left are negative. Also, 0 m/s > -10 m/s.)



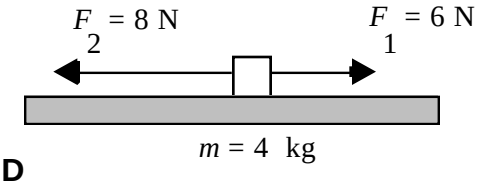
A



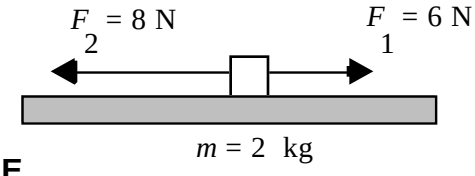
B



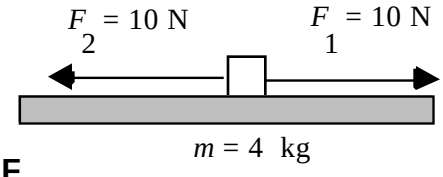
C



D



E



F

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

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

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

Please carefully explain your reasoning.

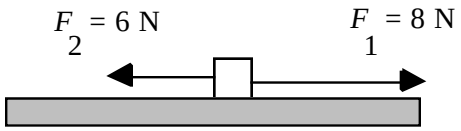
How sure were you of your ranking? (circle one)

Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

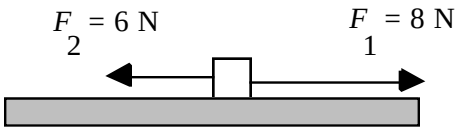
[32] R. Krupp

Forces on Objects on Smooth Surfaces—Speed Change [33]

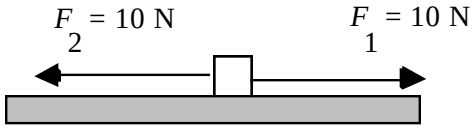
Two forces act on an object that is on a frictionless surface, as shown below. Rank these situations from greatest change in speed to least change in speed.



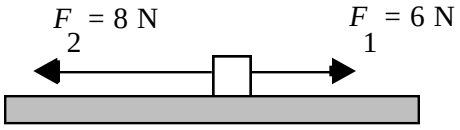
A



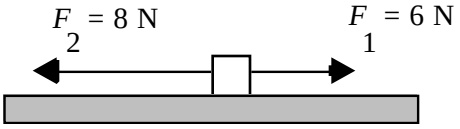
B



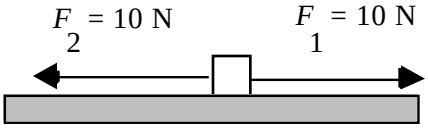
C



D



E



F

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

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

Or, the speed does not change for any of these cases. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

