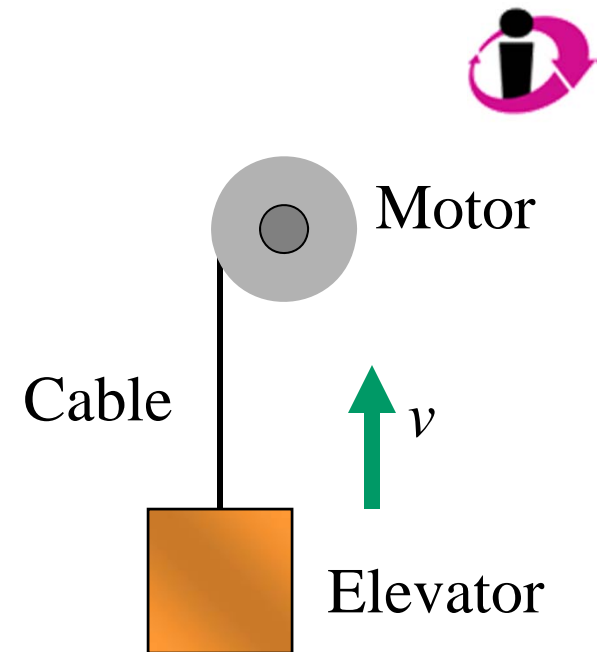


## Q4.1

An elevator is being lifted at a constant speed by a steel cable attached to an electric motor. There is no air resistance, nor is there any friction between the elevator and the walls of the elevator shaft.

The upward force exerted on the elevator by the cable is

- A. greater than the downward force of gravity.
- B. equal to the force of gravity.
- C. less than the force of gravity.
- D. any of the above, depending on the speed of the elevator.

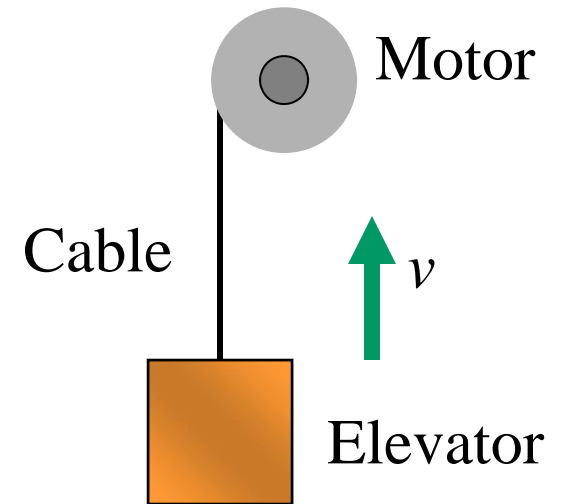


## A4.1

An elevator is being lifted at a constant speed by a steel cable attached to an electric motor. There is no air resistance, nor is there any friction between the elevator and the walls of the elevator shaft.

The upward force exerted on the elevator by the cable is

- A. greater than the downward force of gravity.
- ✓ B. equal to the force of gravity.
- C. less than the force of gravity.
- D. any of the above, depending on the speed of the elevator.

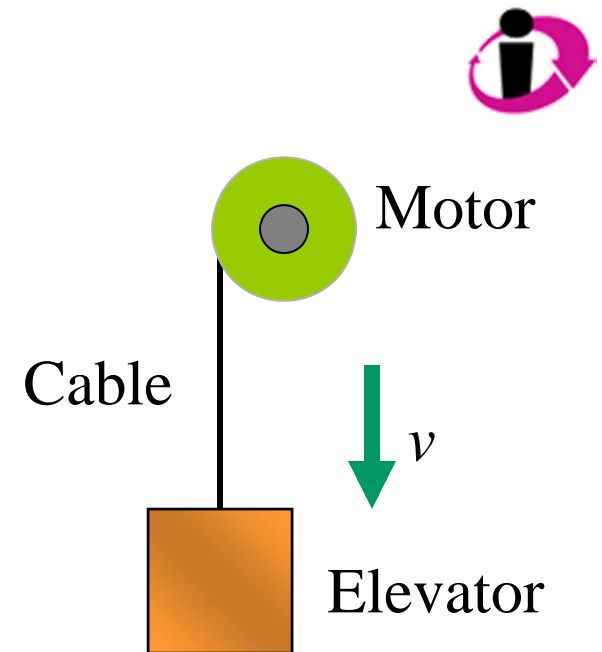


## Q4.2

An elevator is being lowered at a constant speed by a steel cable attached to an electric motor. There is no air resistance, nor is there any friction between the elevator and the walls of the elevator shaft.

The upward force exerted on the elevator by the cable is

- A. greater than the downward force of gravity.
- B. equal to the force of gravity.
- C. less than the force of gravity.
- D. any of the above, depending on the speed of the elevator.

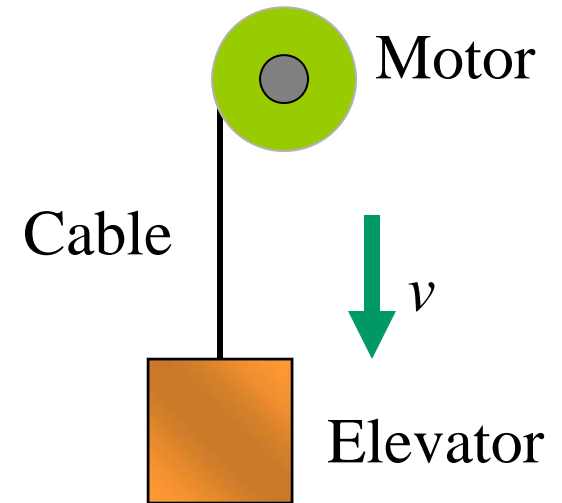


## A4.2

An elevator is being lowered at a constant speed by a steel cable attached to an electric motor. There is no air resistance, nor is there any friction between the elevator and the walls of the elevator shaft.

