1D Dynamics - Master Item List - Active Items

August 3, 2025

1 One Dimensional Dynamics Assessment

The questions which follow ask about the motion of an object in one dimension. All objects move along the x axis. The positive x axis is to the right of the page. For any vector quantity (acceleration, velocity, etc.), the problem asks about the x component of the vector.

Problem 1: (NL-1-V1JS)
A large car and a small car travel toward each other on the road. The large car has twice the mass of the small car. The cars collide head on.

Select the response that best describes the magnitude of the forces on the two cars during the collision.

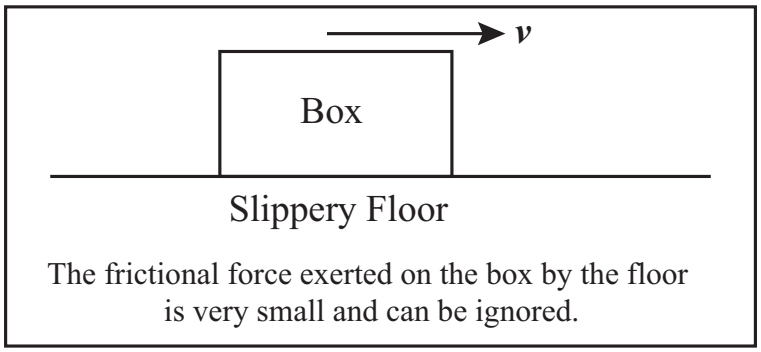
A. The large car exerts more force on the small car than the small car exerts on the large car.

B. The small car exerts more force on the large car than the large car exerts on the small car.

C. Both cars exert the same magnitude force on each other.

D. Neither car exerts a force on the other car.

Problem 2: (NL-2-V3EC)



The figure above shows a box moving to the right on a very slippery floor. The box moves with a constant velocity v, as shown. **The frictional force exerted on the box by the floor is very small and can be ignored.**

Select the response which best describes the force which must be exerted on the box, which is already moving at velocity v, to keep the box moving at a constant velocity.

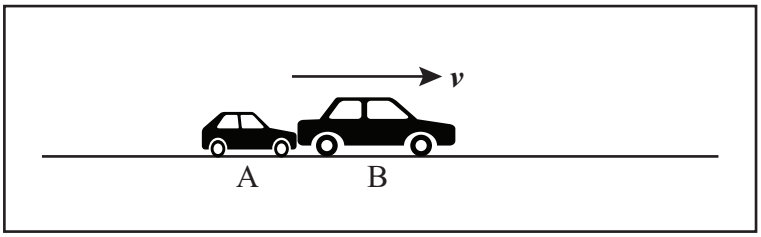
A. A constant force to the right.

B. A force to the right which increases in magnitude.

C. A force to the right which decreases in magnitude.

D. Approximately zero force must be exerted.

Problem 3: (NL-3-V2JS)



The figure above shows a small car, Car A, pushing a larger car, Car B. The larger car has twice the mass of the smaller car. The cars move to the right with increasing velocity v (the cars are speeding up). The larger car is broken so its motor is not running, but its wheels are free to turn.

Select the response which best describes the force the two cars must exert on each other to continue moving with increasing velocity.

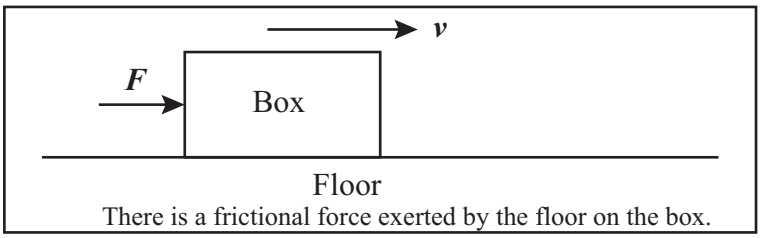
A. Car A must exert a larger force on Car B than Car B exerts on Car A.

B. Car A must exert a smaller force to Car B than Car B exerts on Car A.

C. Car A and Car B exert forces of equal magnitude on each other.

D. Car A exerts a force on Car B, but Car B exerts no force on Car A.

Problem 4: (NL-5-V2EC)



The figure above shows a box moving to the right on the floor. A constant horizontal force F is applied to the left side of the box which causes it to move with a constant velocity v as shown. **There is a frictional force exerted by the floor on the box.** Neglect air resistance.

Select the response which best describes the force F which must be applied to keep the box, which is already moving at velocity v, moving at a constant velocity.

A. The force F must be equal to the weight of the box.

B. The force F must be greater than the weight of the box.

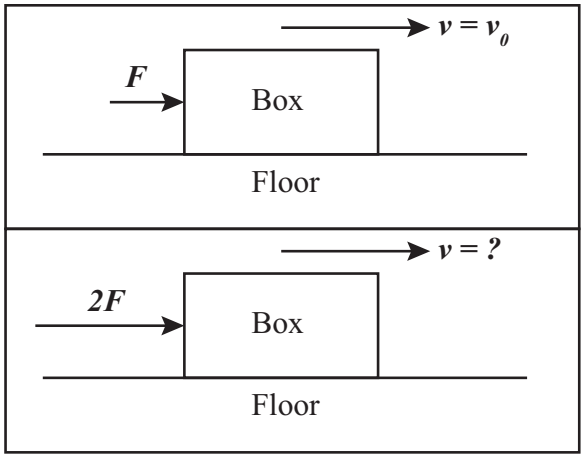
C. The force F must be equal to the frictional force resisting the motion of the box.

D. The force F must be greater than the frictional force resisting the motion of the box.

E. The force F must be greater than the larger of the weight of the box or the frictional force resisting the motion of the box.

F. The force F must be greater than the the weight of the box plus the frictional force resisting the motion of the box.

Problem 5: (NL-6-V3EC)



There is a frictional force exerted by the floor on the box.

The top figure above shows a box moving to the right on the floor. A constant horizontal force F is applied to the left side of the box, causing it to move with a constant velocity $v = v_0$. **There is a frictional force exerted by the floor on the box.** Neglect air resistance.

Suppose the force applied to the box, which is already in motion with velocity $v = v_0$, is doubled to $2F$ as shown in the bottom figure. Select the response which best describes motion of the box after the force is doubled.

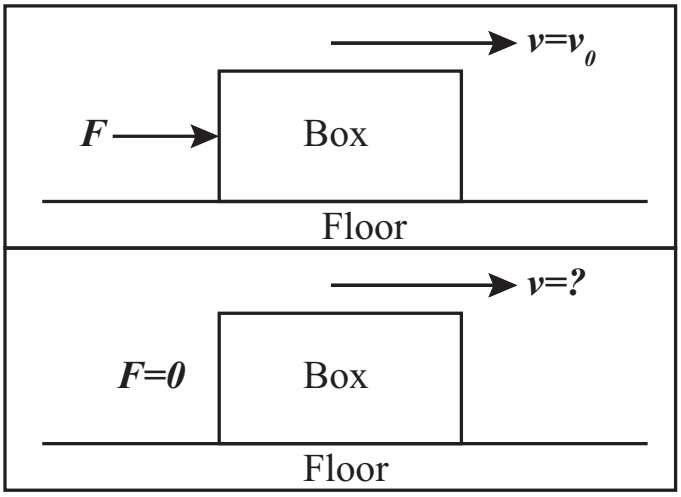
A. The box will move with a constant speed.

