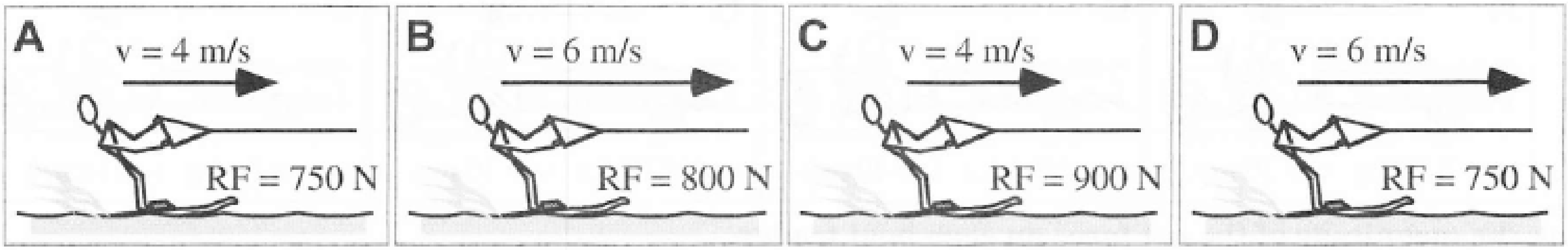
B3-RT02: WATER SKIERS—NET FORCE

Water skiers are pulled at a constant speed by a towrope attached to a speedboat. Because the weight of the skiers and the type of skis they are using varies, they experience different resistive forces from the water. Values for this resistive force (RF) and for the speed of the skiers are given.



Rank the magnitude of the net force on each water skier.

1 Greatest	2	3	4 Least	OR	All the same	All zero	Cannot determine

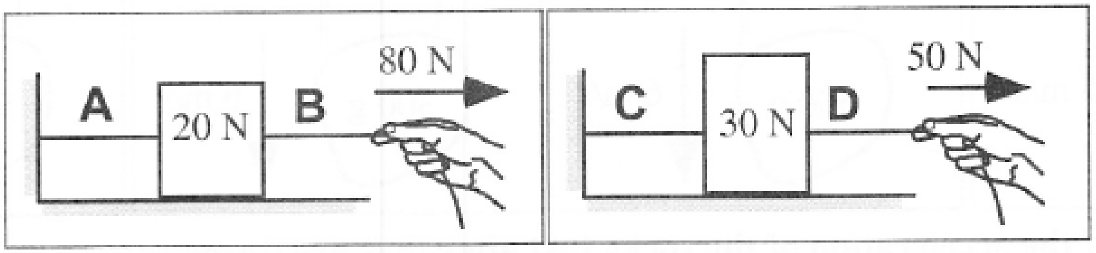
Explain your reasoning.

Answer: All Zero.

The net force on each skier must be zero due to Newton's 1st Law since they are not accelerating.

B3-RT16: Blocks Attached to Wall—Rope Tension

Two blocks are attached by a rope to a wall. A child pulls horizontally on a second rope attached to each block. Both blocks remain at rest on the frictionless surface. The weights of the blocks and the magnitudes of the forces exerted by the child are given.



Rank the tensions in the ropes.

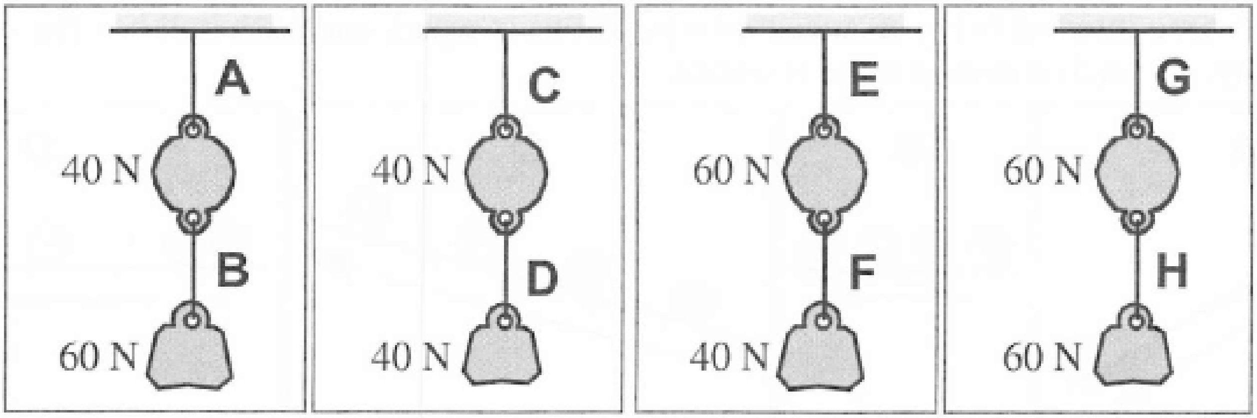
1 Greatest	2	3	4 Least	OR	All the same	All zero	Cannot determine

Explain your reasoning.

Answer: B = A > D = C.
Since the blocks remain at rest, the vector sum of the forces on the blocks in the horizontal direction must be zero. So the tensions in the two ropes in the left case are both 80 N and the tensions in the right case are both 50 N.

B3-RT17: Hanging Weights—Rope Tension

Two weights are hung by ropes from a ceiling as shown. All of these systems are at rest.



Rank the tensions in the ropes.

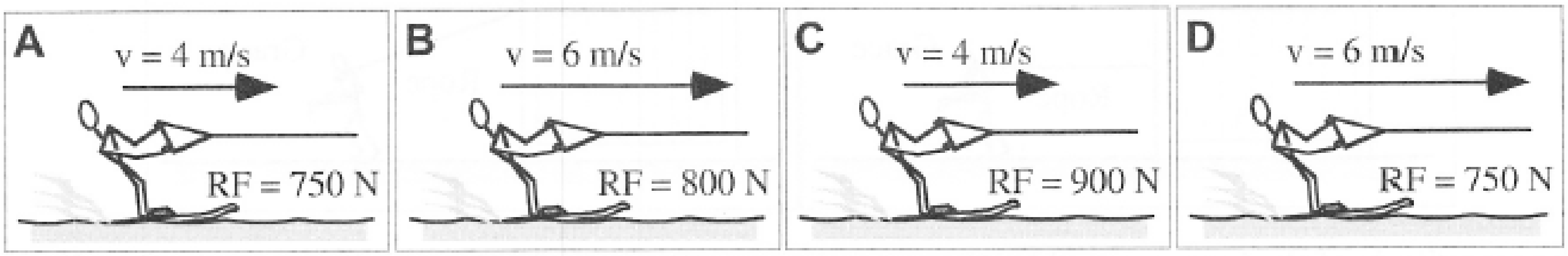
								OR		
1 Greatest	2	3	4	5	6	7	8 Least		All the same	Cannot determine

Explain your reasoning.

Answer: G > A = E > C > B = H > D = F.
Since the systems are at rest the vector sum of the forces on each block has to be zero. Working up from the bottom the lower tensions must be equal to the weights of the lower blocks, and the tensions in the upper ropes must be equal to the sum of the two weights.

B3-RT71: Water Skiers—Tension

Water skiers are pulled at a constant speed by a towrope attached to a speedboat. Because the weight of the skiers and the type of skis they are using varies, they experience different resistive forces from the water. Values for this resistive force (RF) and for the speed of the skiers are given.



Rank the tension in the towrope.

