INSTRUCTIONS FOR USE

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- Use the bookmarks at left
- Click the triangle in front of desired subject to reveal all *ConcepTests* for that subject.
- Click on the desired *ConcepTest*.
- Use “Print” from the “File” menu to make a printout of the *ConcepTest*.

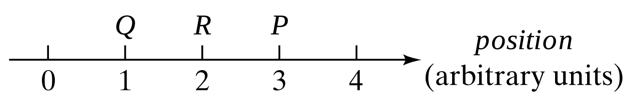
To search for a specific word or phrase within this file:

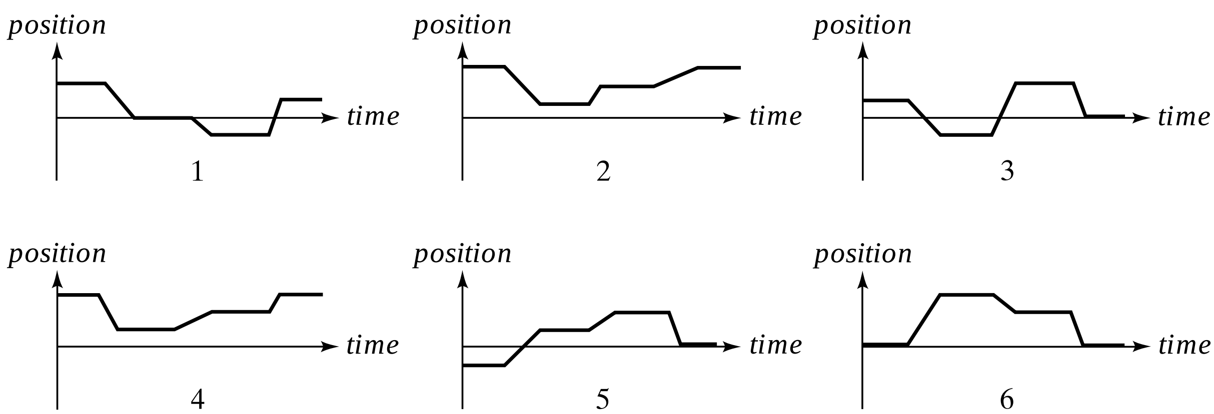
- Use “Find” from the “Tools” menu .

To re-organize or modify the text in this file:

- Use “Select Text” from the “Tools” menu to copy the text you want to edit.
- Paste the copied text into your word processor or other application.
- To copy artwork, use “Select Graphics” from the “Tools” menu.

A person initially at point P in the illustration stays there a moment and then moves along the axis to Q and stays there a moment. She then runs quickly to R, stays there a moment, and then strolls slowly back to Q. Which of the position vs. time graphs below correctly represents this motion?



