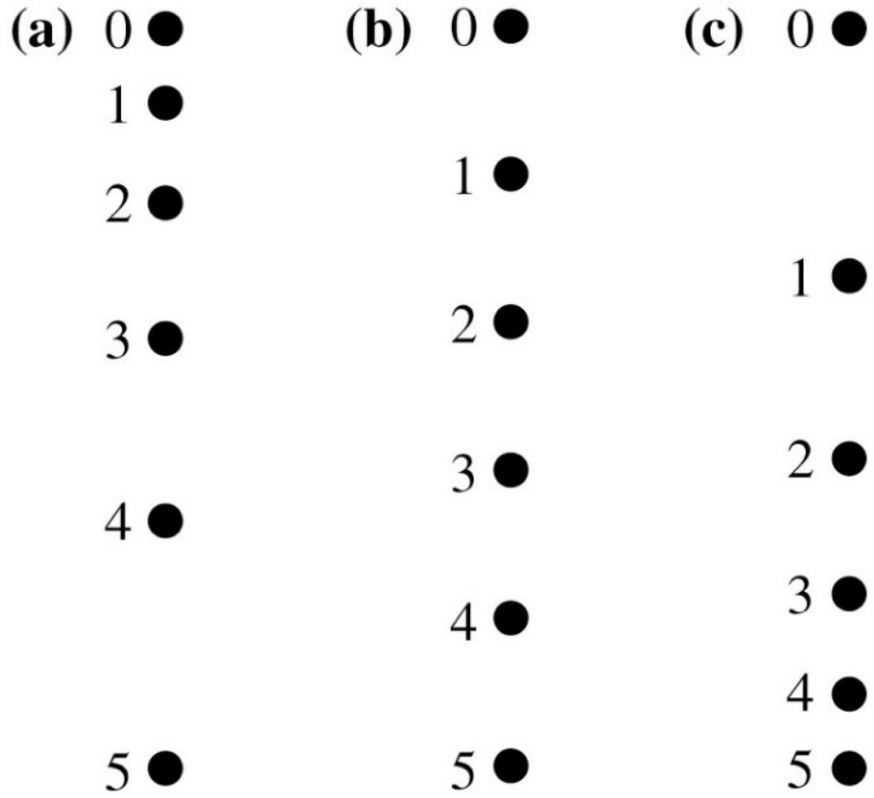
Question #1

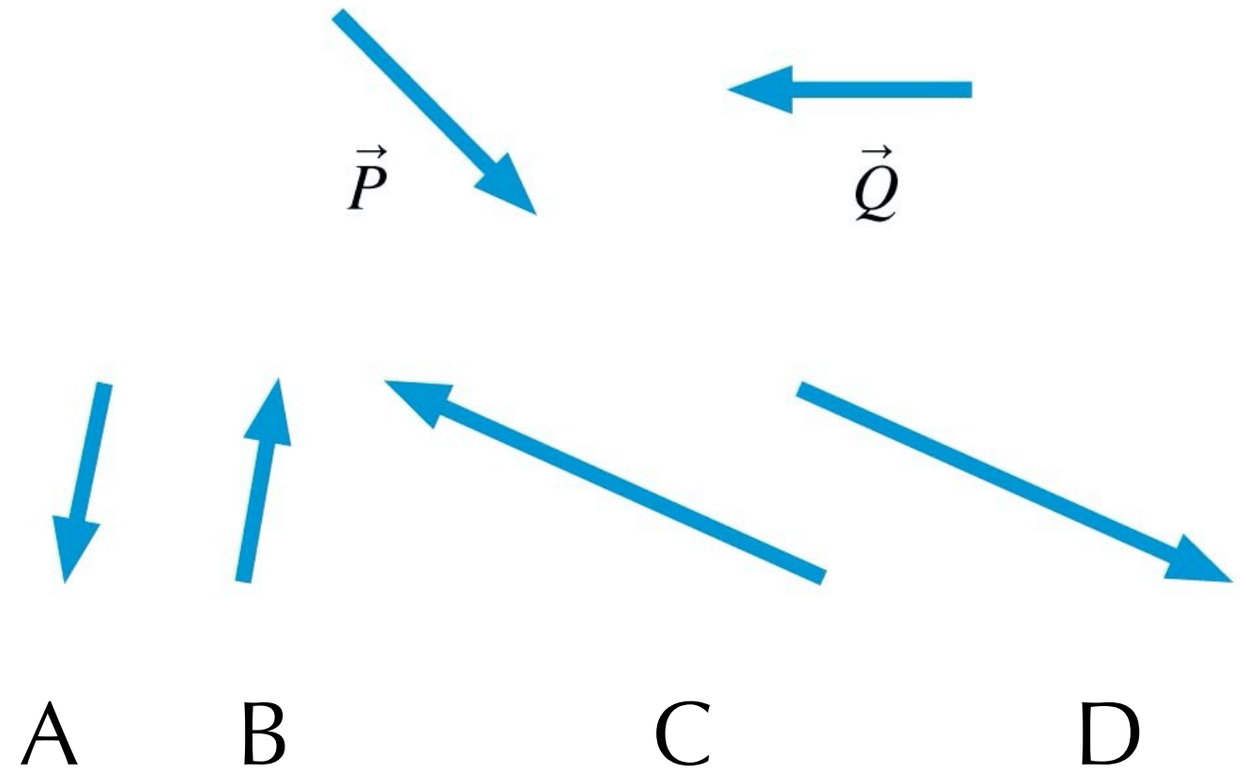
Three motion diagrams are shown. Which is a dust particle settling to the floor at constant speed, which is a ball dropped from the roof of a building, and which is a descending rocket slowing to make a soft landing on Mars?



A. (a) is dust, (b) is ball, (c) is rocket.
B. (a) is rocket, (b) is dust, (c) is ball.
C. (a) is rocket, (b) is ball, (c) is dust.
D. (a) is ball, (b) is dust, (c) is rocket.
E. (a) is ball, (b) is rocket, (c) is dust.

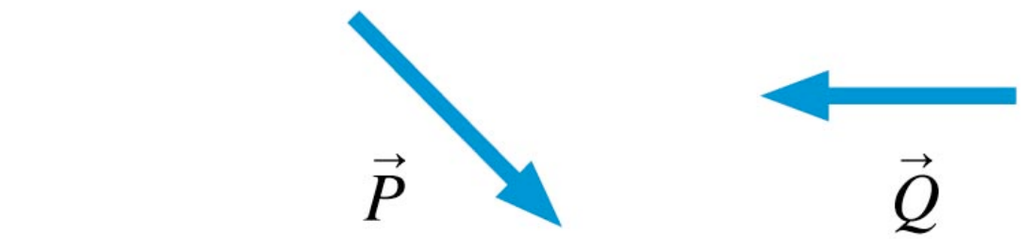
Question #2

Given the vectors $\vec{P}$ and $\vec{Q}$, what is $\vec{P} + \vec{Q}$



Question #3

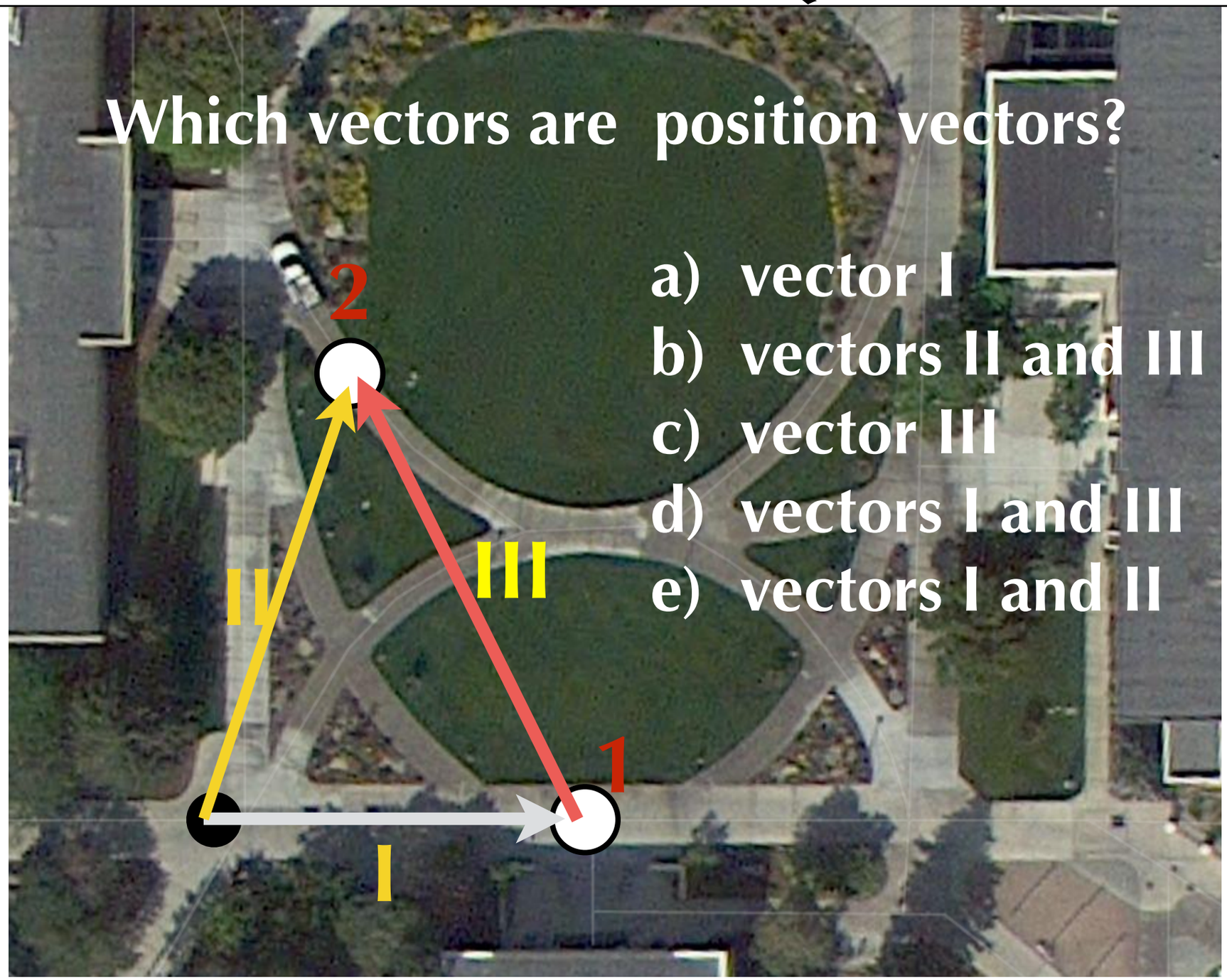
Given the vectors $\vec{P}$ and $\vec{Q}$, what is $\vec{P} - \vec{Q}$



E B A C

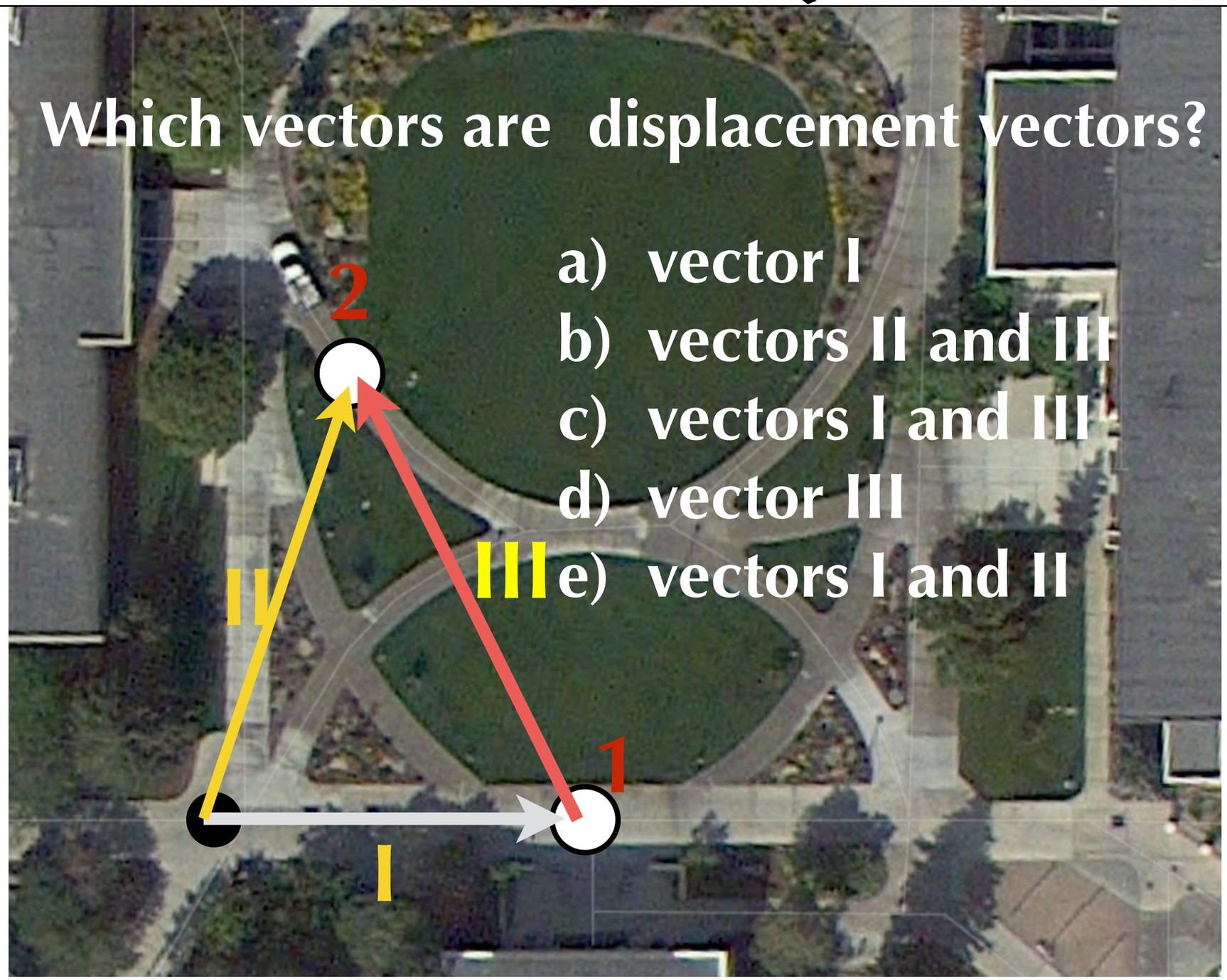
You are standing just outside the library (point 1 in the figure) when you notice that you are late for physics class. Several seconds later, after running towards the Romney building, you find yourself at point 2. (The black point has been chosen as the origin of our coordinate system for this problem)

Question #4



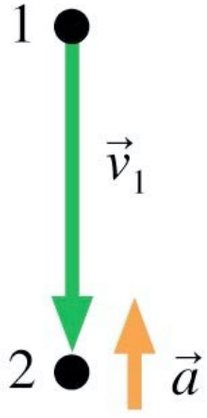
You are standing just outside the library (point 1 in the figure) when you notice that you are late for physics class. Several seconds later, after running towards the Romney building, you find yourself at point 2. (The black point has been chosen as the origin of our coordinate system for this problem)

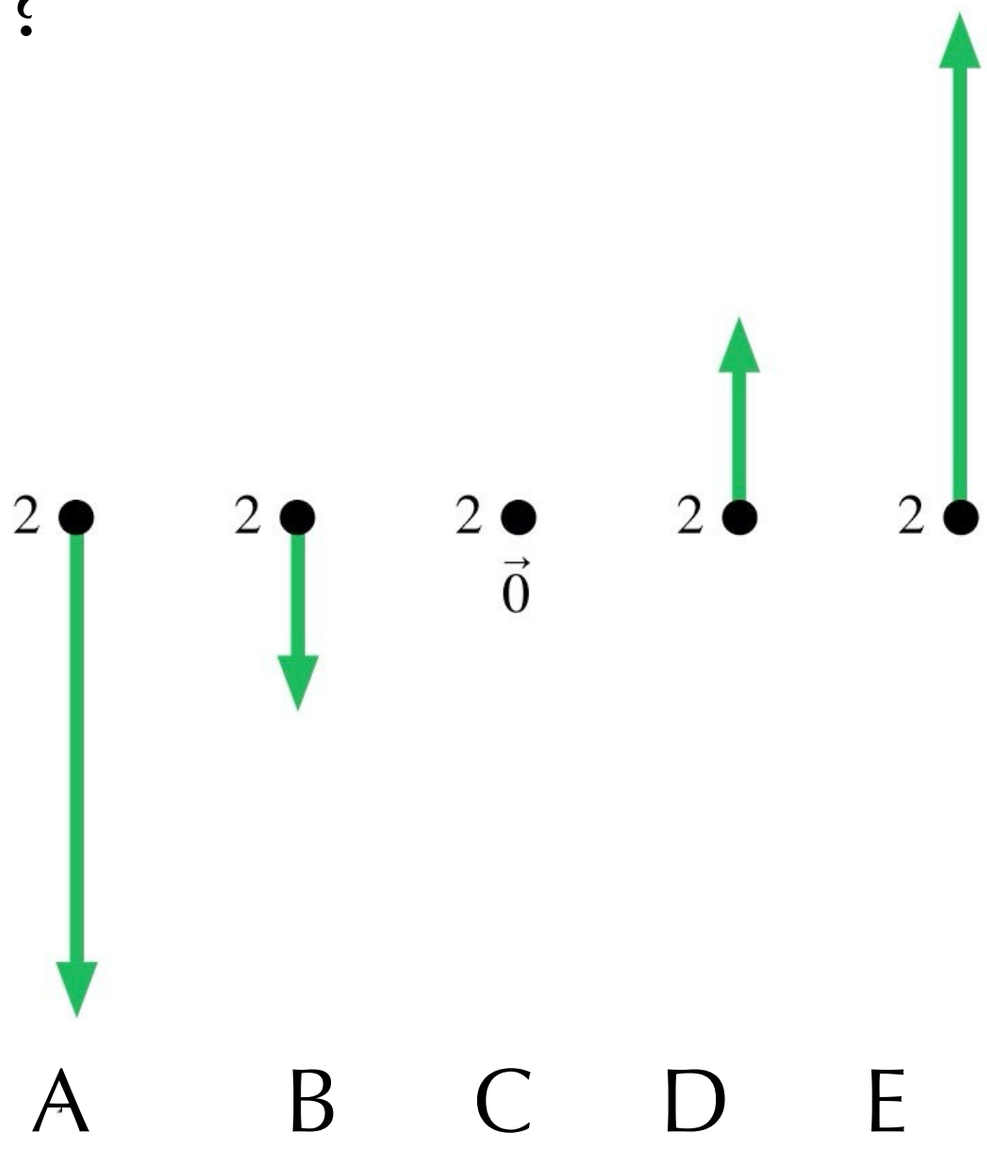
Question #5



Question #6

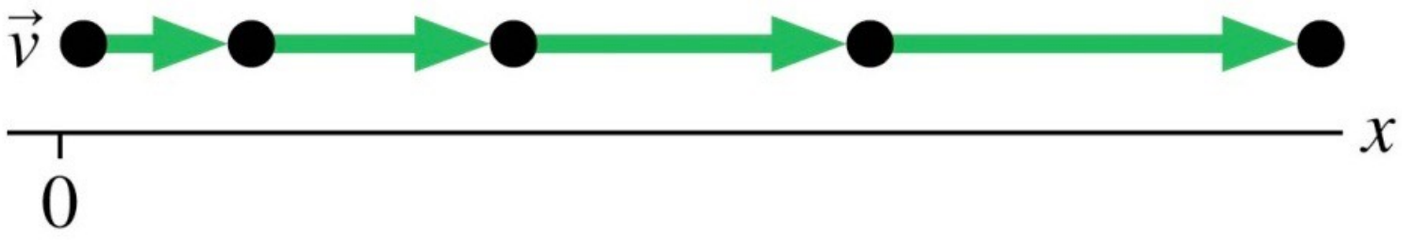
A particle has velocity $\vec{v}_1$ as it accelerates from 1 to 2. What is its velocity vector $\vec{v}_2$ as it moves away from point 2 on its way to point 3?





Question #7

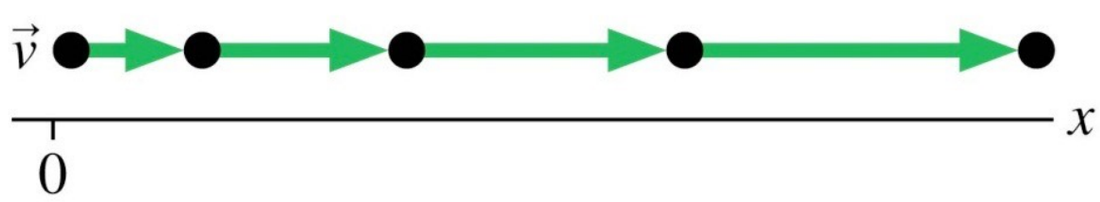
Is the object speeding up or slowing down?



a) slowing down
b) .
c) speeding up
d) .
e) neither speeding up or slowing down.

Question #8

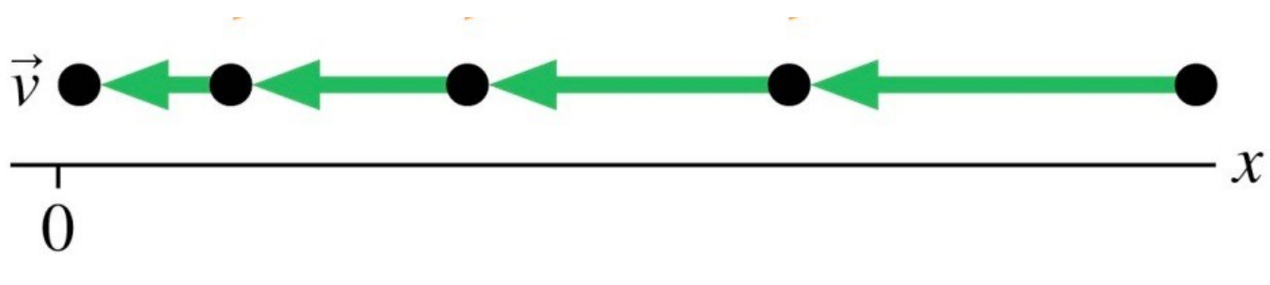
- What direction do the acceleration vectors point?



a) .
b) to the right.
c) to the left.
d) .
e) they are zero.

Question #9

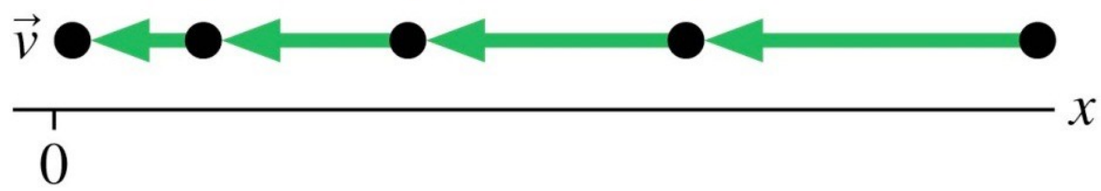
Is the object speeding up or slowing down?



a) .
b) .
c) neither speeding up or slowing down.
d) slowing down
e) speeding up

Question #10

What direction do the acceleration vectors point?

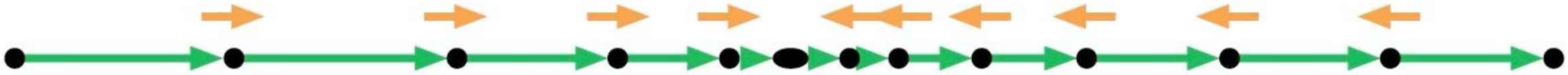


a) to the right.
b) to the left.
c) they are zero.
d) .
e) .

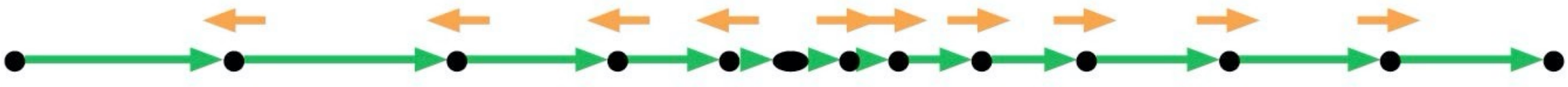
Question #11

A cyclist riding at 20 mph sees a stop sign and actually comes to a complete stop in 4 s. He then, in 6 s, returns to a speed of 15 mph. Which is his motion diagram?

A



B



C

D

Quiz

A ball is tossed straight up in the air. At its very highest point, the ball's acceleration vector $\vec{a}$

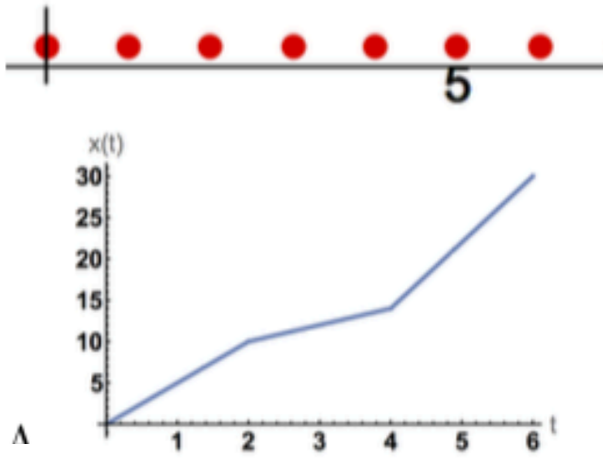
a. Points up.

b. Is zero.