B. The box will move with a constant speed for a period of time, then the speed will continuously increase.

C. The box will move with increasing speed for a while, then move at constant speed.

D. The box will move with continuously increasing speed.

Problem 6: (NL-7-V3EC)



There is a frictional force exerted by the floor on the box.

The top figure above shows a box moving to the right on the floor. If a constant horizontal force F is applied to the left side of the box, it moves with a constant velocity v_0. **There is a frictional force exerted by the floor on the box.** Neglect air resistance.

Suppose the force applied to the box, which is already in motion with velocity $v = v_0$, is suddenly removed as shown in the bottom figure. Select the response which best describes motion of the box after the force is removed.

A. The box immediately stops.

B. The box will continue to move with velocity v_0.

C. The box will move with velocity v_0 for a short time, then slow down until it stops.

D. The box will immediately start slowing down until it stops.

E. The box's speed will increase for a short time, then the box will slow to a stop.

Problem 7: (NL-8-V3EC)

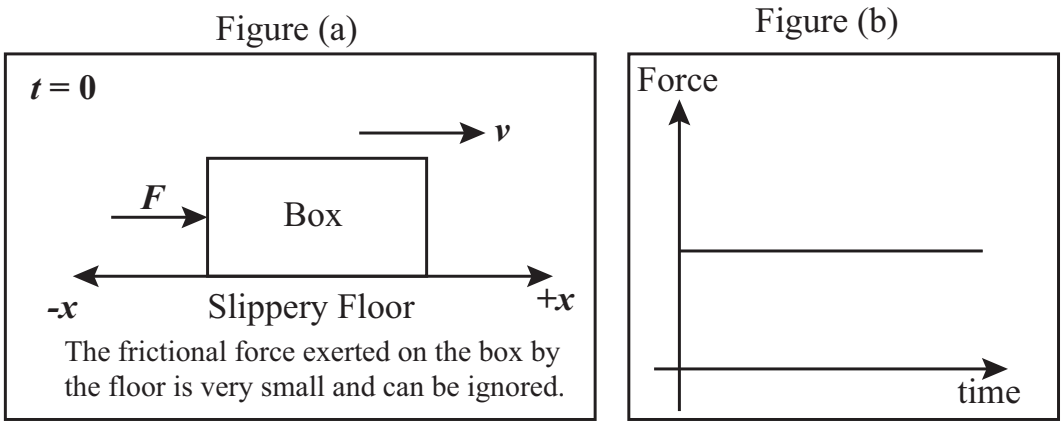


Figure (a) above shows a box moving to the right on a slippery floor at time $t = 0$. A horizontal force F is exerted on the left side of the box in the direction drawn. Figure (b) shows the force F exerted on the box as a function of time. **The frictional force exerted on the box by the floor is very small and can be ignored.** Neglect air resistance.

Select the response which best describes motion of the box.

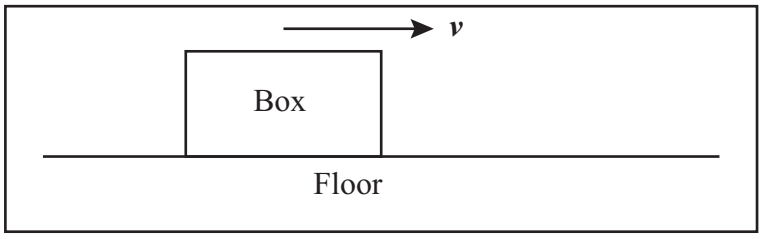
A. The box moves to the right with a constant speed.

B. The box moves to the right with a continuously increasing speed.

C. The box moves to the right with a continuously increasing speed until its speed becomes constant.

D. The box moves to the right with a continuously decreasing speed.

Problem 8: (NL-10-V1JS)



The figure above shows a box moving to the right on the floor. **The box is slowing down.**

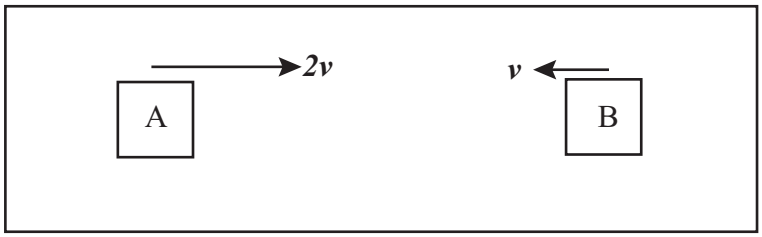
Select the response which best describes the net force exerted on the box.

A. The net force on the box is to the left.

B. The net force on the box is to the right.

C. The net force on the box is zero.

Problem 9: (NL-11-V1JS)



The figure above shows two objects, Object A and B, moving toward each other. The objects are the same size and have equal mass. Object A is traveling twice as fast as Object B. The velocity of each object is shown in the figure. The objects collide.

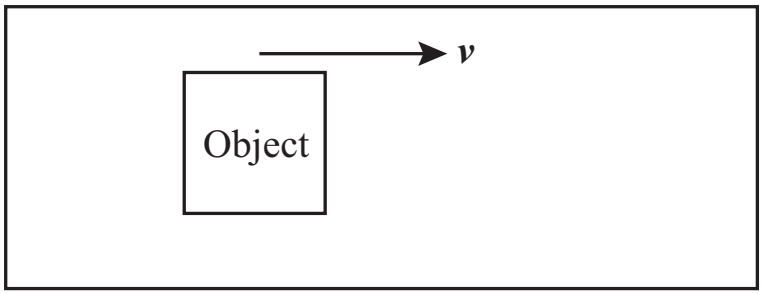
Select the response which best describes the force between the objects during the collision.

A. Object A exerts a **larger** force on Object B during the collision than Object B exerts on Object A.

B. Object A exerts a **smaller** force on Object B during the collision than Object A exerts on Object B.

C. Object A and Object B exert forces of **equal** magnitude during the collision.

Problem 10: (NL-12-V2JS)



The figure above shows an object moving to the right. At time $t = 0$, the object's velocity v is to the right, as shown. The object's velocity at other times is unknown.

Select the response which best describes what can be concluded about the net force on the object at $t = 0$.

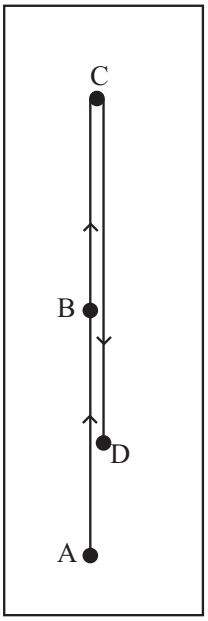
A. There must be a net force on the object to the right.

B. There must be a net force on the object to the left.

C. There could be a net force either to the left or to the right on the object.

Problem 11: (NL-13-V3EC)

The figure to the right shows the path of an object thrown directly upward near the earth's surface. The object starts at point A, travels upward through point B until it reaches point C, then reverses direction and falls downward through point D. The object travels along the same line both while traveling upward and downward. The two paths are separated in the figure to make it easier to read. Neglect air resistance. Select the response that best describes the forces exerted on the object at **point B** as it moves **upward**.



A. A downward force of gravity.

B. An upward force of motion.

C. A downward force of motion.

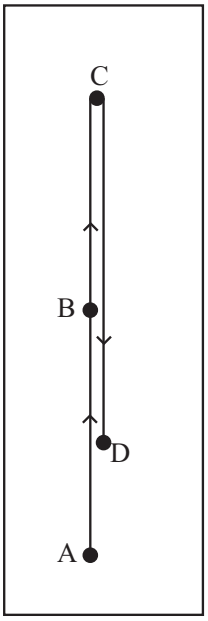
D. A downward force of gravity and an upward force of motion.