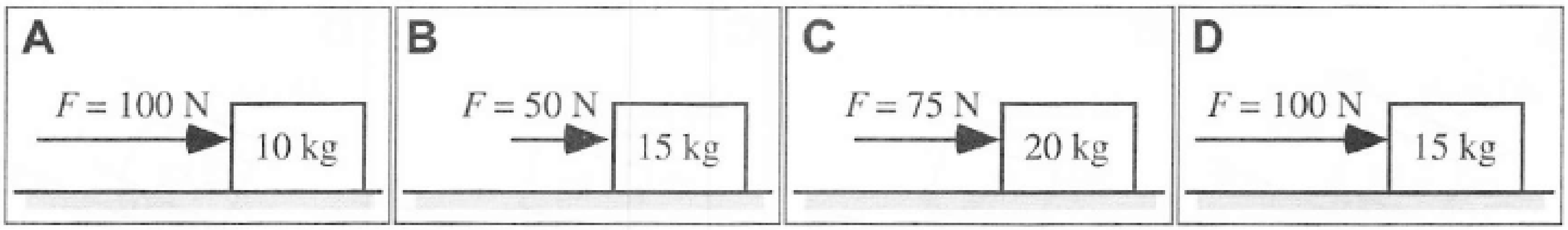
1 Greatest	2	3	4 Least	OR	All the same	All zero	Cannot determine

Explain your reasoning.

Answer: C > B > A = D.
The net force on each skier must be zero because they are not accelerating. The only horizontal forces are the tension in the ski rope and the resistive force. These must be equal and opposite to each other to give zero net force. So the ranking of the tension is the same as the ranking of the resistive force.

B3-RT08: FORCE PUSHING BOX—ACCELERATION

Various similar boxes are being pushed for 10 m across a floor by a net horizontal force as shown below. The mass of the boxes and the net horizontal force for each case are given in the indicated figures. All boxes have the same initial velocity of 10 m/s to the right.



Rank the acceleration of the boxes.

1 Greatest	2	3	4 Least	OR	All the same	All zero	Cannot determine

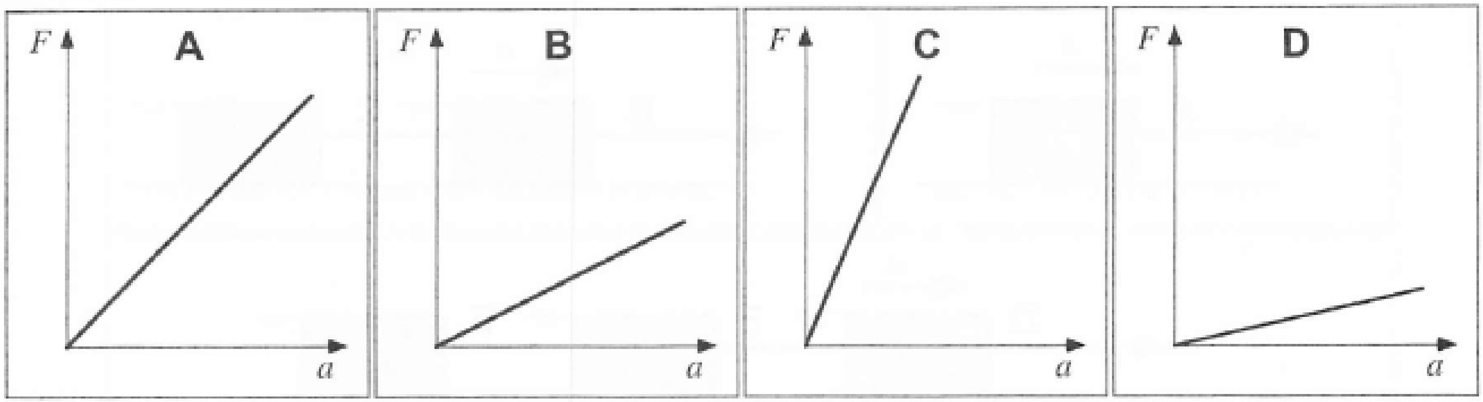
Explain your reasoning.

Answer: A > D > C > B

The acceleration equals the net force on each box divided by the mass of the block or a= Fnet/m using Newton's 2nd Law. For A, a = Fnet /m = 100 N/ 10 kg = 10 m/s² ; for B, a = Fnet /m = 50 N/ 15 kg = 3.33 m/s² ; for C, a = Fnet /m = 75 N/ 20 kg = 3.75 m/s²; and for D, a = Fnet /m = 100 N/ 15 kg = 6.67 m/s²

B3-RT20: NET FORCE-ACCELERATION GRAPHS—MASS

These graphs are of net force versus acceleration for different objects. All graphs have the same scale for each respective axis.



Rank the mass of the objects.

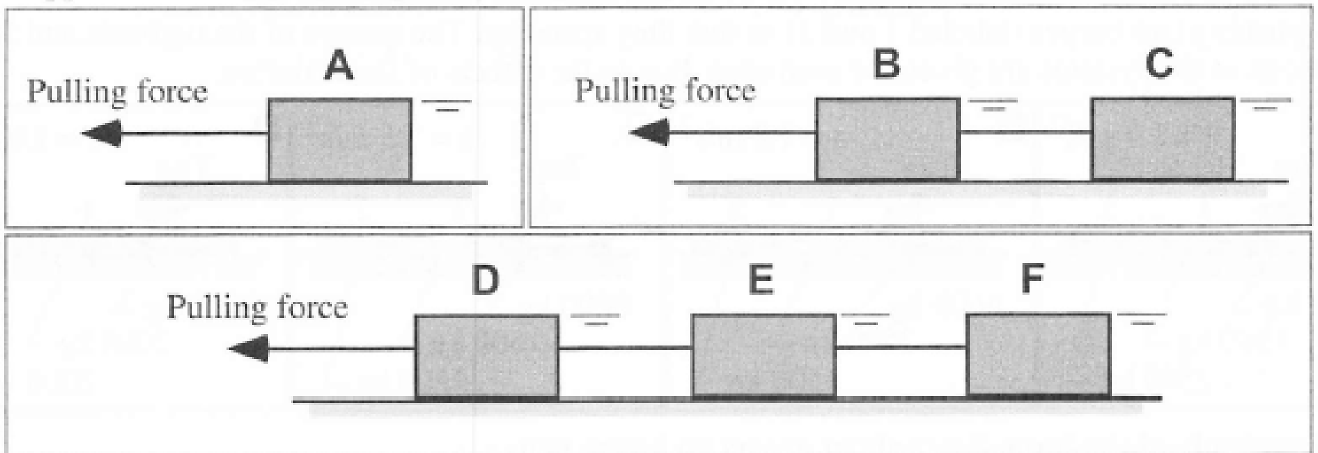
1 Greatest	2	3	4 Least	OR	All the same	All zero	Cannot determine

Explain your reasoning.

Answer: C > A > B > D.
The slopes of these graphs—given by the force divided by the acceleration—is the mass of the object involved.

B3-RT21: Ropes Pulling Boxes—Acceleration

Boxes are 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.



Rank the accelerations of the blocks.