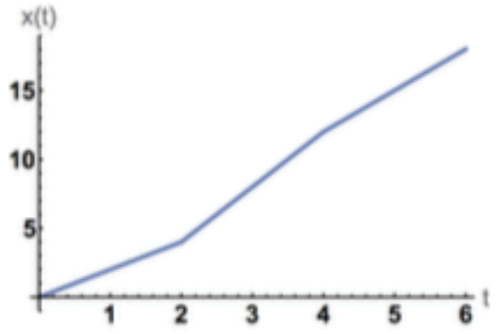
c. Points down.

Question #13 From motion diagram to graph

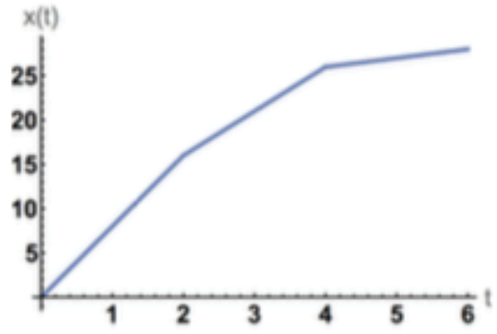
Below you will see a simple motion diagram. Which of the position vs. time graphs below is correct?



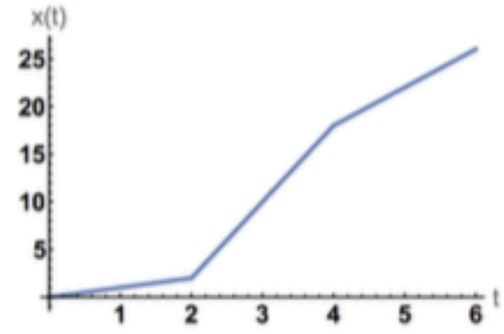
A



B.



C.

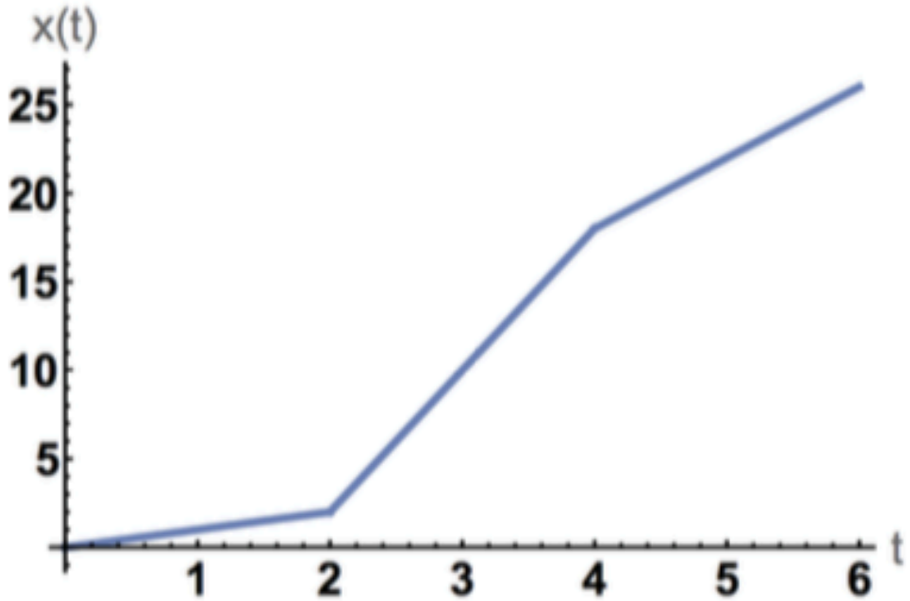


D.

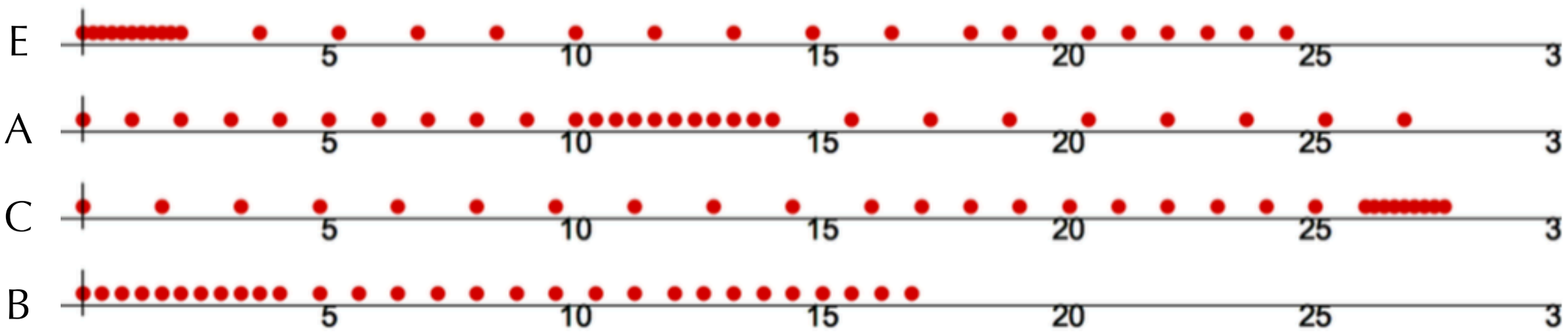
A **B** **C** **D**

From graph to diagram **Question #14**

A position vs. time graph is shown below.



What is the corresponding motion diagram.



Units tracking as a way to check your work.

Use unit tracking to determine which equation is correct.

B $v_f^2 = v_i^2 + 2a\Delta t$

A $v_f^2 = v_i^2 + 2a\Delta x$

C $v_f^2 = v_i^2 + 2a\Delta x^2$

Question #16

Significant Figures **Question #17**

Rank in order, from the most to the least, the number of significant figures in the following numbers. For example, if b has more than c, c has the same number as a, and a has more than d, you would give your answer as $b > c = a > d$.

a. 8200 b. 0.0052 c. 0.430 d. 4.321×10^{-10}

a. $a = b = d > c$
b. $d > c > b = a$
c. $b = d > c > a$
d. $d > c > a > b$
e. $a = d > c > b$

Question # 18

Consider the following simple calculation: $5.27 + 1.1$. What should you report for the answer?

D 6.4

C 6.37

A 6.5

E 7

B 6.370

Question # 19

Consider the following simple calculation: 5.27 x 1.1. What should you report for the answer?

a) 5.80
b) 6.0
c) 5.797
d) 5.7970
e) 5.8

Question # 20

Consider the following simple calculation: $5.27 \times (1.1 + 2.056)$. What should you report for the answer?

C 17

E 16.6

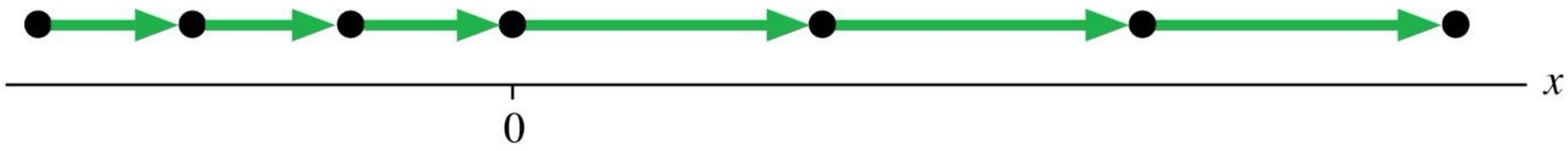
A 16.63

B 16.632

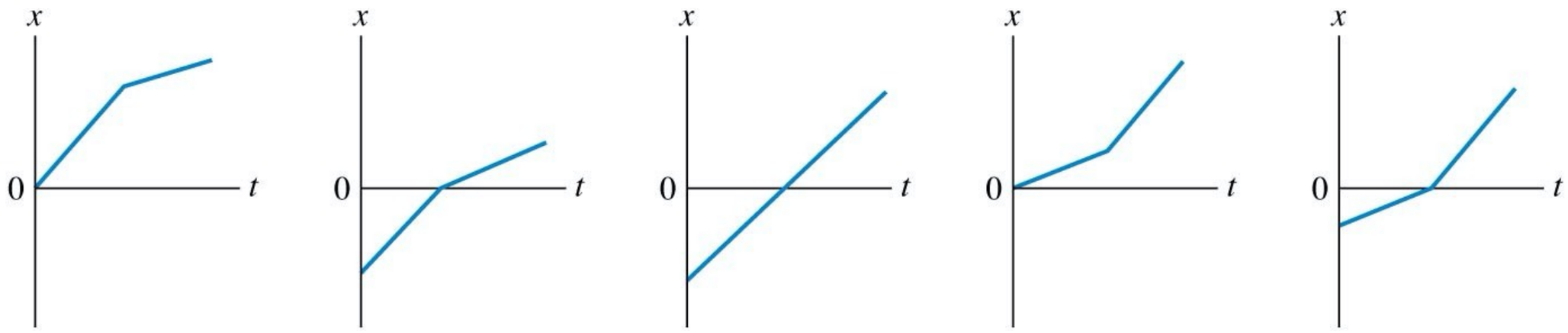
D 16.6320

Question #1

Here is a motion diagram of a car moving along a straight road:



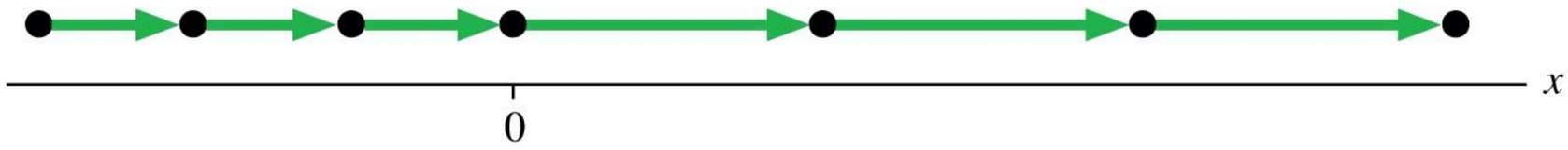
Which **position-versus-time** graph matches this motion diagram?



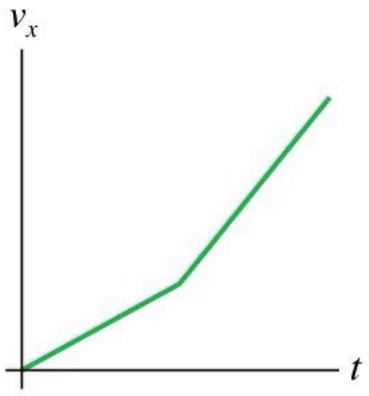
A B C D E

Question #2

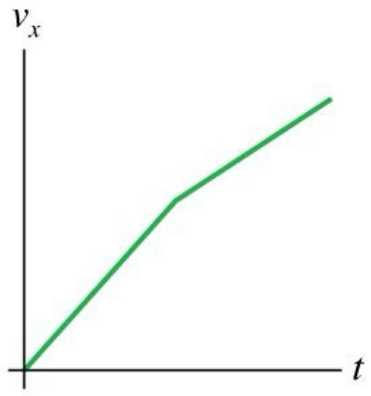
Here is a motion diagram of a car moving along a straight road:



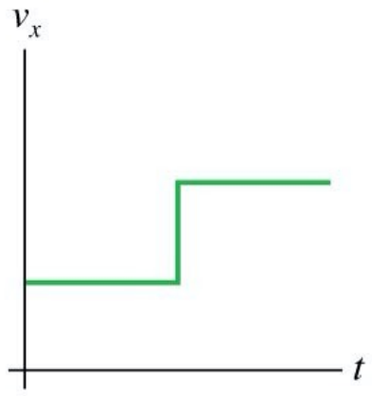
Which **velocity-versus-time** graph matches this motion diagram?



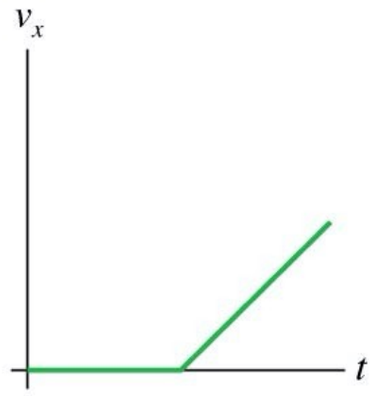
A



B



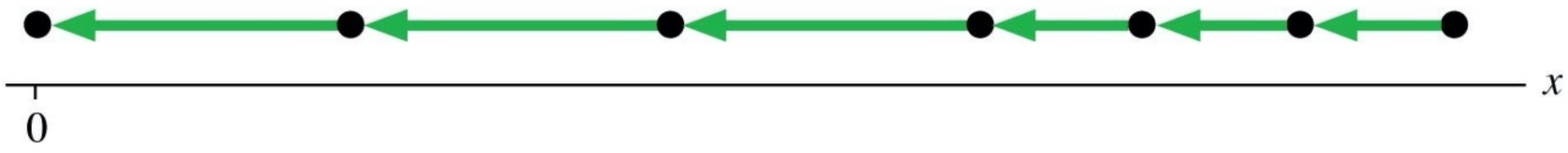
C



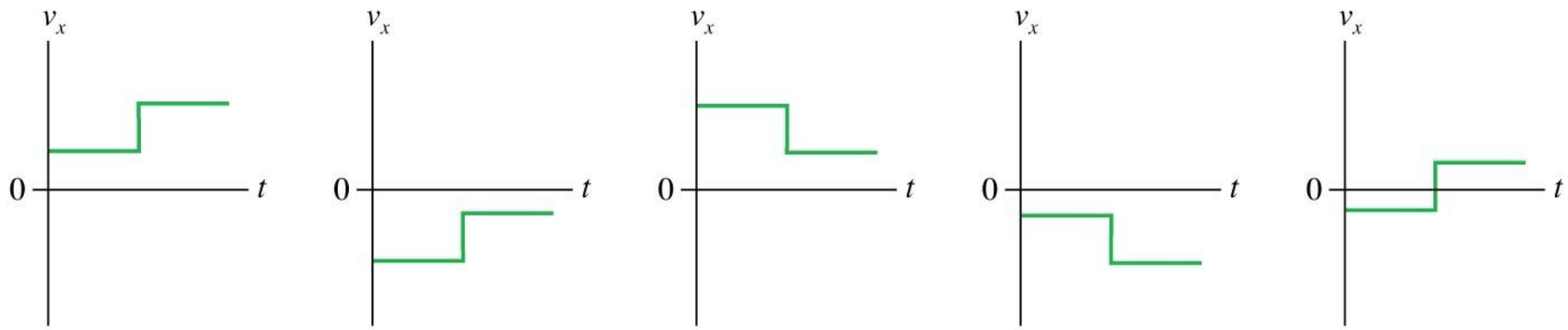
D

Question #3

Here is a motion diagram of a car moving along a straight road:



Which **velocity-versus-time** graph matches this motion diagram?

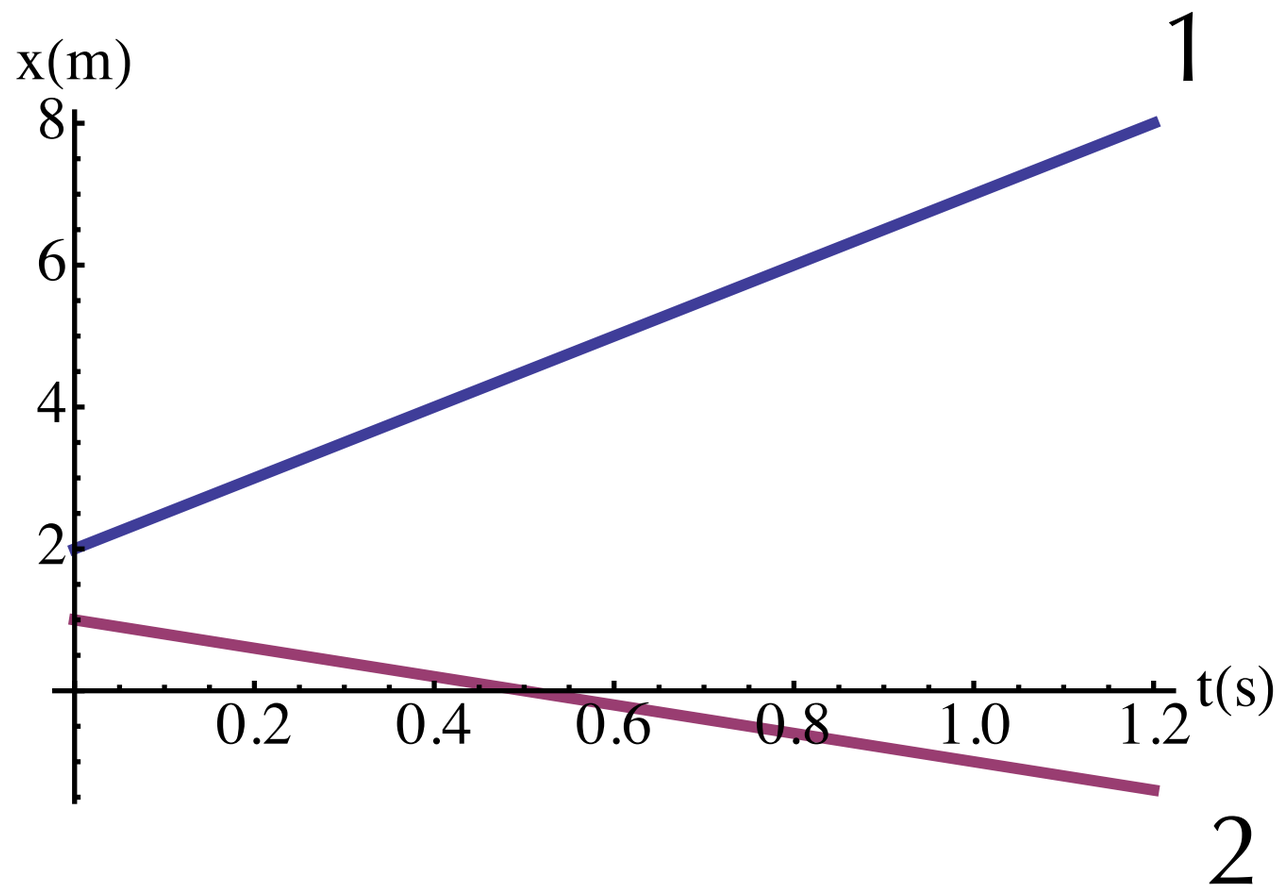


A B C D E

Question #5

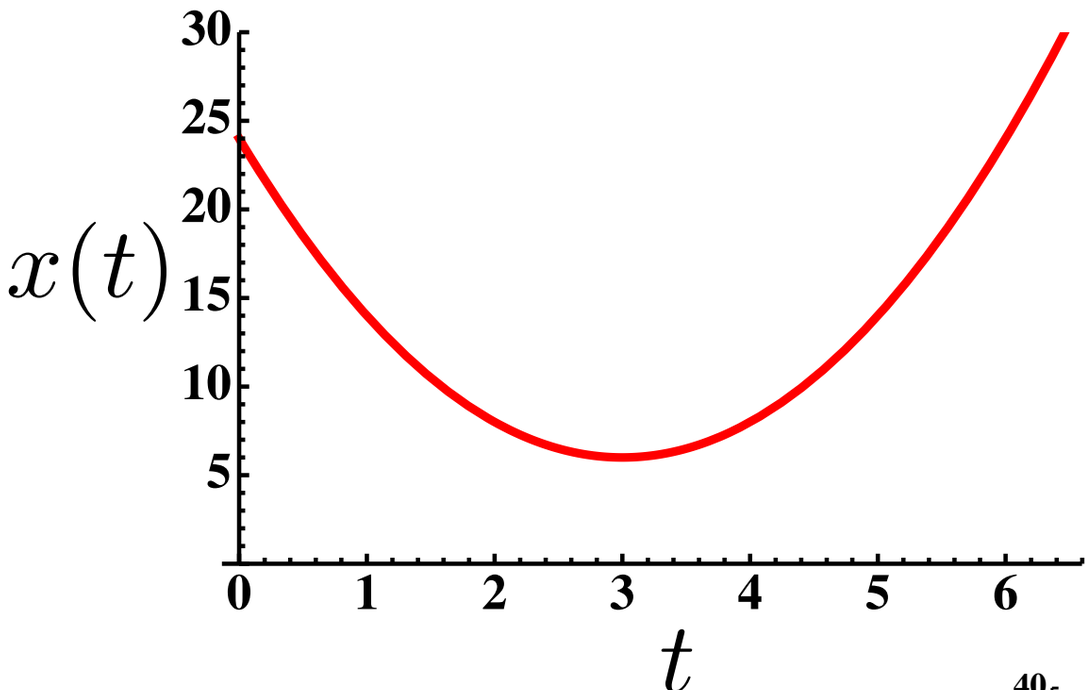
Consider the position vs. time graphs below

For which object does the velocity vector point in the negative direction? (leftward)

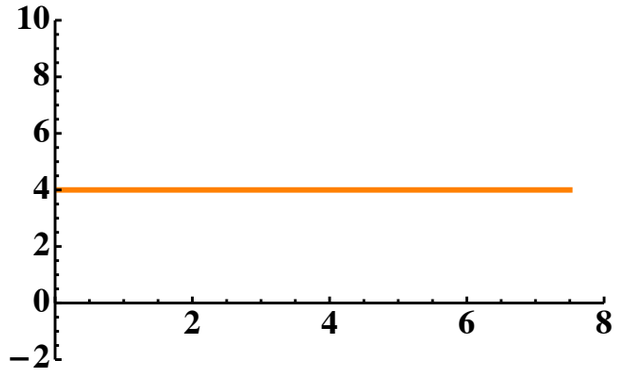


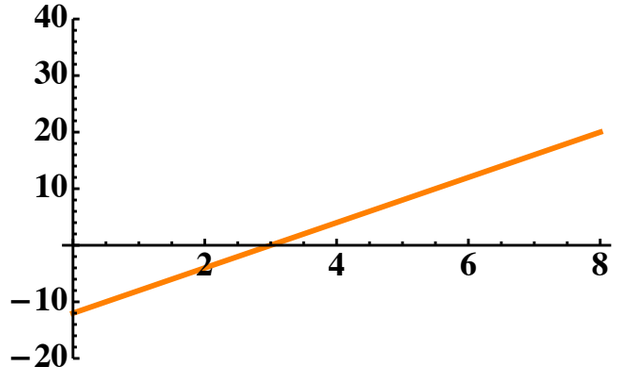
a) object 2
b) object 1
c) Neither velocity vector points in the negative direction

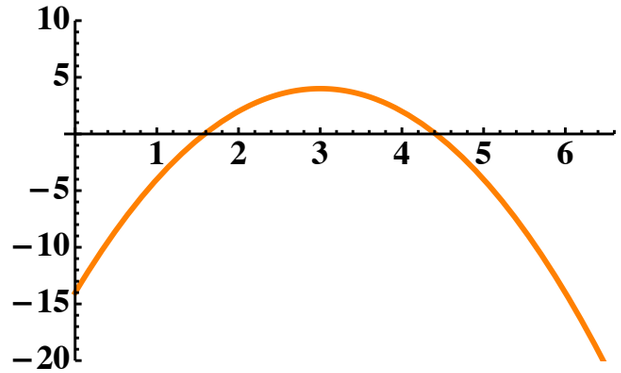
Question #6



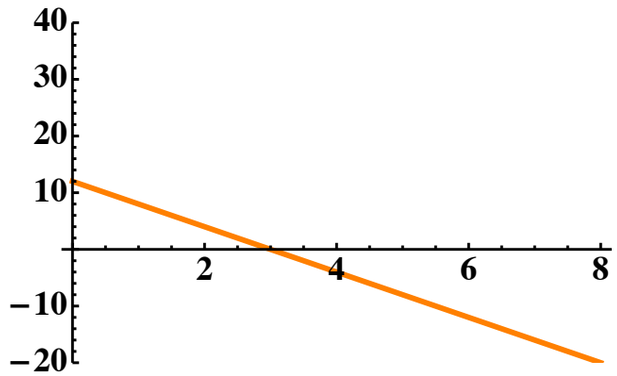
Find the velocity vs. time graph that corresponds to the position vs. time graph seen at left.

a)


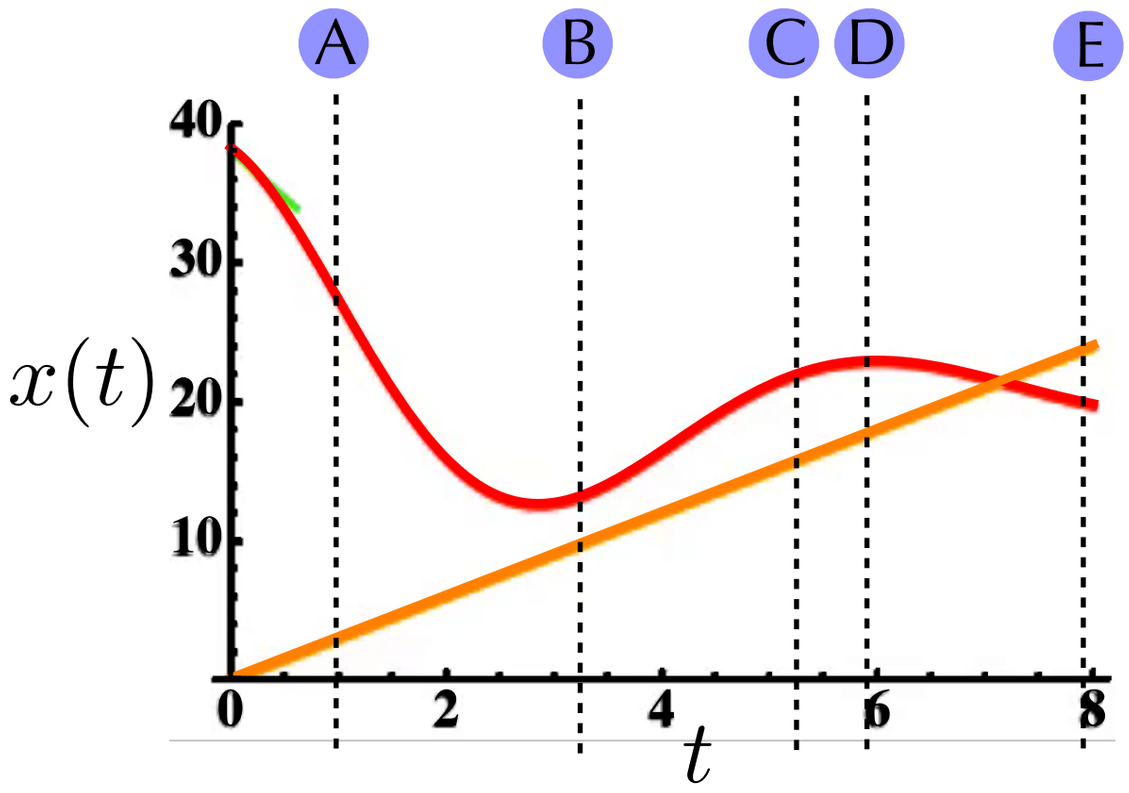
b)


c)


d) none of the above

e)