The upward force exerted on the elevator by the cable is

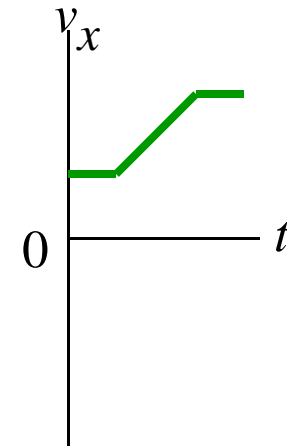
- A. greater than the downward force of gravity.
- ✓ B. equal to the force of gravity.
- C. less than the force of gravity.
- D. any of the above, depending on the speed of the elevator.



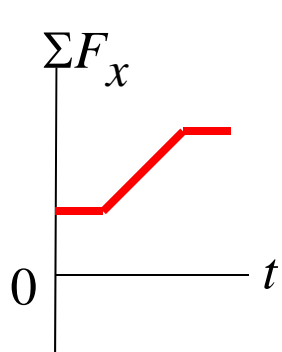
### Q4.3



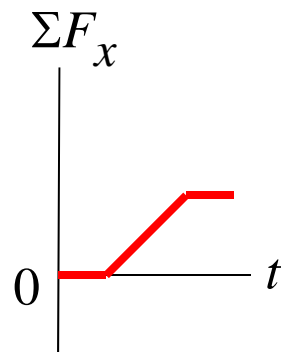
The graph to the right shows the velocity of an object as a function of time.



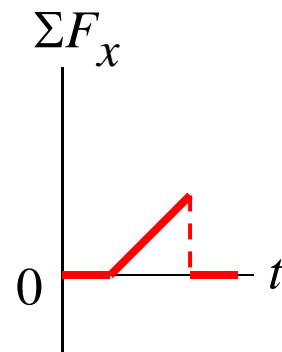
Which of the graphs below best shows the net force versus time for this object?



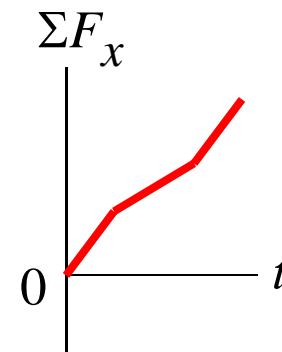
A.



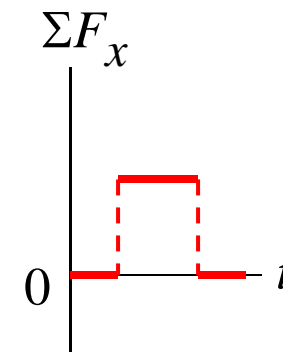
B.



C.



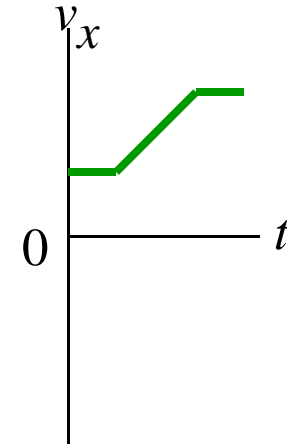
D.



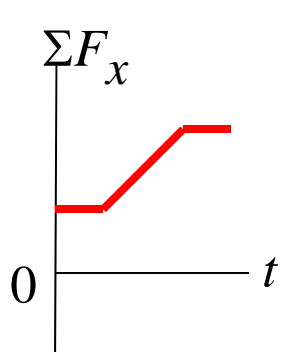
E.

### A4.3

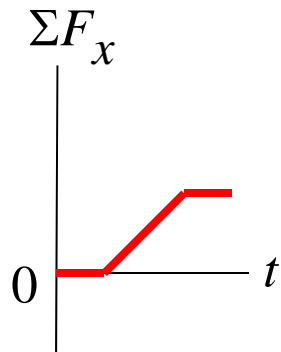
The graph to the right shows the velocity of an object as a function of time.



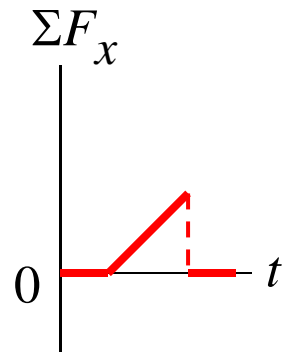
Which of the graphs below best shows the net force versus time for this object?



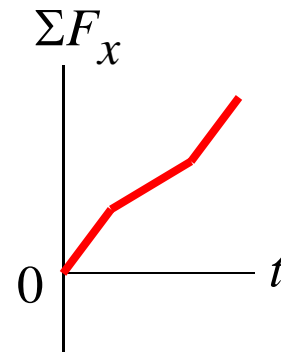
A.



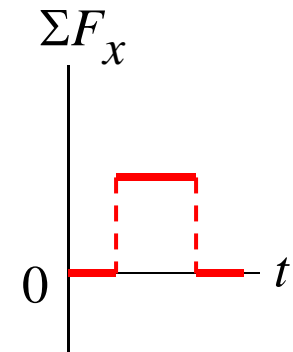
B.



C.



D.



E.

## Q4.4



A horse is hitched to a wagon. Which statement is correct?

A. The force that the horse exerts on the wagon is greater than the force that the wagon exerts on the horse.

B. The force that the horse exerts on the wagon is less than the force that the wagon exerts on the horse.

C. The force that the horse exerts on the wagon is just as strong as the force that the wagon exerts on the horse.

D. The answer depends on the velocity of horse and wagon.


E. The answer depends on the acceleration of horse and wagon.

## A4.4

A horse is hitched to a wagon. Which statement is correct?