E. A downward force of gravity and a downward force of motion.

F. No forces are exerted on the object at point B.

Problem 12: (NL-14-V3EC)

The figure to the right shows the path of an object thrown directly upward near the earth's surface. The object starts at point A, travels upward through point B until it reaches point C, then reverses direction and falls downward through point D. The object travels along the same line both while traveling upward and downward. The two paths are separated in the figure to make it easier to read. **Neglect air resistance.** Select the response that best describes the forces exerted on the object at **point C**, the object's **highest point**.



A. A downward force of gravity.

B. An upward force of motion.

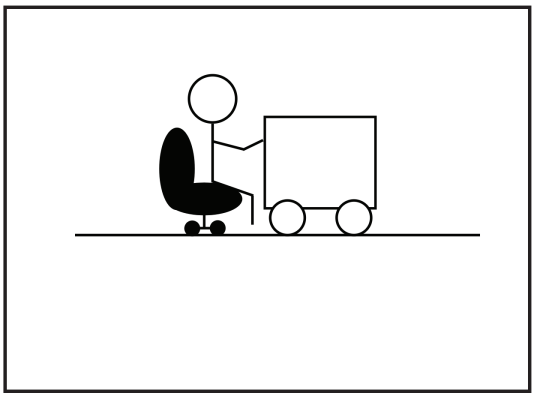
C. A downward force of motion.

D. A downward force of gravity and an upward force of motion.

E. A downward force of gravity and a downward force of motion.

F. No forces are exerted on the object at its highest point.

Problem 13: (NL-15-V2HM)



The figure above shows a cart containing a heavy box at rest on a flat surface. A person sitting in a chair that rolls freely places their hands on the box. The person and chair together have a much lower mass than the box. At time $t = 0$, the person pushes on the box causing it to roll to the right and the person and chair to roll to the left.

Select the response which best describes the forces between the person and the box as they move apart.

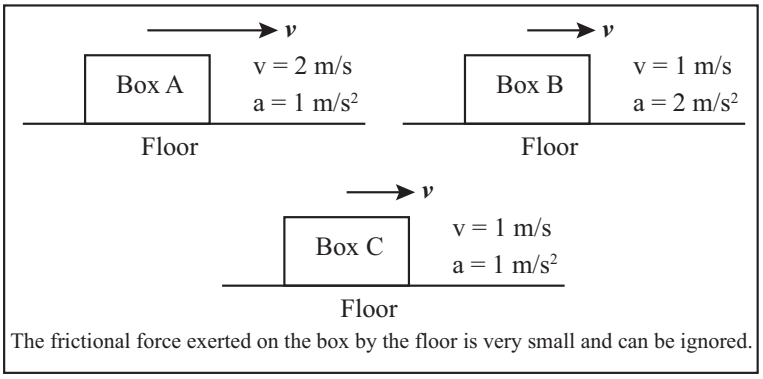
A. The box exerts a larger force on the person than the person exerts on the box.

B. The person exerts a larger force on the box than the box exerts on the person.

C. The box and the person exert forces of equal magnitude on each other.

D. The person exerts a force on the box, but the box exerts no force on the person.

Problem 14: (NL-16-V1JS)



The figure above shows three boxes, Box A, B, and C, on a flat surface. The mass of each box is identical. Each box is moving to the right with the velocity v shown on the figure. A force to the right is exerted on each box, F_A, F_B, and F_C. The force causes the box to accelerate with the acceleration a shown in the figure.

Select the inequality below which best represents the magnitude of the forces.

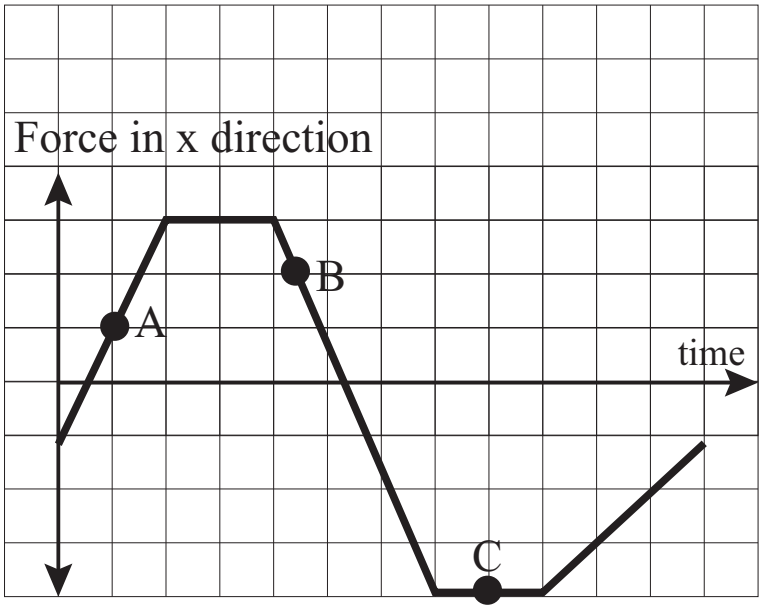
A. $F_A = F_B = F_C$

B. $F_A = F_B > F_C$

C. $F_B > F_A = F_C$

D. $F_A > F_B = F_C$

Problem 15: (NL-17-V3EC)



The figure above shows the force exerted on an object as a function of time. Three points A, B, and C have been marked on the graph.

Select the inequality below which best represents the magnitude of the acceleration a of the object at each point.

A. $a_B > a_A > a_C$

B. $a_A > a_B > a_C$

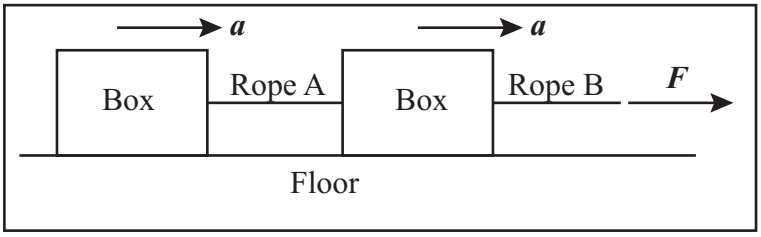
C. $a_C > a_B > a_A$

D. $a_A > a_C = a_B$

E. $a_A > a_B > a_C$

F. $a_A > a_C > a_B$

Problem 16: (NL-18-V2JS)



There is a frictional force exerted by the floor on the boxes.

The figure above shows two boxes with identical masses connected by a rope, Rope A. A second rope, Rope B, is attached to the box on the right. A force F is exerted on the end of Rope B causing both boxes to slide across the floor with the same acceleration a as shown on the figure. Both ropes have negligible mass. **There is a frictional force exerted by the floor on the boxes.**

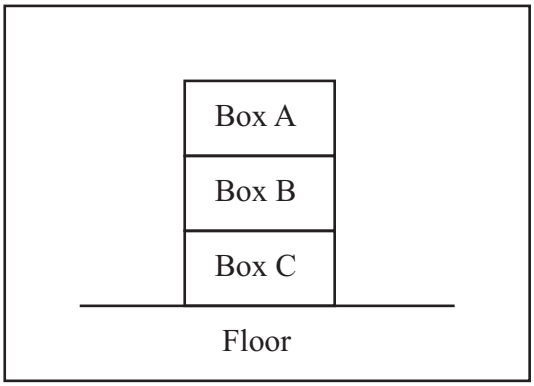
Compare the tension force in the two ropes.