Question #7



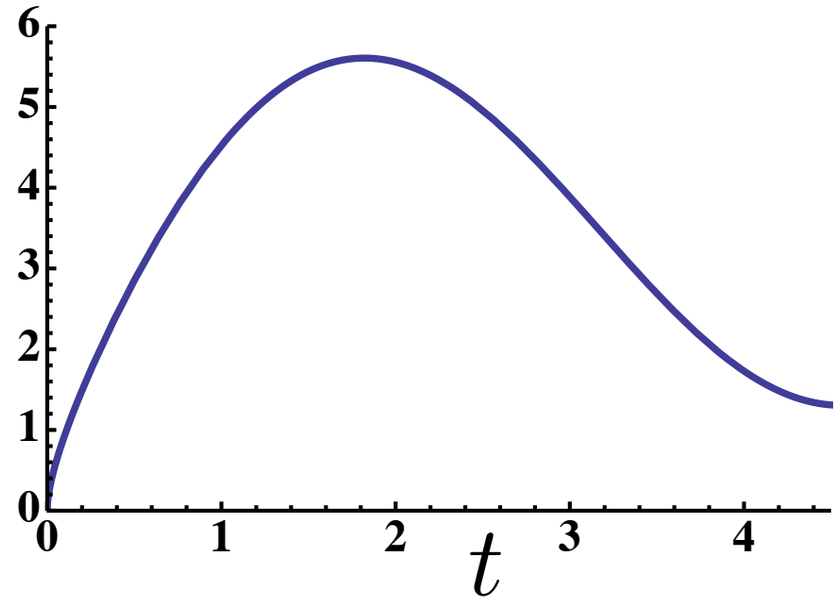
At what time(s) do these two objects have the same **<u>speed</u>**?

a) A & E
b) B only
c) B,C, & E
d) B & C
e) C only
f) The two objects never have the same speed

Question #8

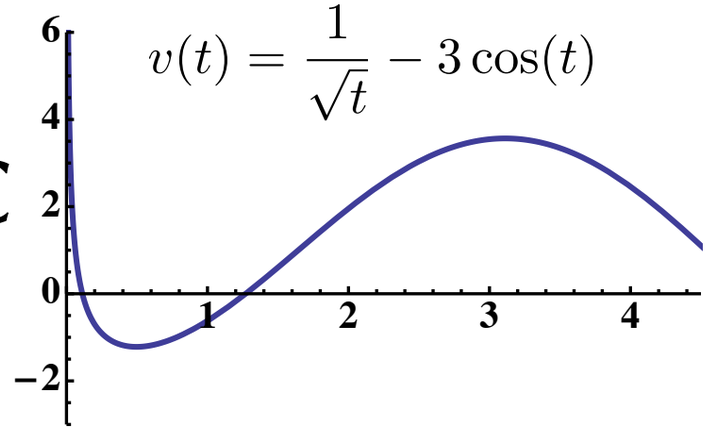
$$x(t) = 2\sqrt{t} + 3\sin(t)$$

$x(t)$

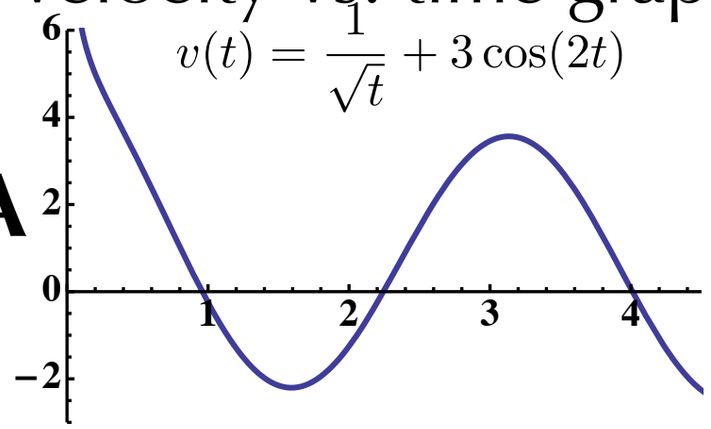


Which of the following is the velocity vs. time graph for the bus?

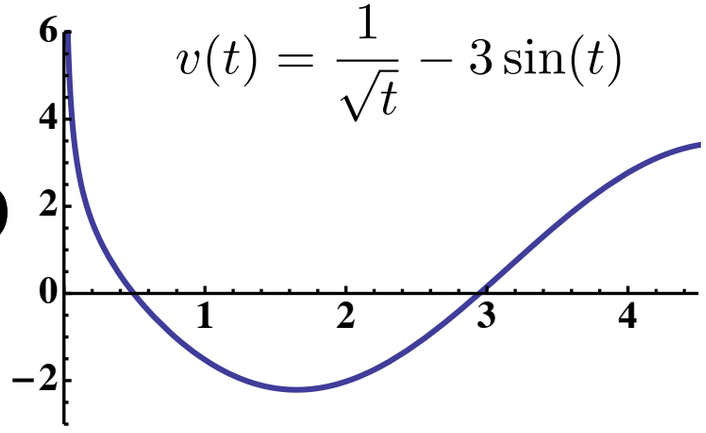
C



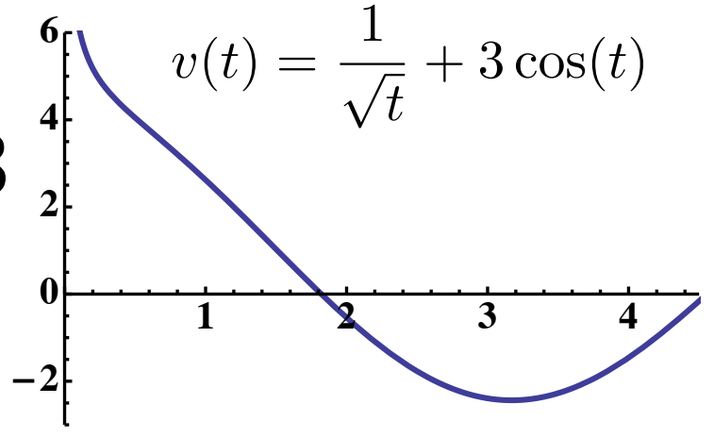
A



D



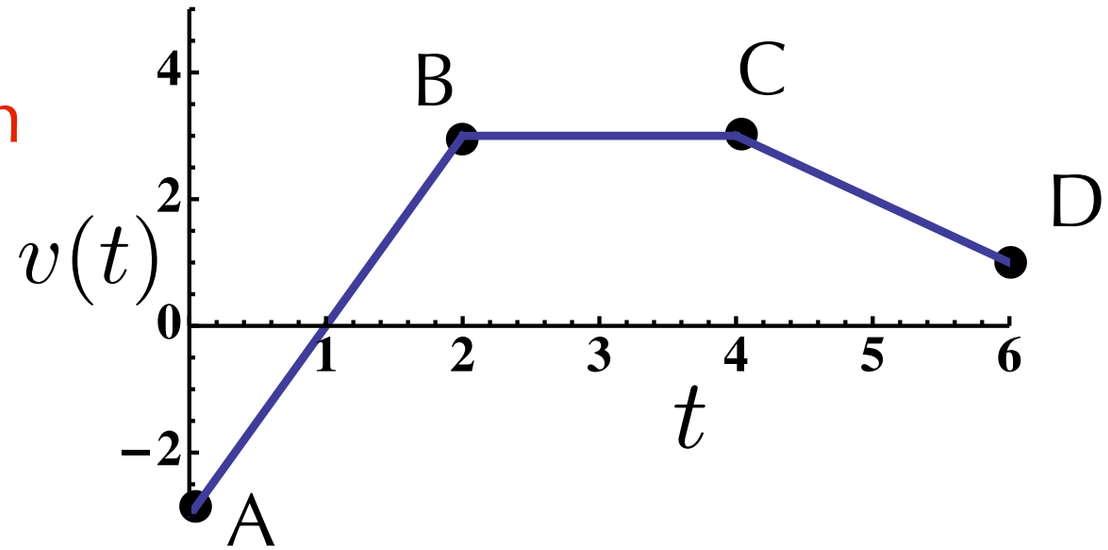
B



e) b & c are both correct

The object is located at x = 5 m at t = 0 s. What is the object's location at t = 1 s

$$v(t) \rightarrow x(t)$$



at t = 2 s?

at t = 4 s?

Question #1

a) 6.5 m
b) 1.5 m
c) 3.5 m
d) -1.5 m
e) 8 m

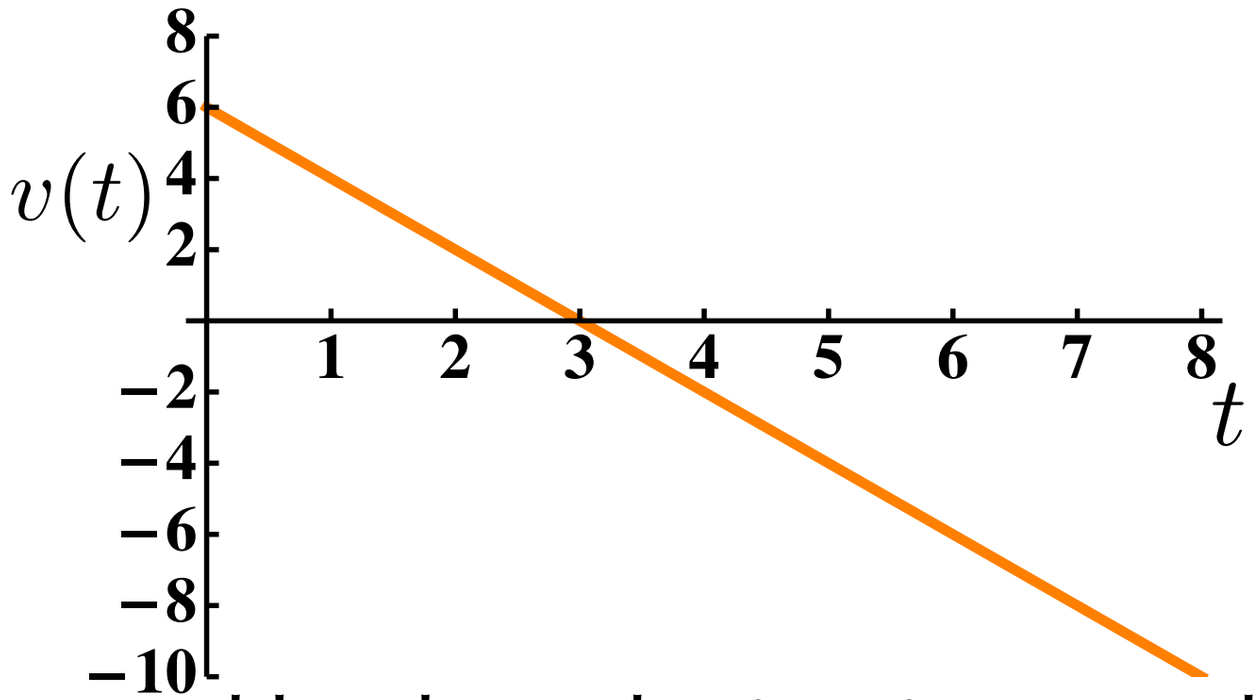
Question #2

a) 3.5 m
b) 1.5 m
c) 6.5 m
d) 0 m
e) 5 m

Question #3

a) 11 m
b) 3.5m
c) 6 m
d) 5 m
e) 8 m

Question #4



The object represented by the velocity-time graph above is at x=7 at t=0. Does the object ever reach x=0? If so, at what time does this happen?

a) The object never reaches the origin.

b) The object reaches the origin at t = 7.

c) The object reaches the origin at t = 6.

d) The object reaches the origin at t = 3.

e) I have no idea.

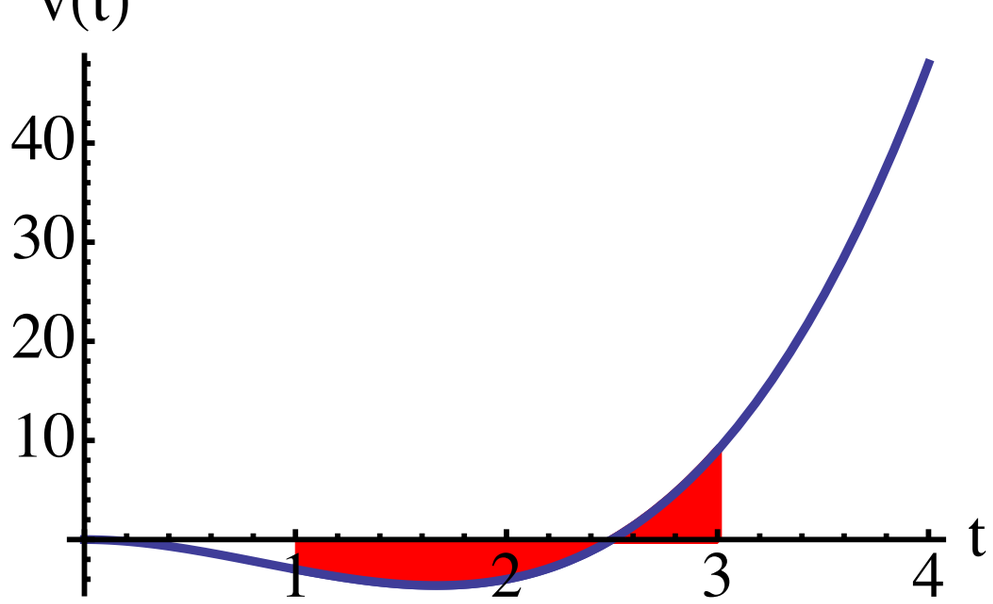
Question #5

The velocity of a particle is given by the expression

$$v(t) = 2t^3 - 5t^2$$

If the object's position at $t = 1$ is $x = 5$,

what is it's position when $t = 3$?



a) -10/3

b) 3

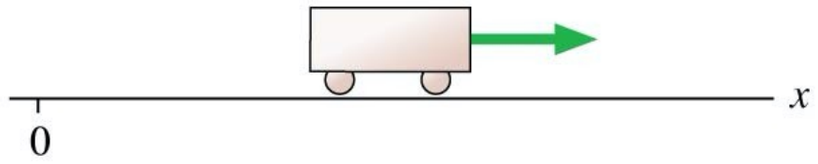
c) 5

d) -10

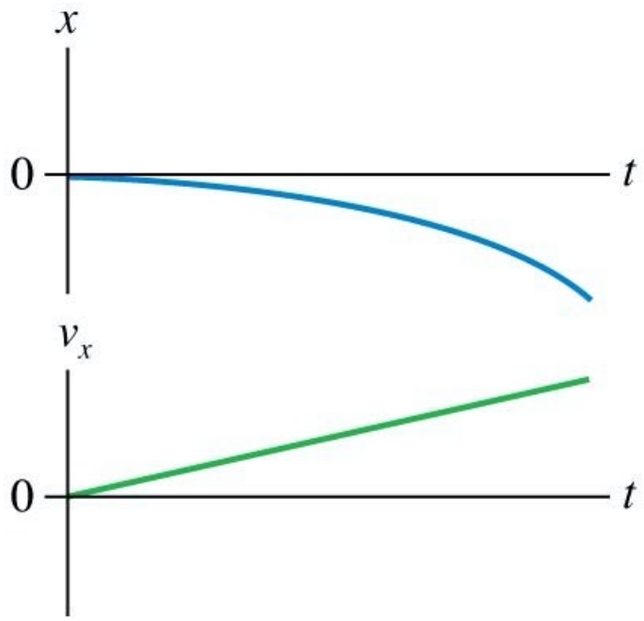
e) 5/3

Question #6

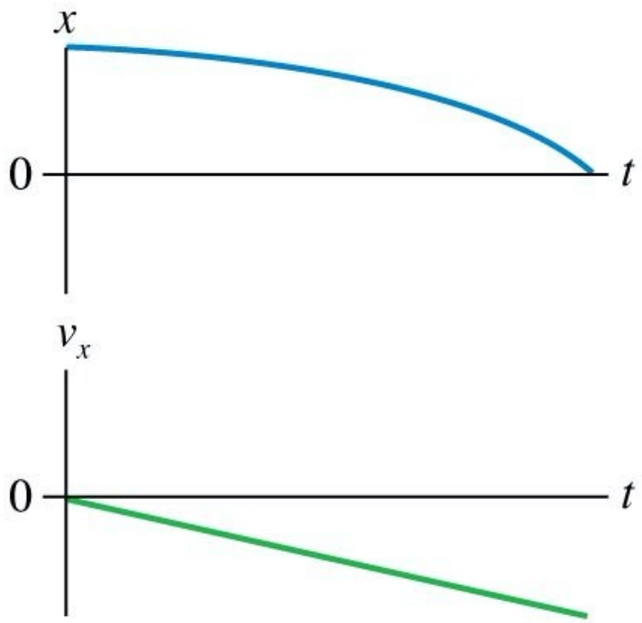
A cart slows down while moving away from the origin. What do the position and velocity graphs look like?



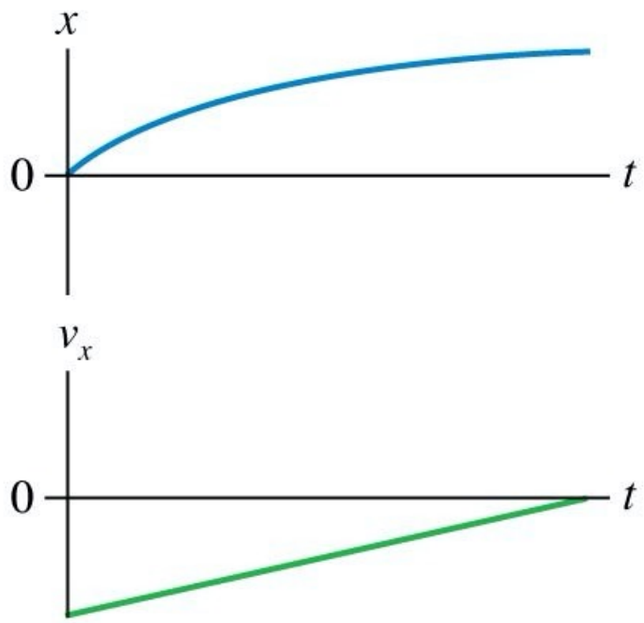
C



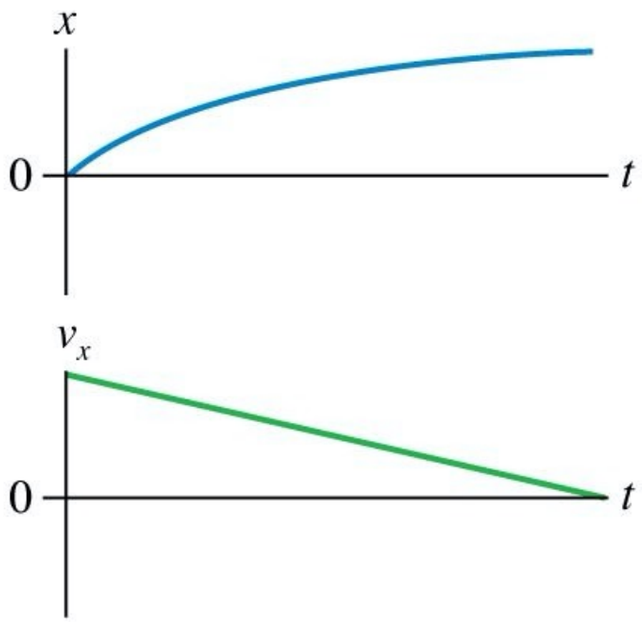
A



B

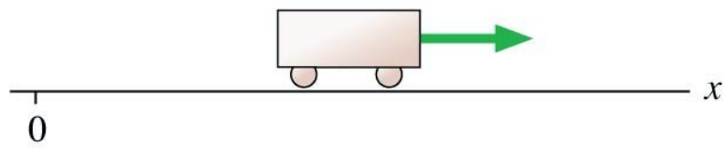


D

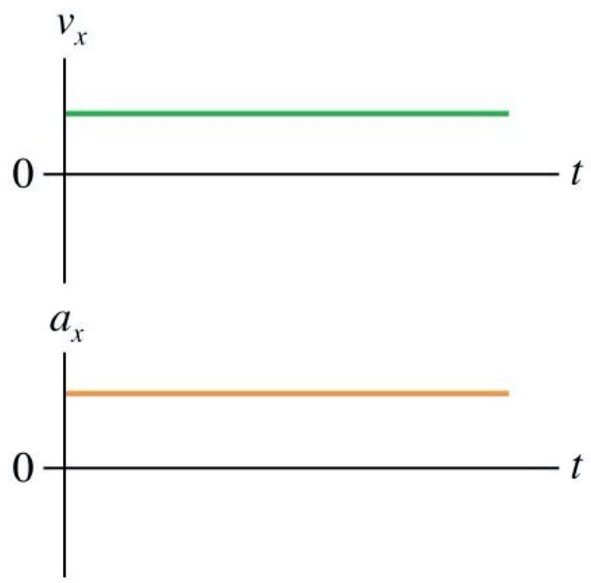


Question #7

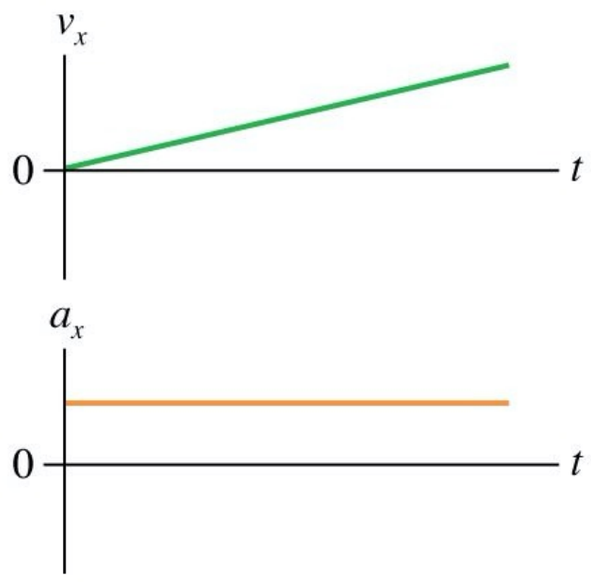
A cart speeds up while moving away from the origin. What do the velocity and acceleration graphs look like?



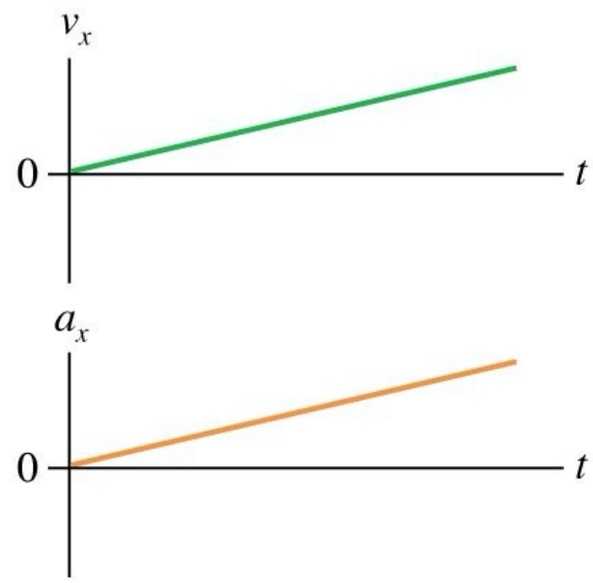
A



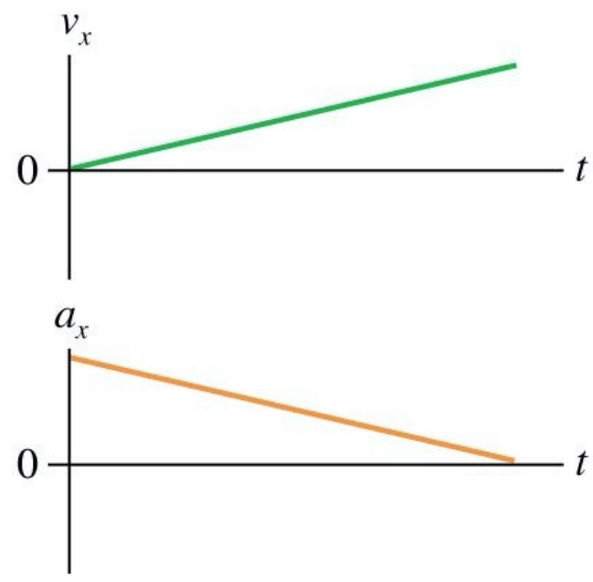
B



C

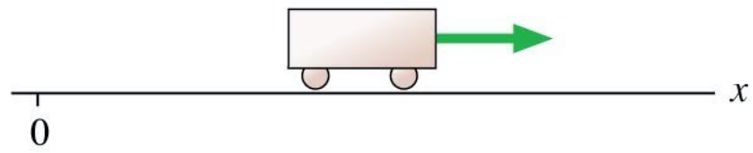


D

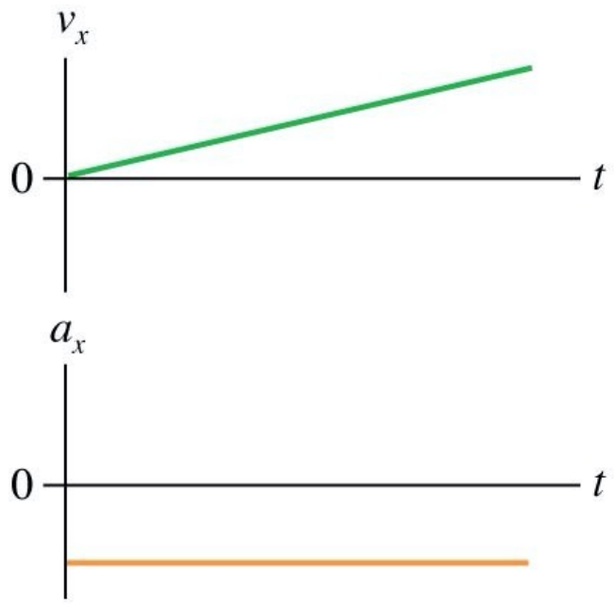


Question #8

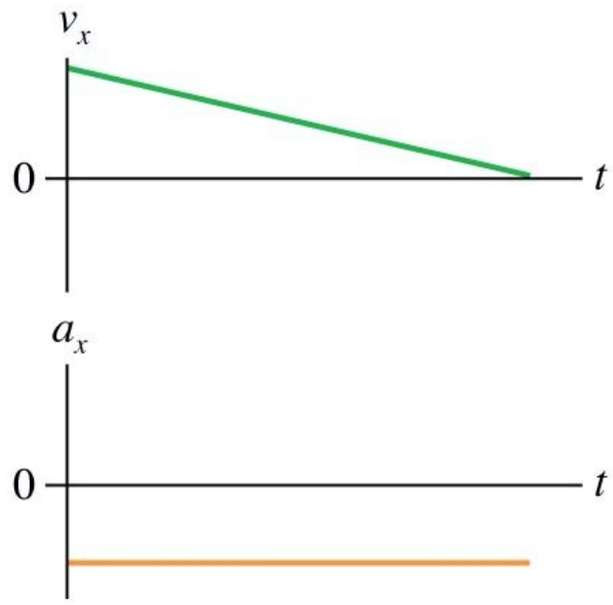
A cart slows down while moving away from the origin. What do the velocity and acceleration graphs look like?