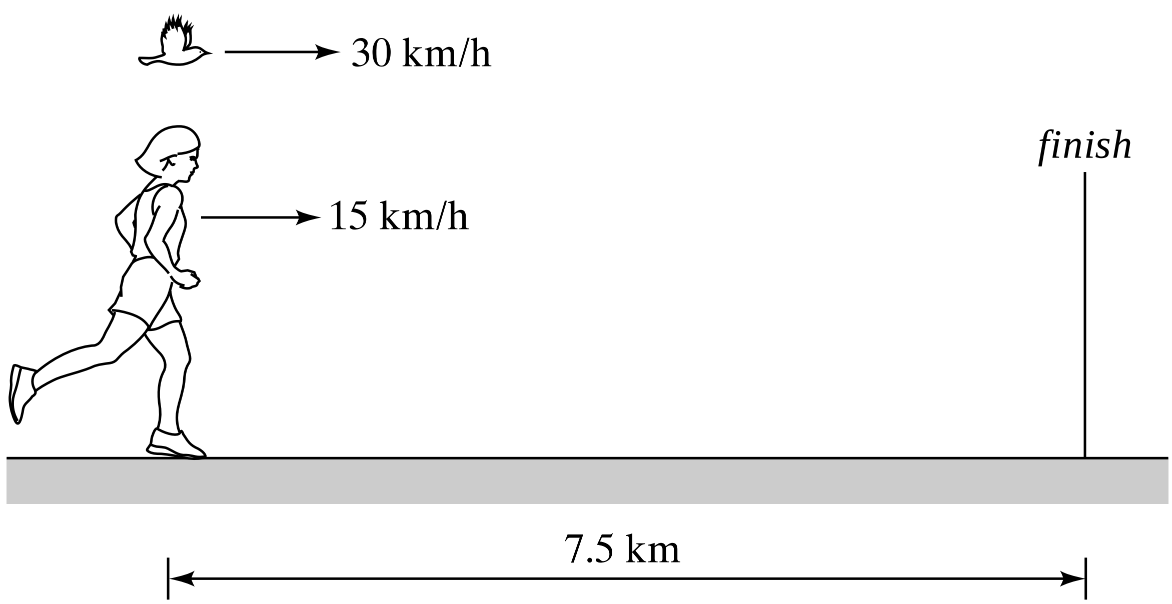


An object goes from one point in space to another. After it arrives at its destination, its displacement is:

1. either greater than or equal to
2. always greater than
3. always equal to
4. either smaller than or equal to
5. always smaller than
6. either smaller or larger

than the distance it traveled.

A marathon runner runs at a steady 15 km/hr. When the runner is 7.5 km from the finish, a bird begins flying from the runner to the finish at 30 km/hr. When the bird reaches the finish line, it turns around and flies back to the runner, and then turns around again, repeating the back-and-forth trips until the runner reaches the finish line. How many kilometers does the bird travel?



1. 10 km
2. 15 km
3. 20 km
4. 30 km

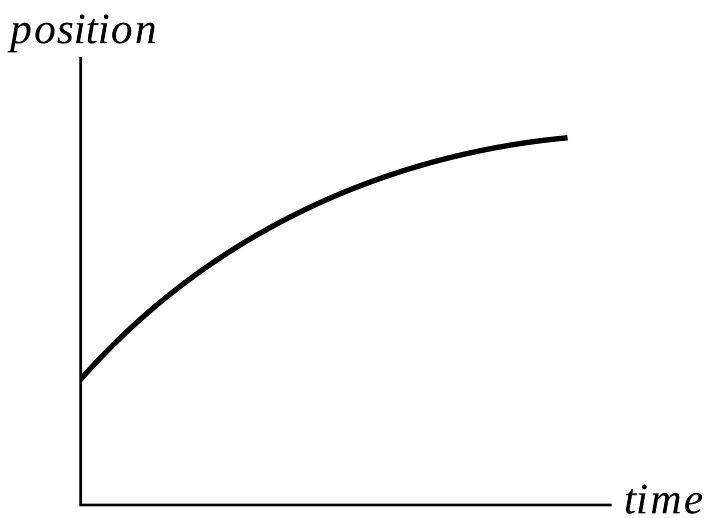
If you drop an object in the absence of air resistance, it accelerates downward at 9.8 m/s^2. If instead you throw it downward, its downward acceleration after release is

1. less than 9.8 m/s^2.
2. 9.8 m/s^2.
3. more than 9.8 m/s^2.

A person standing at the edge of a cliff throws one ball straight up and another ball straight down at the same initial speed. Neglecting air resistance, the ball to hit the ground below the cliff with the greater speed is the one initially thrown

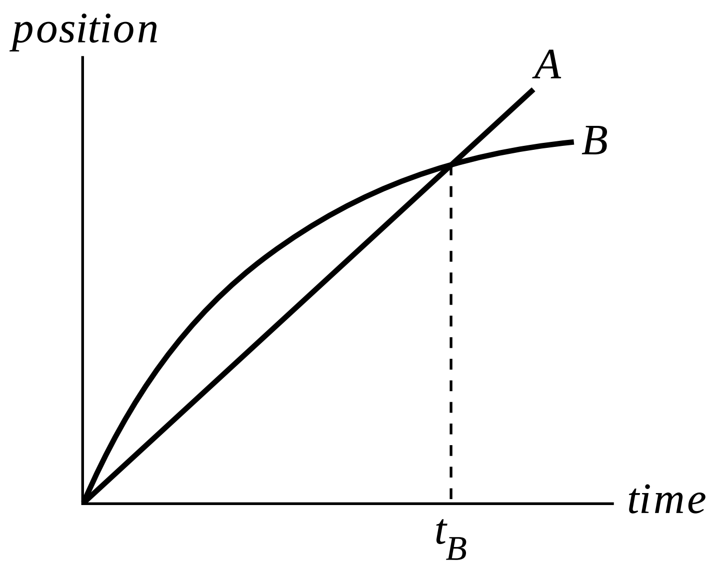
1. upward.
2. downward.
3. neither—they both hit at the same speed.