A. The tension force in Rope A is larger than the tension force in Rope B.

B. The tension force in Rope B is larger than the tension force in Rope A.

C. Both tension forces are equal.

Problem 17: (NL-19-V1JS)



The figure above shows a stack of three boxes sitting stationary on the floor. Each box has mass m. The acceleration of gravity is g.

What is the magnitude of the normal force Box C exerts on Box B?

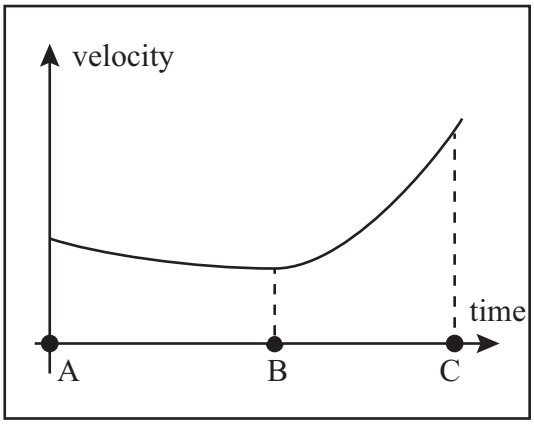
A. zero

B. mg

C. $2mg$

D. $3mg$

Problem 18: (NL-20-V4EC)



The figure above shows the velocity as a function of time of an object moving in one dimension. Three different times, A, B, and C are labeled on the axis.

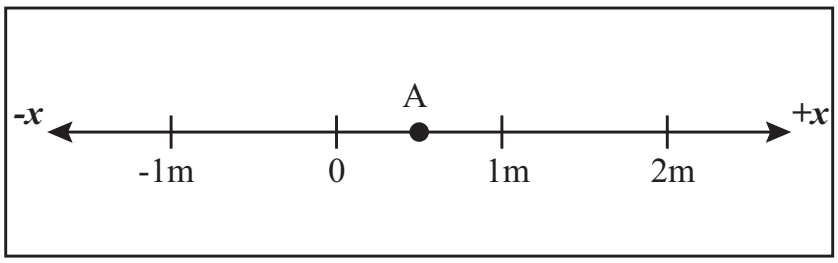
Select the response below which bests describes the net force exerted on the object.

A. A constant force in the positive x direction is exerted on the object at all times.

B. A force in the positive x-direction is exerted on the object from time A to time B, then a larger force in the positive x-direction is exerted on the object from time B to time C.

C. A force in the negative x-direction is exerted on the object from time A to time B, then a larger force in the positive x-direction is exerted on the object from time B to time C.

Problem 19: (NL-21-V2EC)



An object is located on the x-axis as shown above. A force is exerted on the object. When it is at point A, the force exerted on the object is 3 N in the positive x direction.

Which of the following could be true about the speed of the object when it it is at point A?

A. The speed is decreasing.

B. The speed is increasing.

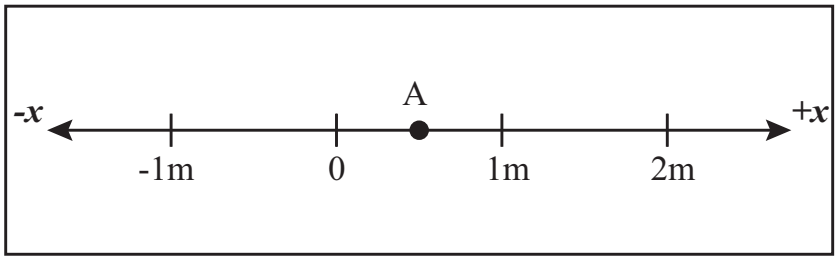
C. The speed is instantaneously zero.

D. Both A and B are possible.

E. Both A and C are possible.

F. A, B, and C are possible.

Problem 20: (NL-21-V3EC)



An object is located on the x-axis as shown above. A force is exerted on the object. When it is at point A, the force exerted on the object is 3 N in the positive x direction.

Which of the following could be true about the speed of the object when it it is at point A?

A. The speed is decreasing.

B. The speed is increasing.

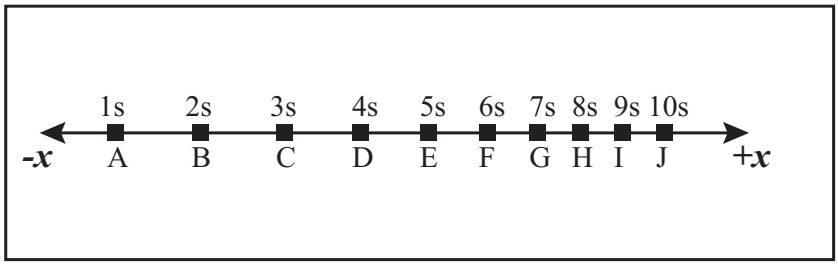
C. The speed is instantaneously zero.

D. Both A and B are possible.

E. Both A and C are possible.

F. A, B, and C are possible.

Problem 21: (NL-22-V2JS)



The figure above shows the motion of an object in the positive x-direction. The position of the object is indicated by a set of squares. Each sequential square is one second apart in time.

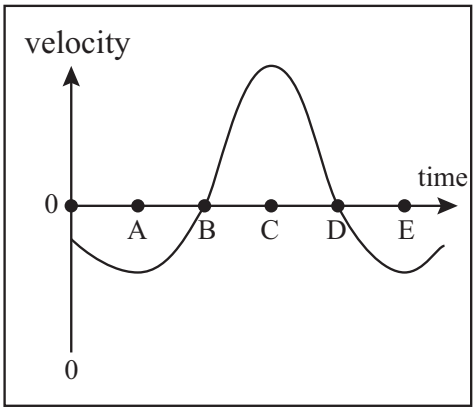
Select the response which describes the average force exerted on the object between point C and point H.

A. The average force is zero.

B. The average force is in the negative x-direction.

C. The average force is in the positive x-direction.

Problem 22: (NL-23-V2EC)



An object is moving in one dimension. The velocity of the object as a function of time is shown in the figure above.

When is the force exerted on the object equal to zero?

A. At times A and E

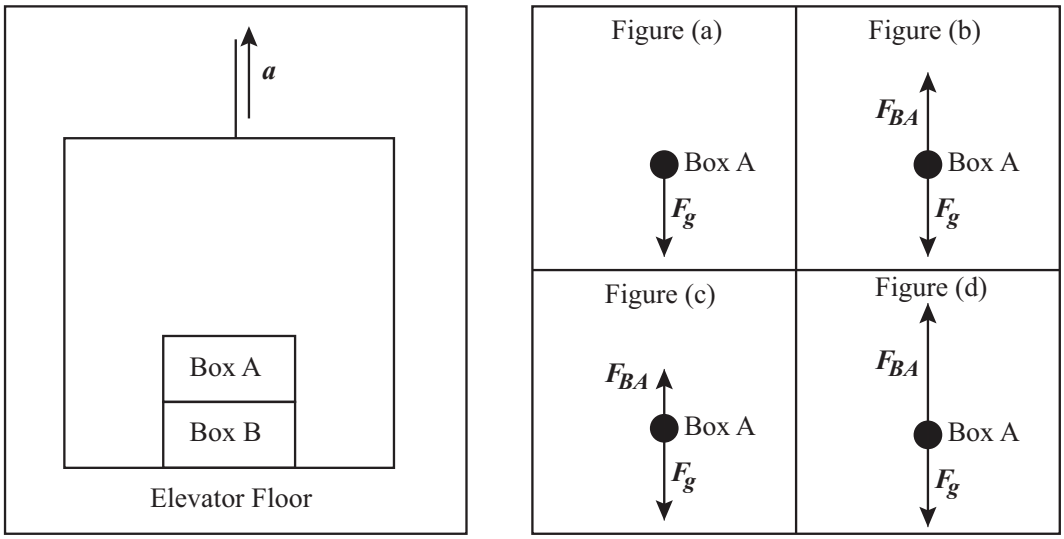
B. At times B and D

C. At time C

D. At times A, C, and E

E. At times A, B, C, D, and E

Problem 23: (NL-24-V1JS)