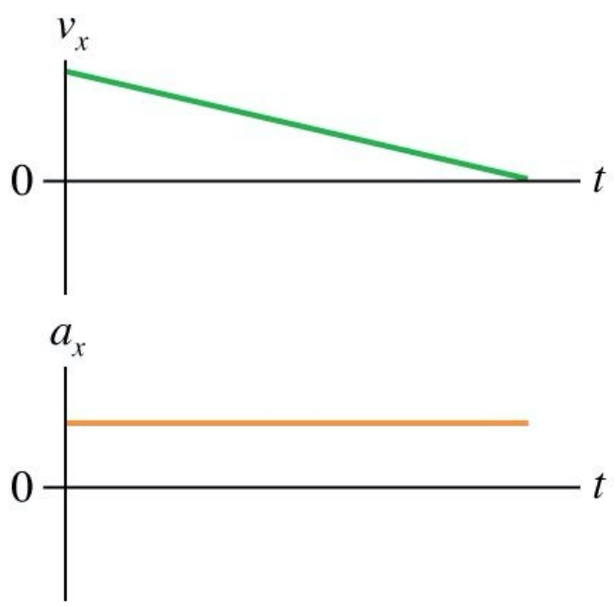
B



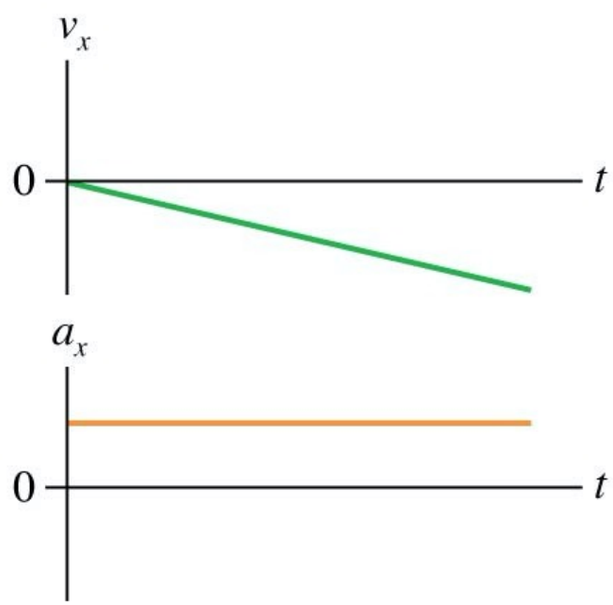
A



D



C



Question #16

A rock is tossed straight up from the ground level with an initial speed of 20 m/s. When it returns it falls into a 10-m deep hole. How fast is it going when it hits the bottom of the hole?

This is a one-equation problem. Which equation is the best choice to answer the question?

a) Equation I
b) Equation II
c) Equation III
d) Both I and III would work.

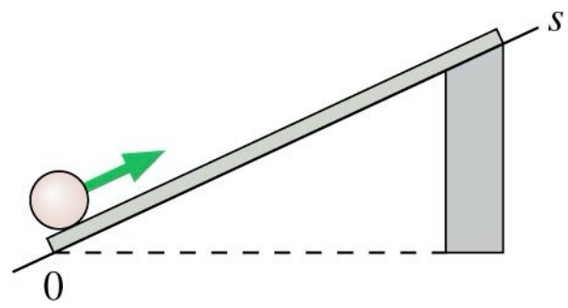
I $v_f = v_i + a\Delta t$

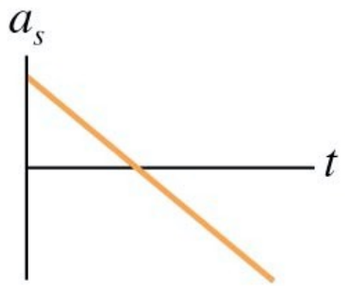
II $x_f = x_i + v_i\Delta t + \frac{1}{2}a(\Delta t)^2$

III $v_f^2 = v_i^2 + 2a\Delta x$

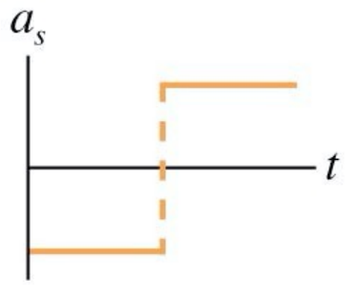
Question #17

A ball rolls up the ramp, and then rolls back down. Which is the correct acceleration graph?





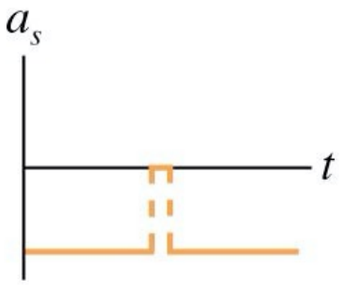
B



D

C

A



E

Question #18

A car traveling 30 m/s runs out of gas on a 10 degree incline. How far up the hill will it coast before starting to roll back down?

This is a one-equation problem. Which equation is the best choice to answer the question?

a) Equation I
b) Equation II
c) Equation III
d) Both I and III would work.

I $v_f = v_i + a\Delta t$

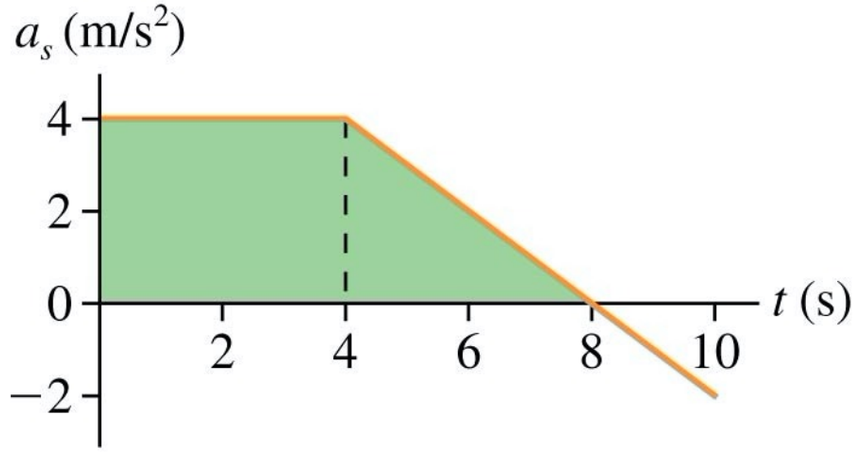
II $x_f = x_i + v_i\Delta t + \frac{1}{2}a(\Delta t)^2$

III $v_f^2 = v_i^2 + 2a\Delta x$

Question #25

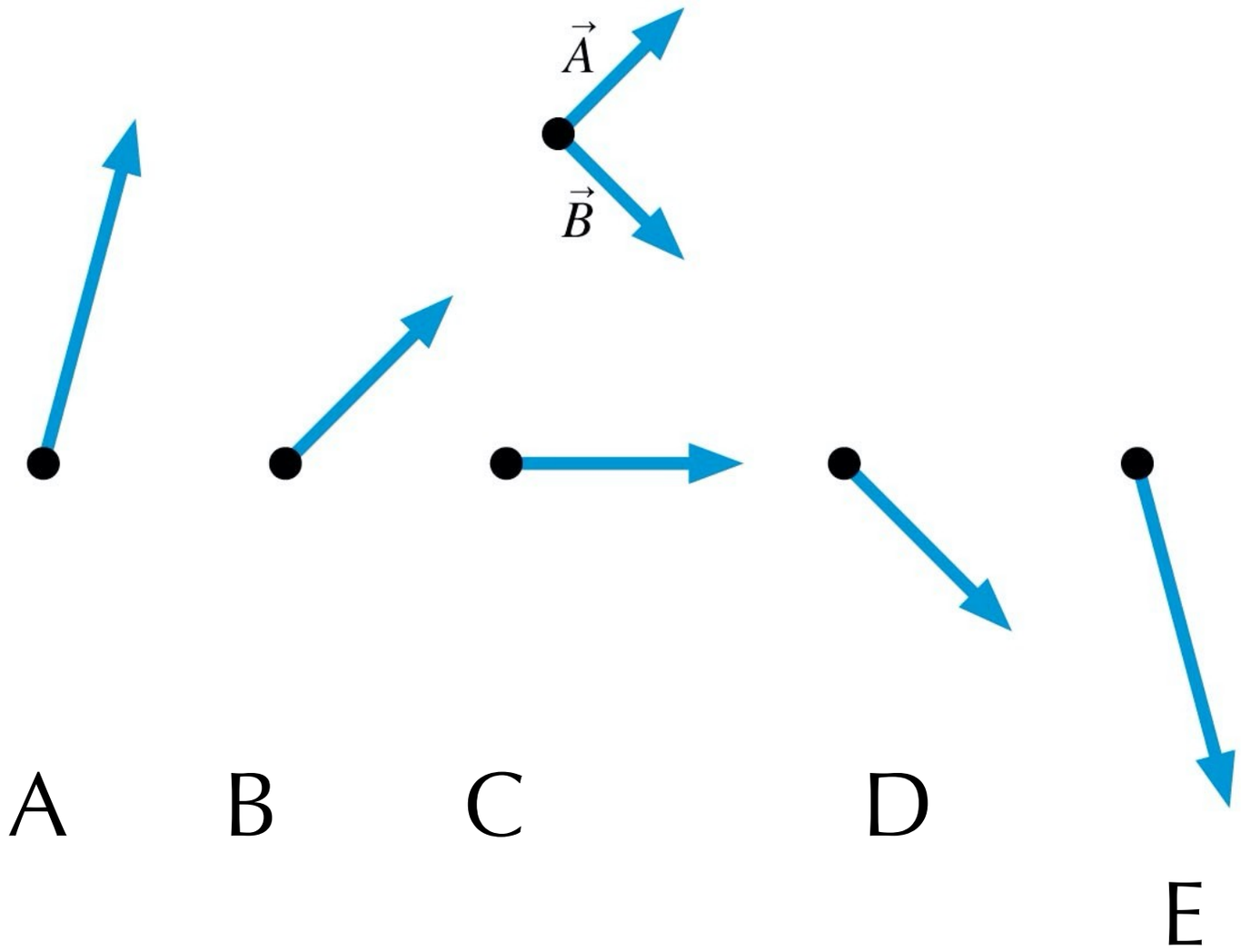
The figure below shows the acceleration graph for a particle with an initial velocity of 10 m/s. What is the particle's velocity at t = 8 s?

a. 24 m/s
b. 32 m/s
c. 16 m/s
d. 26 m/s
e. 34 m/s



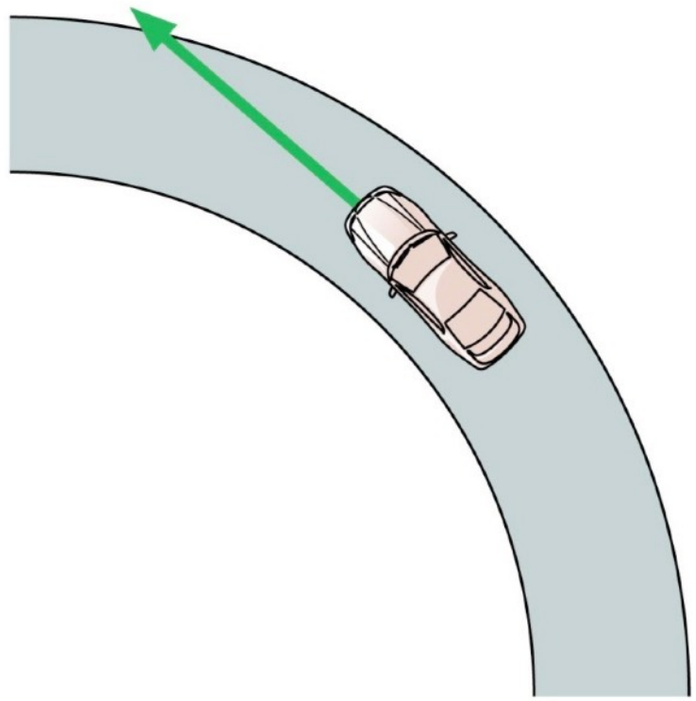
Question #19

Which of the vectors represents $\vec{A} + \vec{B}$



Question #1

A car is traveling around a curve at a **<u>steady</u>** 45 mph. Is the car accelerating?

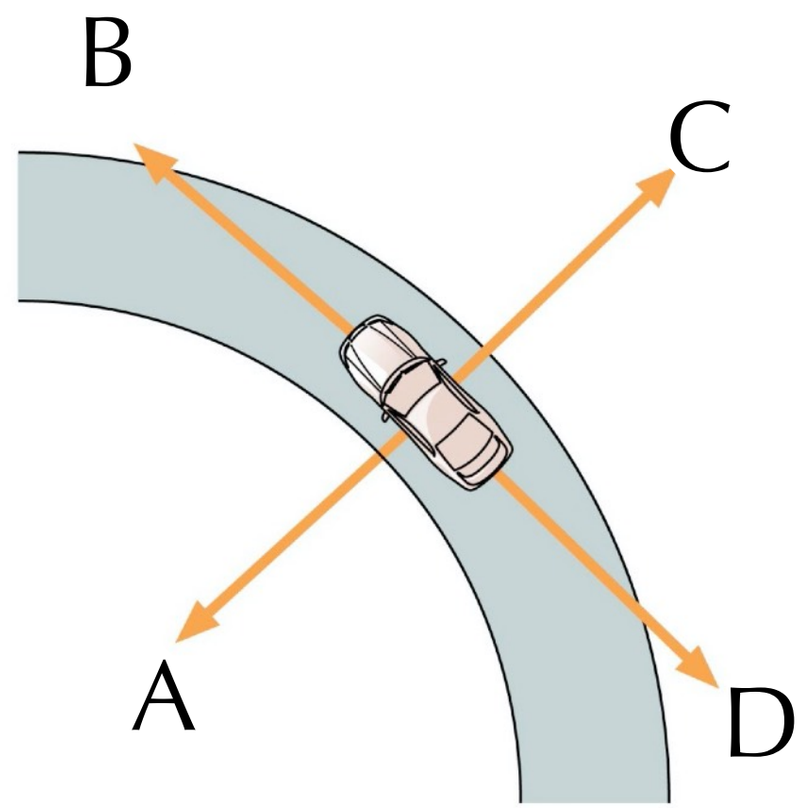


d) No

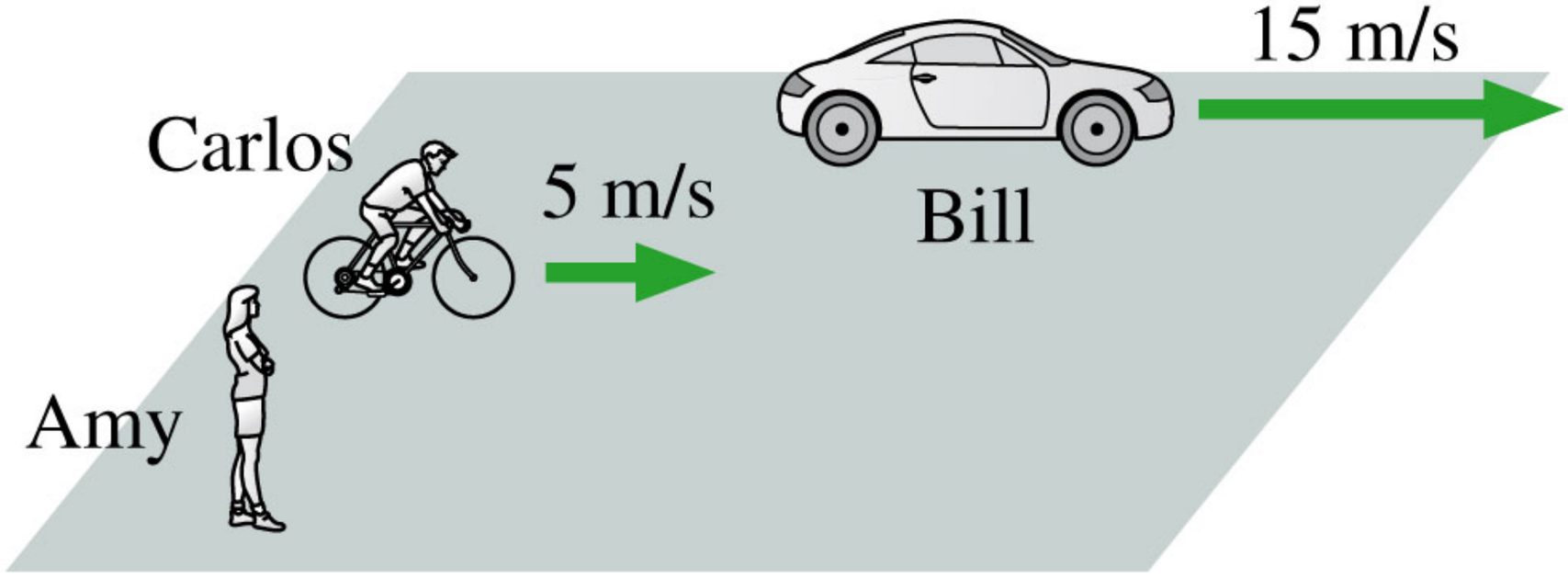
e) Yes

Question #2

A car is traveling around a curve at a steady 45 mph. Which vector shows the direction of the car's acceleration?



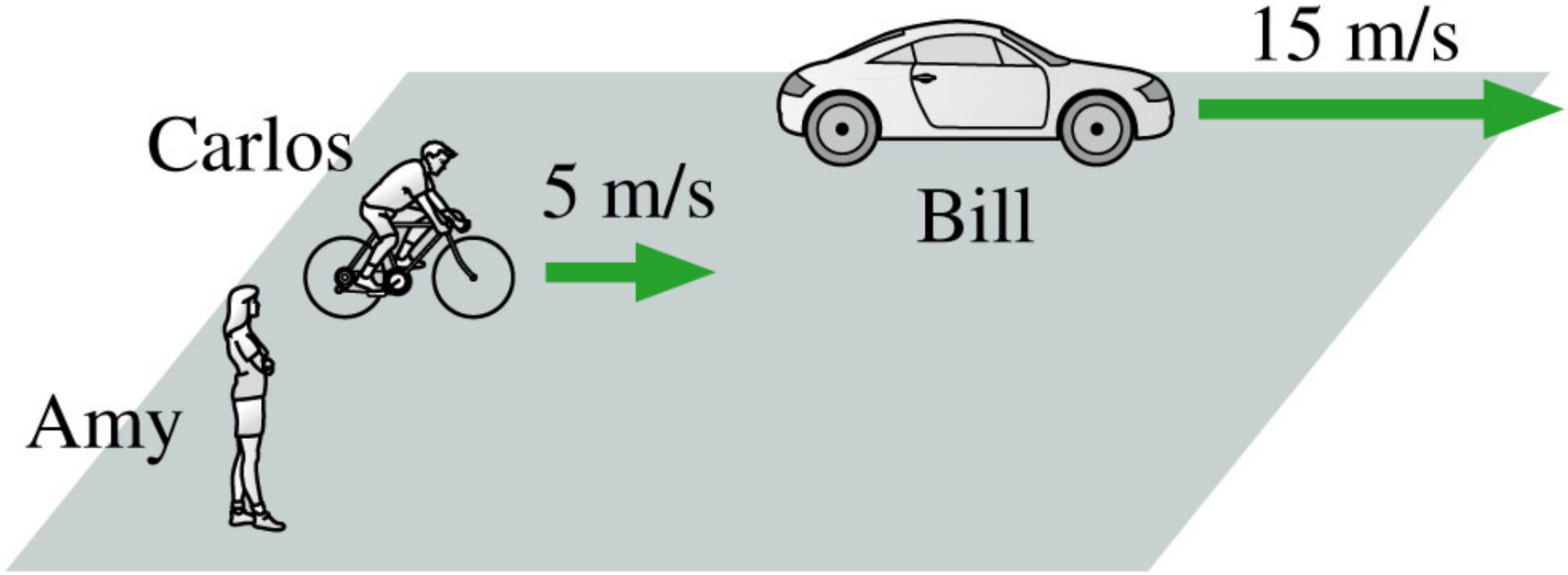
Relative Motion **Question #10**



What is Carlos's velocity as measured by Bill (v_{CB})?

a)+15 m/s
b) - 15 m/s
c) +10 m/s
d) +5 m/s
e) -10 m/s

Relative Motion **Question #11**



What is Amy's speed as measured by Bill (v_{AB})?

a)+15 m/s
b) - 10 m/s
c) +10 m/s
d) -15 m/s
e) +5 m/s

Reference Frames **Question #12**

$$\vec{v}_{CB} = \vec{v}_{CA} + \vec{v}_{AB}$$

What is C's velocity (red car) as measured by B (green car)?

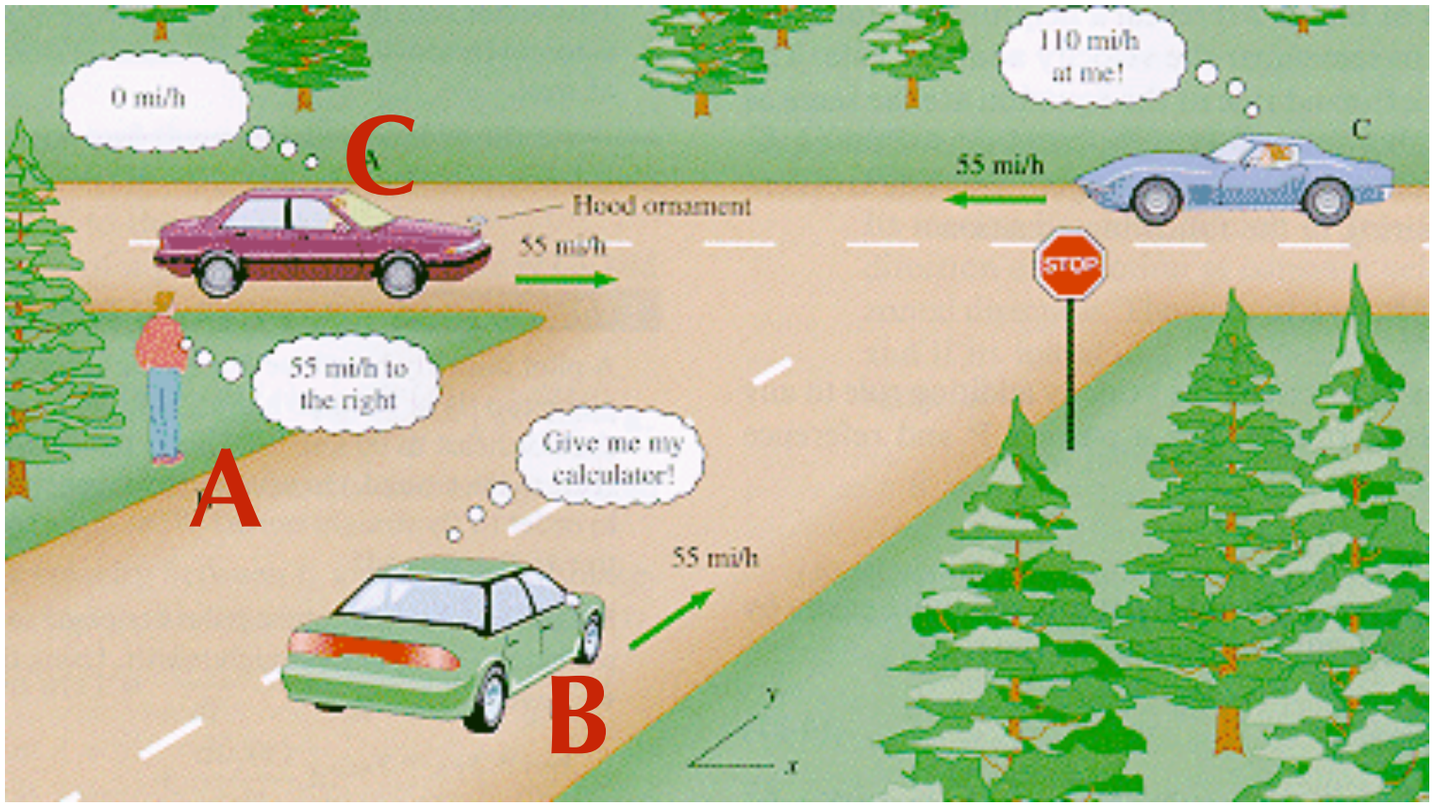
a) $(-55\ \hat{i} - 55\ \hat{j})$ mph

b) $(-55\ \hat{i} + 55\ \hat{j})$ mph

c)

d) $(55\ \hat{i} + 55\ \hat{j})$ mph

e) $(55\ \hat{i} - 55\ \hat{j})$ mph



Relative motion applet

Circular Motion **Question #13**

What is the meaning of the word period (T)?

a) The time it takes for an object to turn through **<u>one full radian</u>**.
b) The time it takes for an object to make **<u>one full revolution.</u>**
c) .
d) The time it takes to travel through 90 degrees.
e) The distance a particle travels during one full revolution.