A. The force that the horse exerts on the wagon is greater than the force that the wagon exerts on the horse.

B. The force that the horse exerts on the wagon is less than the force that the wagon exerts on the horse.

 C. The force that the horse exerts on the wagon is just as strong as the force that the wagon exerts on the horse.

D. The answer depends on the velocity of horse and wagon.

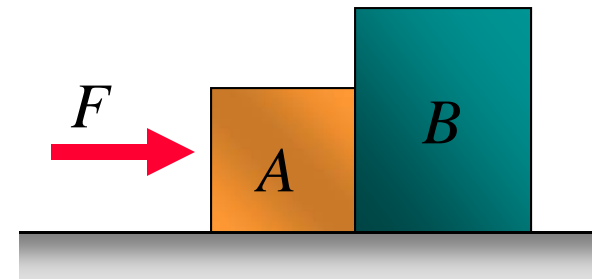
E. The answer depends on the acceleration of horse and wagon.



## Q4.5



A lightweight crate ( $A$ ) and a heavy crate ( $B$ ) are side-by-side on a horizontal floor. You apply a horizontal force  $F$  to crate  $A$ . There is friction between the crates and the floor.

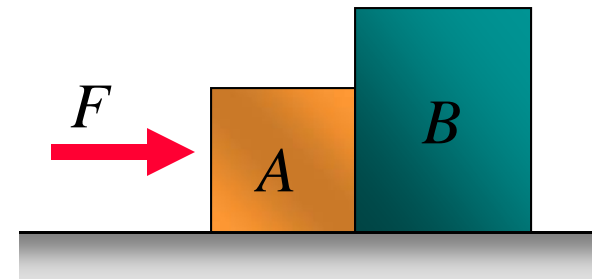


If the two crates are *accelerating to the right*,

- A. crate  $A$  exerts more force on crate  $B$  than  $B$  exerts on  $A$
- B. crate  $A$  exerts less force on crate  $B$  than  $B$  exerts on  $A$
- C. crate  $A$  exerts as much force on crate  $B$  as  $B$  exerts on  $A$
- D. Answer depends on the details of the friction force

## A4.5

A lightweight crate ( $A$ ) and a heavy crate ( $B$ ) are side-by-side on a horizontal floor. You apply a horizontal force  $F$  to crate  $A$ . There is friction between the crates and the floor.



If the two crates are *accelerating to the right*,

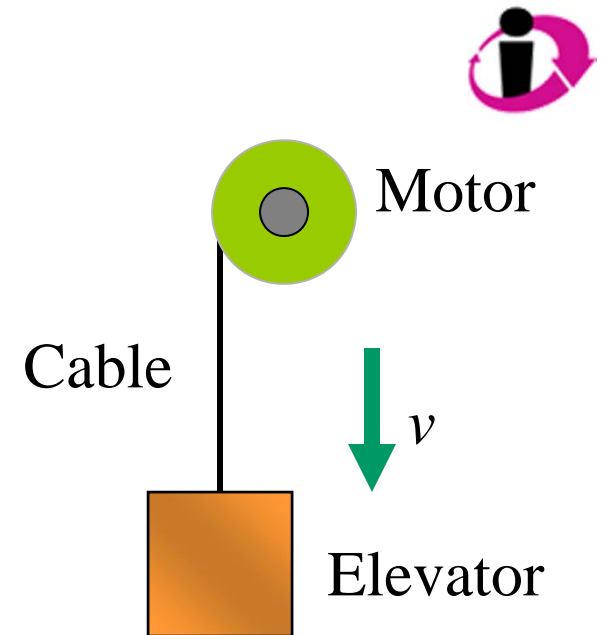
- A. crate  $A$  exerts more force on crate  $B$  than  $B$  exerts on  $A$
- B. crate  $A$  exerts less force on crate  $B$  than  $B$  exerts on  $A$
- ✓ C. crate  $A$  exerts as much force on crate  $B$  as  $B$  exerts on  $A$
- D. Answer depends on the details of the friction force

## Q4.6

An elevator is being lowered at constant speed by a steel cable attached to an electric motor. There is no air resistance, nor is there any friction between the elevator and the walls of the elevator shaft.

The upward force exerted on the elevator by the cable has the same magnitude as the force of gravity on the elevator, but points in the opposite direction. Why?

- A. Newton's first law
- B. Newton's second law
- C. Newton's third law

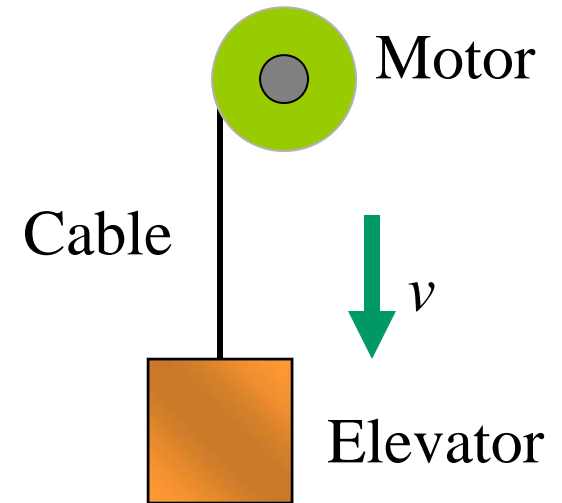


## A4.6

An elevator is being lowered at constant speed by a steel cable attached to an electric motor. There is no air resistance, nor is there any friction between the elevator and the walls of the elevator shaft.

The upward force exerted on the elevator by the cable has the same magnitude as the force of gravity on the elevator, but points in the opposite direction. Why?