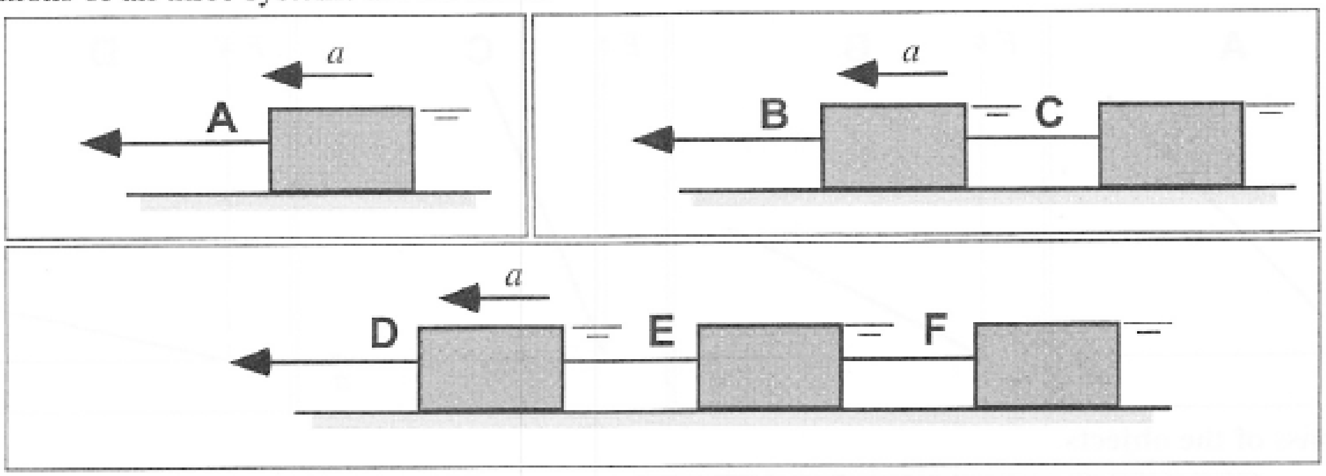
1 Greatest	2	3	4	5	6 Least	OR	All the same	All zero	Cannot determine

Explain your reasoning.

Answer: A > B = C > D = E = F.
Since the same net force is acting on all three systems the accelerations will depend on the masses of the systems and all masses in a system will have the same acceleration.

B3-RT22: ROPES PULLING BOXES—ROPE TENSION

Boxes are pulled by ropes along frictionless surfaces, accelerating toward the left. All of the boxes are identical, and the accelerations of all three systems are the same.



Rank the tensions in the ropes.

						OR			
1 Greatest	2	3	4	5	6 Least		All the same	All zero	Cannot determine

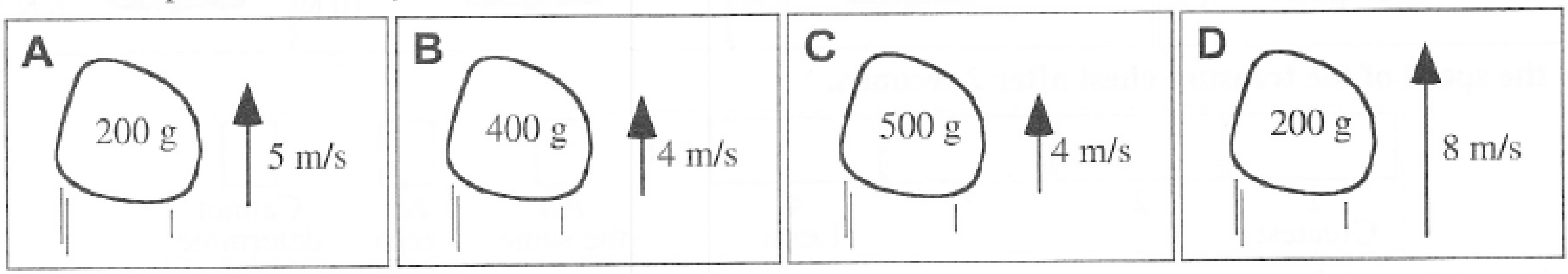
Explain your reasoning.

Answer: D > B = E > A = C = F.

Since the boxes all have the same mass (m) and all of the accelerations are the same, the tensions will be determined by how many boxes the rope is accelerating. The only horizontal force on the rightmost blocks in each case is the tension in the rope to the left of that block (A, C, and F), and this tension must therefore be the mass of that block times the acceleration, ma. The tension in ropes B and E are the net forces on the systems of the two blocks to their right, so the tensions in these ropes must be 2ma. For the system of all 3 blocks in the last case the net force is the tension in rope D, 3ma.

B3-RT12: Rocks Thrown Upward—Net Force

Rocks that are thrown up into the air all have the same shape, but they have different masses. The masses of the rocks and their speeds when they were thrown are given.



Rank the magnitude of the net force on the rocks just after they are thrown.

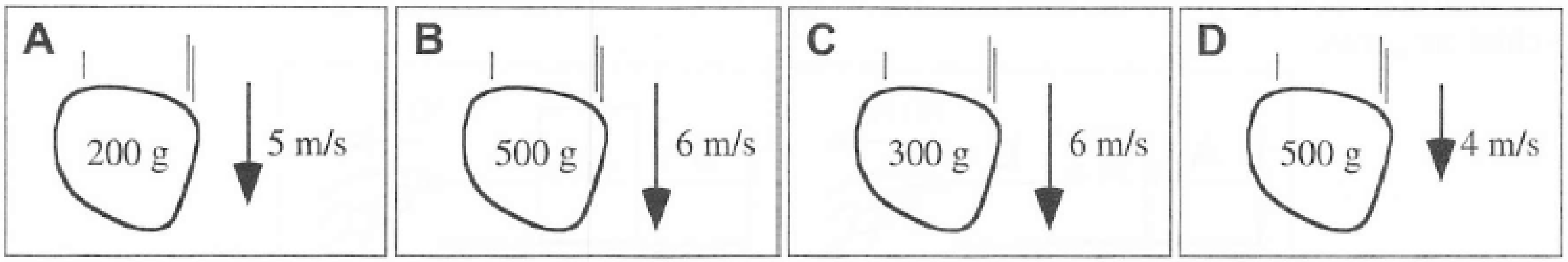
1 Greatest	2	3	4 Least	OR	All the same	All zero	Cannot determine

Explain your reasoning.

Answer: C > B > A = D.
The net force acting on each rock is the gravitational force the Earth exerts on the rock (the weight of the rock). The gravitational force is proportional to the mass of the rock, so the ranking depends on the masses of the rocks only.

B3-RT14: Rocks Thrown Downward—Acceleration

Rocks that are thrown straight downward all have the same shape, but they have different masses. The masses of the rocks and their speeds when they were thrown are given.



Rank the magnitude of the acceleration of the rocks just after they are thrown.

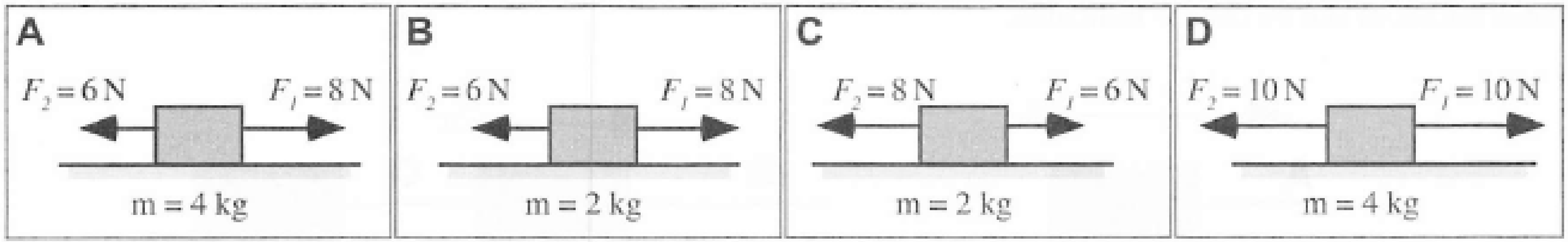
				OR			
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

Explain your reasoning.

Answer: All the same.
The net force acting on each rock is the gravitational force the Earth exerts on the rock (the weight of the rock). The gravitational force is proportional to the mass of the rock, so when we divide the net force by the mass to get the acceleration the masses of the rocks cancel, and they all have the same acceleration of 9.8 m/s^2.

B3-RT25: Forces on Blocks on Smooth Surfaces—Speed

Two forces act on a block that is initially at rest on a frictionless surface.