Angular Velocity ω Question #14

If the ferris wheel makes one full revolution in T minutes, which expression below is a correct?

b)

$$\omega = \frac{1}{T} \text{ revs/min}$$

$$\omega = \frac{2\pi}{T} \text{ rads/min}$$

a)

c)

$$\omega = \frac{T}{2\pi} \text{ revs/min}$$

d) a) and b) are both correct

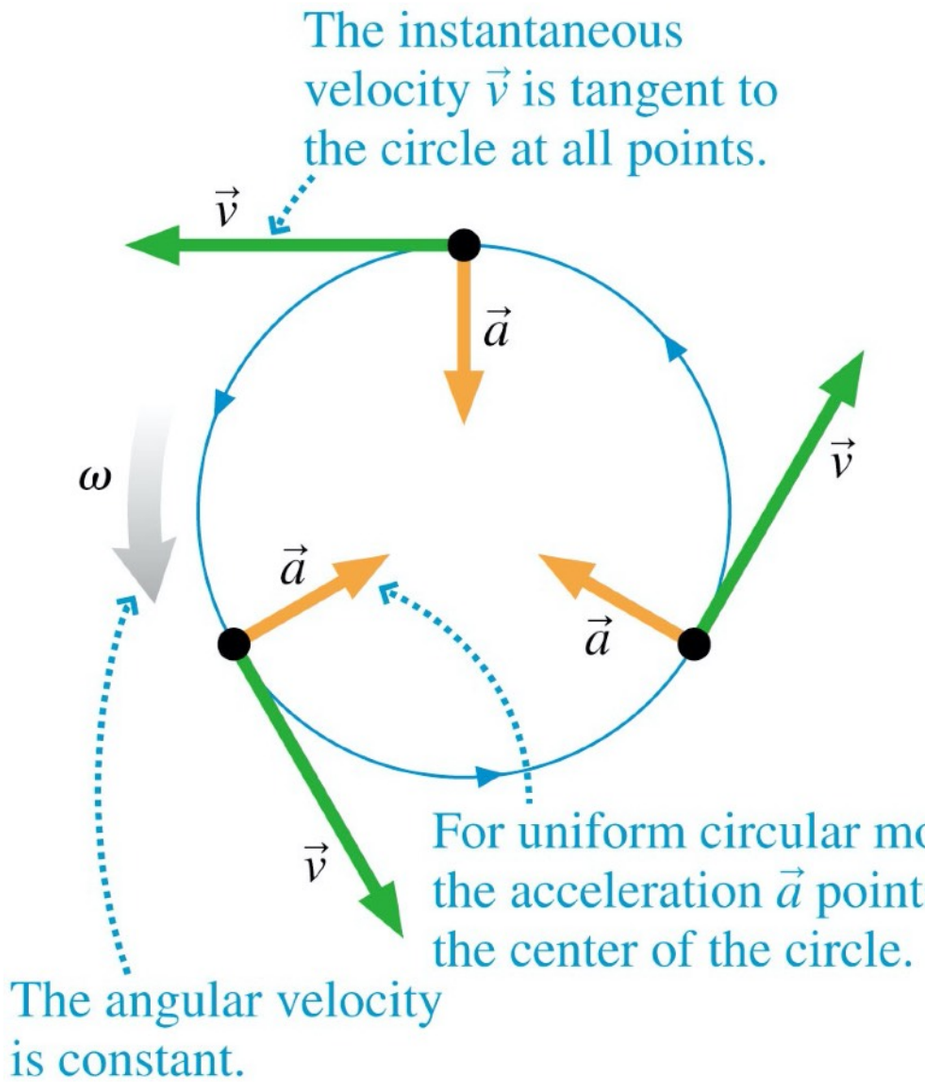
e) a) and c) are both correct.

Tangential Velocity

Question #15

A wheel is spinning with a period of 10 sec. What is the speed of point on the wheel, 10 cm away?

a) 0.0628 meters/min
b) 6.28 meters/sec
c) 62.8 meters/sec
d) 0.0628 meters/ sec
e) a) and b) are both correct.

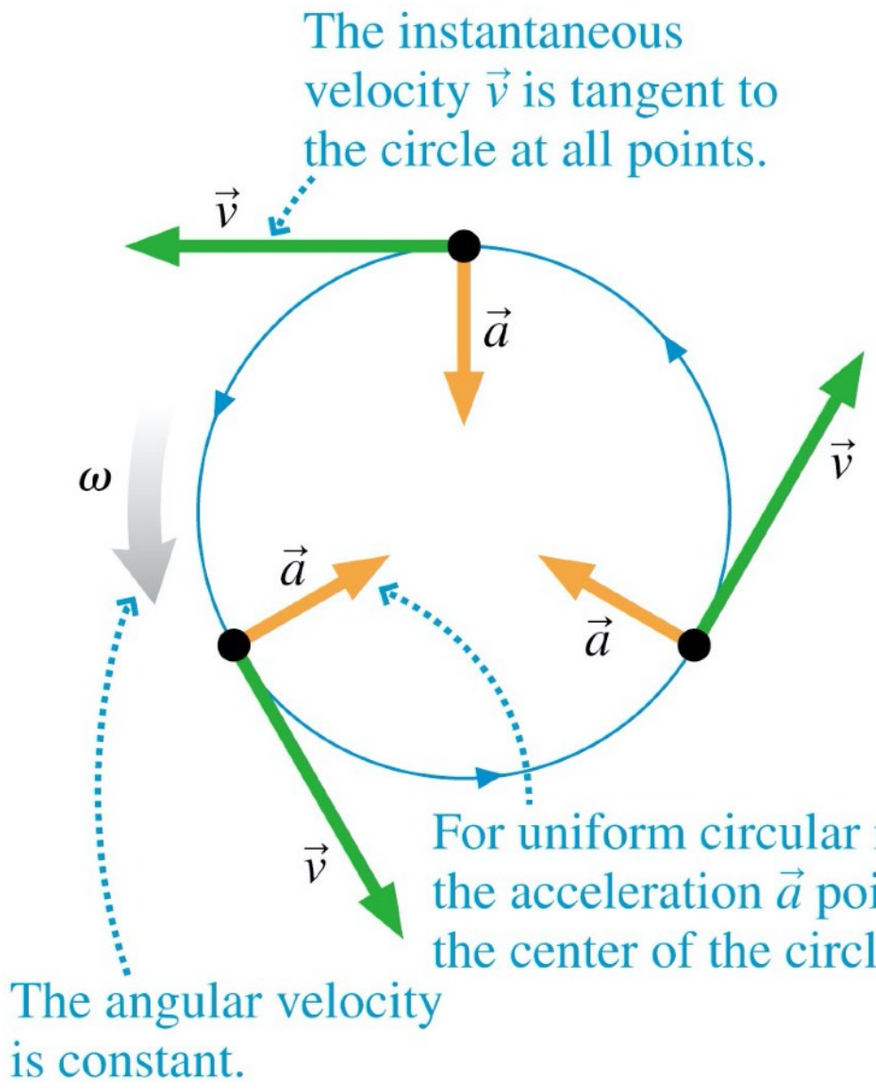


Tangential Velocity

Question #16

A wheel is spinning at a rate of 5 rpm. What is the speed of a point on the wheel, 10 cm away?

a) 50 meters/min
b) 314 meters/min
c) d) and e) are both correct.
d) 0.0524 meters/ s
e) 3.14 meters/min



After setting this wheel in motion you measure that it takes 10 s to make 15 revolutions. Find the tangential velocity v_t of a point on the rim, the angular velocity ω and the period T.

Question #17

v_t

a) 1.89 meters/sec
b) 0.13 meters/sec
c) 1.89 meters/min
d) 0.13 meters/ sec
e) b) and c) are both correct.

Question #18

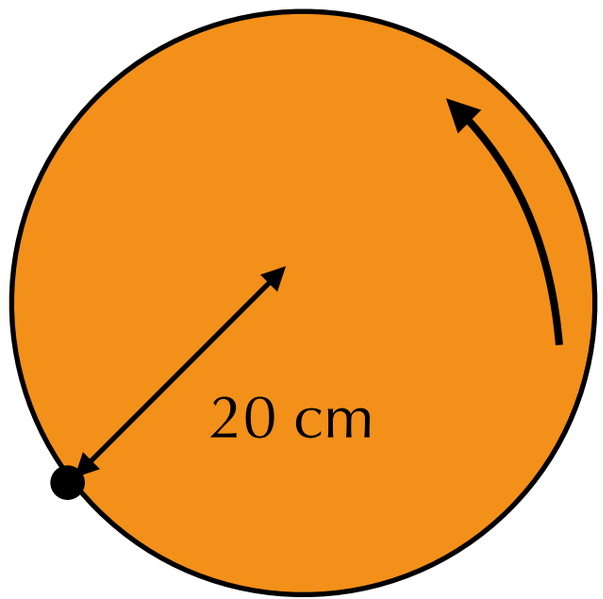
ω

a) 0.63 rads/min
b) 0.63 rads/sec
c) 9.42 rads/sec
d) 9.42 rads/ min
e) a) and d) are both correct.

Question #19

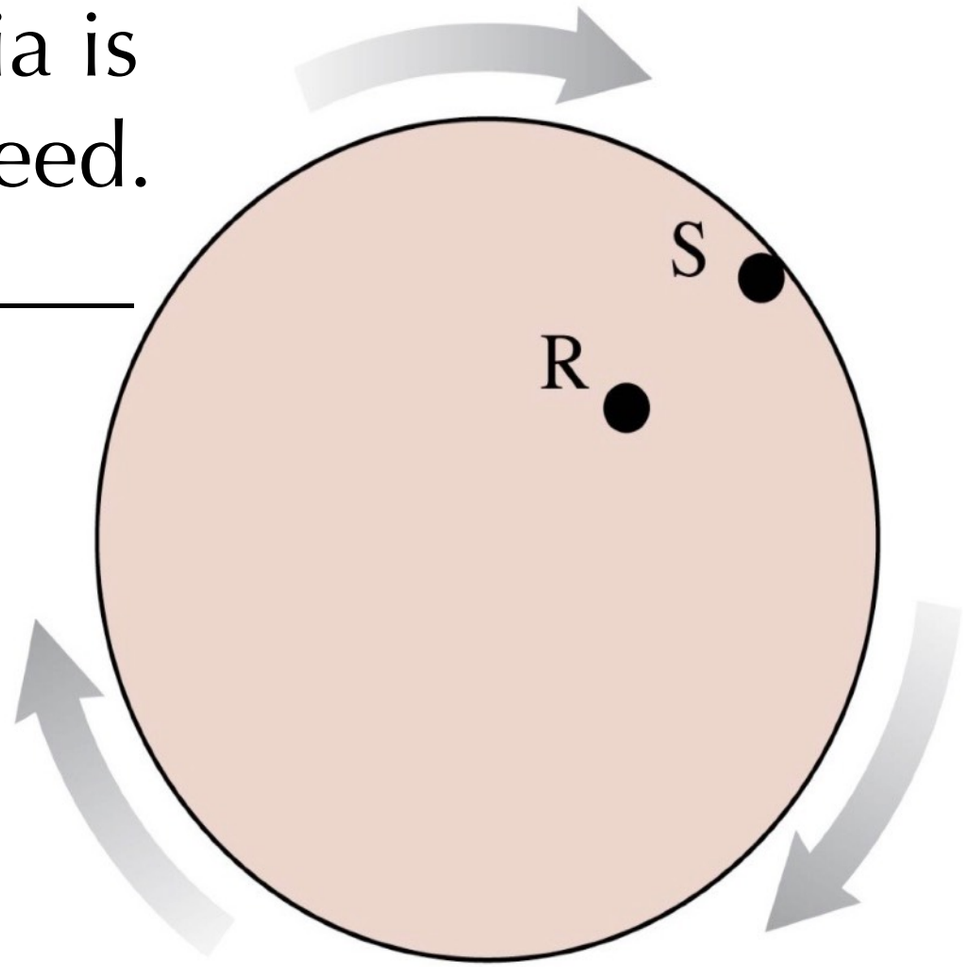
T

a) 0.667 min
b) 0.667 s
c) 1.5 s
d) 1.5 min
e) a) and b) are both correc



Question #21

Rasheed and Sofia are riding a merry-go-round that is spinning steadily. Sofia is twice as far from the axis as is Rasheed. Sofia's angular velocity is _____ that of Rasheed.



a) the same as

b) four times

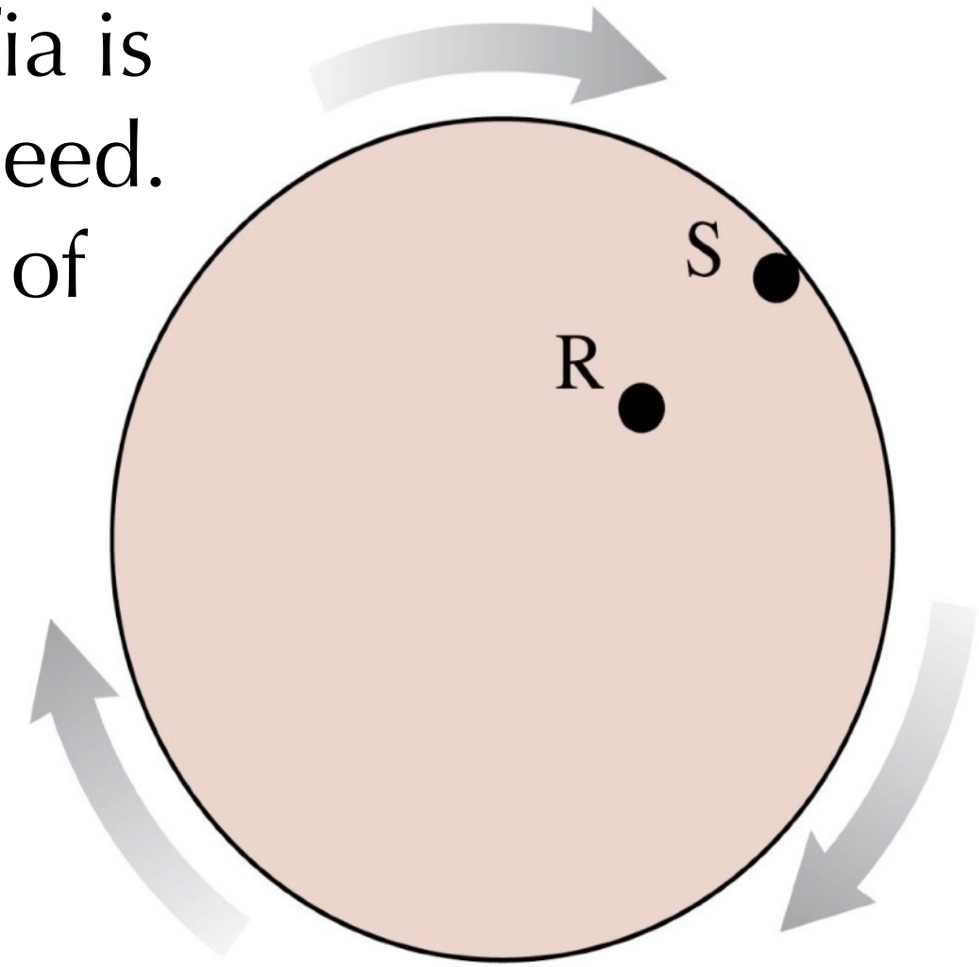
c) twice

d) half

e) We can't say

Question #22

Rasheed and Sofia are riding a merry-go-round that is spinning steadily. Sofia is twice as far from the axis as is Rasheed. Sofia's speed is _____ that of Rasheed.



a) half

b) the same as

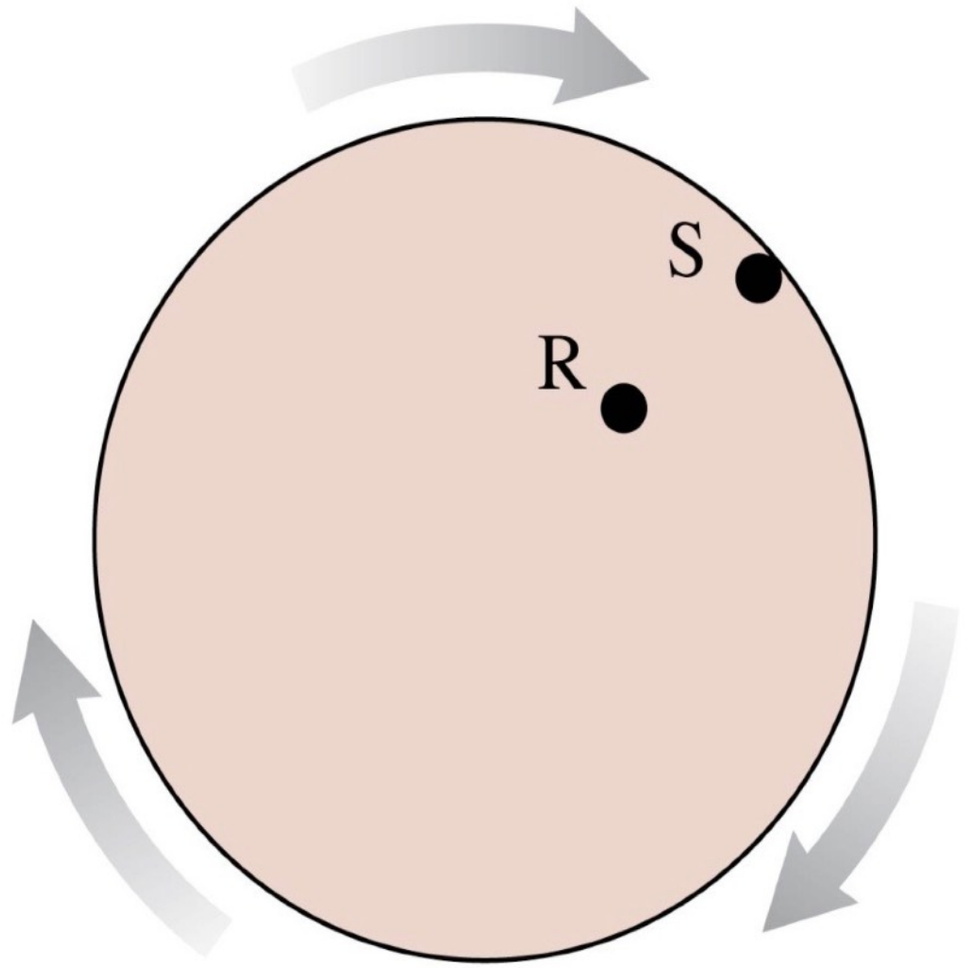
c) twice

d) four times

e) We can't say

Question #23

Rasheed and Sofia are riding a merry-go-round that is spinning steadily. Sofia is twice as far from the axis as is Rasheed. Sofia's acceleration is _____ that of Rasheed.



a) half

b) the same as

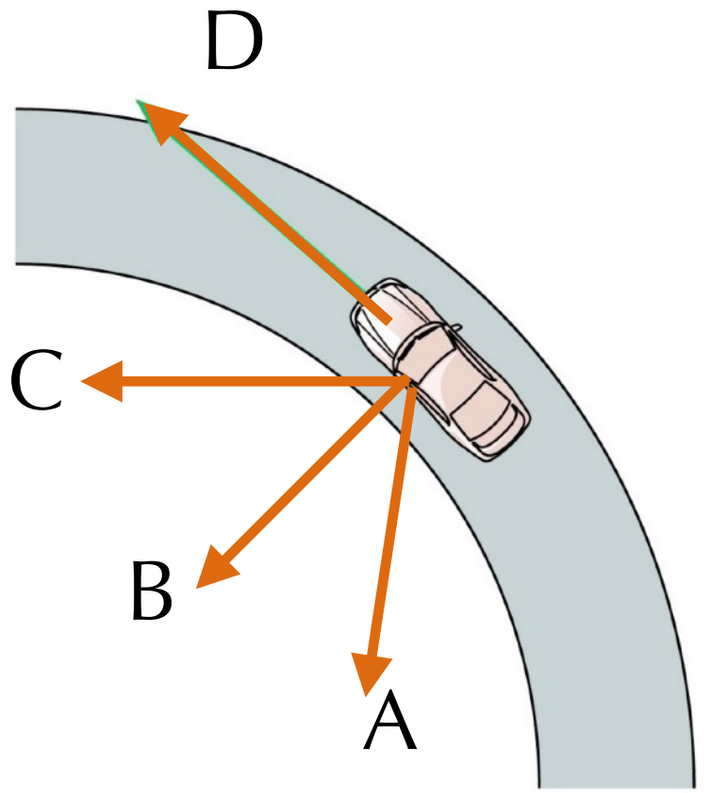
c) We can't say

d) four times

e) twice

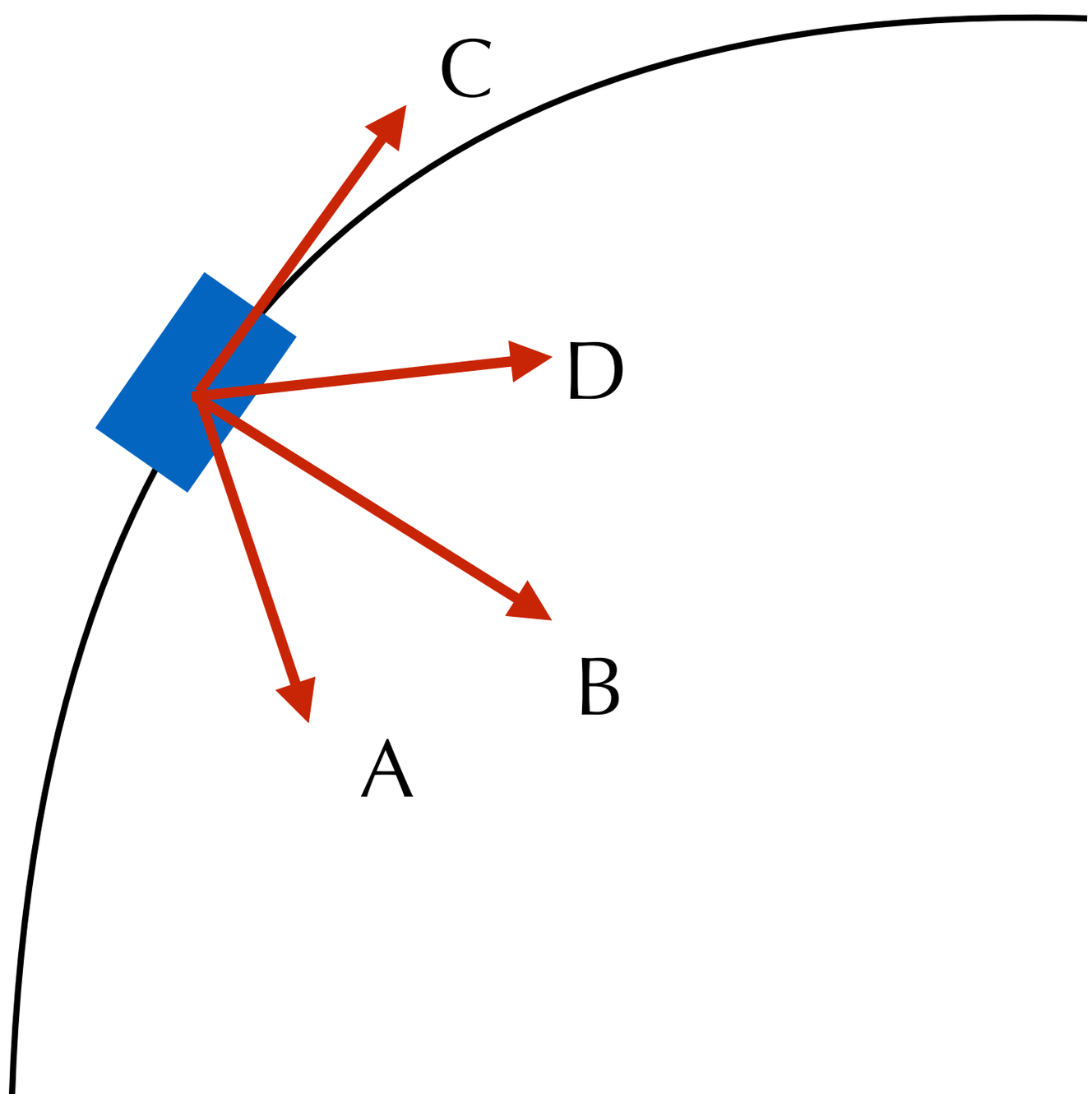
Question #3

A car is traveling around a curve and speeding up. Which vector shows the direction of the car's acceleration?