A train car moves along a long straight track. The graph shows the position as a function of time for this train. The graph shows that the train:



1. speeds up all the time.
2. slows down all the time.
3. speeds up part of the time and slows down part of the time.
4. moves at a constant velocity.

The graph shows position as a function of time for two trains running on parallel tracks. Which is true:

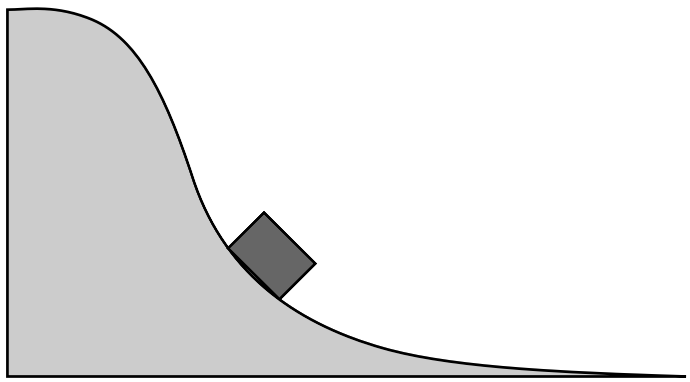


1. At time t_B,both trains have the same velocity.
2. Both trains speed up all the time.
3. Both trains have the same velocity at some time before t_B.
4. Somewhere on the graph, both trains have the same acceleration.

You are throwing a ball straight up in the air. At the highest point, the ball's

1. velocity and acceleration are zero.
2. velocity is nonzero but its acceleration is zero.
3. acceleration is nonzero, but its velocity is zero.
4. velocity and acceleration are both nonzero.

A cart on a roller-coaster rolls down the track shown below. As the cart rolls beyond the point shown, what happens to its speed and acceleration in the direction of motion?

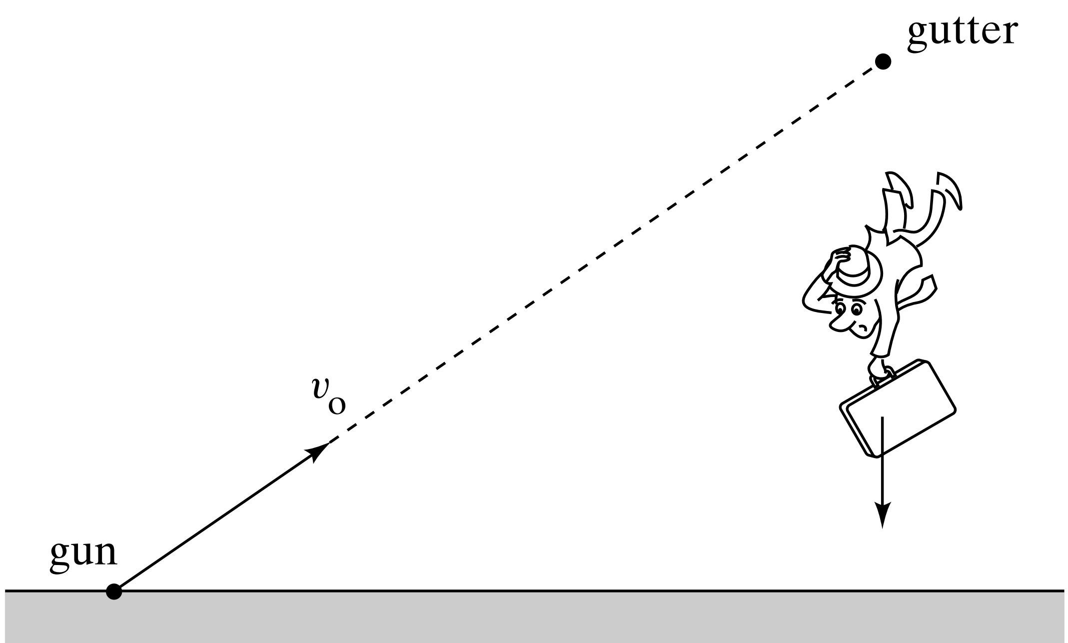


1. Both decrease.
2. The speed decreases, but the acceleration increases.
3. Both remain constant.
4. The speed increases, but acceleration decreases.
5. Both increase.
6. Other