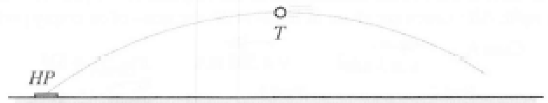
Rank the speed of the block after 3 seconds.

1 Greatest	2	3	4 Least	OR	All the same	All zero	Cannot determine

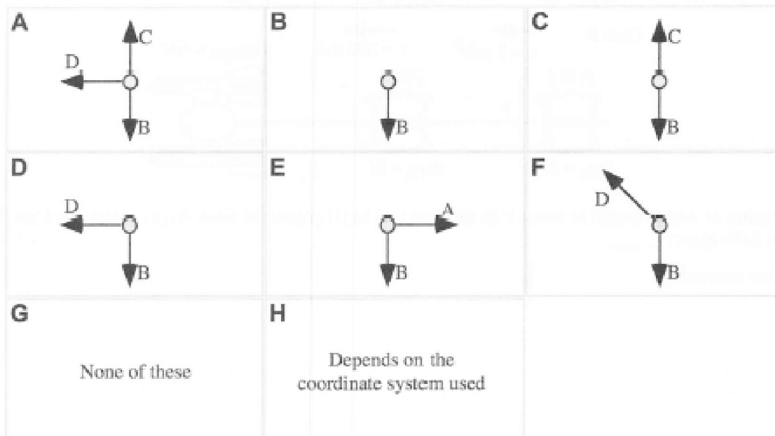
Explain your reasoning.

Answer: B = C > A > D.
The change in speed will be determined by the acceleration, which is the net force divided by the mass of the object. The net force in each case is the vector sum of the forces.

A baseball is thrown from right field to home plate (HP), traveling from right to left in the diagram.



A group of physics students watching the game create the following free-body diagrams for the baseball at the top of its path (point *T*). Note that the forces are not drawn to scale.



(a) If they decide to *ignore air friction,* which is the correct free-body diagram for the baseball at point *T*?

(b) Define all forces on the ball for this force diagram.

(c) If they decide to *include air friction,* which is the correct free-body diagram for the baseball at point *T*?

(d) Define all forces on the ball for this force diagram.

(a) If they decide to *ignore air friction,* which is the correct free-body diagram for the baseball at point *T*?

B, The only force acting is the weight of the ball since we are ignoring friction.

(b) Define all forces on the ball for this force diagram.

B is the gravitational force on the baseball by the earth (i.e., the weight of the baseball).

(c) If they decide to *include air friction,* which is the correct free-body diagram for the baseball at point *T*?

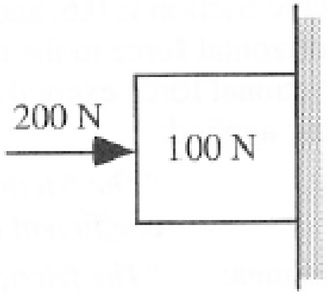
Diagram E includes air friction (A) acting opposite to the direction of motion, and the force of gravity (B).

(d) Define all forces on the ball for this force diagram.

B is the gravitational force on the baseball by the earth (i.e., the weight of the baseball) and A is the frictional force on the baseball by the air.

B3-SCT88: BOX HELD AGAINST VERTICAL SURFACE—FRICTIONAL FORCE ON BOX

A constant horizontal force on a 200 N is applied to a box in contact with a vertical surface. The coefficient of static friction between the box and the surface is 0.6, and the coefficient of kinetic friction is 0.4. Several students are discussing the frictional force on the box 1 second after the force is first applied:



Art: *"The frictional force is 60 N since the box will not be moving and the coefficient of static friction is 0.6."*

Bratislav: *"The frictional force is 100 N upward since the box has a weight of 100 N downward."*

Celeste: *"The frictional force will be 120 N since the box will not be moving and the normal force will be 200 N."*

Dorothy: *"The frictional force will be 40 N for the kinetic frictional force and 60 N for the static frictional force. The weight is 100 N and the coefficient of kinetic friction is 0.4, giving 40 N for the kinetic friction. Likewise, for the static frictional force it has a coefficient of static friction of 0.6, giving a static frictional force of 60 N."*

With which, if any, of these students do you agree?

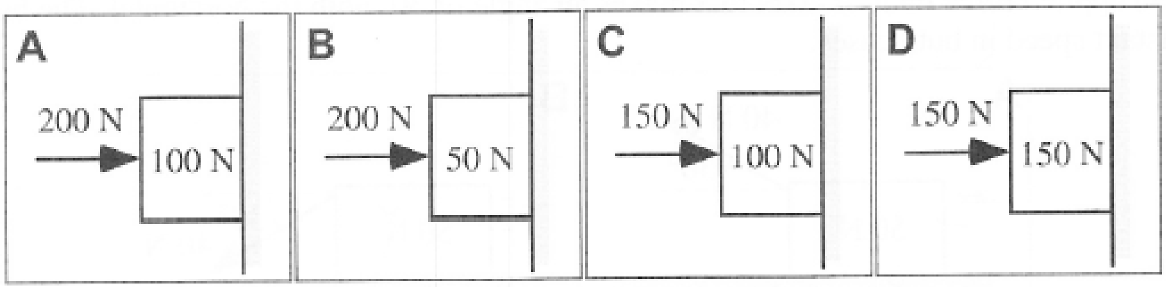
Art _____ Bratislav _____ Celeste _____ Dorothy _____ None of them _____

Explain your reasoning.

Answr: Bratislav is correct.
The coefficient of static friction is 0.6, so the maximum static frictional force is 0.6 times the normal force acting to the left on the box by the vertical surface. Since the box is not moving horizontally, this normal force must have the same magnitude as the horizontal applied force, 200 Newtons. The maximum frictional force will then be 120 Newtons. This is greater than the weight of the box, so the box will not slip downward. The static frictional force will be less than its maximum possible value, and will equal 100 Newtons, keeping the box at rest.

B3-RT89: BOXES HELD AGAINST VERTICAL SURFACES—FRICTIONAL FORCES ON THE WALL

A box is held at rest against a rough, vertical surface by a force pushing horizontally as shown. Values for the applied force and the weight of the boxes are given. The boxes are all made of the same material and the walls are identical.



Rank the magnitude of the frictional force exerted on the wall by these boxes.

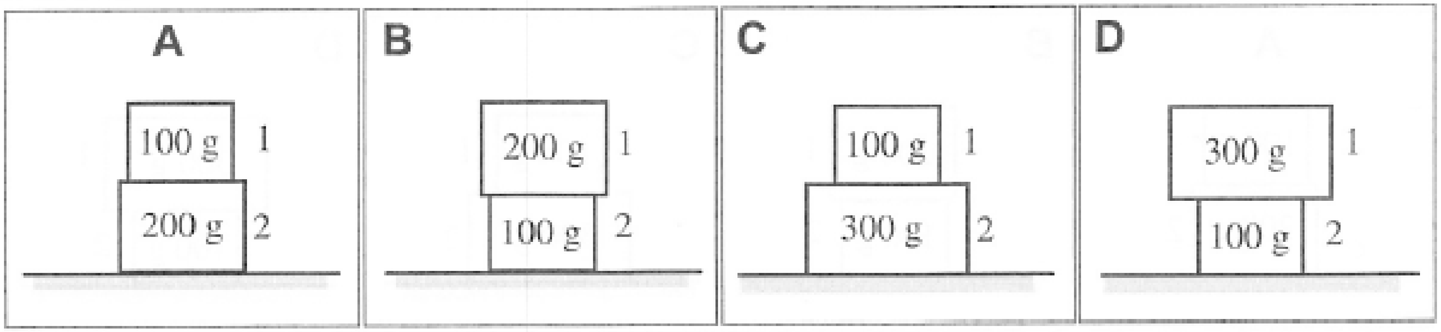
				OR	☐	☐	☐
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

Explain your reasoning.