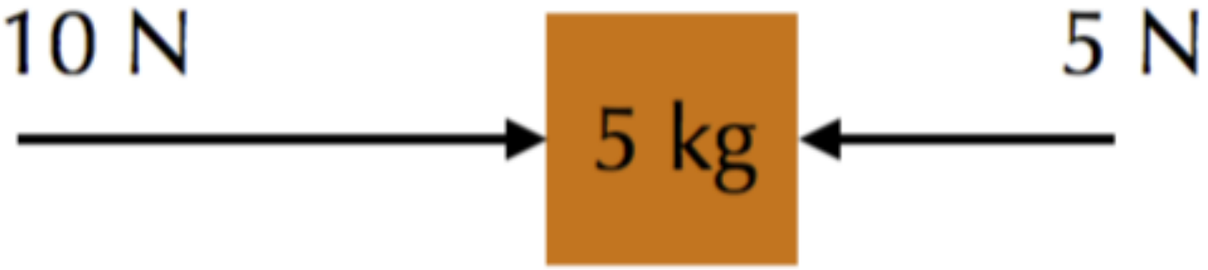
Question #18

A car is **speeding up** as it goes around a curve. What is the acceleration vector at this moment in time?



Question #1

An object is acted on by two forces of unequal magnitude, as shown in the figure. Which statement is true?



A The acceleration vector points to the right and has magnitude 5 m/s^2

B The acceleration vector points to the right and has magnitude 1 m/s^2

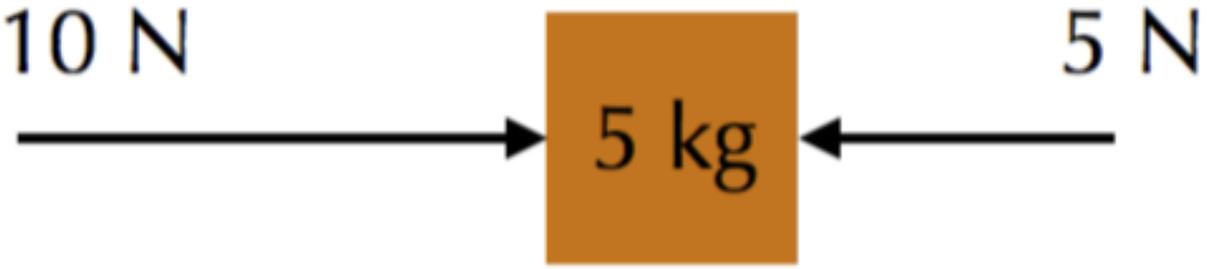
C The acceleration vector points to the left and has magnitude 1 m/s^2

D The acceleration vector points to the left and has magnitude 5 m/s^2

E The acceleration vector points to the right and has magnitude 2 m/s^2

Question #2

Now quadruple the 5 N force so that it becomes 20 N. Now which statement is true?



A The acceleration vector points to the right and has magnitude 1 m/s^2

B The acceleration vector points to the right and has magnitude 5 m/s^2

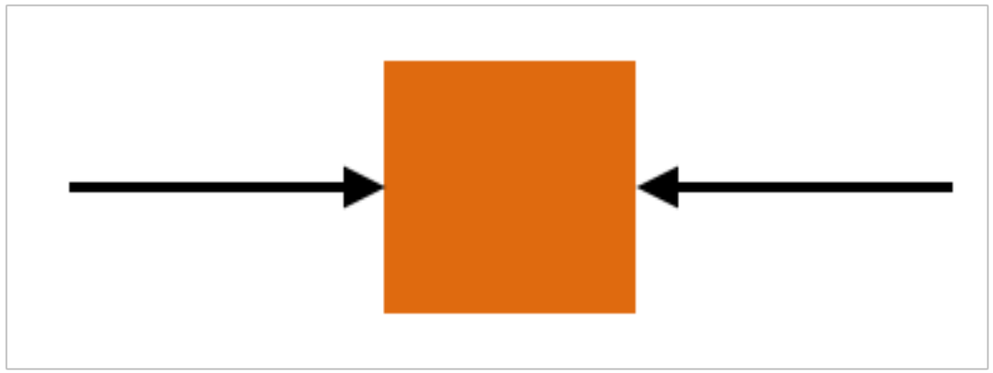
C The acceleration vector points to the left and has magnitude 1 m/s^2

D The acceleration vector points to the right and has magnitude 2 m/s^2

E The acceleration vector points to the left and has magnitude 2 m/s^2

Question #3

An object is acted on by two forces of equal magnitude, as shown in the figure. Describe the motion of the box



A The object is stationary (not moving).

B The object is moving to the right at constant speed.

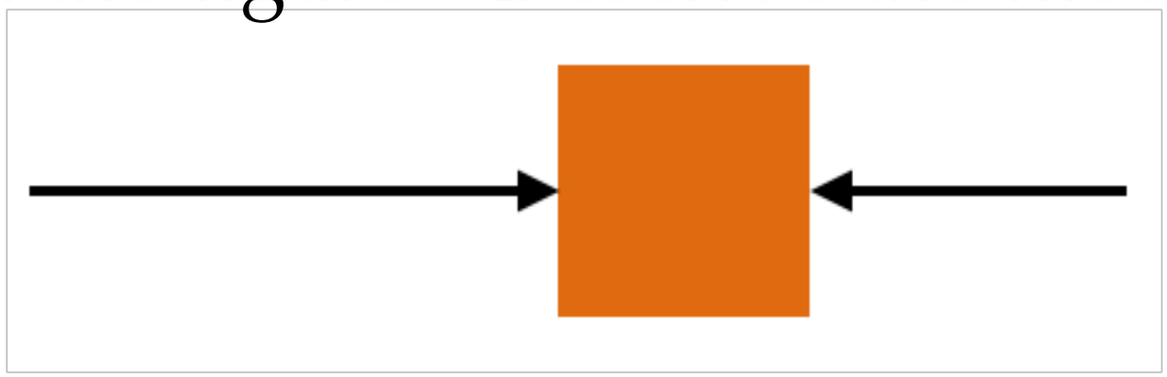
C A, B, and E are all possible.

D The object is moving and speeding up.

E The object is moving to the left at constant speed.

Question #4

An object is acted on by two forces of **unequal** magnitude, as shown in the figure. Describe the motion of the box



A B, and E are both possible.

B The object is moving to the right and its speed is increasing.

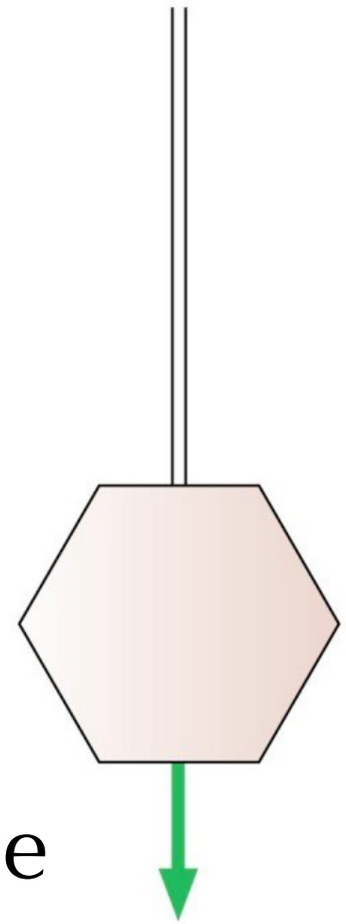
C The object is moving at constant speed.

D The object is moving to the right and its speed is decreasing.

E The object is moving to the left and its speed is decreasing.

Question #5

An object on a rope is lowered at constant speed. Which is true?



b) The rope tension is greater than the force of gravity.

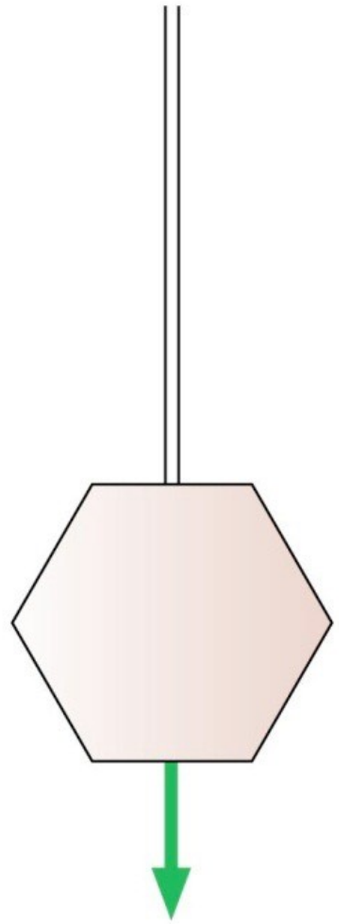
c) The rope tension can't be compared to the force of gravity.

d) The rope tension is less than the force of gravity.

e) The rope tension equals the force of gravity.

Question #6

An object on a rope is lowered at a **steadily decreasing** speed. Which is true?



a) The rope tension is greater than the force of gravity.

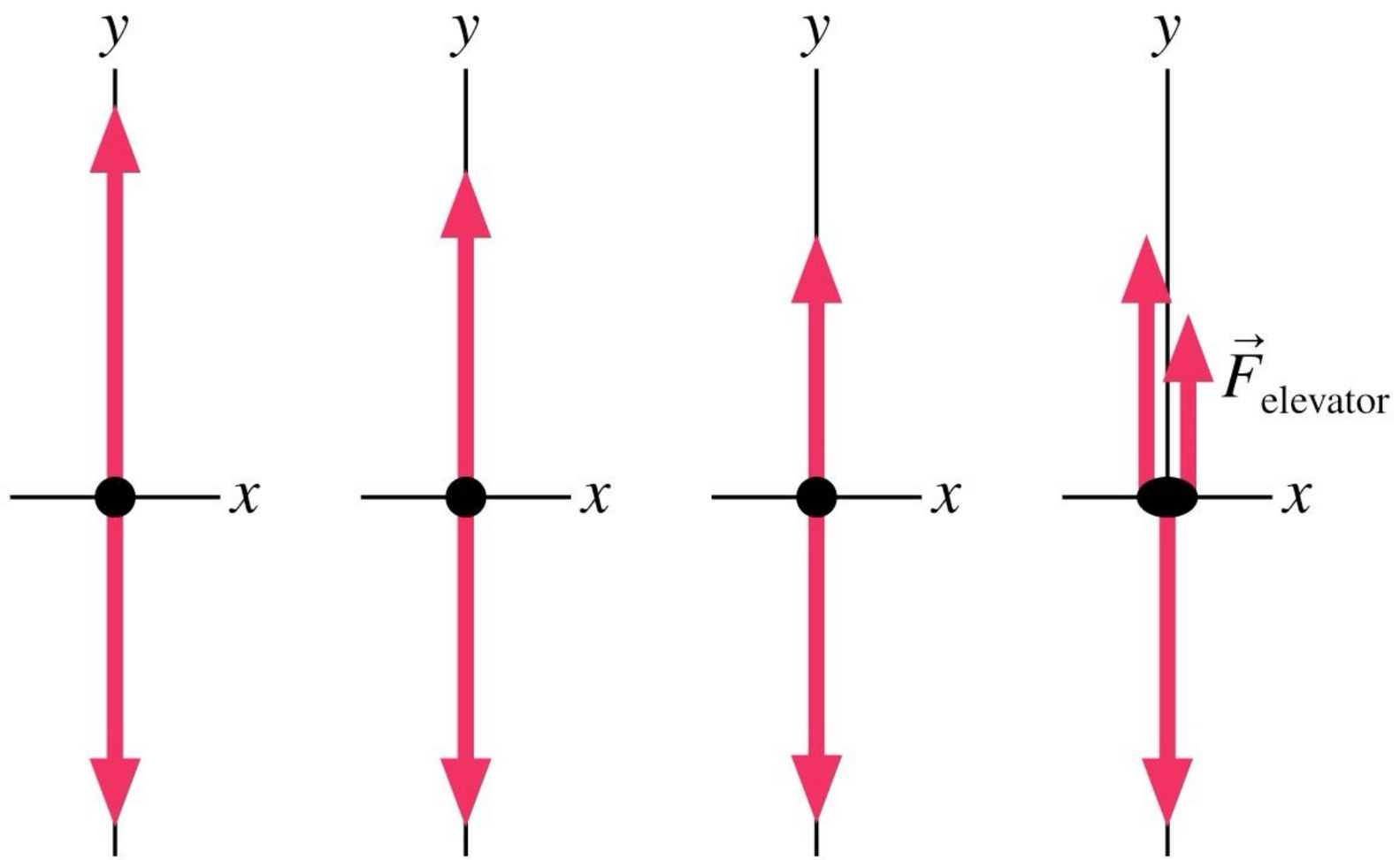
b) The rope tension equals the force of gravity.

c) The rope tension is less than the force of gravity.

d) The rope tension can't be compared to the force of gravity.

Question #7

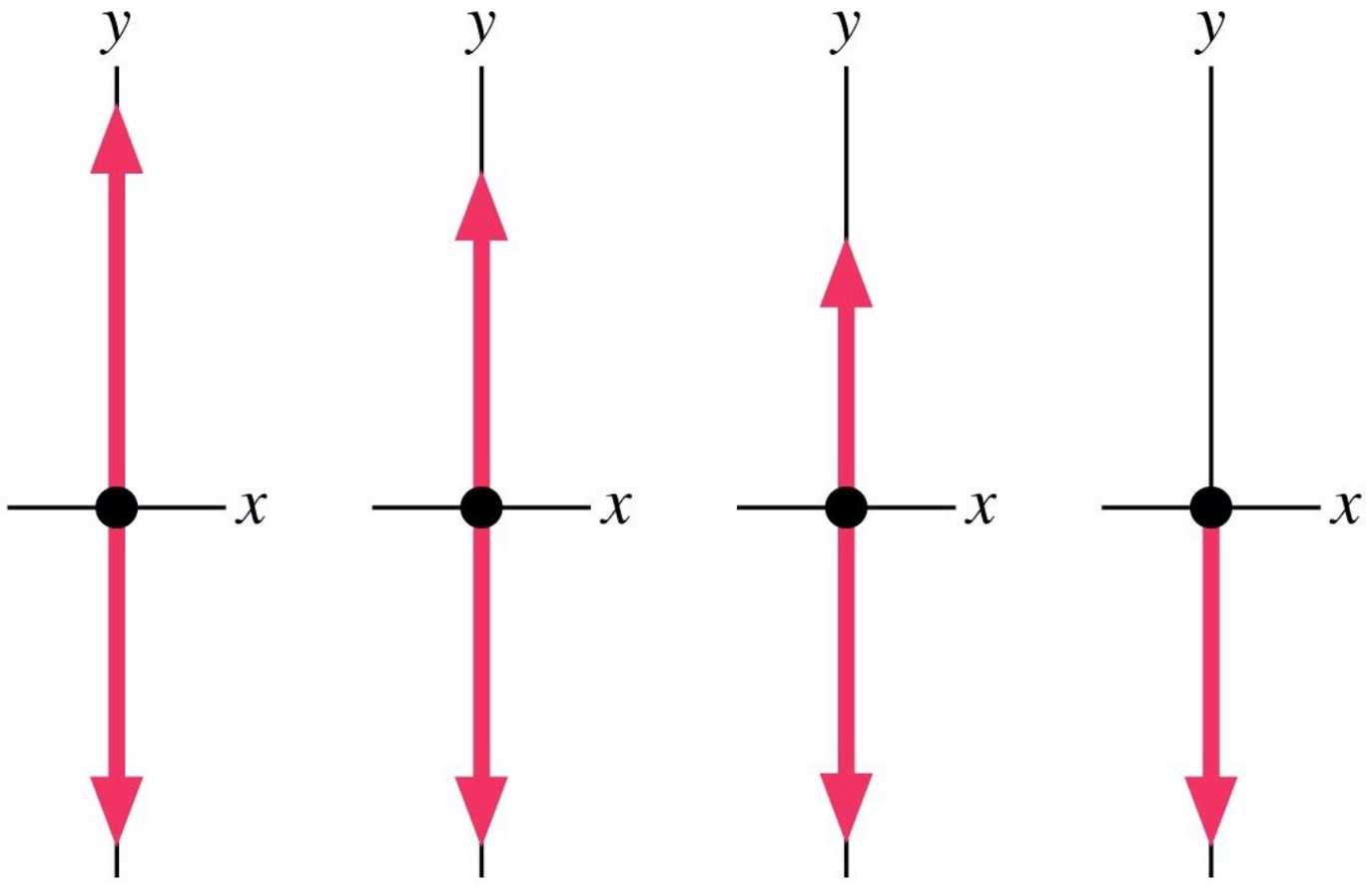
An elevator, lifted by a cable, is moving upward and slowing. Which is the correct free-body diagram?



C B E A

Question #8

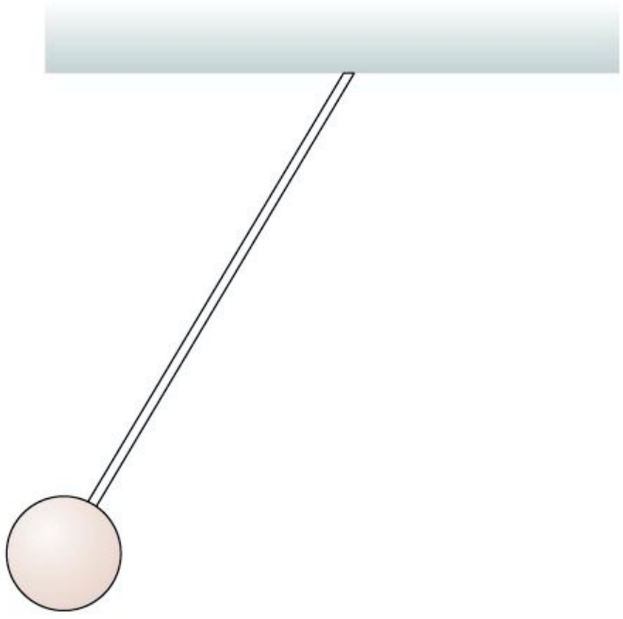
A ball has been tossed straight up. Which is the correct free-body diagram just after the ball has left the hand? Ignore air resistance.

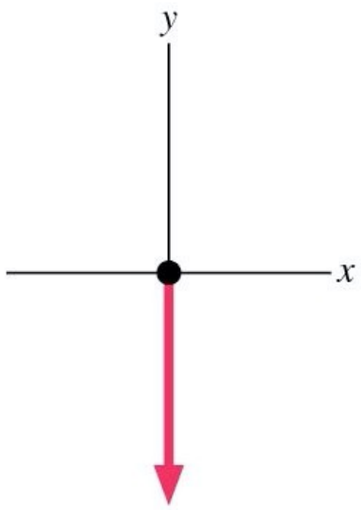


A B C D

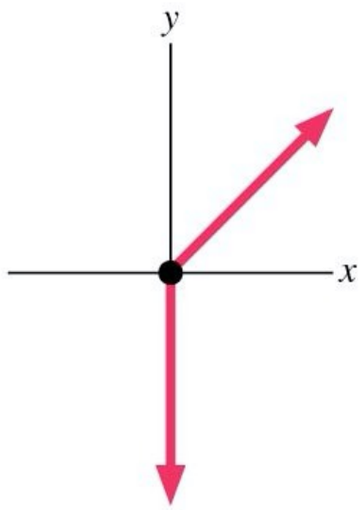
Question #9

A ball, hanging from the ceiling by a string, is pulled back and released. Which is the correct free-body diagram just after its release?

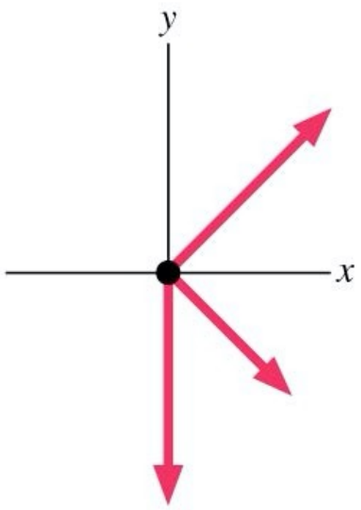




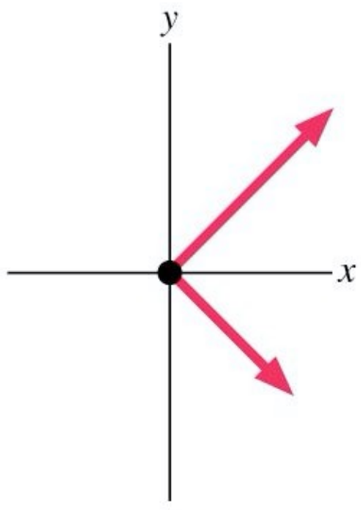
B



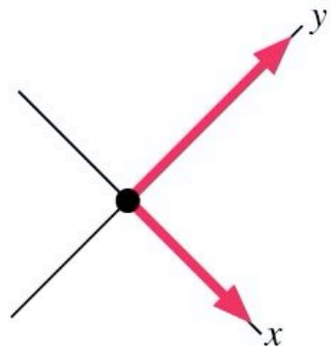
C



D



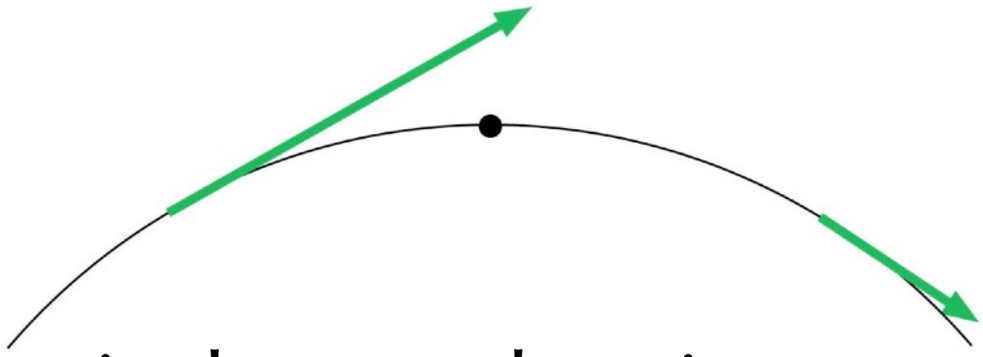
A



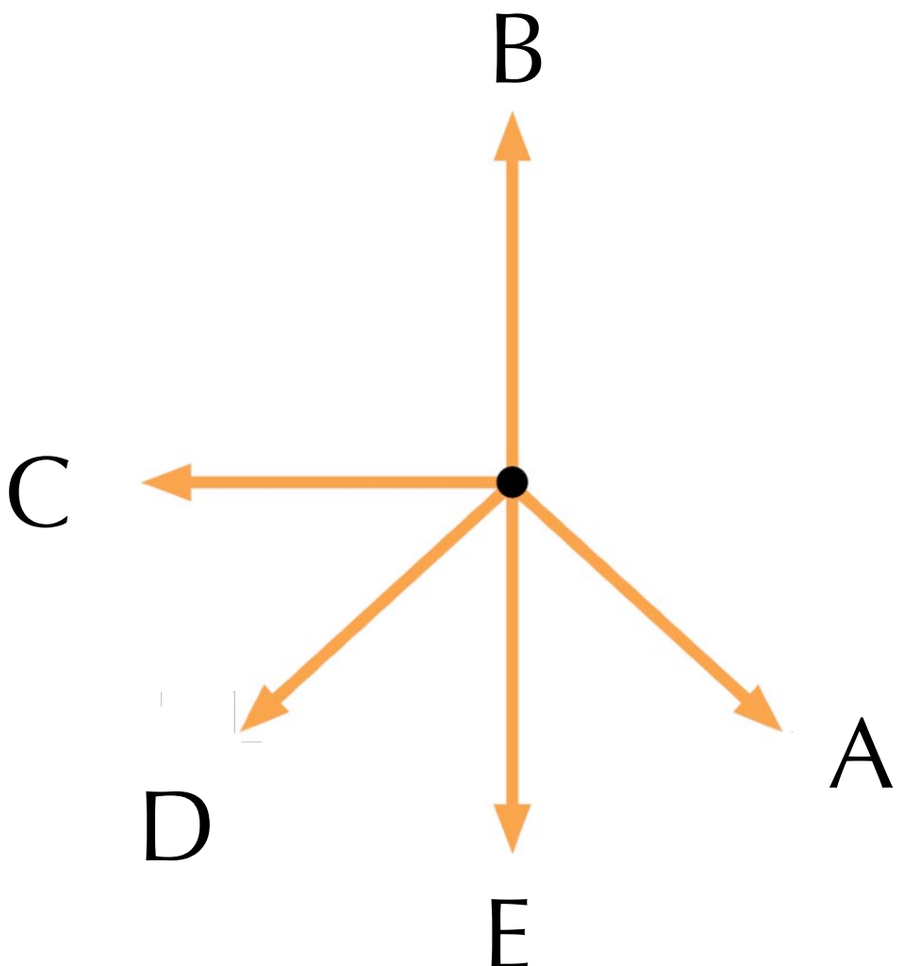
E

Question #4

A car is slowing down as it drives over a circular hill.



Which of these is the acceleration vector at the highest point?