- ✓ A. Newton's first law
- B. Newton's second law
- C. Newton's third law



### Q4.7



A lightweight crate ( $A$ ) and a heavy crate ( $B$ ) are side by side on a frictionless horizontal surface. If you apply a horizontal force  $F$  to crate  $A$ ,

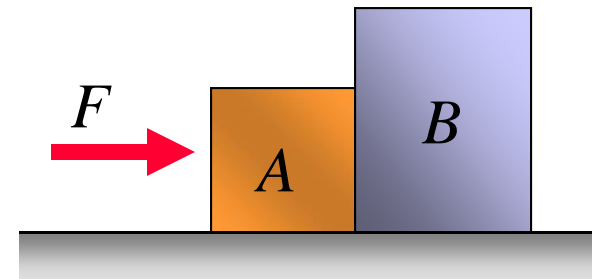
A. the acceleration is greater than if  $B$  were on the left and  $A$  were on the right.

B. the acceleration is less than if  $B$  were on the left and  $A$  were on the right.

C. the crates will not move if  $F$  is less than the combined weight of  $A$  and  $B$ .

D. two of the above are correct.

E. none of the above is correct.



### A4.7

A lightweight crate ( $A$ ) and a heavy crate ( $B$ ) are side by side on a frictionless horizontal surface. If you apply a horizontal force  $F$  to crate  $A$ ,

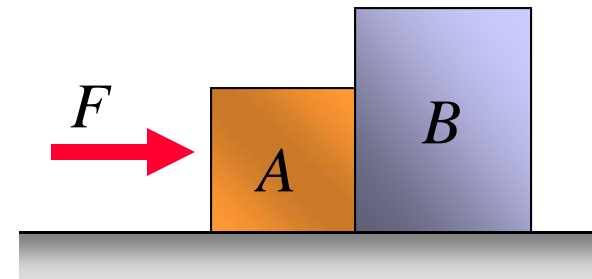
A. the acceleration is greater than if  $B$  were on the left and  $A$  were on the right.

B. the acceleration is less than if  $B$  were on the left and  $A$  were on the right.

C. the crates will not move if  $F$  is less than the combined weight of  $A$  and  $B$ .

D. two of the above are correct.

✓ E. none of the above is correct.



Q4.8




You are standing at rest and begin to walk forward. What force pushes you forward?

- A. the force of your feet on the ground
- B. the force of your acceleration
- C. the force of your velocity
- D. the force of your momentum
- E. the force of the ground on your feet

## A4.8

You are standing at rest and begin to walk forward. What force pushes you forward?

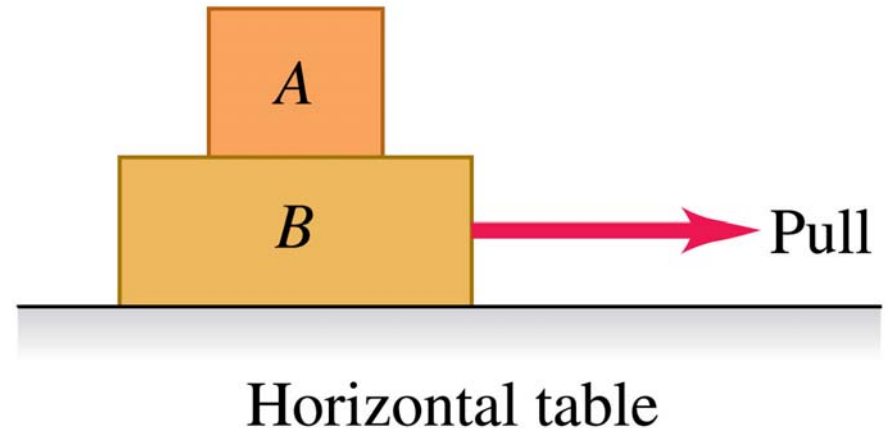
- A. the force of your feet on the ground
- B. the force of your acceleration
- C. the force of your velocity
- D. the force of your momentum
-  E. the force of the ground on your feet



## Q4.9



A person pulls horizontally on block  $B$ , causing both blocks to move horizontally as a unit. There is friction between block  $B$  and the horizontal table.



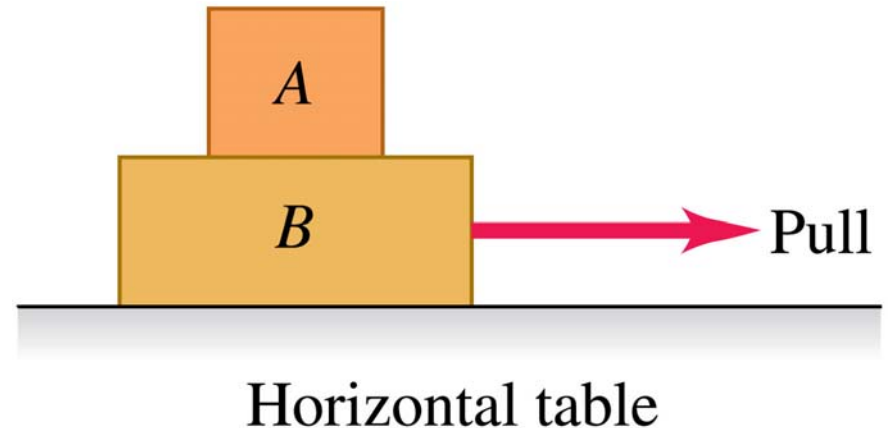
If the two blocks are moving to the right at constant velocity,

- A. the horizontal force that  $B$  exerts on  $A$  points to the left.
- B. the horizontal force that  $B$  exerts on  $A$  points to the right.
- C.  $B$  exerts no horizontal force on  $A$ .
- D. not enough information given to decide

## A4.9

A person pulls horizontally on block  $B$ , causing both blocks to move horizontally as a unit. There is friction between block  $B$  and the horizontal table.