A ball is thrown vertically up, its speed slowing under the influence of gravity. Suppose (*a*) we film this motion and play the tape backward (so the tape begins with the ball at its highest point and ends with it reaching the point from which it was released), and (*b*) we observe the motion of the ball from a frame of reference moving up at the initial speed of the ball. The ball has a downward acceleration g in

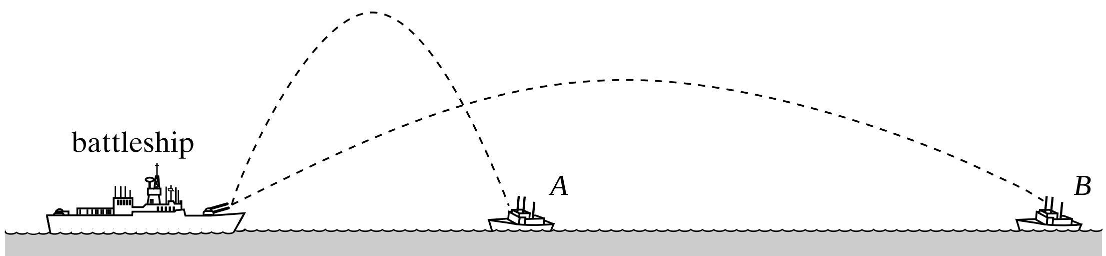
1. (*a*) and (*b*).
2. only (*a*).
3. only (*b*).
4. neither (*a*) nor (*b*).

Consider the situation depicted here. A gun is aimed directly at a dangerous criminal hanging from the gutter of a building. The target is well within the gun's range, but the instant the gun is fired and the bullet moves with a speed v_o, the criminal lets go and drops to the ground. What happens? The bullet



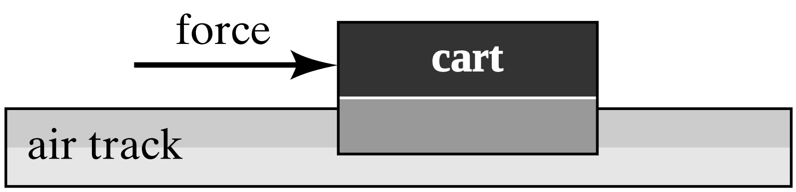
1. hits the criminal regardless of the value of v_o.
2. hits the criminal only if v_o is large enough.
3. misses the criminal.

A battleship simultaneously fires two shells at enemy ships. If the shells follow the parabolic trajectories shown, which ship gets hit first?



1. *A*
2. both at the same time
3. *B*
4. need more information

A constant force is exerted on a cart that is initially at rest on an air track. Friction between the cart and the track is negligible. The force acts for a short time interval and gives the cart a certain final speed.

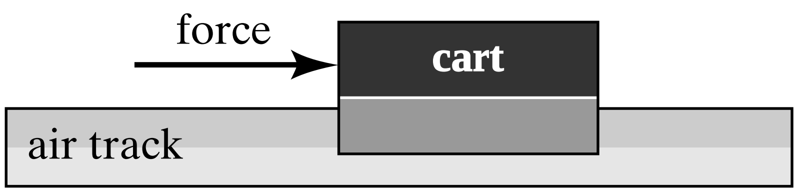


To reach the same final speed with a force that is only half as big, the force must be exerted on the cart for a time interval

1. four times as long as
2. twice as long as
3. equal to
4. half as long as
5. a quarter of

that for the stronger force.

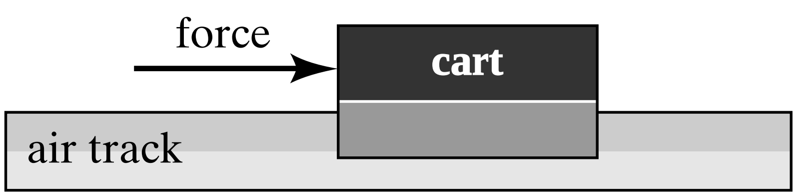
A constant force is exerted for a short time interval on a cart that is initially at rest on an air track. This force gives the cart a certain final speed. The same force is exerted for the same length of time on another cart, also initially at rest, that has twice the mass of the first one. The final speed of the heavier cart is



1. one-fourth
2. four times
3. half
4. double
5. the same as

that of the lighter cart.