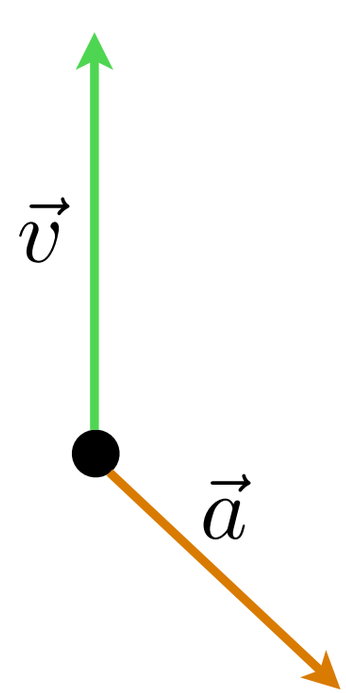
Question #5

At this instant, is the object in the figure speeding up, slowing down, or traveling at constant speed.

a) slowing down

b) speeding up

c) constant speed



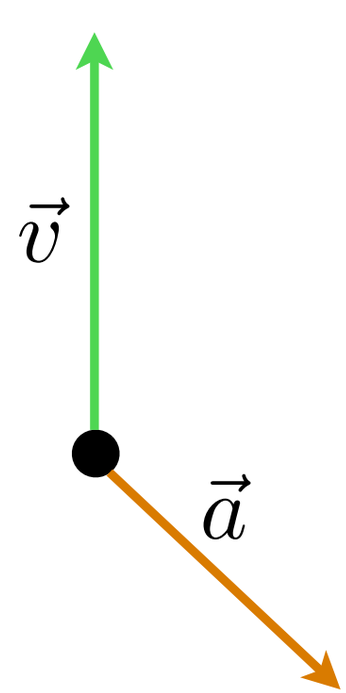
Question #6

At this instant, is the object in the figure curving to the left, curving to the right, or driving straight?

a) curving left

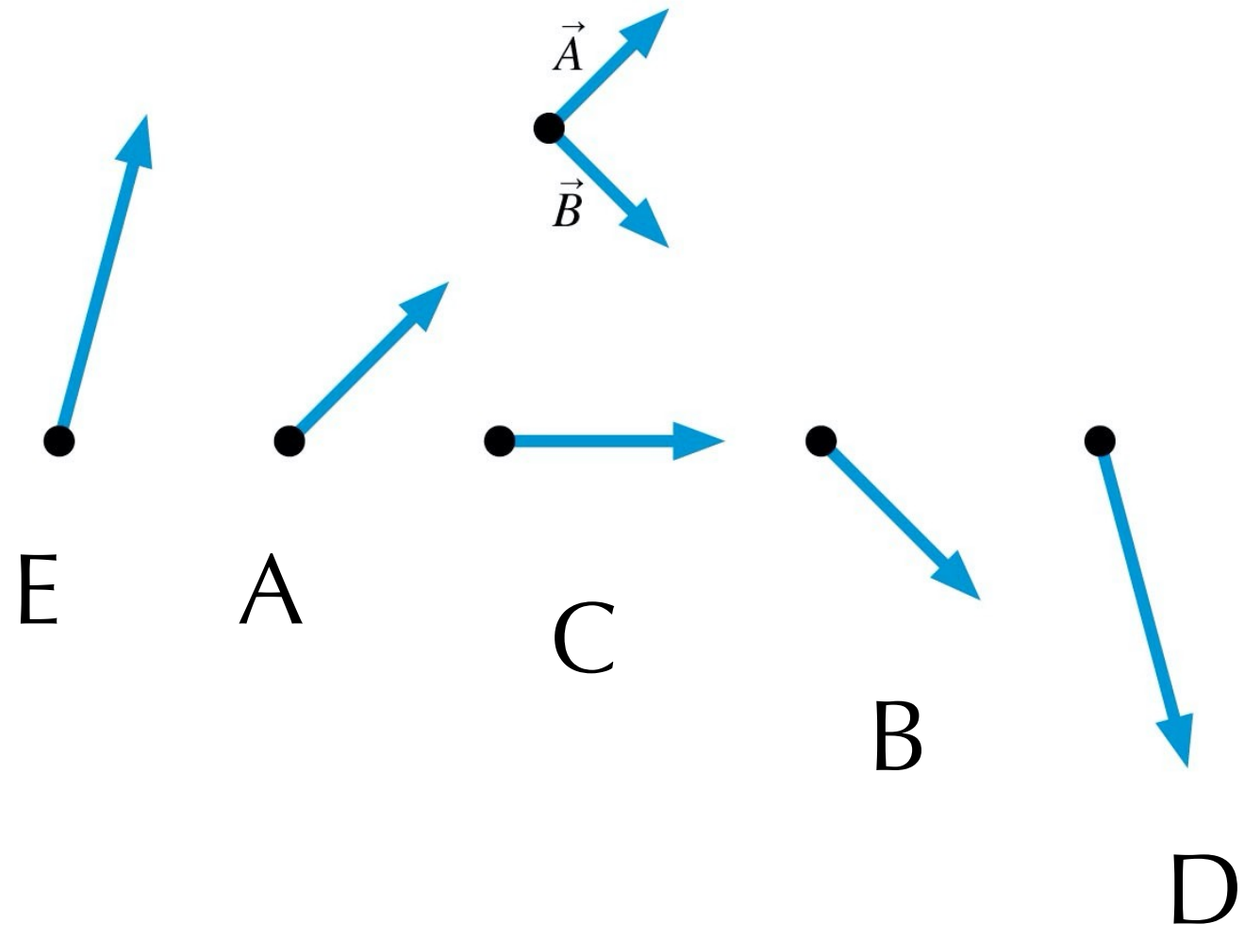
b) curving right

c) driving straight



Question #20

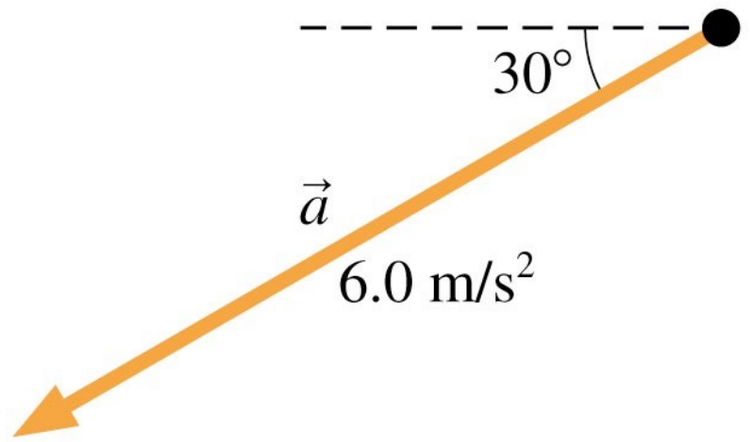
Which vector represents $2\vec{A} - \vec{B}$



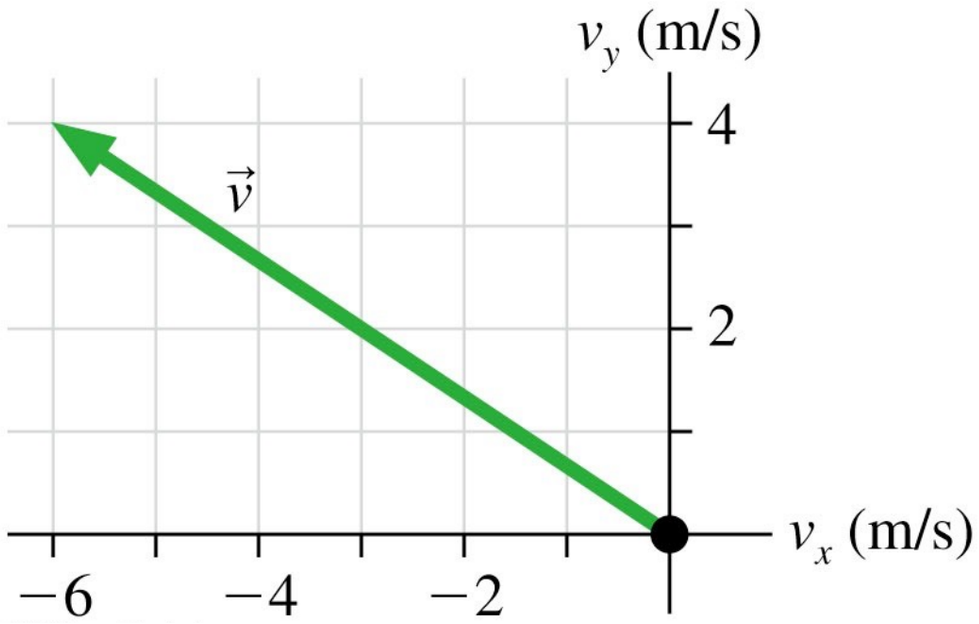
Question #24

Find the x- and y- components of the acceleration vector shown below.

a) (5.2,3) m/s^2
b) (-5.2,-3) m/s^2
c) (-3,-5.2) m/s^2
d) (-0.9,-5.9) m/s^2
e) (-5.9,-0.9) m/s^2



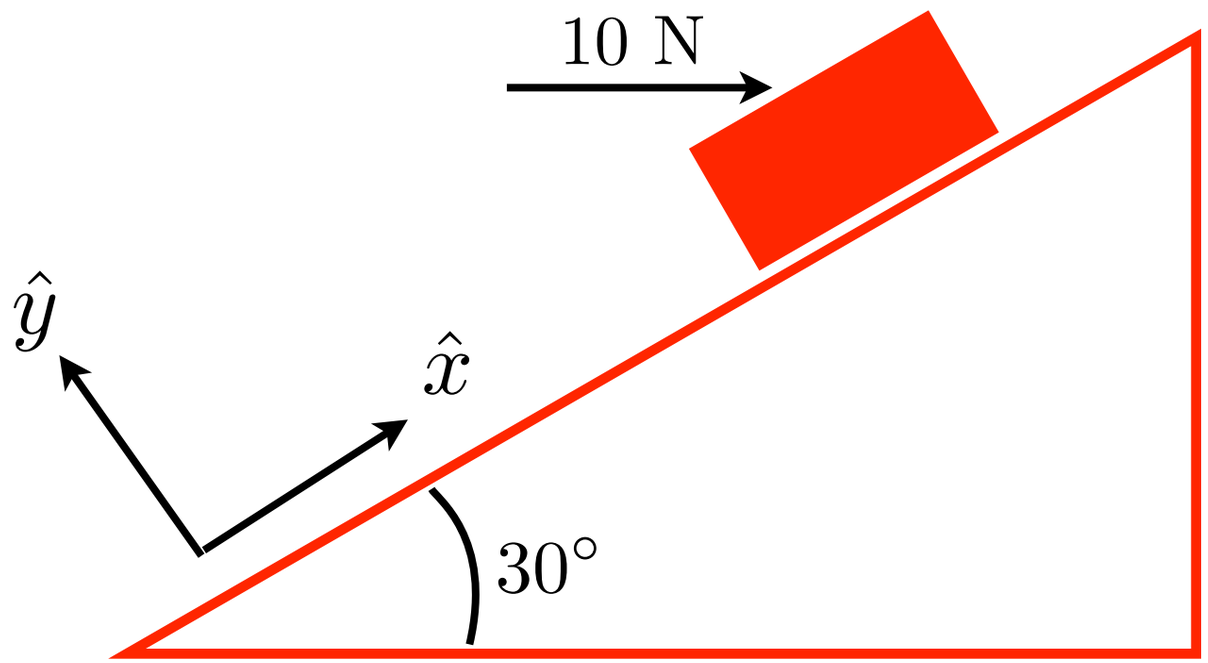
The figure below shows a car's velocity vector. Determine the car's speed and direction of motion.



Question #25

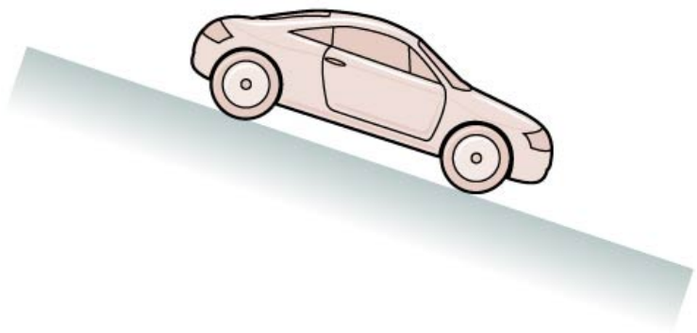
You apply a horizontal force of 10 N to a box on an incline. What are the components of the force perpendicular and parallel to the incline?

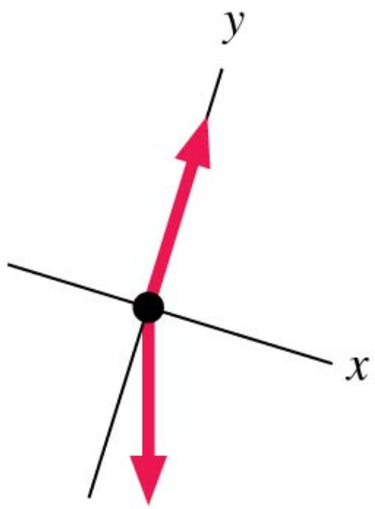
a) (8.7,-5) N
b) (5,8.7) N
c) (1.5,-9.8) N
d) (-8.7,-5) N
e) (-5,-8.7) N



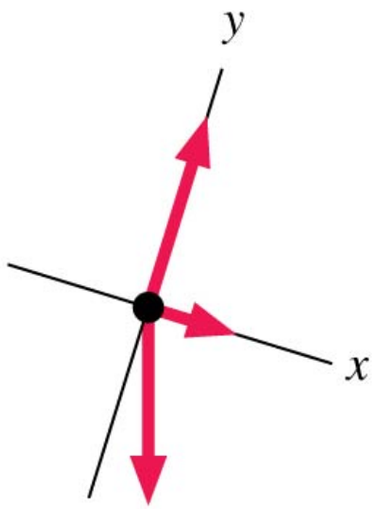
Question #21

A car is parked on a hill.
Which is the correct free-body diagram?

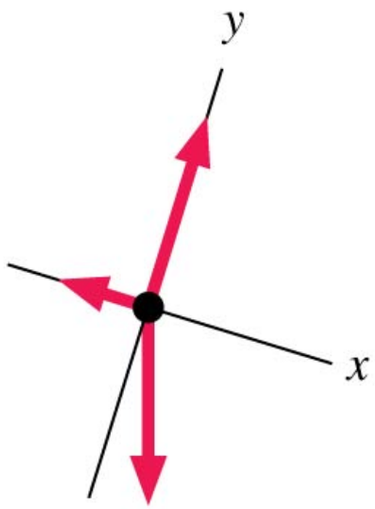




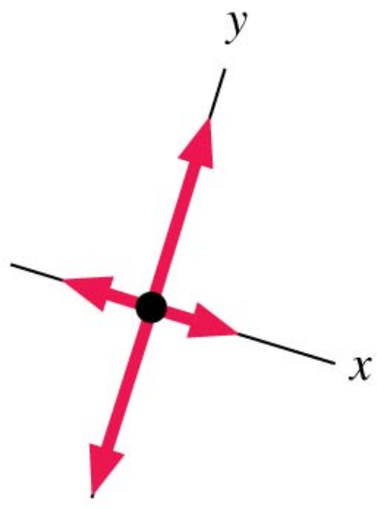
E



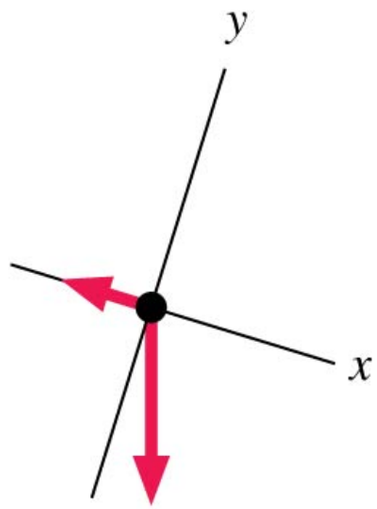
C



B



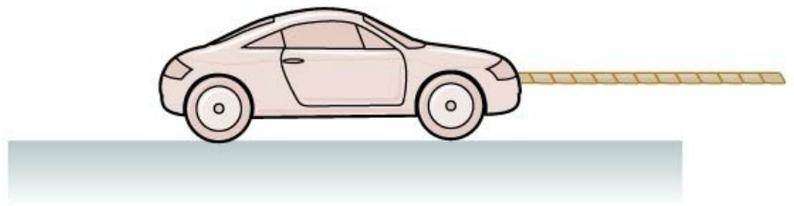
D

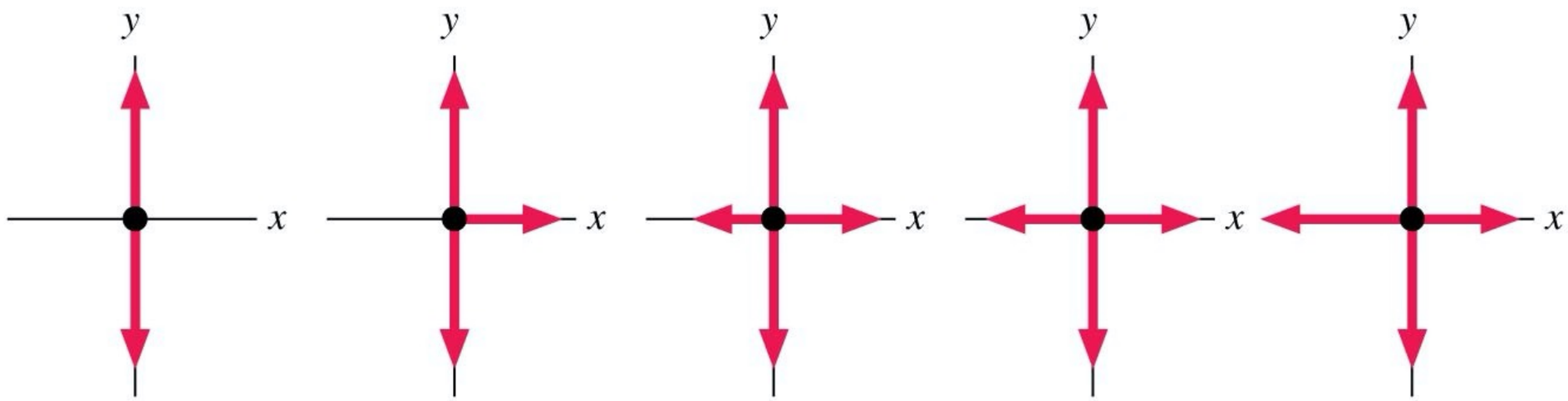


A

Question #22

A car is towed to the right at constant speed. Which is the correct free-body diagram?

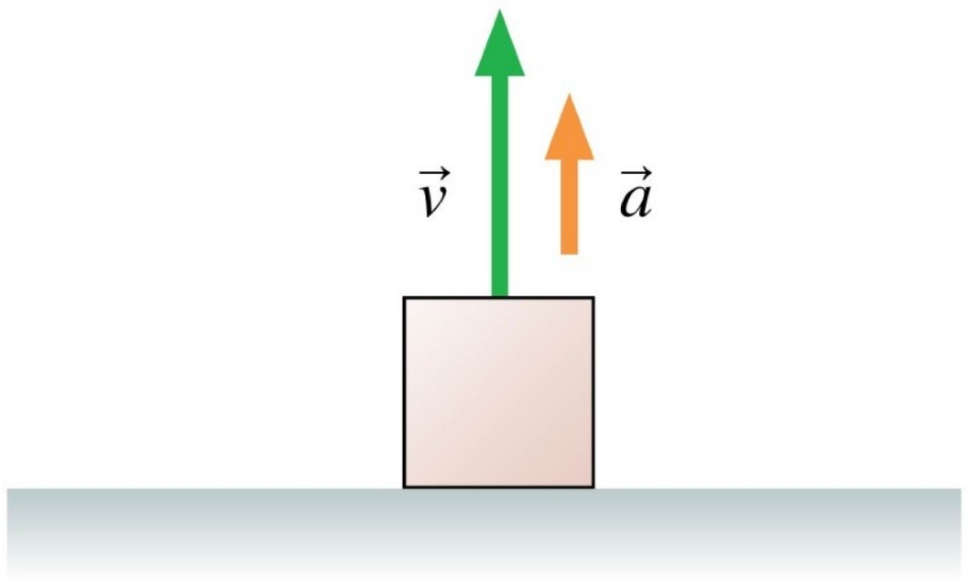




E C B D A

Question #23

The box is sitting on the floor of an elevator. The elevator is accelerating upward. The magnitude of the normal force on the box is



a. $n = 0$.

b. $n = F_g$.

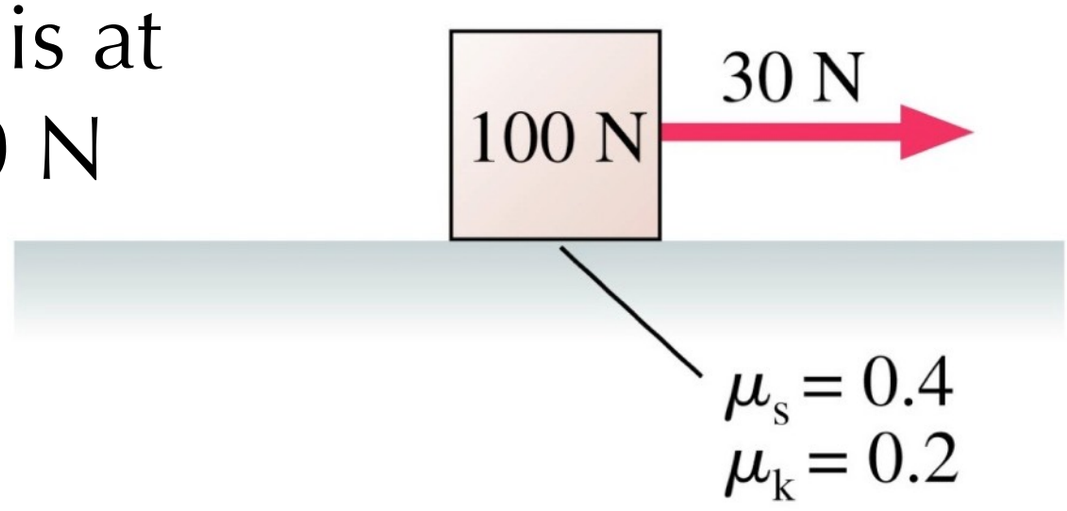
c. $n < F_g$.

d. Not enough information to tell.

e. $n > F_g$.

Question #10

A box with a weight of 100 N is at rest. It is then pulled by a 30 N horizontal force.



Does the box move?

D Yes
E No
B Not enough information to say.

Question #4

A mosquito runs head-on into a truck. Splat! Which is true during the collision?

A. The mosquito exerts more force on the truck than the truck exerts on the mosquito.
B. The truck exerts a force on the mosquito but the mosquito does not exert a force on the truck.
C. The truck exerts more force on the mosquito than the mosquito exerts on the truck.
D. The mosquito exerts the same force on the truck as the truck exerts on the mosquito.
E. The mosquito exerts a force on the truck but the truck does not exert a force on the mosquito.

Question #8

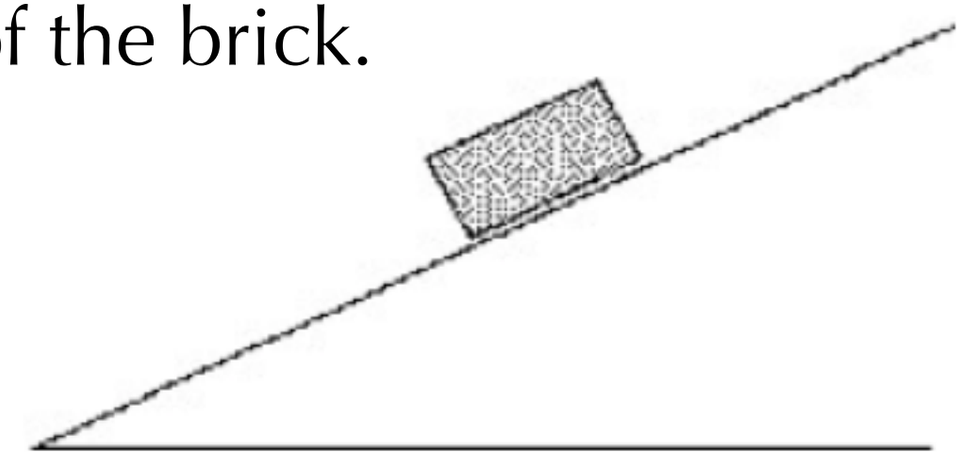
A mosquito runs head-on into a truck. Which is true during the collision?

A. The truck accelerates but the mosquito does not.
B. The magnitude of the mosquito's acceleration is larger than that of the truck.
C. The magnitude of the mosquito's acceleration is the same as that of the truck.
D. The magnitude of the truck's acceleration is larger than that of the mosquito.
E. The mosquito accelerates but the truck does not.

Question #11

A brick is resting on a rough incline as shown in the figure, the friction force acting on the brick is?

a) equal to the weight (mg) of the brick.
b) greater than the weight of the brick.
c) zero
d) less than the weight of the brick.