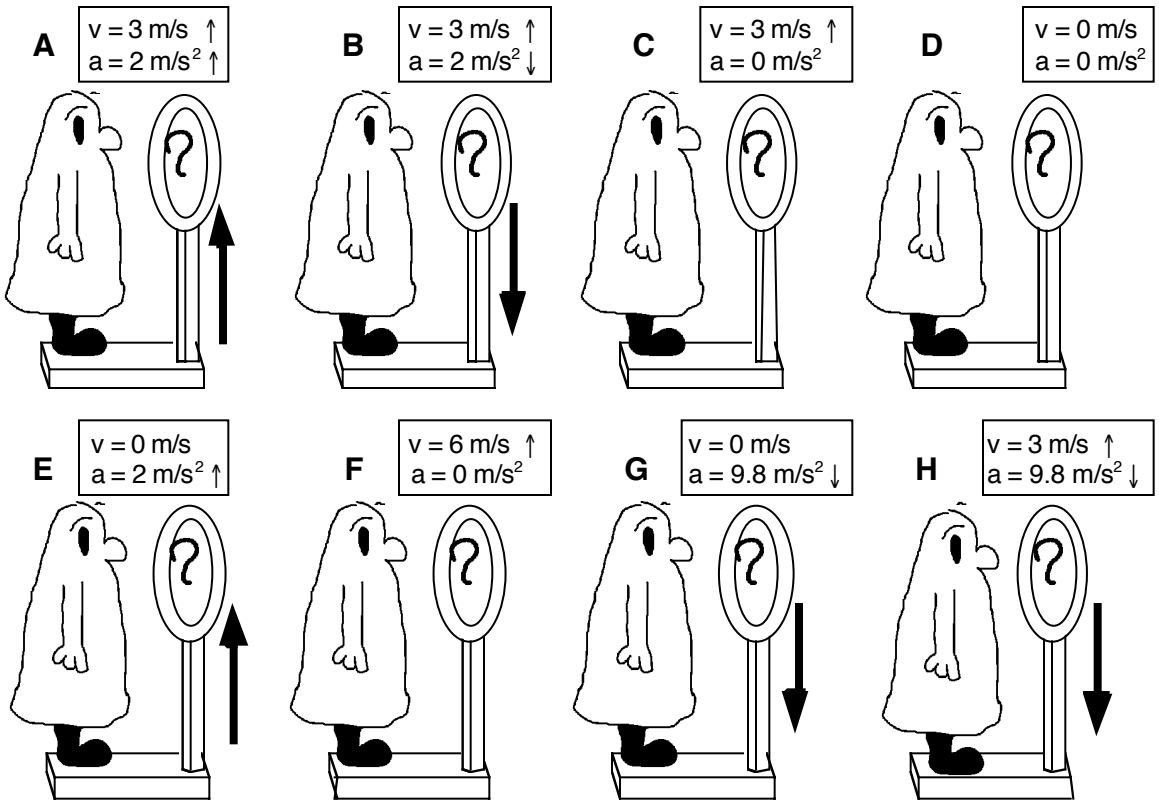
Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[33] R. Krupp

Person in an Elevator Moving Upward—Scale Weight [36]

The figures below depict situations where a person is standing on a scale in eight 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 $g = 9.8$ m/s^2.)



Greatest 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ Least

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

Or, all of the scales read zero weight. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

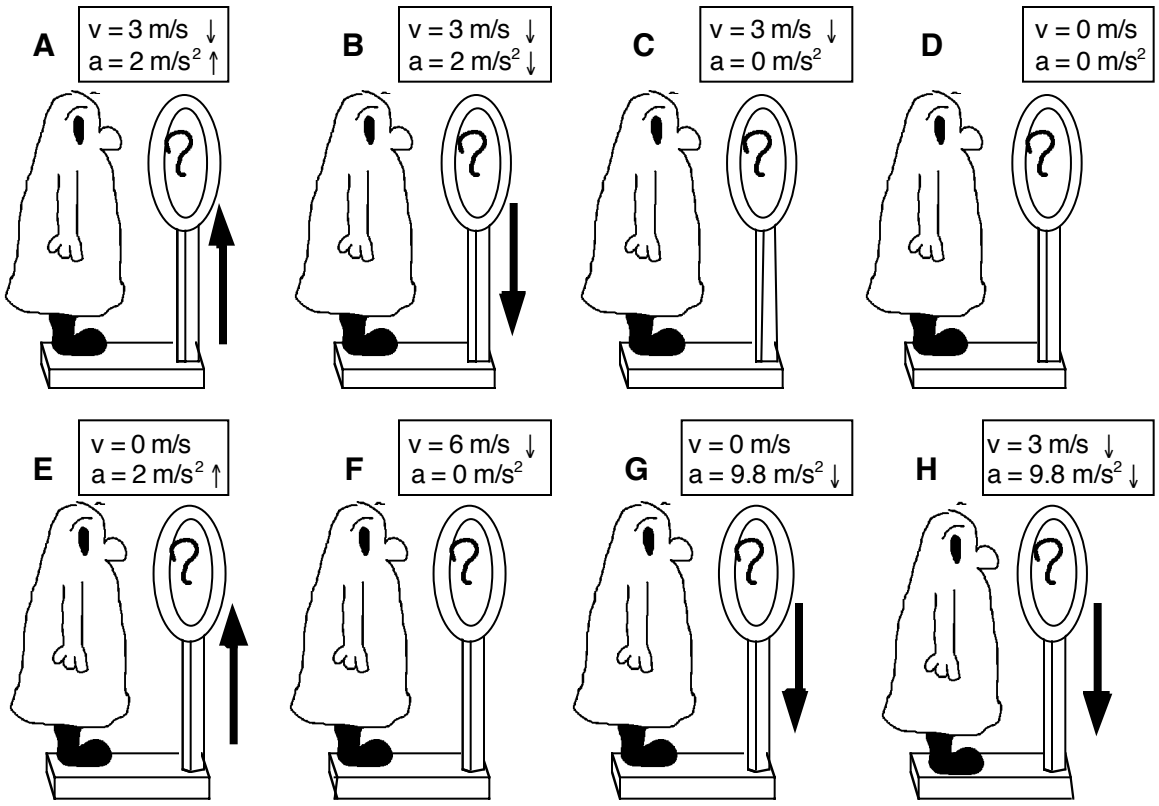
Basically Guessed				Sure				Very Sure	
1	2	3	4	5	6	7	8	9	10