The figure above on the left shows a stack of two boxes sitting on the floor of an elevator. Each box has mass m. The elevator and its contents are accelerating upward as shown. The figures on the right show possible combinations of the forces on Box A. The vector $\boldsymbol{F_g}$ is the force of gravity and the vector $\boldsymbol{F_{BA}}$ is the normal force Box B exerts on Box A.

Select the figure which best shows the forces on Box A.

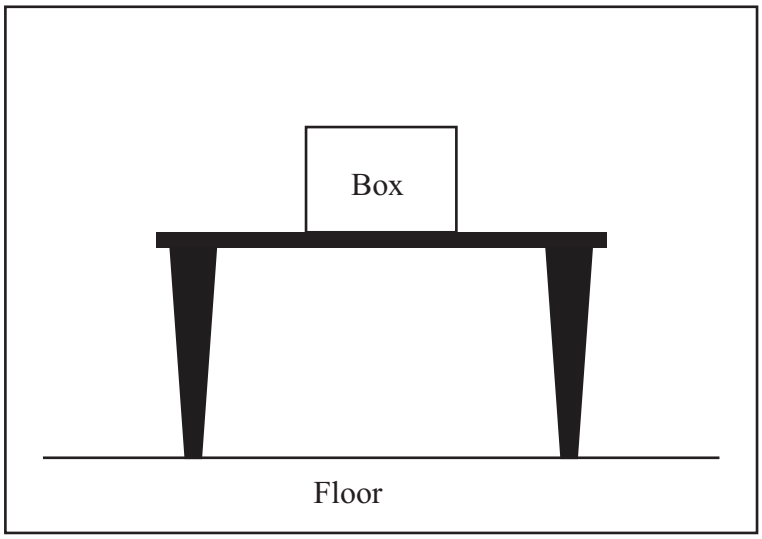
A. Figure a

B. Figure b

C. Figure c

D. Figure d

Problem 24: (NL-25-V2EC)



The figure above shows a box sitting on a table. The box is stationary. One of the forces exerted on the box is a downward force of gravity. Newton's 3rd law states that this force must be paired an equal but opposite force; these forces are sometimes called action-reaction pairs or Newton's 3rd law pairs.

Select the response which is this equal but opposite force that pairs with a downward force of gravity.

A. A force of gravity on the box.

B. The upward normal force of the table on the box.

C. An upward gravitation force of the box on the earth.

D. The downward normal force of the box on the table.

Problem 25: (NL-26-V1JS)
At time $t = 0$, a car's velocity is in the negative x-direction. After $t = 0$, the car slows to a stop.

Which of the following statements best describes acceleration and net force on the car?

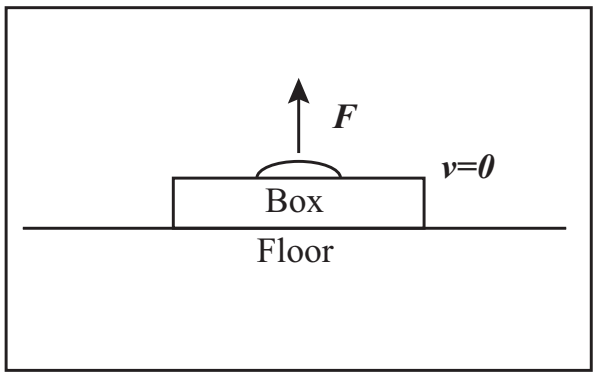
A. The car's acceleration is in the positive x-direction and the net force is in the positive x-direction.

B. The car's acceleration is in the positive x-direction and the net force is in the negative x-direction.

C. The car's acceleration is in the negative x-direction and the net force is in the positive x-direction

D. The car's acceleration is in the negative x-direction and the net force is in the negative x-direction.

Problem 26: (NL-27-V4EC)



A box is at rest on the floor. A person is trying to lift the box straight up using a handle as shown, but it remains on the floor.

Which of the following is true of the normal force exerted by the floor on the box while the person exerts an upward force on the box yet the box remains stationary on the floor?

A. The magnitude of the normal force is less than the weight of the box.

B. The magnitude of the normal force is equal to the weight of the box.

C. The magnitude of the normal force is greater than the weight of the box.

Problem 27: (NL-28-V1JS)
At time $t = 0$, the net force on an object is in the positive x-direction. Let the positive x-direction be to the right.

Which of the following is the most complete description of its motion at time $t = 0$?

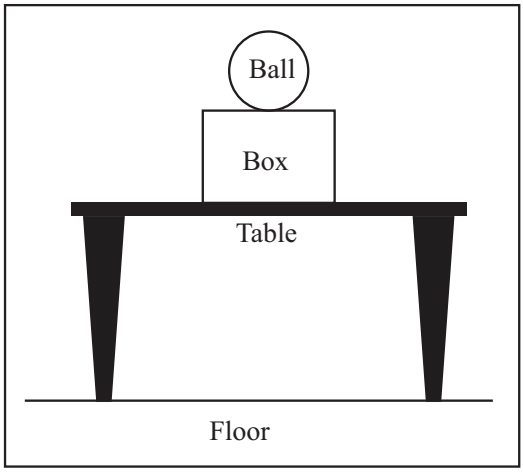
A. The object's acceleration must be to the right.

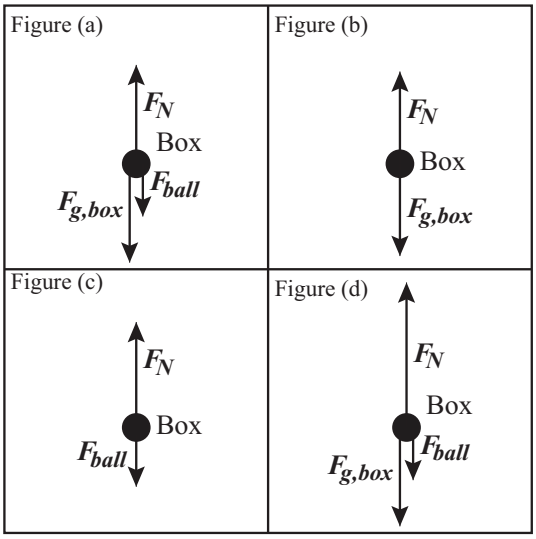
B. The object's acceleration must be to the right and its velocity must be to the right.

C. The object's velocity must be to the right.

D. The object's velocity must be increasing.

Problem 28: (NL-29-V1JS)





The figure to the left above shows a box sitting on a table. A ball rests on top of the box. All objects are stationary. The ball exerts a force of $\boldsymbol{F_{ball}}$ on the box. The gravitational force on the box is $\boldsymbol{F_{g,box}}$. The table may exert a normal force on the box of $\boldsymbol{F_N}$.