If the two blocks are moving to the right at constant velocity,

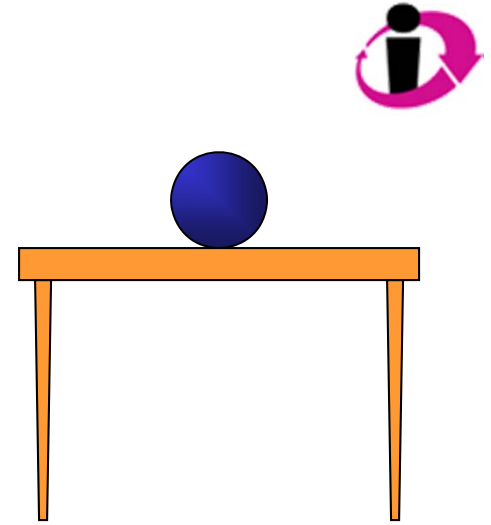


- A. the horizontal force that  $B$  exerts on  $A$  points to the left.
- B. the horizontal force that  $B$  exerts on  $A$  points to the right.
- ✓ C.  $B$  exerts no horizontal force on  $A$ .
- D. not enough information given to decide

## Q4.10

A ball sits at rest on a horizontal table top.

The gravitational force on the ball (its weight) is one half of an action–reaction pair. Which force is the other half?

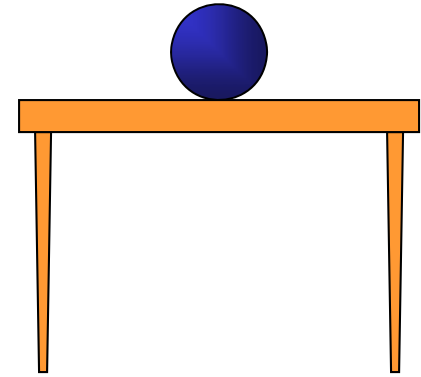


- A. the force of the earth's gravity on the ball
- B. the upward force that the table top exerts on the ball
- C. the upward force that the ball exerts on earth
- D. the downward force that the ball exerts on the table top
- E. the frictional force between the ball and the table top

## A4.10

A ball sits at rest on a horizontal table top.

The gravitational force on the ball (its weight) is one half of an action–reaction pair. Which force is the other half?



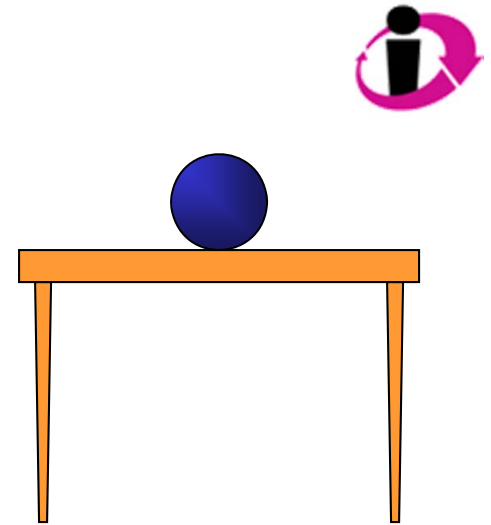
- A. the force of the earth's gravity on the ball
- B. the upward force that the table top exerts on the ball
- ✓ C. the upward force that the ball exerts on earth
- D. the downward force that the ball exerts on the table top
- E. the frictional force between the ball and the table top

## Q4.11

A ball sits at rest on a horizontal table top.

The weight of the ball is equal to the magnitude of the upward force that the table top exerts on the ball. Why?

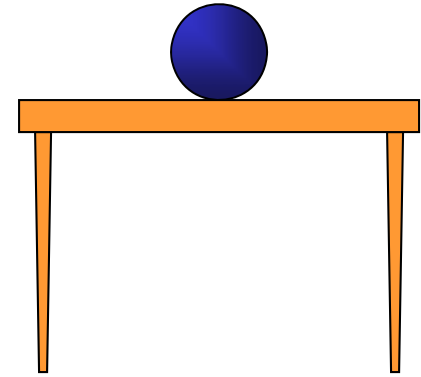
- A. This is a consequence of Newton's first law.
- B. This is a consequence of Newton's third law.
- C. Because we assume that the table top is perfectly rigid.
- D. Two of the above three statements are correct.
- E. All of the first three statements are correct.



## A4.11

A ball sits at rest on a horizontal table top.

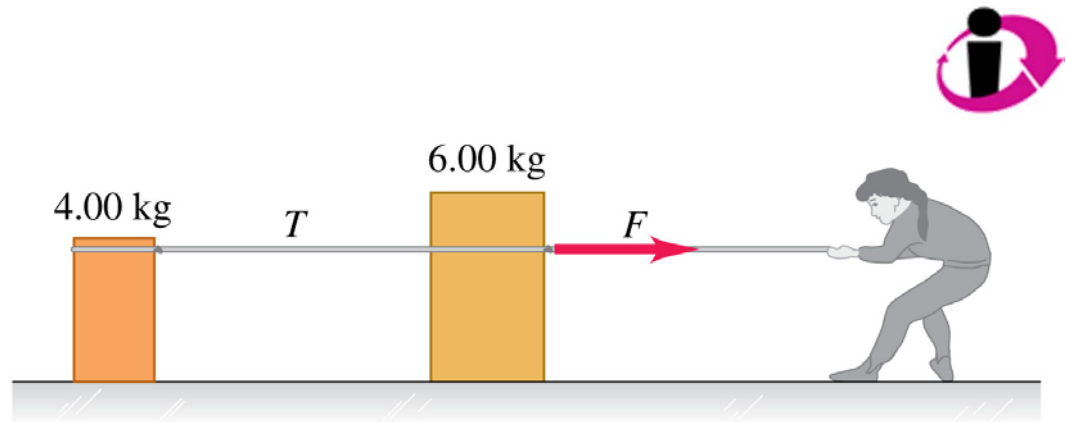
The weight of the ball is equal to the magnitude of the upward force that the table top exerts on the ball. Why?