Answer: D > A = C > B.
The frictional force on the box by the wall is equal to the weight of each box since they are at rest. The net force must be zero on each box, and the friction force must have the same magnitude as the weight and be in the opposite direction. The friction force on the wall by the box is the Newton's Third Law pair to the friction force on the box by the wall, and has the same magnitude, so the friction force on the wall by the box has the same magnitude as the weight of the box.

B3-RT47: TWO STACKED BLOCKS AT REST—FORCE ON THE TOP BLOCK BY BOTTOM BLOCK

Two wooden blocks with different masses are at rest, stacked on a table. The top block is labeled **1**, and the bottom block is labeled **2**.



Rank the magnitude of the force that the bottom block (2) exerts on the top block (1).

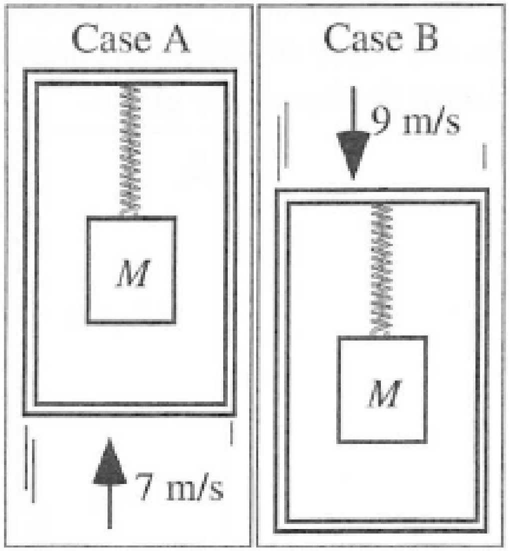
☐	☐	☐	☐	OR	☐	☐	☐
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

Explain your reasoning.

Answer: D > B > A = C.
The systems are at rest so the vector sum of the forces in the vertical direction has to be zero. There are two vertical forces acting on the top blocks, their weights, which are directed down, and the normal force that block 1 exerts, directed up. So the magnitudes of the forces that the lower blocks exert are equal to the weights of the top blocks.

B3-CT09: BLOCKS IN MOVING ELEVATORS—STRETCH OF SPRING

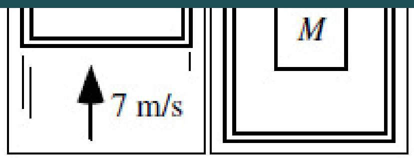
A spring is attached to the ceiling of an elevator, and a block of mass M is suspended from the spring. The cases are identical except that in Case A the elevator is moving upward with a constant speed of 7 m/s, while in Case B the elevator is moving downward with a constant speed of 9 m/s.



Will the spring be stretched (i) *more* in Case A, (ii) *more* in Case B, or (iii) *the same* in both cases? _____

Explain your reasoning.

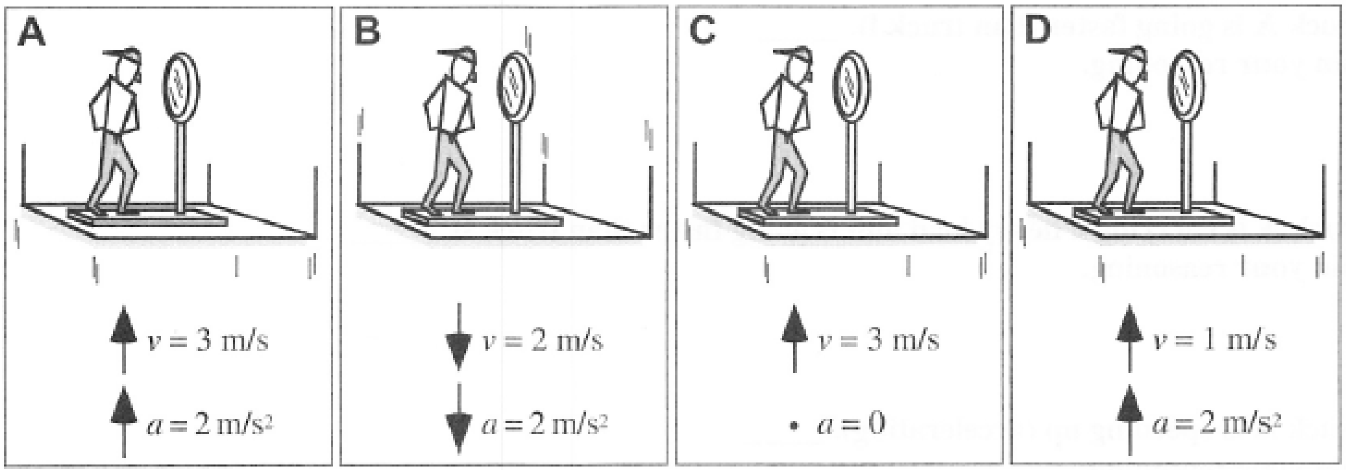
Answer: The same in both cases.



In both cases the block is moving with a constant velocity, so the net force on the block is zero. Since the only forces acting on the block are the weight of the block and the force from the spring, these forces must be equal in magnitude and opposite in direction to give zero net force. Since the weight of the block is the same in case A as in case B, the force by the spring must be the same also, and therefore the springs are stretched the same amount.

B3-RT60: PERSON IN A MOVING ELEVATOR—SCALE READING

A person who weighs 600 N is standing on a scale in an elevator. The elevator is identical in all cases. The velocity and acceleration of the elevators at the instant shown are given.



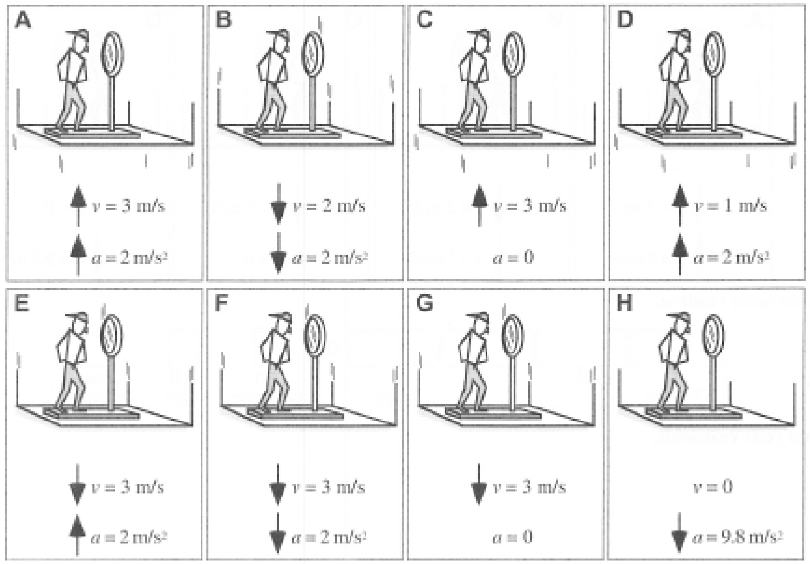
Rank the scale reading.

☐	☐	☐	☐	OR	☐	☐	☐
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

Explain your reasoning.

Answer: A = D > C > B.
The scale is providing the normal force on the person, and the scale reading indicates the magnitude of this force. For cases A and D that normal force is larger than the person's weight because the scale also has to accelerate the person upward. For case C the normal force is equal in magnitude to the person's weight, and for case B it is less than the person's weight since the person is accelerating downward.

A person who weighs 500 N is standing on a scale in an elevator. The elevator is identical in all cases. The velocity and acceleration of the elevators at the instant shown are given.