Select the figure at the right which best represents the forces exerted on the box. The lengths of the arrows are proportional to the magnitude of the forces.

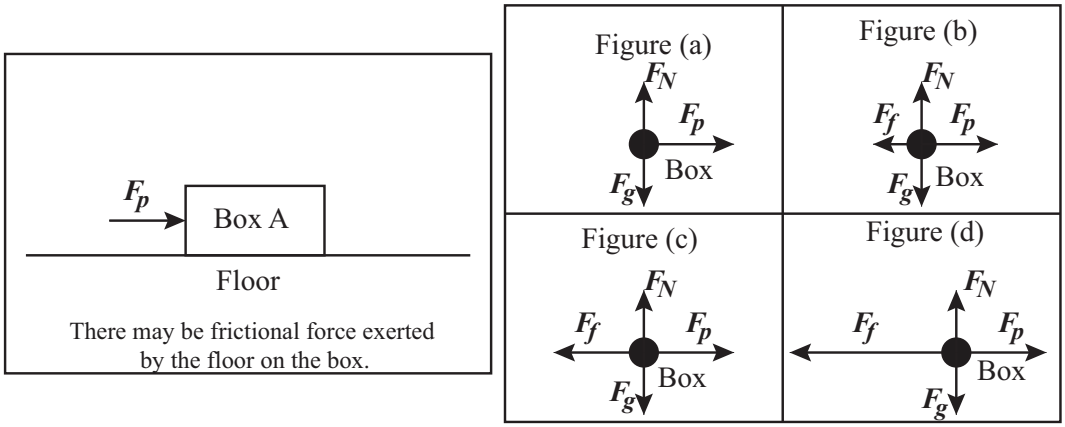
A. Figure a

B. Figure b

C. Figure c

D. Figure d

Problem 29: (NL-30-V1JS)



The figure to the left above shows a box sitting on the floor. A person applies a force $\boldsymbol{F_p}$ to the right as shown, but the box remains stationary. There may be a force of friction, $\boldsymbol{F_f}$, exerted by the floor on the box. The normal force of the floor on the box is $\boldsymbol{F_N}$ and the gravitational force exerted on the box is $\boldsymbol{F_g}$.

Select the figure which best shows the forces exerted on the box.

A. Figure a

B. Figure b

C. Figure c

D. Figure d

Problem 30: (NL-31-V1JS)
The net force on an object is zero.

What can be concluded about the motion of the object?

A. The object must be at rest.

B. The object may be at rest or moving with a constant velocity.

C. The object may be at rest, moving with a constant velocity, or moving with a changing velocity.

Problem 31: (NL-32-V2JS)
A net force F is exerted on an object of mass m producing an acceleration of a.

Suppose the same force was applied to an object with twice the mass. Select the response representing the acceleration of the heavier object.

A. $\frac{1}{4}a$

B. $\frac{1}{2}a$

C. a

D. $2a$

E. $4a$

Problem 32: (NL-33-V2EC)
A box is at rest on the floor.

How does the magnitude of the gravitational force the earth exerts on the box compare to the magnitude of the gravitational force the box exerts on the earth?

A. The magnitude of both forces are **equal**.

B. The magnitude of the gravitational force the earth exerts on the box is much **larger** the magnitude of the gravitational force the box exerts on the earth.

C. The magnitude of the gravitational force the earth exerts on the box is much **smaller** the magnitude of the gravitational force the box exerts on the earth.

D. The earth exerts a gravitational force on the box, but the box does not exert a gravitational force on the earth.

Problem 33: (NL-34-V1JS)
The gravitational force at the surface of the moon is different than the gravitational force at the surface of the earth.

How does the weight and mass of an object at rest on the earth's surface compare to the weight and mass of the same object at rest on the surface of the moon?

A. The masses are equal and the weights are equal.

B. The masses are equal and the weights different.

C. Both the masses and the weights are different.

Problem 34: (NL-35-V1JS)
Two forces are exerted on a box of mass 2 kg. The first force has magnitude 4 N and points to the right. The second force has magnitude 2 N and points to the left.

What is the acceleration of the box?

A. $1\,\frac{\mathrm{m}}{\mathrm{s}^2}$ to the left.

B. $1\,\frac{\mathrm{m}}{\mathrm{s}^2}$ to the right.

C. $2\,\frac{\mathrm{m}}{\mathrm{s}^2}$ to the right.

D. $3\,\frac{\mathrm{m}}{\mathrm{s}^2}$ to the right.

E. $4\,\frac{\mathrm{m}}{\mathrm{s}^2}$ to the right.

Problem 35: (NL-37-V2EC)
An object moving with an initial velocity v collides with a wall of a house. The mass of the object is much smaller than the mass of the house, and the wall is initially at rest. The object bounces off the wall.

Select the response that best describes the forces the object and the wall exert on each other during the collision.

A. The object must exert a larger force on the wall than the wall exerts on the object.

B. The wall must exert a larger force on the object than the object exerts on the wall.

C. The wall and the object exert forces of equal magnitude on each other.

D. The object exerts a force on the wall, but the wall exerts no force on the object.

E. The wall exerts a force on the object, but the object exerts no force on the wall.

Problem 36: (NL-38-V2EC)
An object moving with an initial velocity v collides with a wall of a house. The mass of the object is much smaller than the mass of the house, and the wall is initially at rest. The object sticks to the wall.

Select the response that best describes the forces the object and the wall exert on each other during the collision.

A. The object must exert a larger force on the wall than the wall exerts on the object.

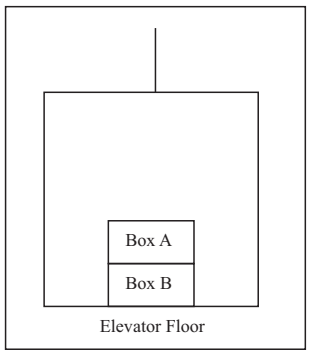
B. The wall must exert a larger force on the object than the object exerts on the wall.

C. The wall and the object exert forces of equal magnitude on each other.

D. The object exerts a force on the wall, but the wall exerts no force on the object.

E. The wall exerts a force on the object, but the object exerts no force on the wall.

Problem 37: (NL-39-V1EC)



The figure above shows a stack of two boxes sitting on the floor of an elevator. Each box has mass m.

Which of the following forces must be equal in magnitude to the force of gravity exerted on the elevator by the earth, regardless of whether the elevator and boxes are accelerating up, accelerating down, or not accelerating?

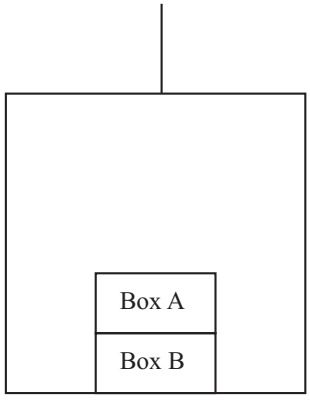
A. The tension force exerted by the cable on the elevator

B. The normal force exerted by Box B on the elevator

C. The gravitational force exerted by the elevator on the earth

D. There is not a force that is always equal and opposite to the the force of gravity exerted on the elevator by the earth.

Problem 38: (NL-39-V2EC)



The figure above shows a stack of two boxes sitting on the floor of an elevator. Each box has mass m.