A constant force is exerted for a short time interval on a cart that is initially at rest on an air track. This force gives the cart a certain final speed. Suppose we repeat the experiment but, instead of starting from rest, the cart is already moving with constant speed in the direction of the force at the moment we begin to apply the force. After we exert the same constant force for the same short time interval, the increase in the cart's speed



1. is equal to two times its initial speed.
2. is equal to the square of its initial speed.
3. is equal to four times its initial speed.
4. is the same as when it started from rest.
5. cannot be determined from the information provided.

Consider a person standing in an elevator that is accelerating upward. The upward normal force N exerted by the elevator floor on the person is

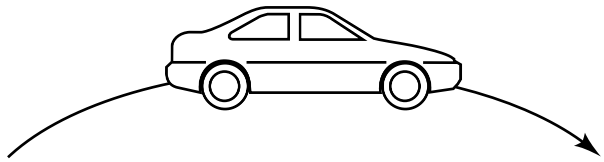
1. larger than
2. identical to
3. smaller than

the downward weight W of the person.

A person pulls a box across the floor. Which is the correct analysis of the situation?

1. The box moves forward because the person pulls forward slightly harder on the box than the box pulls backward on the person.
2. Because action always equals reaction, the person cannot pull the box- the box pulls backward just as hard as the person pulls forward, so there is no motion.
3. The person gets the box to move by giving it a tug during which the force on the box is momentarily greater than the force exerted by the box on the person.
4. The person's force on the box is as strong as the force of the box on the person, but the frictional force on the person is forward and large while the backward frictional force on the box is small.
5. The person can pull the box forward only if he or she weighs more than the box.

A car rounds a curve while maintaining a constant speed. Is there a net force on the car as it rounds the curve?



1. No—its speed is constant.
2. Yes.
3. It depends on the sharpness of the curve and the speed of the car.

In the 17th century, Otto von Güricke, a physicist in Magdeburg, fitted two hollow bronze hemispheres together and removed the air from the resulting sphere with a pump. Two eight-horse teams could not pull the halves apart even though the hemispheres fell apart when air was readmitted. Suppose von Güricke had tied both teams of horses to one side and bolted the other side to a heavy tree trunk. In this case, the tension on the hemispheres would be

1. twice
2. exactly the same as
3. half

what it was before.

You are pushing a wooden crate across the floor at constant speed. You decide to turn the crate on end, reducing by half the surface area in contact with the floor. In the new orientation, to push the same crate across the same floor with the same speed, the force that you apply must be about

1. four times as great
2. twice as great
3. equally great
4. half as great
5. one-fourth as great

as the force required before you changed the crate's orientation.

An object is held in place by friction on an inclined surface. The angle of inclination is increased until the object starts moving. If the surface is kept at this angle, the object

1. slows down.
2. moves at uniform speed.
3. speeds up.
4. none of the above

You are a passenger in a car and not wearing your seat belt. Without increasing or decreasing its speed, the car makes a sharp left turn, and you find yourself colliding with the right-hand door. Which is the correct analysis of the situation?

1. Before and after the collision, there is a rightward force pushing you into the door.
2. Starting at the time of collision, the door exerts a leftward force on you.
3. both of the above
4. neither of the above

Consider a horse pulling a buggy. Is the following statement true?

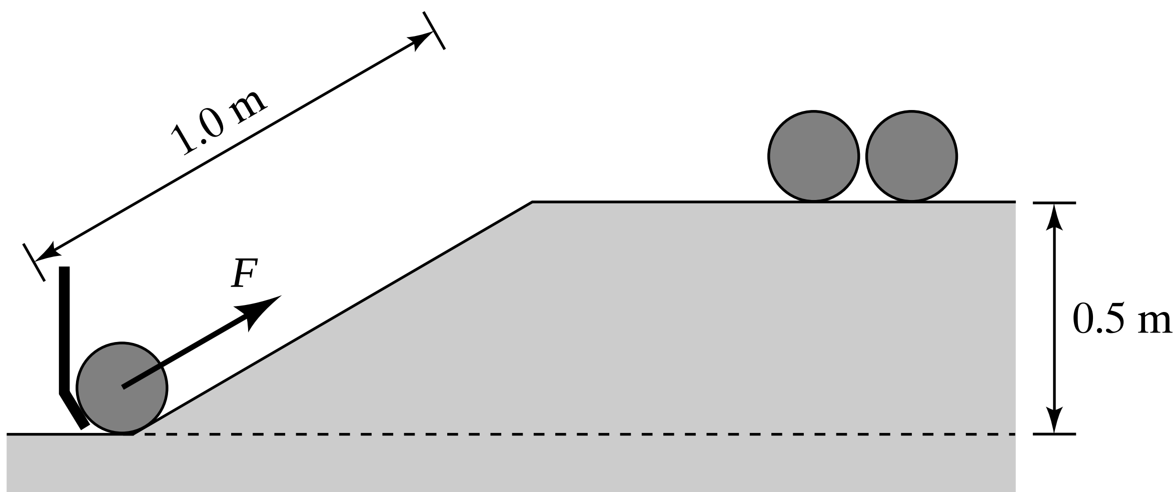
The weight of the horse and the normal force exerted by the ground on the horse constitute an interaction pair that are always equal and opposite according to Newton's third law.