[36] O. Karmon

Person in an Elevator Moving Downward—Scale Weight [37]

The figures below depict situations where a person is standing on a scale in eight 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 downward.

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



Greatest 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ Least

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

Or, all of the scales read zero weight. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

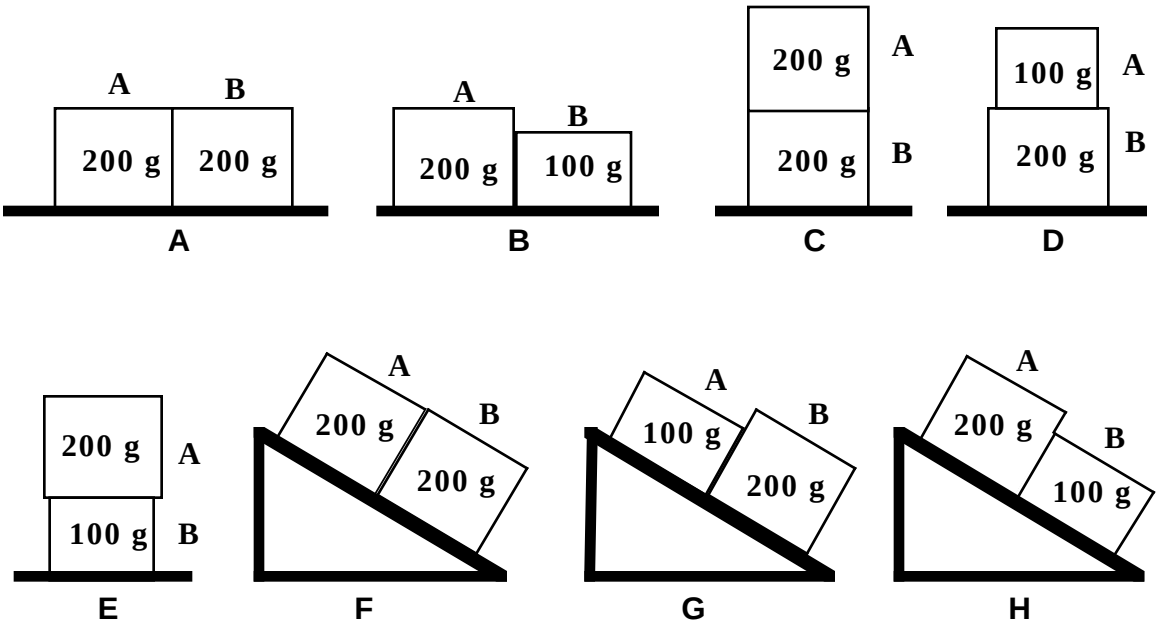
Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[37] O. Karmon