- ✓ A. This is a consequence of Newton's first law.
- B. This is a consequence of Newton's third law.
- C. Because we assume that the table top is perfectly rigid.
- D. Two of the above three statements are correct.
- E. All of the first three statements are correct.

## Q4.12

A woman pulls on a 6.00-kg crate, which in turn is connected to a 4.00-kg crate by a light rope. The light rope remains taut.

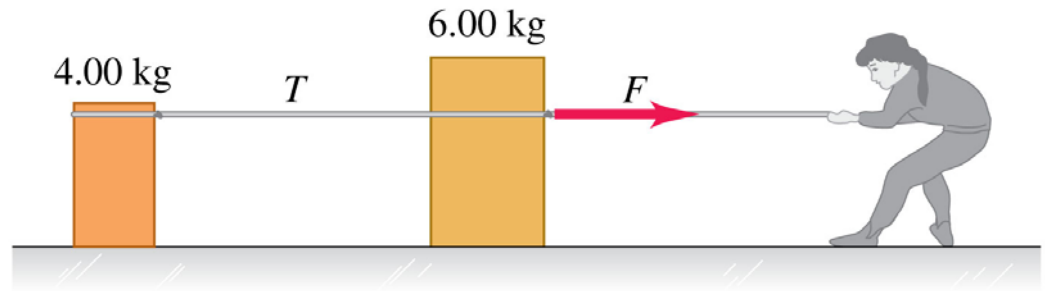


Compared to the 6.00-kg crate, the lighter 4.00-kg crate

- A. is subjected to the same net force and has the same acceleration.
- B. is subjected to a smaller net force and has the same acceleration.
- C. is subjected to the same net force and has a smaller acceleration.
- D. is subjected to a smaller net force and has a smaller acceleration.
- E. none of the above

## A4.12

A woman pulls on a 6.00-kg crate, which in turn is connected to a 4.00-kg crate by a light rope. The light rope remains taut.



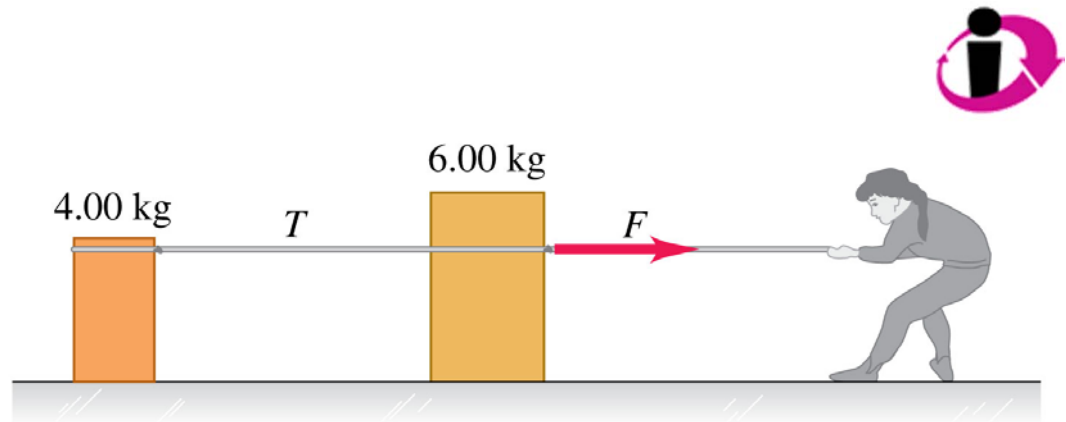
Compared to the 6.00-kg crate, the lighter 4.00-kg crate

- A. is subjected to the same net force and has the same acceleration.
- ✓ B. is subjected to a smaller net force and has the same acceleration.
- C. is subjected to the same net force and has a smaller acceleration.
- D. is subjected to a smaller net force and has a smaller acceleration.
- E. none of the above



### Q4.13

A woman pulls on a 6.00-kg crate, which in turn is connected to a 4.00-kg crate by a light rope. The light rope remains taut.

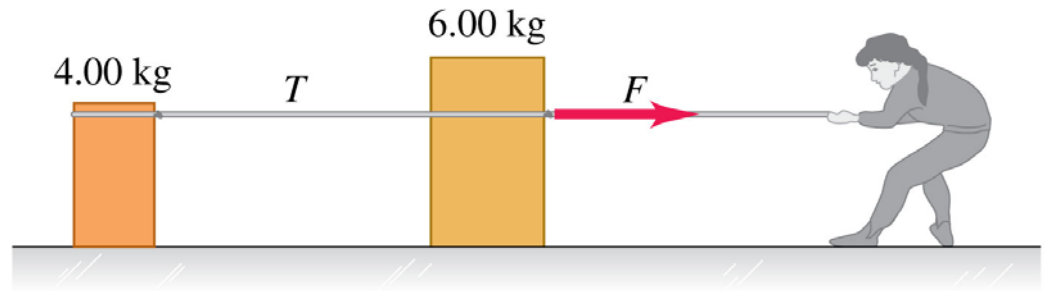


If the two crates *move at constant speed*,

- A. the 6.00-kg crate exerts more force on the 4.00-kg crate than the 4.00-kg crate exerts on the 6.00-kg crate.
- B. the 6.00-kg crate exerts less force on the 4.00-kg crate than the 4.00-kg crate exerts on the 6.00-kg crate.
- C. the 6.00-kg crate exerts as much force on the 4.00-kg crate as the 4.00-kg crate exerts on the 6.00-kg crate.