1. yes
2. no

Consider a car at rest. We can conclude that the downward gravitational pull of Earth on the car and the upward contact force of Earth on it are equal and opposite because

1. the two forces form an interaction pair.
2. the net force on the car is zero.
3. neither of the above

At the bowling alley, the ball-feeder mechanism must exert a force to push the bowling balls up a 1.0-m long ramp. The ramp leads the balls to a chute 0.5 m above the base of the ramp. Approximately how much force must be exerted on a 5.0-kg bowling ball?



1. 200 N
2. 50 N
3. 25 N
4. 5.0 N
5. impossible to determine

Pi

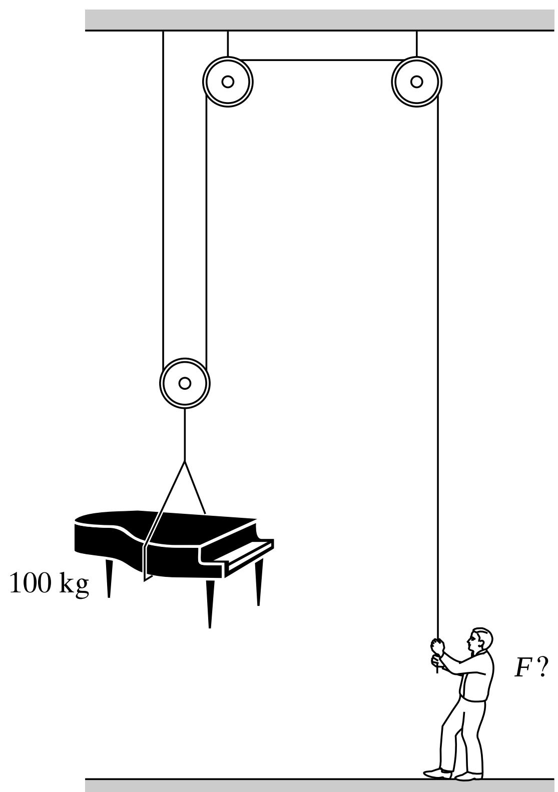
Two marbles, one twice as heavy as the other, are dropped to the ground from the roof of a building. Just before hitting the ground, the heavier marble has

1. as much kinetic energy as the lighter one.
2. twice as much kinetic energy as the lighter one.
3. half as much kinetic energy as the lighter one.
4. four times as much kinetic energy as the lighter one.
5. impossible to determine

Suppose you want to ride your mountain bike up a steep hill. Two paths lead from the base to the top, one twice as long as the other. Compared to the average force you would exert if you took the short path, the average force you exert along the longer path is

1. four times as small.
2. three times as small.
3. half as small.
4. the same.
5. undetermined—it depends on the time taken.

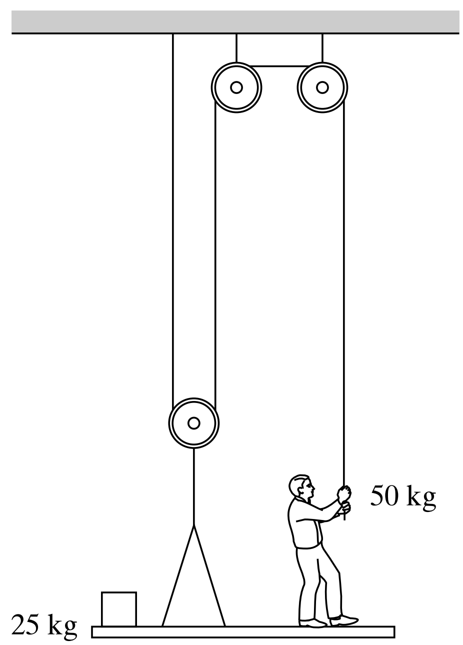
A piano mover raises a 100-kg piano at a constant rate using the frictionless pulley system shown here. With how much force is he pulling on the rope? Ignore friction and assume $g = 10\ m/s^2$.