Two Blocks at Rest—Force Difference [38]

Shown below are eight arrangements of two wooden blocks. There are two different mass blocks, either 100 g or 200 g. In all of the arrangements, the blocks are in contact, that is, they are touching each other. Also, in all of the arrangements the blocks are at rest, i.e., they are not moving. As you can see, one of the blocks given in each arrangement is labeled **A,** and the other is labeled **B**. The mass of each block is given in the figures.

Rank these arrangements from largest to smallest on the basis of the difference of the strengths (magnitudes) of the forces between the force **A** exerts on **B** and the force **B** exerts on **A**. In other words, the arrangement where the force **A** exerts on **B** minus the force **B** exerts on **A** is the largest will rank first. In the same way, the arrangement where the force **A** exerts on **B** minus the force **B** exerts on **A** is the smallest will rank last. Keep in mind that some of these values might be negative. If **B** is exerting a stronger force on **A** than **A** exerts on **B**, then the difference will be negative. Negative values are smaller than positive values or zero. (A force is a push or a pull.)



Largest 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 _____ 8 _____ Smallest

Or, all of these differences will be the same. _____

If you think all of the differences will be the same, what is the approximate value of the difference?

_____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

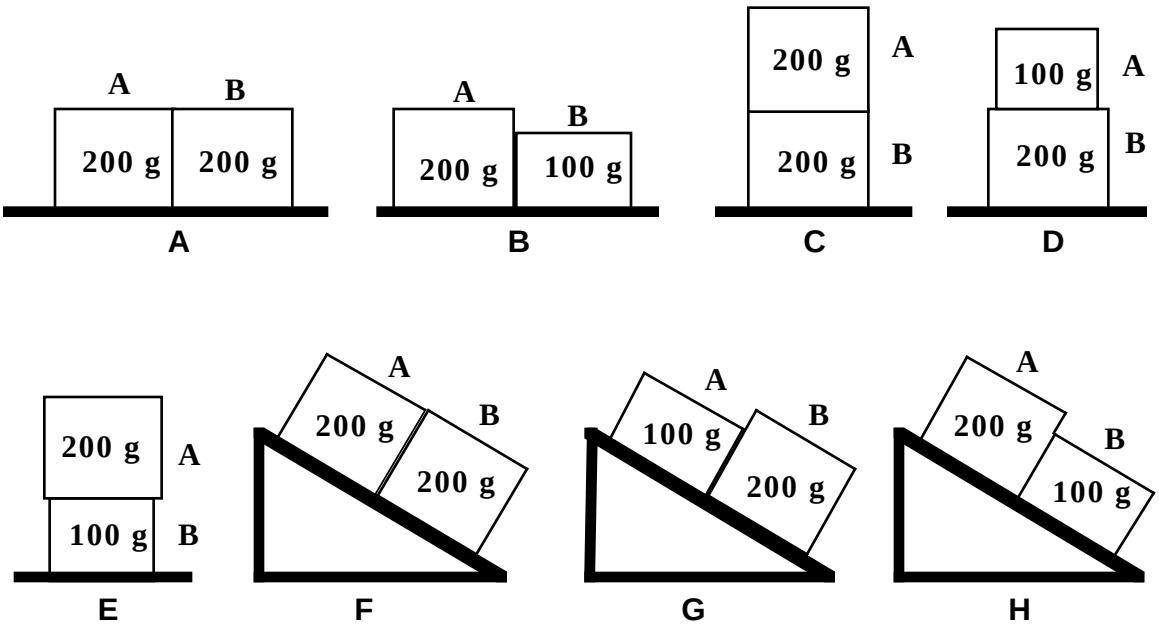
Basically Guessed					Sure				Very Sure
1	2	3	4	5	6	7	8	9	10

[38] D. Maloney

Two Moving Blocks—Force Difference [39]

Shown below are eight arrangements of two wooden blocks both moving left to right at 2 m/s. There are two different mass blocks, either 100 g or 200 g. In all of the arrangements, the blocks are in contact, that is, they are touching each other. As you can see, one of the blocks given in each arrangement is labeled **A**, and the other is labeled **B**. The mass of each block is given in the figures.