(a) List the cases where the scale reading is *greater than* 500 N. ______

Explain your reasoning.

(b) List the cases where the scale reading is *less than* 500 N. ______

Explain your reasoning.

(c) List the cases when the scale reading is *equal to* the scale reading of 500 N. ______

Explain your reasoning.

(a) **List the cases where the scale reading is *greater than* 500 N. _____**

Explain your reasoning.

Answer: A, D, and E.
The reading on the scale will be larger than the person's weight (500 N) when he/she is being accelerated upward by the scale. When that occurs the scale has to both balance the weight of the person and provide the force to accelerate the person upward.

(b) **List the cases where the scale reading is *less than* 500 N. _____**

Explain your reasoning.

Answer: B, F and H.
Here the reading is less than the person's weight because the scale doesn't have to balance the whole weight of the person.

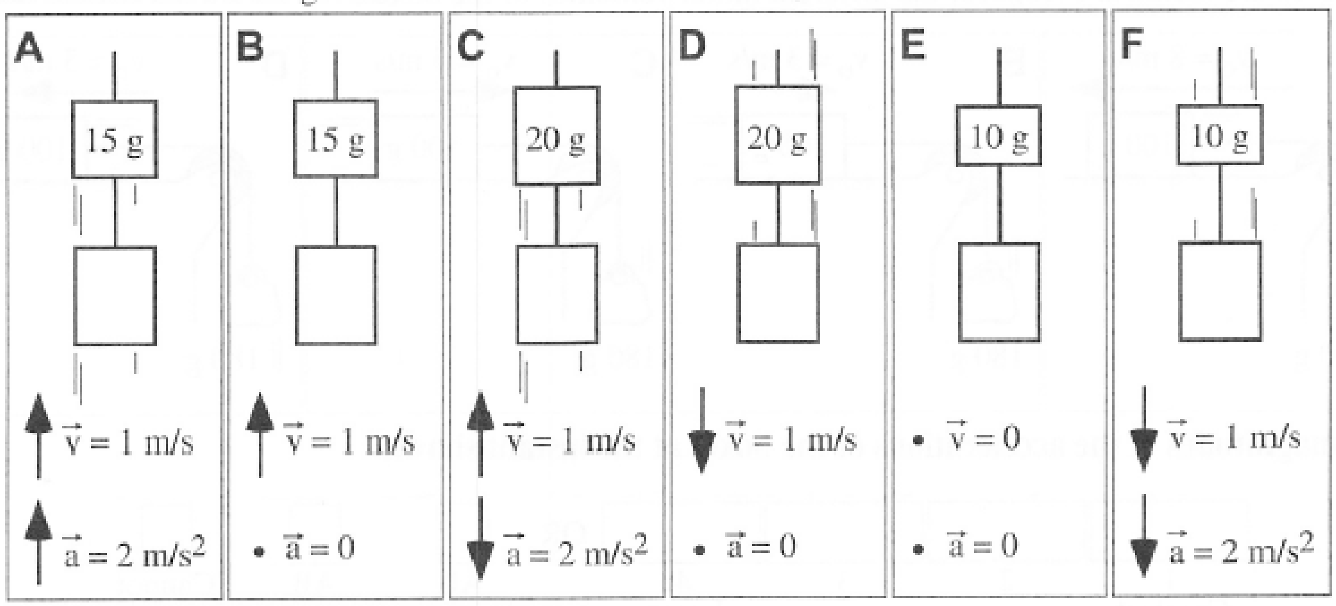
(c) **List the cases when the scale reading is *equal to* the scale reading of 500 N. _____**

Explain your reasoning.

Answer: C and G.
Since there is no acceleration the net force has to be zero, so the scale has to balance the weight of the person.

B3-RT72: Hanging Blocks—Tension

Two blocks are connected by strings and are pulled upward by a second string attached to the upper block. The lower block is the same in all cases, but the mass of the upper block varies. The acceleration and velocity for each system at the instant shown are given.



Rank the tension in the string between the blocks.

						OR	☐	☐	☐
1 Greatest	2	3	4	5	6 Least		All the same	All zero	Cannot determine

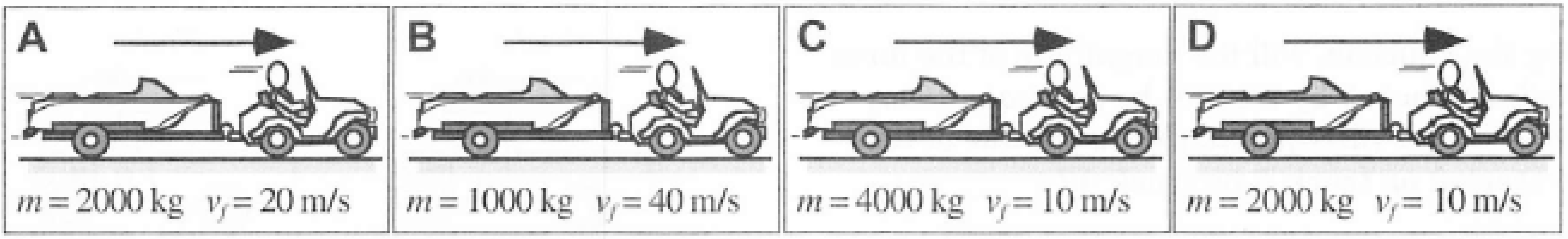
Explain your reasoning.

Answer: A > B = D = E > C = F.

These tensions can be compared by considering a free-body diagram of the lower block. The tension minus the weight of the lower block must equal the mass of the lower block times its acceleration in the upward direction. Since the lower blocks are all identical, the tension must be greatest for blocks that are accelerating upward, less for blocks with no acceleration, and least for blocks that are

B3-RT50: ACCELERATING CAR AND BOAT TRAILER—FORCE DIFFERENCE

All the trailers and cars shown are identical but the boat trailers have different loads. In each case, the car and boat trailer accelerate at 1 m/s² from rest to the final speed shown.



Rank 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 while the cars and trailers are accelerating.

☐	☐	☐	☐	OR	☐	☐	☐
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

Explain your reasoning.

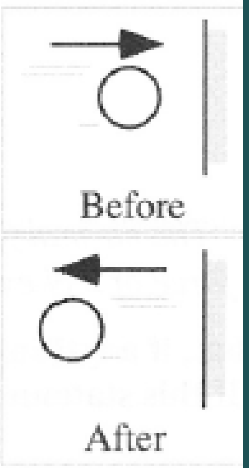
Answer: All the same—zero.
This question is asking about the difference between the magntiudes of Newton's third law force pairs. Since the third law states that in all cases the force the car exerts on the trailer is equal in magnitude, but oppositely directed, to the force the trailer exerts on the car, the differences will all be zero.

B3-WWT56: BALL HITTING A WALL—FORCES

A student observes a rubber ball hitting a wall and rebounding. She states:

"In this situation, the wall exerts a larger force on the ball than the ball exerts on the wall, because the ball undergoes an acceleration but the wall doesn't move. That is, the ball goes from an initial speed to zero and then from zero to the rebound speed, but the wall does not accelerate since it is stationary the whole time."

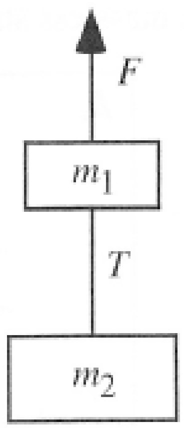
What, if anything, is wrong with this contention? If something is wrong, identify it, and explain how to correct it. If this contention is correct, explain why.



Answer: The student is wrong.
The ball and wall exert equal magnitude, but oppositely directed, forces on each other as required by Newton's Third Law.