1. 2,000 N
2. 1,500 N
3. 1,000 N
4. 750 N
5. 500 N
6. 200 N
7. 50 N
8. impossible to determine

Pi

A 50-kg person stands on a 25-kg platform. He pulls on the rope that is attached to the platform via the frictionless pulley system shown here. If he pulls the platform up at a steady rate, with how much force is he pulling on the rope? Ignore friction and assume $g = 10\ \text{m/s}^2$.



1. 750 N
2. 625 N
3. 500 N
4. 250 N
5. 75 N
6. 50 N
7. 25 N
8. impossible to determine

Pi

A block initially at rest is allowed to slide down a frictionless ramp and attains a speed v at the bottom. To achieve a speed $2v$ at the bottom, how many times as high must a new ramp be?

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6

A spring-loaded toy dart gun is used to shoot a dart straight up in the air, and the dart reaches a maximum height of 24 m. The same dart is shot straight up a second time from the same gun, but this time the spring is compressed only half as far before firing. How far up does the dart go this time, neglecting friction and assuming an ideal spring?

1. 96 m
2. 48 m
3. 24 m
4. 12 m
5. 6 m
6. 3 m
7. impossible to determine

A sports car accelerates from zero to 30 mph in 1.5 s. How long does it take for it to accelerate from zero to 60 mph, assuming the power of the engine to be independent of velocity and neglecting friction?

1. 2 s
2. 3 s
3. 4.5 s
4. 6 s
5. 9 s
6. 12 s

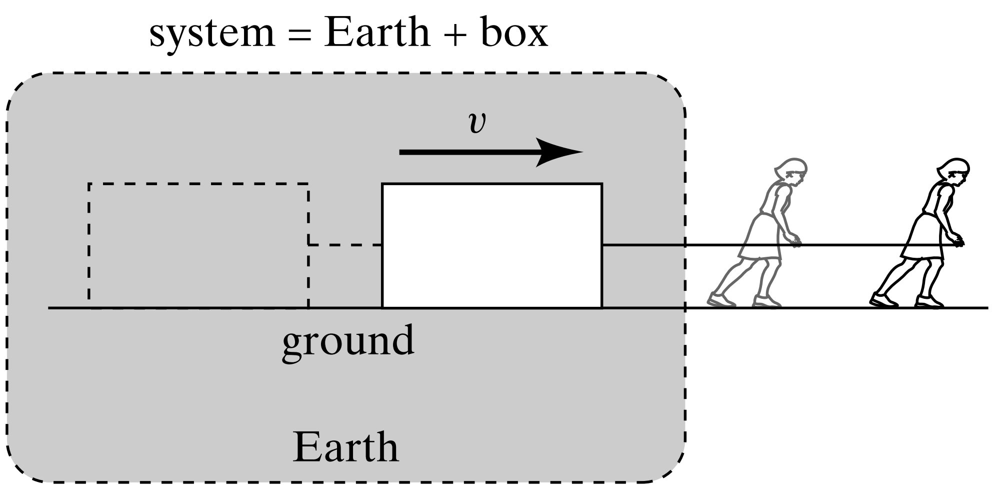
A cart on an air track is moving at 0.5 m/s when the air is suddenly turned off. The cart comes to rest after traveling 1 m. The experiment is repeated, but now the cart is moving at 1 m/s when the air is turned off. How far does the cart travel before coming to rest?

1. 1 m
2. 2 m
3. 3 m
4. 4 m
5. 5 m
6. impossible to determine

Suppose you drop a 1-kg rock from a height of 5 m above the ground. When it hits, how much force does the rock exert on the ground?