Which of the following forces must be equal in magnitude to the force of gravity exerted on the elevator by the earth, regardless of whether the elevator and boxes are accelerating up, accelerating down, or not accelerating?

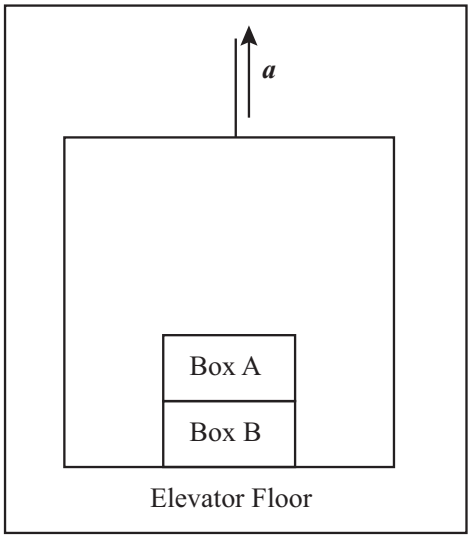
A. The tension force exerted by the cable on the elevator

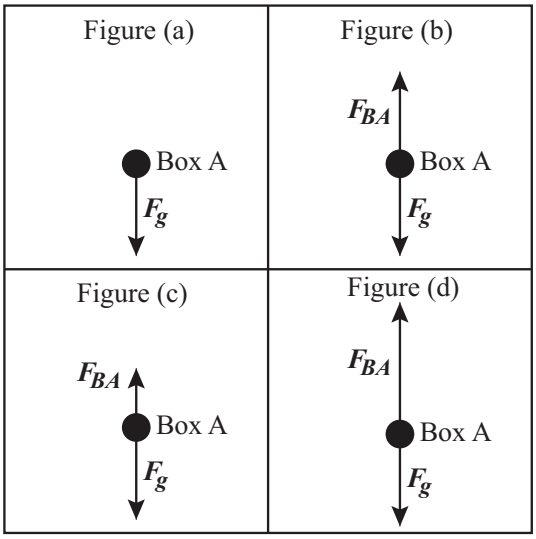
B. The normal force exerted by Box B on the elevator

C. The gravitational force exerted by the elevator on the earth

D. There is not a force that is always equal and opposite to the the force of gravity exerted on the elevator by the earth.

Problem 39: (NL-41-V1EC)





The figure above on the left shows a stack of two boxes sitting on the floor of an elevator. Each box has mass m. The elevator is accelerating upward. Consider the following possible forces.

1. A downward force of gravity exerted by the earth.
2. An upward normal force exerted by the elevator's floor.
3. An upward normal force exerted by Box B.‘

Select the response that includes the forces exerted on Box A.

A. No forces are exerted on Box A.
B. 1 and 2
C. 2 and 3
D. 1 and 3
E. 1, 2, and 3

Problem 40: (NL-42-V1JS)
An object with mass 2 kg travels toward an object with mass 1 kg. The heavier object is moving faster than the lighter object. The objects collide.

Select the response that best describes the magnitude of the forces on the two objects during the collision.

A. The heavier object exerts more force on the lighter object than the lighter object exerts on the heavier object.
B. The lighter object exerts more force on the heavier object than the heavier object exerts on the lighter objects.

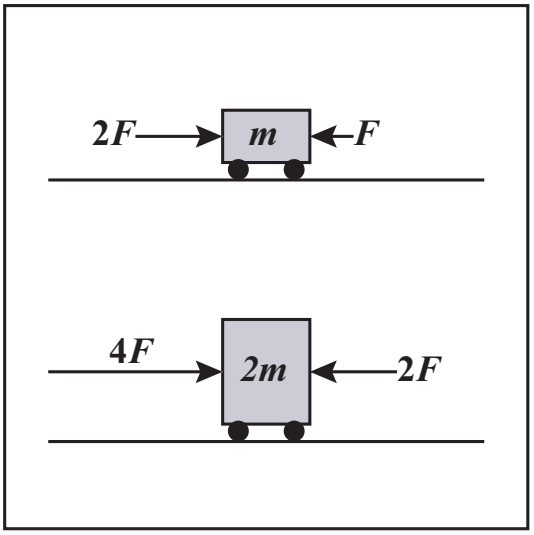
C. Both objects exert the same magnitude force on each other.

D. Only the heavier object exerts a force during the collision.

E. Neither object exerts a force on the other object.

Problem 41: (NL-43-V1JS)

The figures to the right show two carts, a small cart with mass m and a large cart with mass $2m$ as well as the forces acting on each cart. A force F is exerted on the right side of the smaller cart; twice the force $2F$ is exerted on the left side. Forces $2F$ and $4F$ are exerted the larger cart. All frictional forces are negligible.



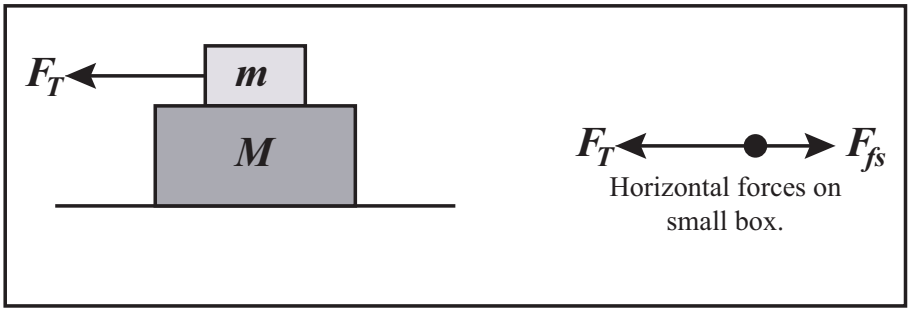
Select the response that best describes the acceleration of the two carts.

A. The small cart has a larger acceleration.

B. The large cart has a larger acceleration.

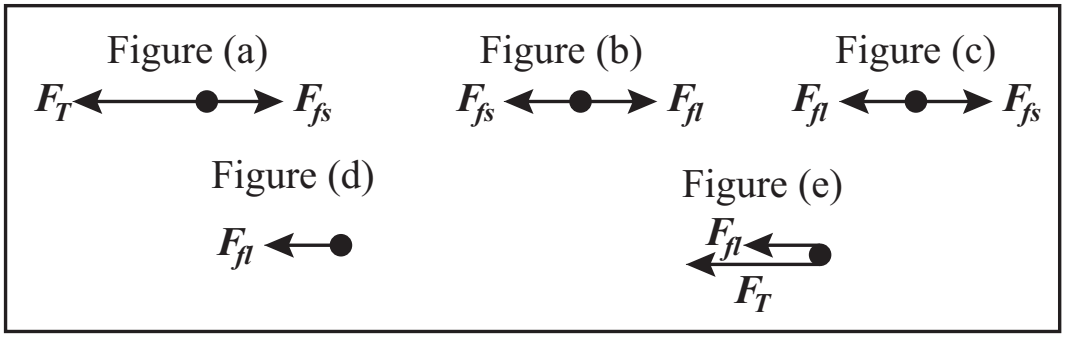
C. They both have the same acceleration.