Rank these arrangements from largest to smallest on the basis of the difference of the strengths (magnitudes) of the forces between the force **A** exerts on **B** and the force **B** exerts on **A**. In other words, the arrangement where the force **A** exerts on **B** minus the force **B** exerts on **A** is the largest will rank first. In the same way the arrangement where the force **A** exerts on **B** minus the force **B** exerts on **A** is the smallest will rank last. Keep in mind that some of these values might be negative. If **B** is exerting a stronger force on **A** than **A** exerts on **B**, then the difference will be negative. Negative values are smaller than positive values or zero. (A force is a push or a pull.)



Largest 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 _____ 8 _____ Smallest

Or, all of these differences will be the same. _____

If you think all of the differences will be the same, what is the approximate value of the difference?

_____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

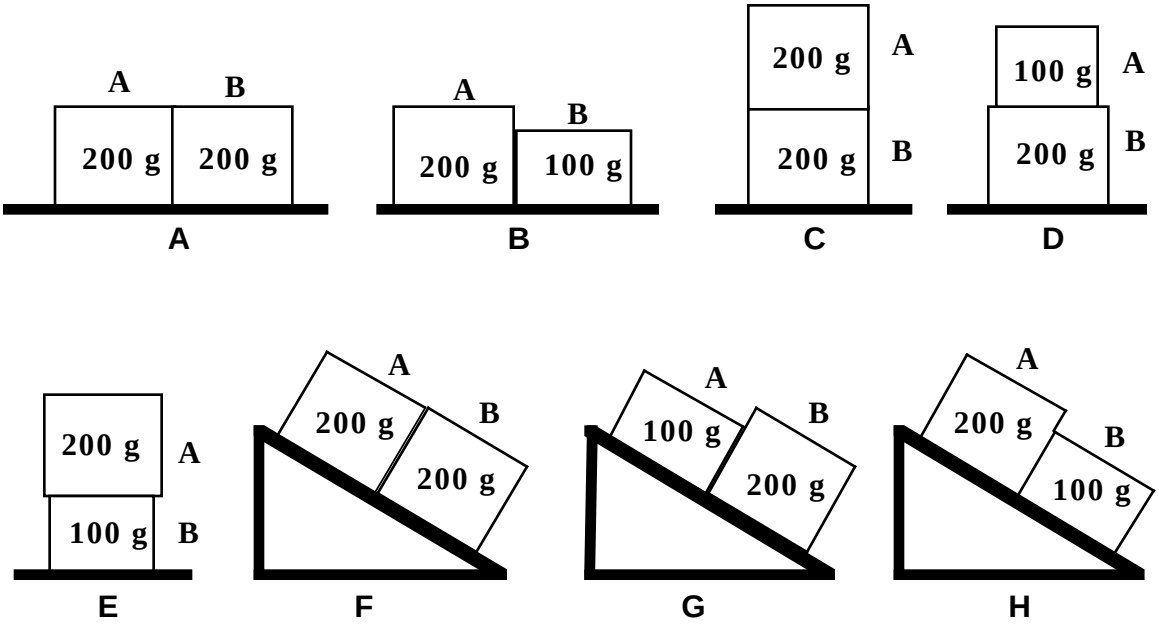
Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[39] D. Maloney, C. Hieggelke

Two Accelerating Blocks—Force Difference [40]

Shown below are eight arrangements of two wooden blocks both moving left to right at 2 m/s and accelerating in the same direction at 3 m/s^2. There are two different mass blocks, either 100 g or 200 g. In all of the arrangements, the blocks are in contact, that is, they are touching each other. As you can see, one of the blocks given in each arrangement is labeled **A**, and the other is labeled **B**. The mass of each block is given in the figures.