### A4.13

A woman pulls on a 6.00-kg crate, which in turn is connected to a 4.00-kg crate by a light rope. The light rope remains taut.

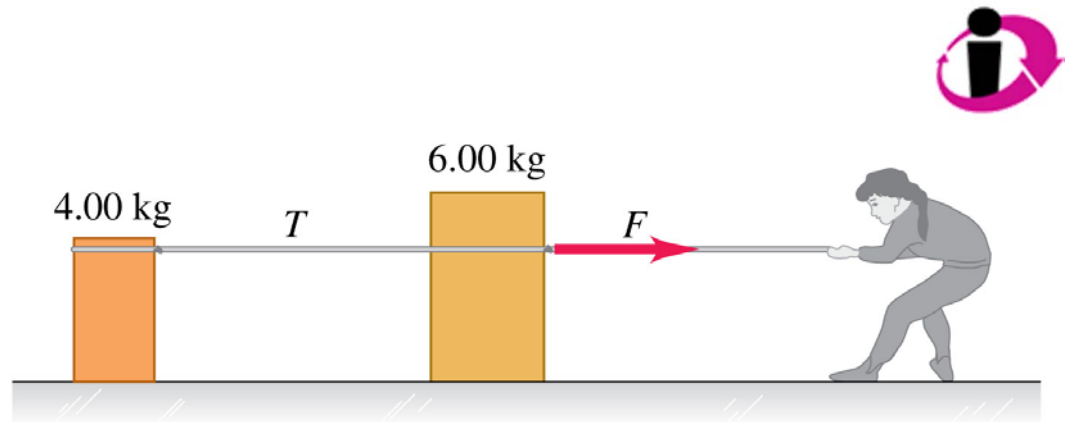


If the two crates *move at constant speed*,

- A. the 6.00-kg crate exerts more force on the 4.00-kg crate than the 4.00-kg crate exerts on the 6.00-kg crate.
- B. the 6.00-kg crate exerts less force on the 4.00-kg crate than the 4.00-kg crate exerts on the 6.00-kg crate.
- ✓ C. the 6.00-kg crate exerts as much force on the 4.00-kg crate as the 4.00-kg crate exerts on the 6.00-kg crate.

## Q4.14

A woman pulls on a 6.00-kg crate, which in turn is connected to a 4.00-kg crate by a light rope. The light rope remains taut.

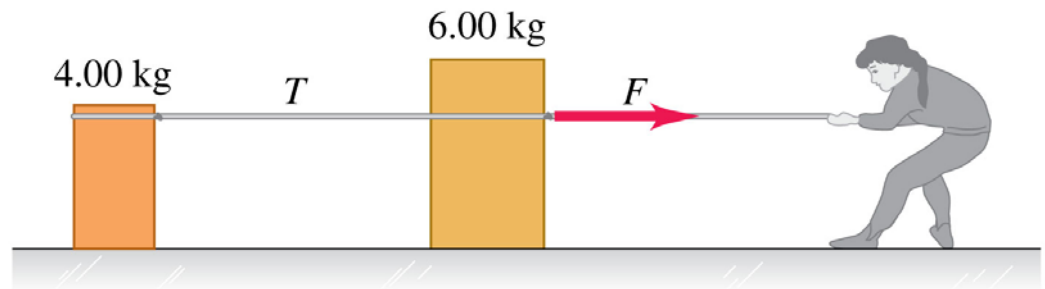


If the two crates are *accelerating to the right*,

- A. the 6.00-kg crate exerts more force on the 4.00-kg crate than the 4.00-kg crate exerts on the 6.00-kg crate.
- B. the 6.00-kg crate exerts less force on the 4.00-kg crate than the 4.00-kg crate exerts on the 6.00-kg crate.
- C. the 6.00-kg crate exerts as much force on the 4.00-kg crate as the 4.00-kg crate exerts on the 6.00-kg crate.

## A4.14

A woman pulls on a 6.00-kg crate, which in turn is connected to a 4.00-kg crate by a light rope. The light rope remains taut.



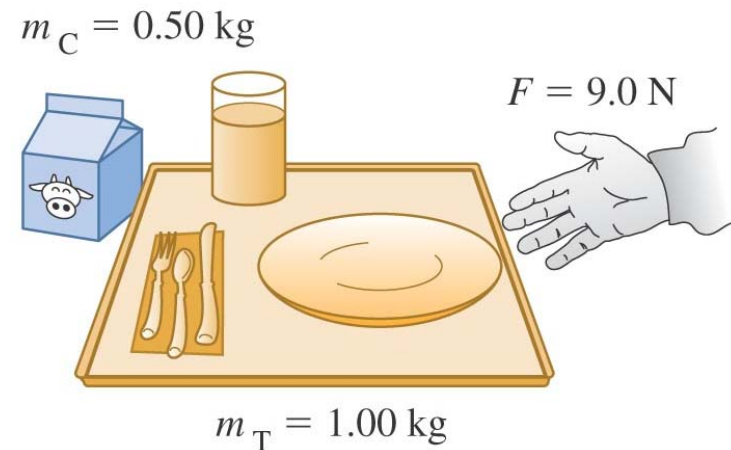
If the two crates are *accelerating to the right*,

- A. the 6.00-kg crate exerts more force on the 4.00-kg crate than the 4.00-kg crate exerts on the 6.00-kg crate.
- B. the 6.00-kg crate exerts less force on the 4.00-kg crate than the 4.00-kg crate exerts on the 6.00-kg crate.
- ✓ C. the 6.00-kg crate exerts as much force on the 4.00-kg crate as the 4.00-kg crate exerts on the 6.00-kg crate.