Problem 42: (NL-44-V1JS)

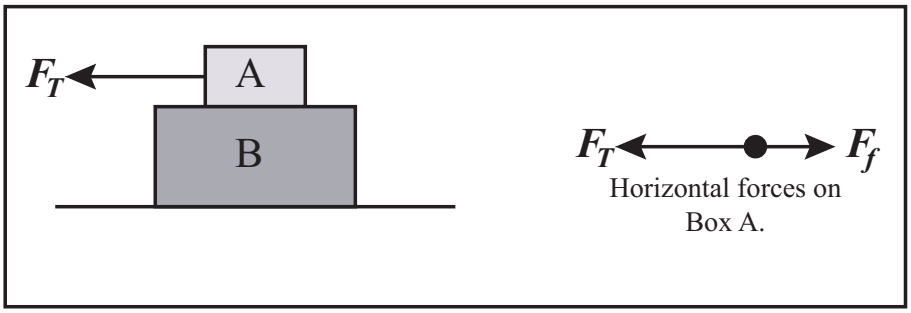


A small box is on top of a large one as shown in the figure above. A rope is pulling on the small box with a tension force of $\boldsymbol{F_T}$. The small box is accelerating to the left, sliding across the large box. The large box remains at rest. There is friction between the boxes, and friction between the large box and the floor. The magnitude of the force of friction on the small box is $\boldsymbol{F_{fs}}$. The frictional force exerted on the large box by the floor is $\boldsymbol{F_{fl}}$ The horizontal forces on the small box are shown in the diagram above.

Select the diagram below which best represents the horizontal forces on the large box.

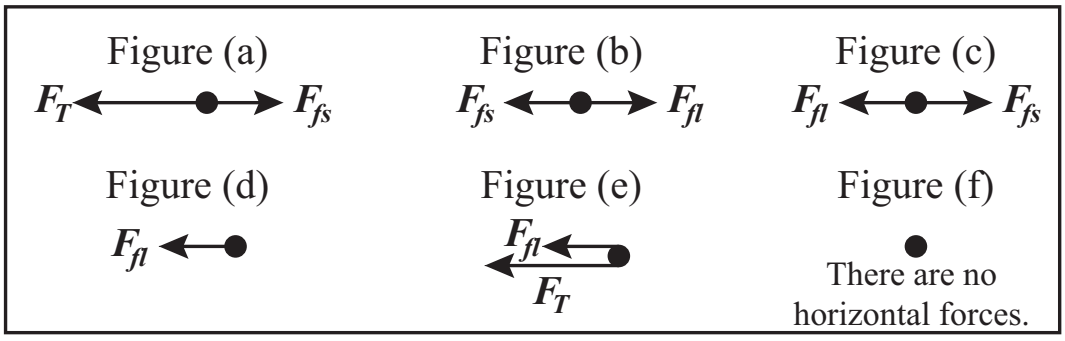


Problem 43: (NL-44-V2JS)

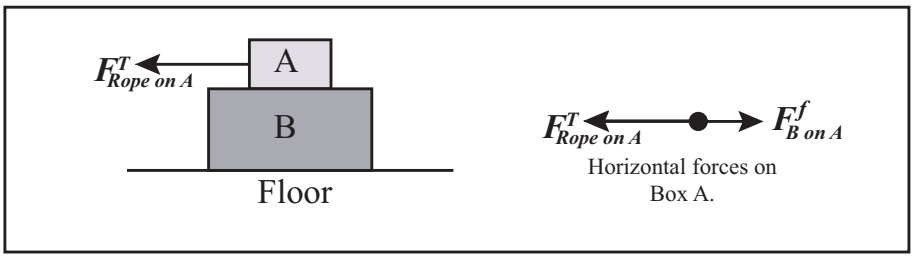


A small box is on top of a large one as shown in the figure above. A rope is pulling on the small box with a tension force of $\boldsymbol{F_T}$. The small box is accelerating to the left, sliding across the large box. The large box remains at rest. There is friction between the boxes, and friction between the large box and the floor. The magnitude of the force of friction on the small box is $\boldsymbol{F_{fs}}$. The frictional force exerted on the large box by the floor is $\boldsymbol{F_{fl}}$ The horizontal forces on the small box are shown in the diagram above.

Select the diagram below which best represents the horizontal forces on the large box.

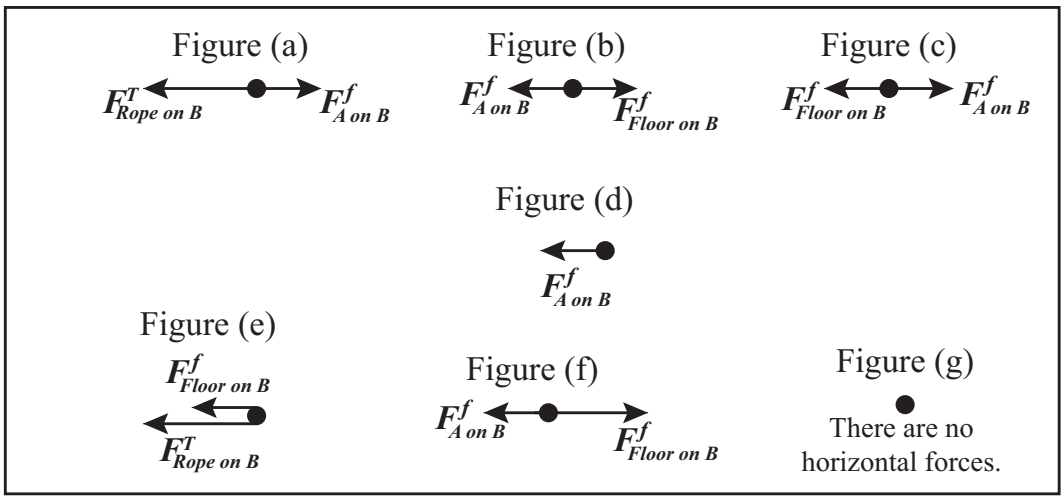


Problem 44: (NL-44-V4JS)

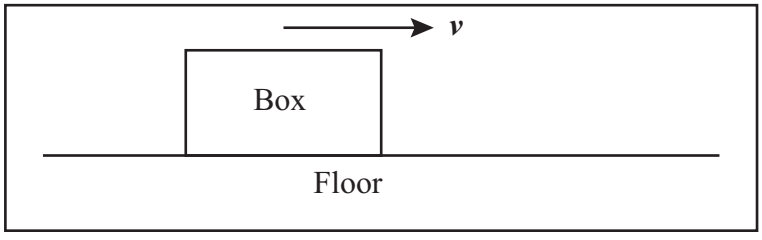


A small box is on top of a large one as shown in the figure above. A rope is pulling on the small box, Box A, with a tension force of $\boldsymbol{F^T_{\text{Rope on A}}}$. Box A is accelerating to the left, sliding across the large box, Box B. The large box remains at rest. There is friction between the boxes, and friction between Box B and the floor. The force of friction exerted by Box B on Box A is $\boldsymbol{F^f_{\text{B on A}}}$. The frictional force exerted on Box B by the floor is $\boldsymbol{F^f_{\text{Floor on B}}}$. The horizontal forces on the small box are shown in the diagram above.

Select the diagram below which best represents the horizontal forces on the large box.



Problem 45: (NL-45-V1JS)



The figure above shows a box moving to the right on the floor. The floor exerts a force of friction on the box. **The box is slowing down.**

Select the response which best describes the direct of the force of friction the floor exerts on the box.

A. The force of friction on the box is to the left.

B. The force of friction on the box is to the right.

C. The force of friction on the box is upward.

D. The force of friction on the box is downward.

E. The force of force on the box is zero.