Rank these arrangements from largest to smallest on the basis of the difference of the strengths (magnitudes) of the forces between the force **A** exerts on **B** and the force **B** exerts on **A**. In other words, the arrangement where the force **A** exerts on **B** minus the force **B** exerts on **A** is the largest will rank first. In the same way the arrangement where the force **A** exerts on **B** minus the force **B** exerts on **A** is the smallest will rank last. Keep in mind that some of these values might be negative. If **B** is exerting a stronger force on **A** than **A** exerts on **B**, then the difference will be negative. Negative values are smaller than positive values or zero. (A force is a push or a pull.)



Largest 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 _____ 8 _____ Smallest

Or, all of these differences will be the same. _____

If you think all of the differences will be the same, what is the approximate value of the difference?

_____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

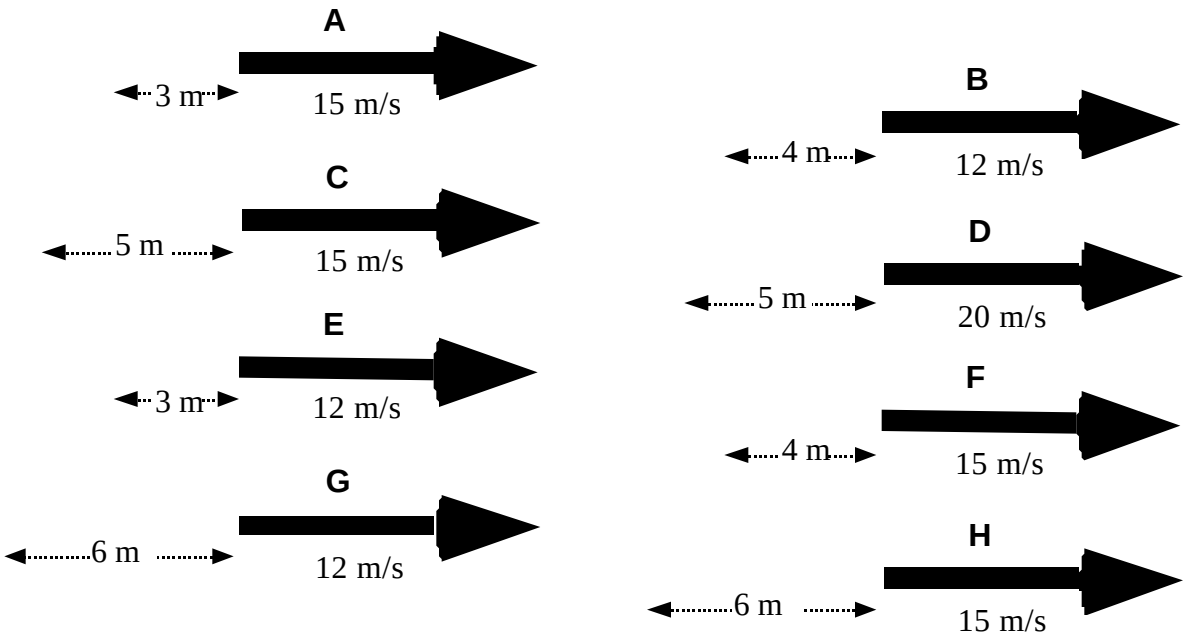
Basically Guessed					Sure				Very Sure
1	2	3	4	5	6	7	8	9	10

[40] D. Maloney, C. Hieggelke

Horizontal Arrows at Different Distances—Force [41]

The figures below show arrows that have been shot from bows. All of the arrows are identical, and they are moving horizontally to the right. The arrows are at different points in their paths from the bows to the targets. The distances the arrows have traveled in reaching the points shown are given in the figures. Also given in the figures are the speeds the arrows have at the points shown.