## Q4.15



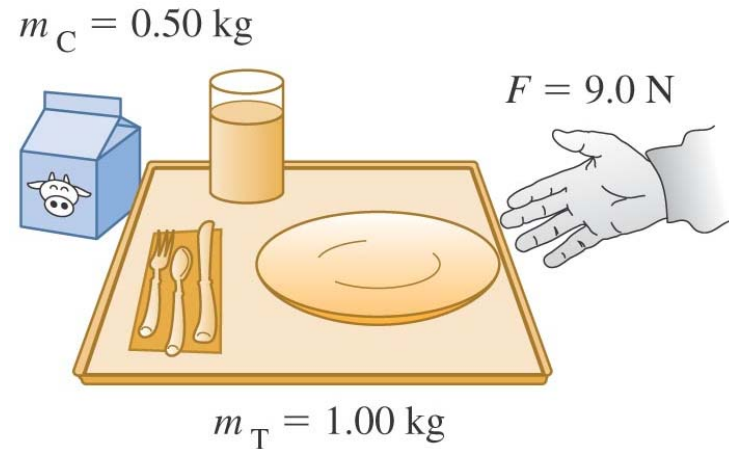
You are pushing a 1.00-kg food tray through the cafeteria line with a constant 9.0-N force. As the tray moves, it pushes on a 0.50-kg milk carton. If the food tray and milk carton *move at constant speed*,



- A. the tray exerts more force on the milk carton than the milk carton exerts on the tray.
- B. the tray exerts less force on the milk carton than the milk carton exerts on the tray.
- C. the tray exerts as much force on the milk carton as the milk carton exerts on the tray.

## A4.15

You are pushing a 1.00-kg food tray through the cafeteria line with a constant 9.0-N force. As the tray moves, it pushes on a 0.50-kg milk carton. If the food tray and milk carton *move at constant speed*,

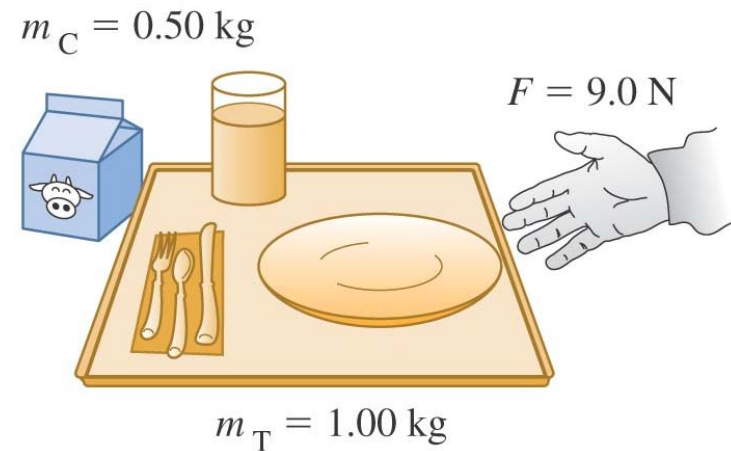


- A. the tray exerts more force on the milk carton than the milk carton exerts on the tray.
- B. the tray exerts less force on the milk carton than the milk carton exerts on the tray.
- ✓ C. the tray exerts as much force on the milk carton as the milk carton exerts on the tray.

## Q4.16



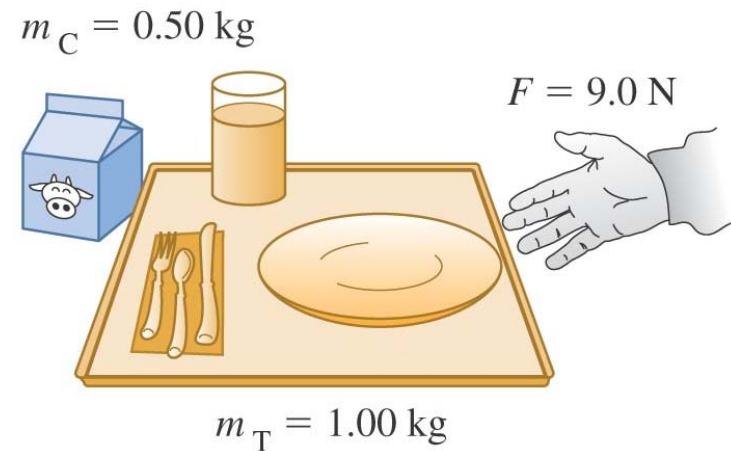
You are pushing a 1.00-kg food tray through the cafeteria line with a constant 9.0-N force. As the tray moves, it pushes on a 0.50-kg milk carton. If the food tray and milk carton are *accelerating to the left*,



- A. the tray exerts more force on the milk carton than the milk carton exerts on the tray.
- B. the tray exerts less force on the milk carton than the milk carton exerts on the tray.
- C. the tray exerts as much force on the milk carton as the milk carton exerts on the tray.

## A4.16

You are pushing a 1.00-kg food tray through the cafeteria line with a constant 9.0-N force. As the tray moves, it pushes on a 0.50-kg milk carton. If the food tray and milk carton are *accelerating to the left*,



- A. the tray exerts more force on the milk carton than the milk carton exerts on the tray.
- B. the tray exerts less force on the milk carton than the milk carton exerts on the tray.
- ✓ C. the tray exerts as much force on the milk carton as the milk carton exerts on the tray.