1. 0.2 N
2. 5 N
3. 50 N
4. 100 N
5. impossible to determine

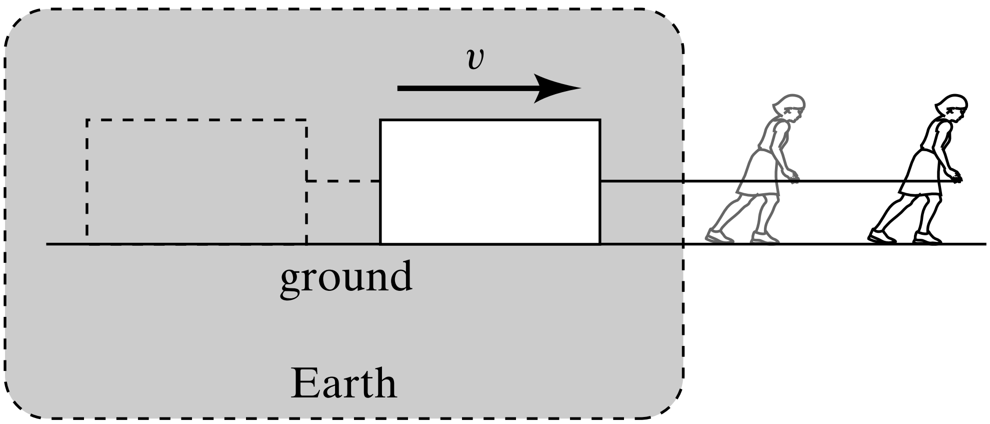
A person pulls a box along the ground at a constant speed. If we consider Earth and the box as our system, what can we say about the net external force on the system?



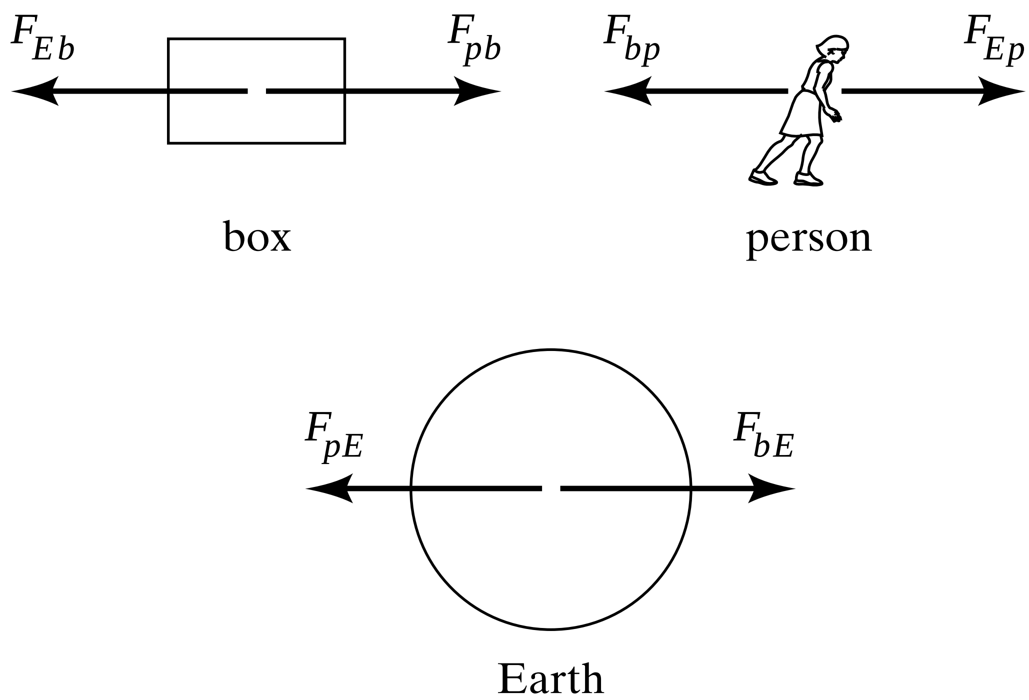
1. It is zero because the system is isolated.
2. It is nonzero because the system is not isolated.
3. It is zero even though the system is not isolated.
4. It is nonzero even though the system is isolated.
5. none of the above

A person pulls a box along the ground at a constant speed. If we consider Earth and the box as our system, the net force exerted by the person on the system is

system = Earth + box



1. zero
2. nonzero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F_{pb}
F_{bp}
F_{Ep}
box
person
F_{pE}
F_{bE}
Earth