Rank these situations, from greatest to least, on the basis of the rightward pointing force, i.e., the force acting in the direction the arrow is moving, acting on each arrow at the point shown. That is, put first the arrow with the largest horizontal force acting on it, and put last the arrow with the smallest horizontal force. (A force is a push or pull.) We are ignoring any effects of air in these situations.



Greatest Force 1____2_____3_____4_____5_____6_____7_____8_____Least Force

Or, all of these arrows have the same horizontal force acting upon them. _____

If you check this answer, what is your estimate of the strength of the force? _____ Please carefully explain your reasoning.

How sure were you of the reasoning you used? (circle one)

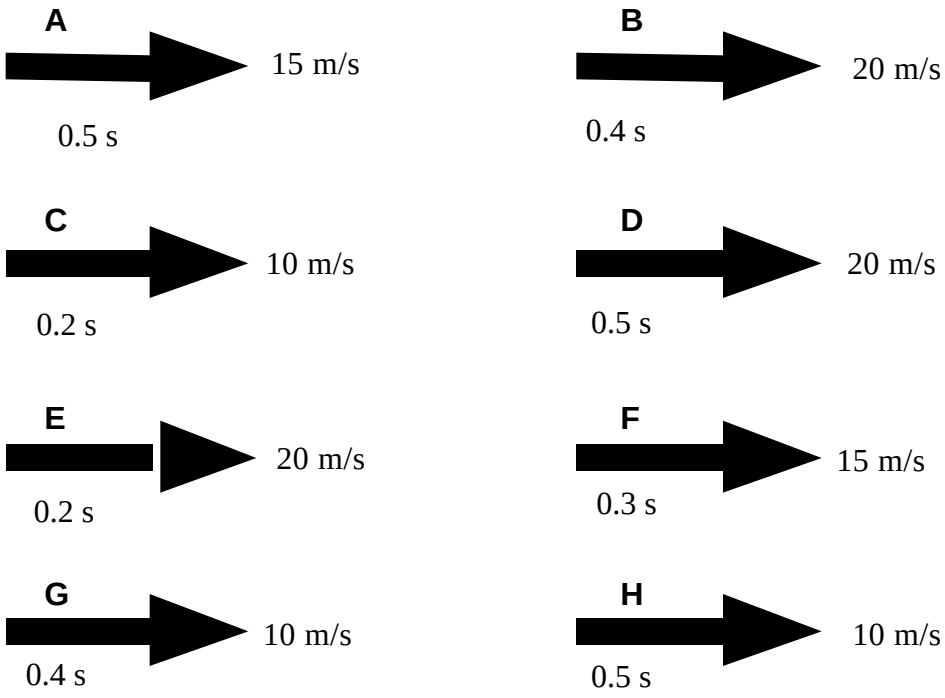
Basically Guessed					Sure				Very Sure
1	2	3	4	5	6	7	8	9	10

[41] D. Maloney

Horizontal Arrows at Different Times—Force [42]

The figures below show arrows that have been shot from bows. All of the arrows are identical, and they are moving horizontally to the right. The arrows are at different points in their paths from the bows to the targets. The times since being shot vary for the arrows. These times are given in the figures. Also given in the figures are the speeds the arrows have at the specified times.

Rank these situations, from greatest to least, on the basis of the rightward pointing force; i.e., the force acting in the direction the arrow is moving, acting on each arrow at the point shown. That is, put first the arrow with the largest horizontal force acting on it, and put last the arrow with the smallest horizontal force. (A force is a push or pull.) We are ignoring any effects of air in these situations.



Greatest Force 1____2_____3_____4_____5_____6_____7_____8_____Least Force

Or, all of these arrows have the same horizontal force acting on them. _____

If you check this answer what is your estimate of the strength of the force? _____

Please carefully explain your reasoning.