B3-SCT79: Two Connected Objects Accelerating Downward—Tension

Two objects with masses of $m_1 = 6$ kg and $m_2 = 10$ kg are connected by a massless string. They are pulled upward by an applied force F. Since this force is smaller than the total weight of the objects, there is a constant downward acceleration of 3 m/s^2. The tension in the string connecting the objects is T. Four students discuss this tension:



Anh: *"The tension in the string is the net force on the lower object. Using Newton's Second law, we get $F_{net} = ma = 30$ N for the tension, since the lower object has a mass of 10 kg and it is accelerating at 3 m/s^2."*

Brandon: *"The tension in the string is more than the net force of 30 N since the lower object has a weight of about 100 N. The tension should be 130 N since the 30 N, the net force, is added to 100 N, the weight."*

Cathy: *"The tension in the string is upward and should be less than the weight since the system is accelerating downward. It should be 70 N by applying Newton's Second law and taking into account the directions of the forces."*

Deshi: *"We cannot answer it until we know which direction the system is moving. Is it moving upward or downward? Won't that make a big difference on the tension?"*

With which, if any, of these students do agree?

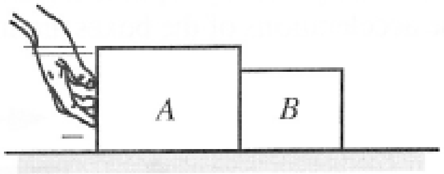
Anh _____ Brandon _____ Cathy _____ Deshi _____ None of them _____

Explain your reasoning.

Answer: Cathy is correct.
From a free-body diagram for the lower mass, and choosing up as the positive direction, we can apply Newton's 2nd Law to the lower mass. The tension T minus the weight of the lower mass equals the mass m_2 times its acceleration. F_{net} (on m_2)= $m_2 a$ = (10kg)(–3 m/s^2) = –30 N. So T– $m_2 g$= T – (10kg)(10m/s^2) or +98 N –30 N = T = 70N.

B3-QRT28: STUDENT PUSHING TWO BLOCKS—FORCE

A student pushes horizontally on two blocks, which are moving to the right. Block A has more mass than block B. There is friction between the blocks and the table.



(a) For the situation where the blocks are moving at a constant speed, which of the following statements is true about the magnitude of the forces?

(i) The force that block A exerts on block B is *greater than* the force that block B exerts on block A.
(ii) The force that block A exerts on block B is *less than* the force that block B exerts on block A.
(iii) The force that block A exerts on block B is *equal to* the force that block B exerts on block A.
(iv) We cannot compare the forces unless we know how fast the blocks are slowing down.

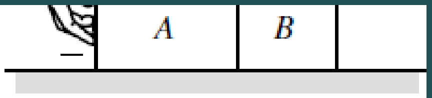
Explain your reasoning.

(b) For the situation where the blocks are moving at a constant speed, which of the following statements is true about the net force?

(i) The net force on block A points *to the right* and is *equal to* the net force on block B.
(ii) The net force on block A points *to the left* and is *equal to* the net force on block B.
(iii) The net force on block A points *to the right* and is *greater than* the net force on block B.
(iv) The net force on block A points *to the left* and is *greater than* the net force on block B.
(v) The net force on block A points *to the right* and is *less than* the net force on block B.
(vi) The net force on block A points *to the left* and is *less than* the net force on block B.
(vii) None of these are correct.

Explain your reasoning.

(a) For the situation where the blocks are moving at a constant speed, which of the following statements is true about the magnitude of the forces?



(i) The force that block A exerts on block B is *greater than* the force that block B exerts on block A.
(ii) The force that block A exerts on block B is *less than* the force that block B exerts on block A.
(iii) The force that block A exerts on block B is *equal to* the force that block B exerts on block A.
(iv) We cannot compare the forces unless we know how fast the blocks are slowing down.

Explain your reasoning.

Answer iii. These two forces are a Newton's Third Law pair.

(b) For the situation where the blocks are moving at a constant speed, which of the following statements is true about the net force?

(i) The net force on block A points *to the right* and is *equal to* the net force on block B.
(ii) The net force on block A points *to the left* and is *equal to* the net force on block B.
(iii) The net force on block A points *to the right* and is *greater than* the net force on block B.
(iv) The net force on block A points *to the left* and is *greater than* the net force on block B.
(v) The net force on block *A* points *to the right* and is *less than* the net force on block B.
(vi) The net force on block A points *to the left* and is *less than* the net force on block B.
(vii) None of these are correct.

Explain your reasoning.

Answer vii. The blocks are moving at a constant speed and so the net force on each block must be zero.

(c) For the situation where the blocks are slowing down, which of the following statements is true about the magnitude of the forces?

(i) The force that block A exerts on block B is *greater than* the force that block B exerts on block A.
(ii) The force that block A exerts on block B is *less than* the force that block B exerts on block A.
(iii) The force that block A exerts on block B is *equal to* the force that block B exerts on block A.
(iv) We cannot compare the forces unless we know how fast the blocks are slowing down.

Explain your reasoning.

(d) For the situation where the blocks are slowing down, which of the following statements is true about the net force?

(i) The net force on block A points *to the right* and is *equal to* the net force on block B.
(ii) The net force on block A points *to the left* and is *equal to* the net force on block B.
(iii) The net force on block A points *to the right* and is *greater than* the net force on block B.
(iv) The net force on block A points *to the left* and is *greater than* the net force on block B.
(v) The net force on block A points *to the right* and is *less than* the net force on block B.
(vi) The net force on block A points *to the left* and is *less than* the net force on block B.
(vii) None of these are correct.

(c) For the situation where the blocks are slowing down, which of the following statements is true about the magnitude of the forces?

(i) The force that block A exerts on block B is *greater than* the force that block B exerts on block A.
(ii) The force that block A exerts on block B is *less than* the force that block B exerts on block A.
(iii) The force that block A exerts on block B is *equal to* the force that block B exerts on block A.
(iv) We cannot compare the forces unless we know how fast the blocks are slowing down.

Explain your reasoning.

Answer iii. The force on B by A and the force on A by B form a Newton's Third Law pair, and are equal and opposite regardless of the state of motion of the blocks.

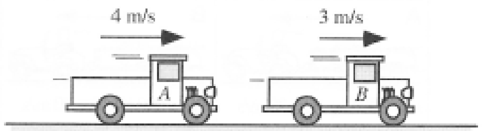
(d) For the situation where the blocks are slowing down, which of the following statements is true about the net force?

(i) The net force on block A points *to the right* and is *equal to* the net force on block B.
(ii) The net force on block A points *to the left* and is *equal to* the net force on block B.
(iii) The net force on block A points *to the right* and is *greater than* the net force on block B.
(iv) The net force on block A points *to the left* and is *greater than* the net force on block B.
(v) The net force on block A points *to the right* and is *less than* the net force on block B.
(vi) The net force on block A points *to the left* and is *less than* the net force on block B.
(vii) None of these are correct.

Answer iv. The blocks are accelerating to the left since they are slowin down, and A has the larger mass.

Two identical toy trucks traveling at different constant speeds are about to collide.

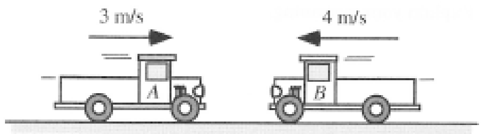
(a) The trucks are traveling in the same direction.



During the collision, will the magnitude of the force exerted on truck A by truck B be (i) *greater than*, (ii) *less than*, or (iii) *equal to* the magnitude of the force exerted on truck B by truck A? _____

Explain your reasoning.