How sure were you of the reasoning you used? (circle one)

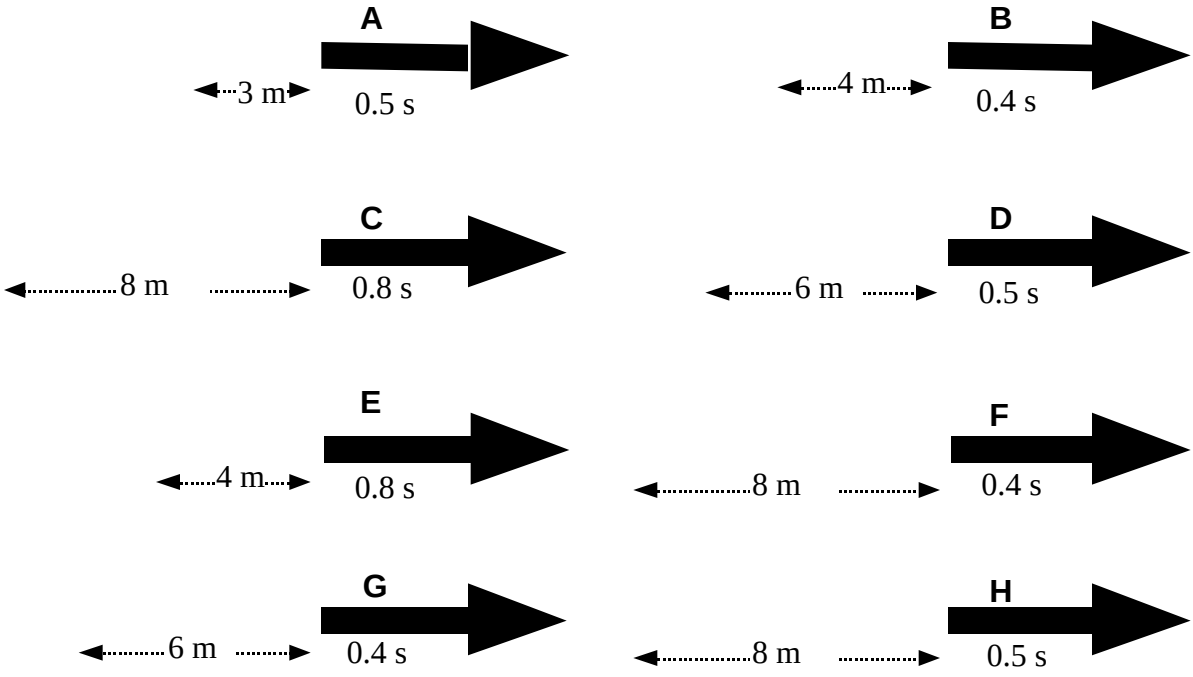
Basically Guessed					Sure				Very Sure
1	2	3	4	5	6	7	8	9	10

[42] D. Maloney

Horizontal Arrows at Different Distances and Times—Force [43]

The figures below show arrows that have been shot from bows. All of the arrows are identical, and they are moving horizontally to the right. The arrows are at different points in their paths from the bows to the targets. The distances the arrows have traveled and the times required are given in the figures.

Rank these situations, from greatest to least, on the basis of the rightward pointing force; i.e., the force acting in the direction the arrow is moving, acting on each arrow at the point shown. That is, put first the arrow with the largest horizontal force acting on it, and put last the arrow with the smallest horizontal force. (A force is a push or pull.) We are ignoring any effects of air in these situations.



Greatest Force 1____2_____3_____4_____5_____6_____7_____8_____Least Force

Or, all of these arrows have the same horizontal force acting on them.__

If you check this answer, what is your estimate of the strength of the force?_____

Please carefully explain your reasoning.

How sure were you of the reasoning you used? (circle one)

Basically Guessed					Sure				Very Sure
1	2	3	4	5	6	7	8	9	10

[43] D. Maloney