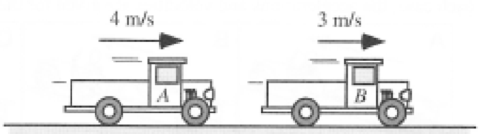
(b) The trucks are traveling in opposite directions.



During the collision, will the magnitude of the force exerted on truck A by truck B be (i) *greater than*, (ii) *less than*, or (iii) *equal to* the magnitude of the force exerted on truck B by truck A? _____

Explain your reasoning.

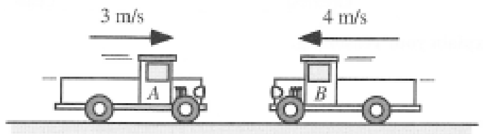
(c) The trucks are traveling in the same direction.



During the collision, will the magnitude of the acceleration of truck A be (i) *greater than*, (ii) *less than*, or (iii) *equal to* the magnitude of the acceleration of truck B? _____

Explain your reasoning.

(d) The trucks are traveling in opposite directions.

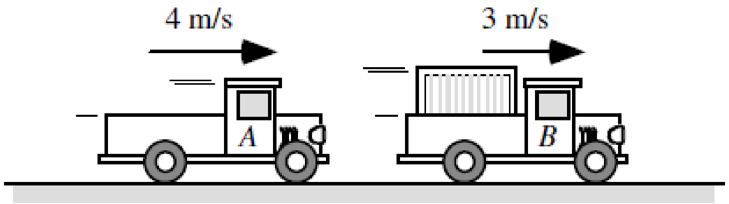


During the collision, will the magnitude of the acceleration of truck A be (i) *greater than*, (ii) *less than*, or (iii) *equal to* the magnitude of the acceleration of truck B? _____

Explain your reasoning.

(a) The two identical trucks are traveling in the same direction, and truck B is carrying a heavy load.

During the collision, will the magnitude of the force exerted on truck A by truck B be (i) *greater than*, (ii) *less than*, or (iii) *equal to* the magnitude of the force exerted on truck B by truck A? _____

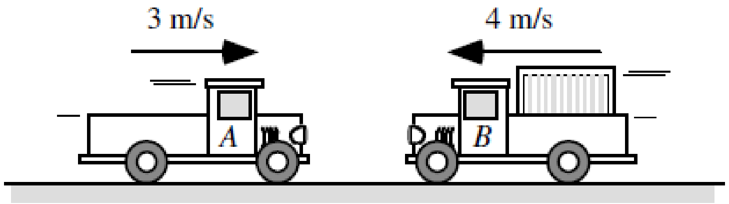


Explain your reasoning.

Answer: The forces will have the same magnitude due to Newton's Third Law.

(b) The two identical trucks are traveling in opposite directions, and truck B is carrying a heavy load.

During the collision, will the magnitude of the force exerted on truck *A* by truck B be (i) *greater than*, (ii) *less than*, or (iii) *equal to* the magnitude of the force exerted on truck B by truck A? _____

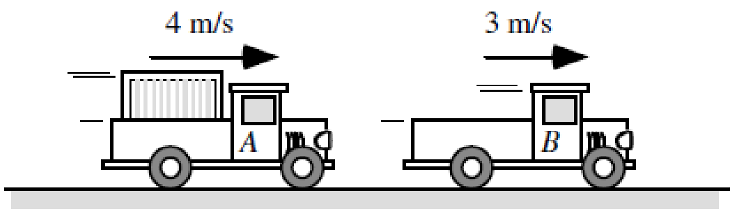


Explain your reasoning.

Answer: The forces will have the same magnitude due to Newton's Third Law.

(c) The two identical trucks are traveling in the same direction, and truck A is carrying a heavy load.

During the collision, will the magnitude of the force exerted on truck A by truck B be (i) ***greater than*****, (ii)** ***less than*****, or (iii)** ***equal to*** **the magnitude of the force exerted on truck B by truck A? _____**

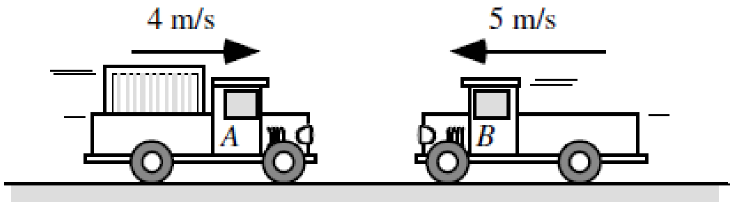


Explain your reasoning.

Answer: The forces will have the same magnitude due to Newton's Third Law.

(e) The two identical trucks are traveling in opposite directions, and truck A is carrying a heavy load.

During the collision, will the magnitude of the force exerted on truck A by truck B be (i) ***greater than*****, (ii)** ***less than*****, or (iii)** ***equal to*** **the magnitude of the force exerted on truck B by truck A? _____**

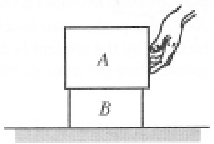


Explain your reasoning.

Answer: The forces will have the same magnitude due to Newton's Third Law.

B3-QRT91: Stacked Blocks Slowing Down—Friction Forces

A student pushes two blocks across a desk. At the instant shown, the blocks are *slowing down*. The force exerted on block A by the student is directed horizontally to the left. The mass of block A is greater than the mass of block B.



(a) The magnitude of the friction force exerted on block A by block B

(i) is *greater than* the magnitude of the friction force exerted on block B by block A.
(ii) is *less than* the magnitude of the friction force exerted on block B by block A.
(iii) is *equal to* the magnitude of the friction force exerted on block B by block A.
(iv) cannot be compared to the magnitude of the friction force exerted on block B by block A based on the information given.

Explain your reasoning.

(b) The magnitude of the friction force exerted on block B by the desk

(i) is *greater than* the magnitude of the friction force exerted on block B by block A.
(ii) is *less than* the magnitude of the friction force exerted on block B by block A.
(iii) is *equal to* the magnitude of the friction force exerted on block B by block A.
(iv) cannot be compared to the magnitude of the friction force exerted on block B by block A based on the information given.

Explain your reasoning.

(c) The magnitude of the friction force exerted on block A by block B

(i) is *greater than* the magnitude of the force exerted on block A by the hand.
(ii) is *less than* the magnitude of the force exerted on block A by the hand.
(iii) is *equal to* the magnitude of the force exerted on block A by the hand.
(iv) cannot be compared to the magnitude of the force exerted on block A by the hand based on the information given.

Explain your reasoning.

(iii) The friction force on block B by block A must be equal to the friction force on block A by block B by Newton's Third Law.

(b) The magnitude of the friction force exerted on block B by the desk

(i) is *greater than* the magnitude of the friction force exerted on block B by block A.
(ii) is *less than* the magnitude of the friction force exerted on block B by block A.
(iii) is *equal to* the magnitude of the friction force exerted on block B by block A.
(iv) cannot be compared to the magnitude of the friction force exerted on block B by block A based on the information given.

Explain your reasoning.

(i) Since block B is slowing down, the net horizontal force acting on it must be directed to the right, so the friction force on B by the desk must be greater in magnitude and opposite in direction to the friction force on B by A.

(c) The magnitude of the friction force exerted on block A by block B

(i) is *greater than* the magnitude of the force exerted on block A by the hand.
(ii) is *less than* the magnitude of the force exerted on block A by the hand.
(iii) is *equal to* the magnitude of the force exerted on block A by the hand.
(iv) cannot be compared to the magnitude of the force exerted on block A by the hand based on the information given.

Explain your reasoning.

(i) Since block A is slowing down, the net horizontal force acting on it must be directed to the right, so the friction force on A by B must be greater in magnitude and opposite in direction to the force on A by the hand.