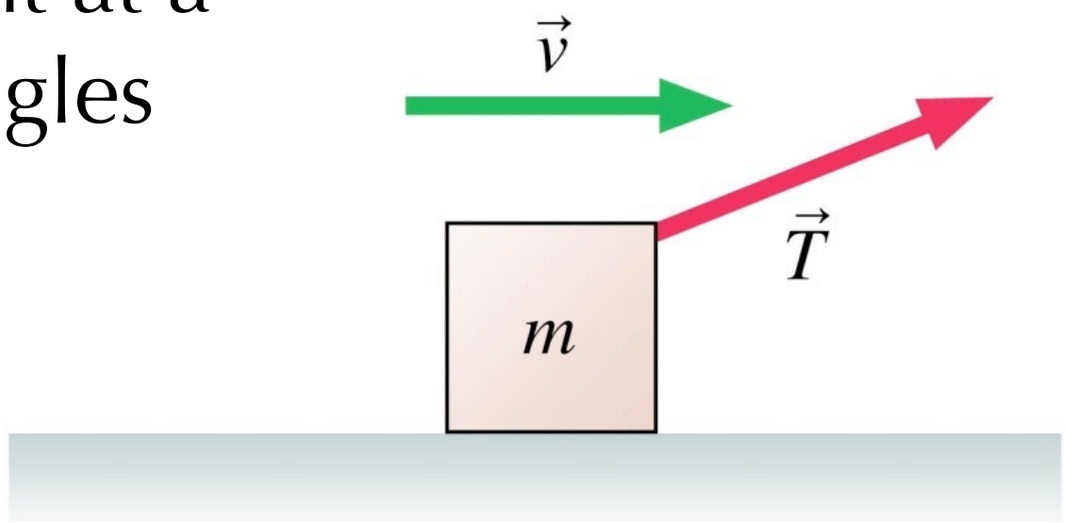
Question #12

A packing crate rests on a horizontal surface. It is acted on by three forces: 600 N to the left, 200 N to the right, and friction. If the 600 N force is removed, the new net force on the crate is?

a) 400 N to the left
b) 200 N to the left
c) 200 N to the right
d) zero

Question #14

A box is being pulled to the right at a steady speed by a rope that angles upward. In this situation:



a) $N > mg$

b) $N = mg$

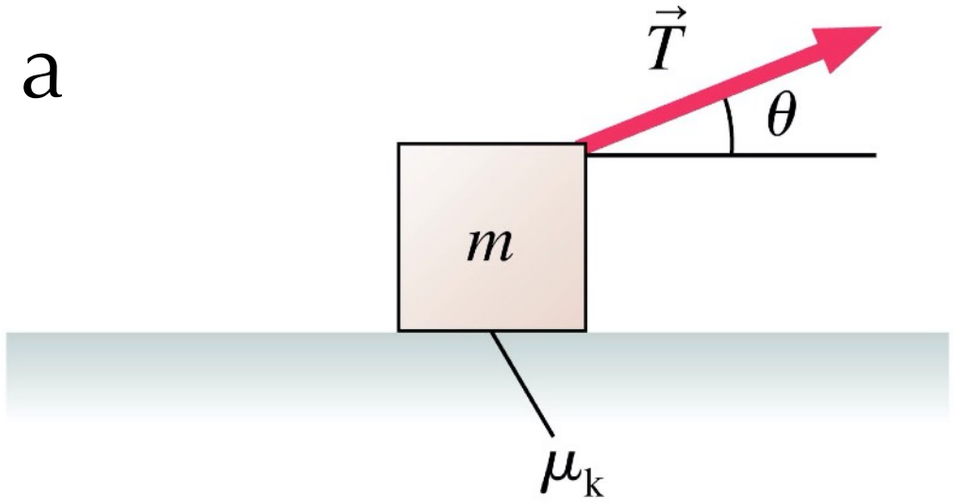
c) Not enough information to judge the size of the normal force

d) $N = 0$

e) $N < mg$

Question #15

A box is being pulled to the right by a rope that angles upward. It is accelerating. Its acceleration is:



a) $\dfrac{T}{m} - \mu_k g$

b) $\dfrac{T}{m}(\cos\theta - \mu_k \sin\theta) - \mu_k g$

c) $\dfrac{T}{m}(\sin\theta + \mu_k \cos\theta) - \mu_k g$

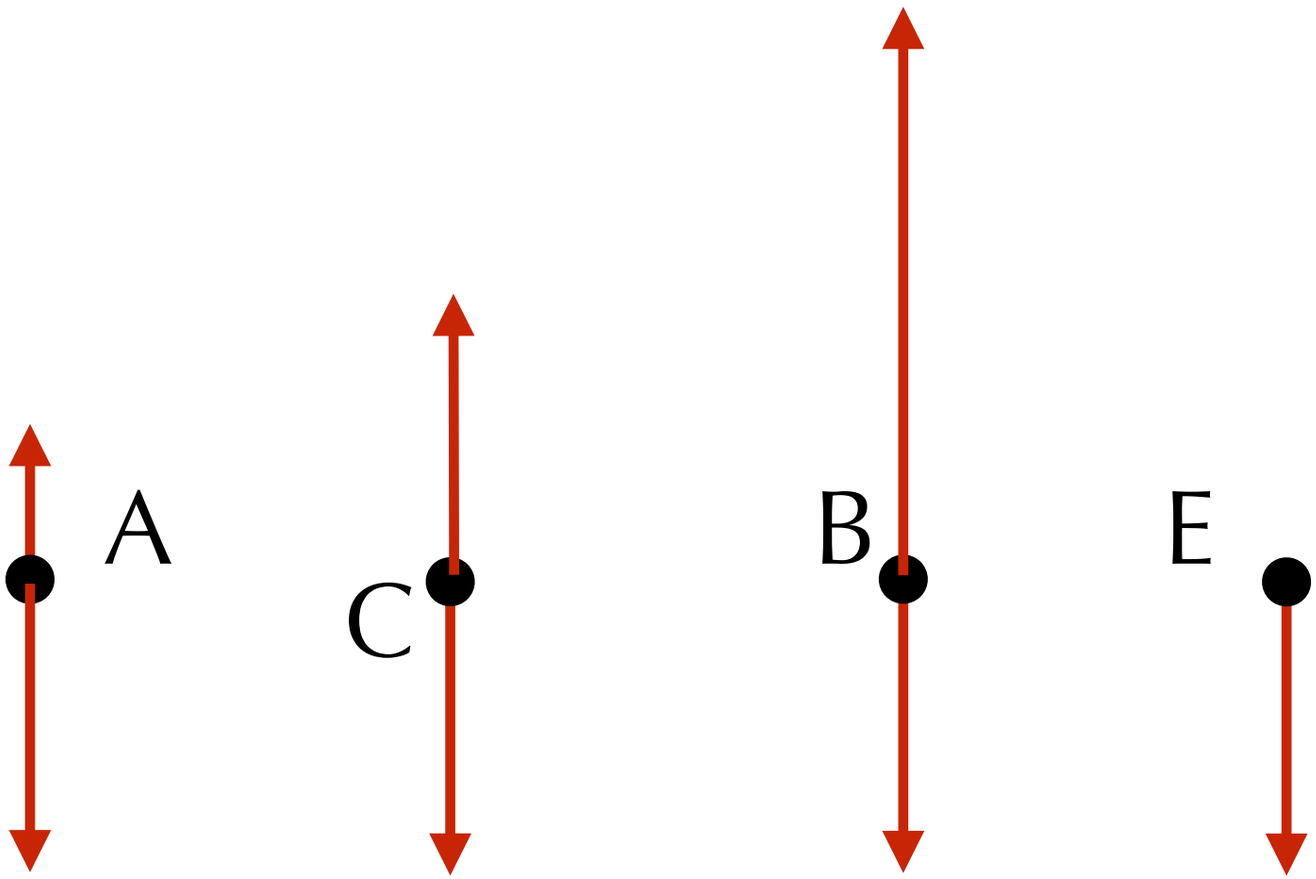
d) $\dfrac{T}{m}(\cos\theta + \mu_k \sin\theta) - \mu_k g$

e) $\dfrac{T}{m}\cos\theta - \mu_k g$

You'll have to work this one out. Don't just guess!

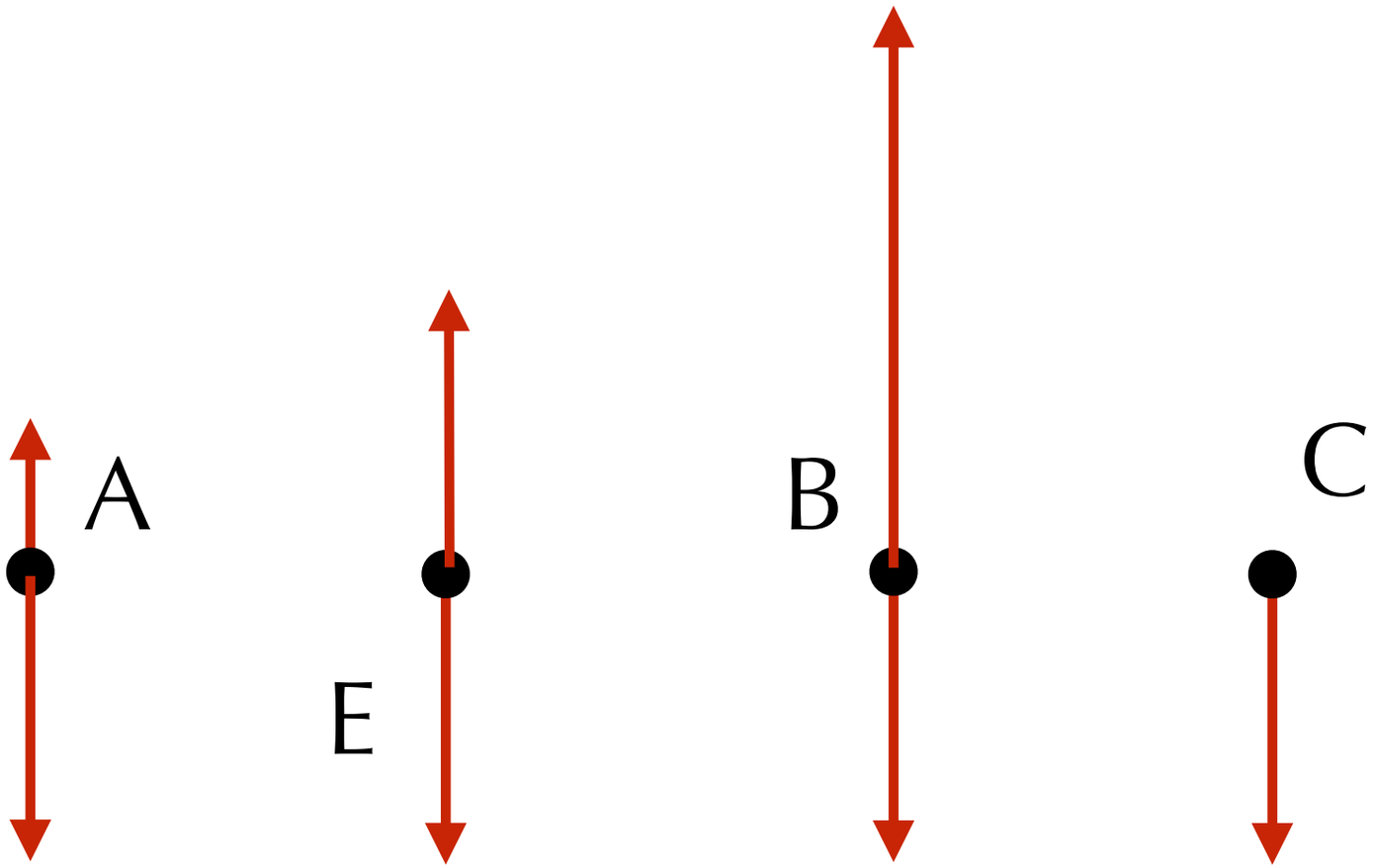
Question #1

Which is the correct free-body diagram for the man **<u>immediately after</u>** jumping out of the plane?



Question #2

Which is the correct free-body diagram for the man a short time after jumping out of the plane?



Question #3

Which is the correct free-body diagram for the man a long time after jumping out of the plane?

A

B

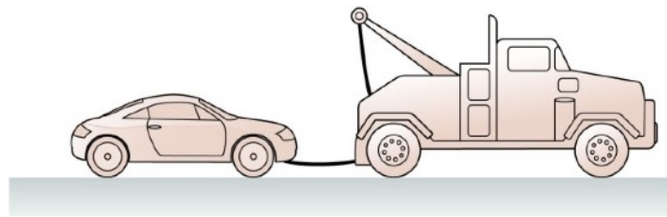
C

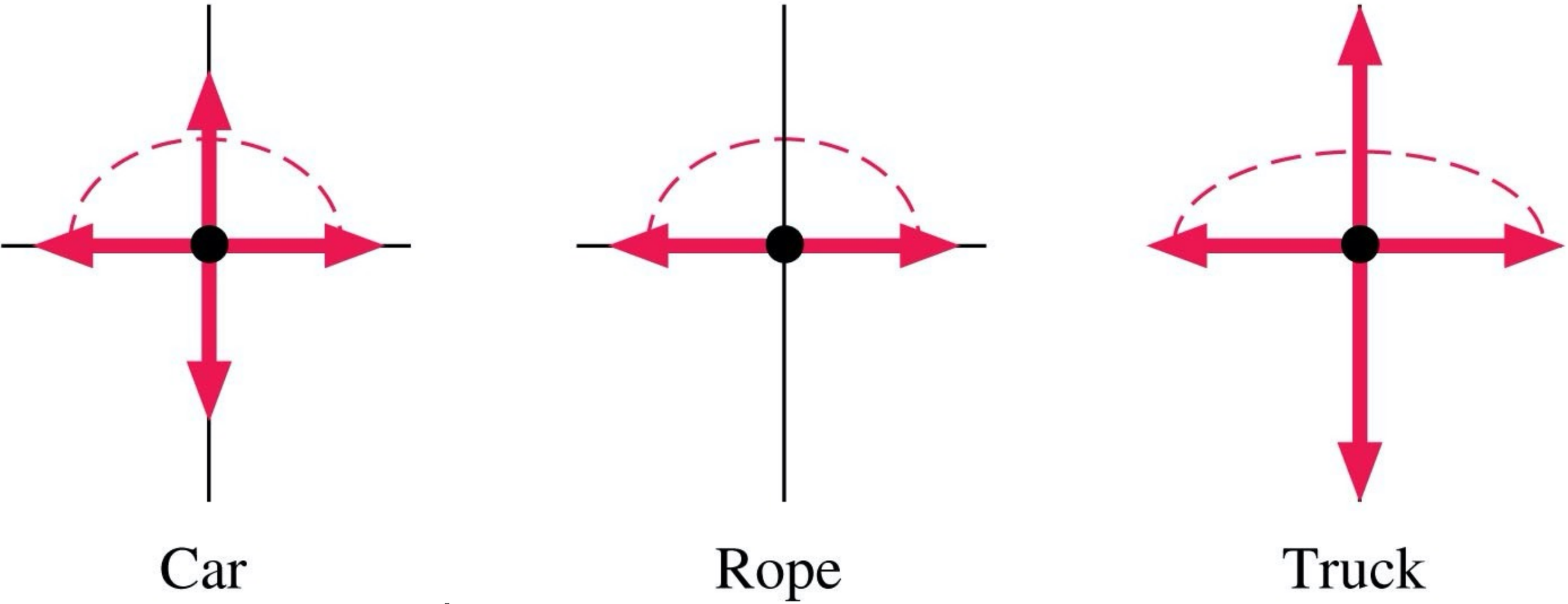
D

$$v_{\text{term}} = \sqrt{\frac{2mg}{C\rho A}}$$

Question #9

What, if anything, is wrong with these free-body diagrams for a truck towing a car <u>at steady speed</u>? The truck is heavier than the car and the rope is massless.

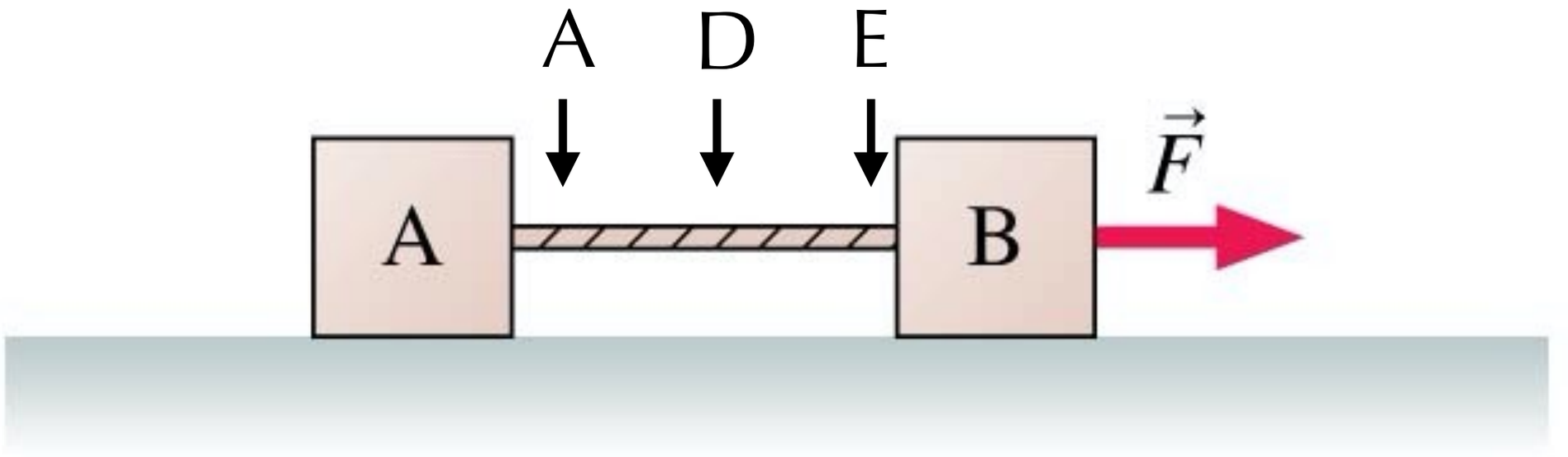




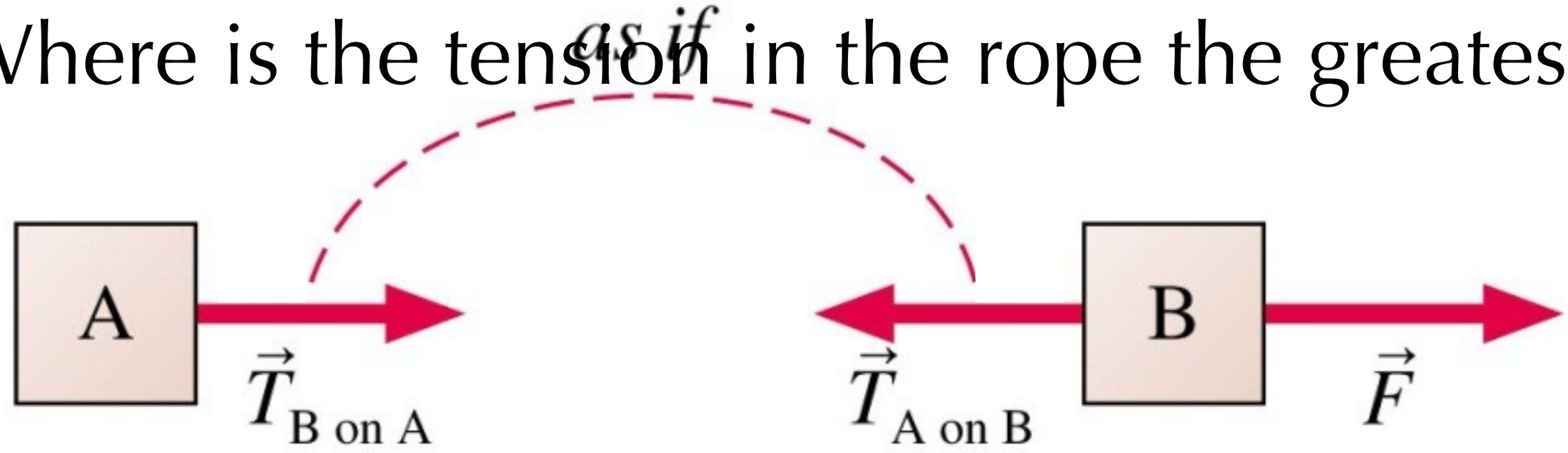
a. Nothing is wrong.
b. One of more forces have the wrong direction.
c. Both D and E.
d. One or more action/reaction pairs are wrong.
e. One or more forces have the wrong length.

The massless string approximation

Question #10



Where is the tension in the rope the greatest?



Question #11

Boxes A and B are being pulled to the right on a frictionless surface. Box A has a larger mass than B. How do the two tension forces compare?

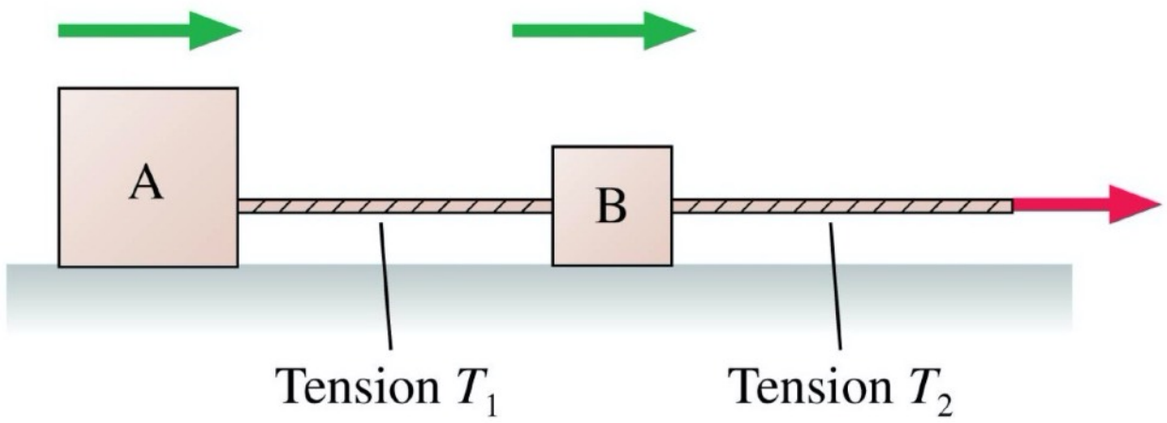
a. $T_1 > T_2$

b. $T_1 = T_2$

c. .

d. $T_1 < T_2$

e. Not enough information to tell.



Question #12

Boxes A and B are sliding to the right on a frictionless surface. Hand H is slowing them. Box A has a larger mass than B. Considering only the *horizontal* forces:

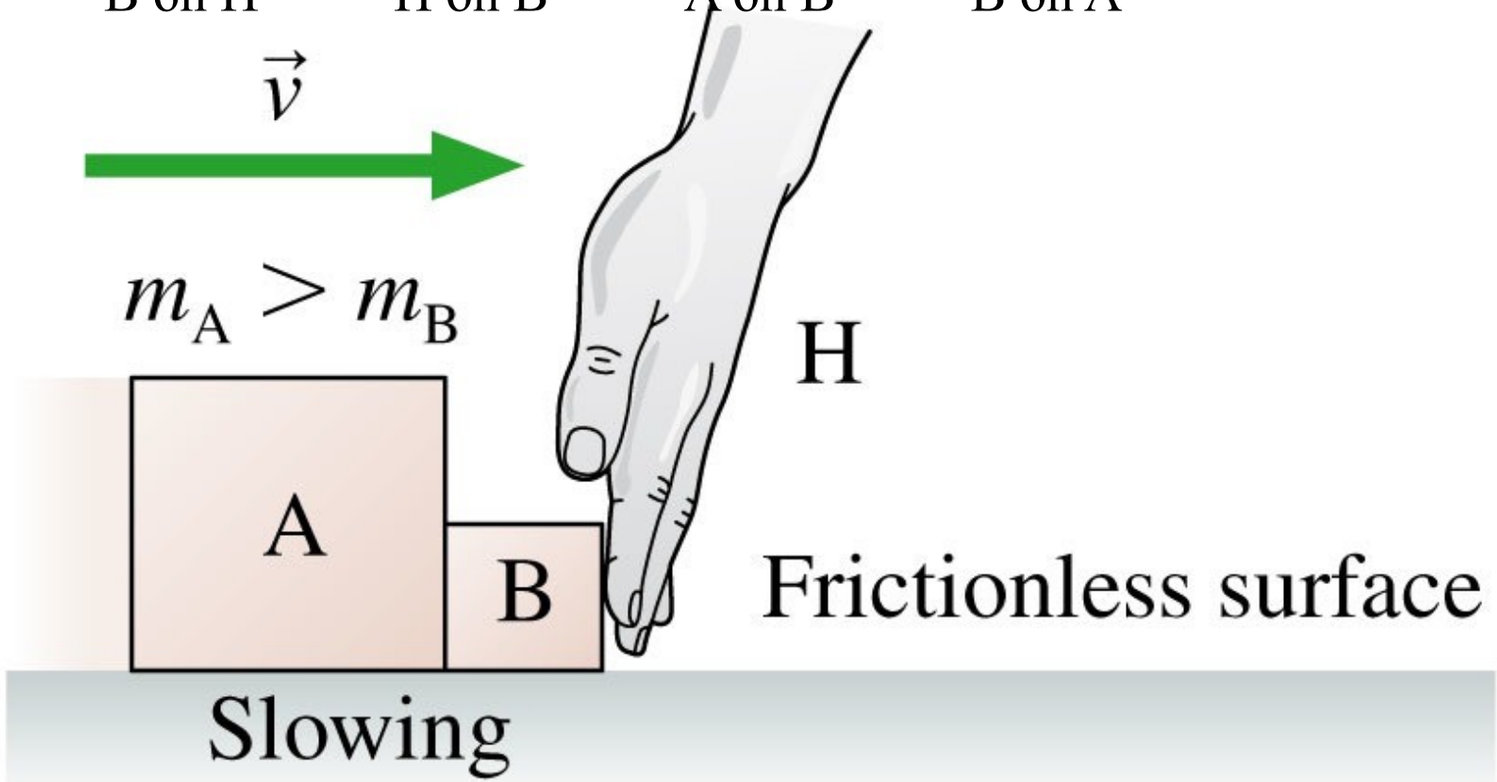
a. $F_{\text{B on H}} = F_{\text{H on B}} = F_{\text{A on B}} = F_{\text{B on A}}$

b. $F_{\text{B on H}} = F_{\text{H on B}} < F_{\text{A on B}} = F_{\text{B on A}}$

c.

d. $F_{\text{H on B}} = F_{\text{H on A}} > F_{\text{A on B}}$

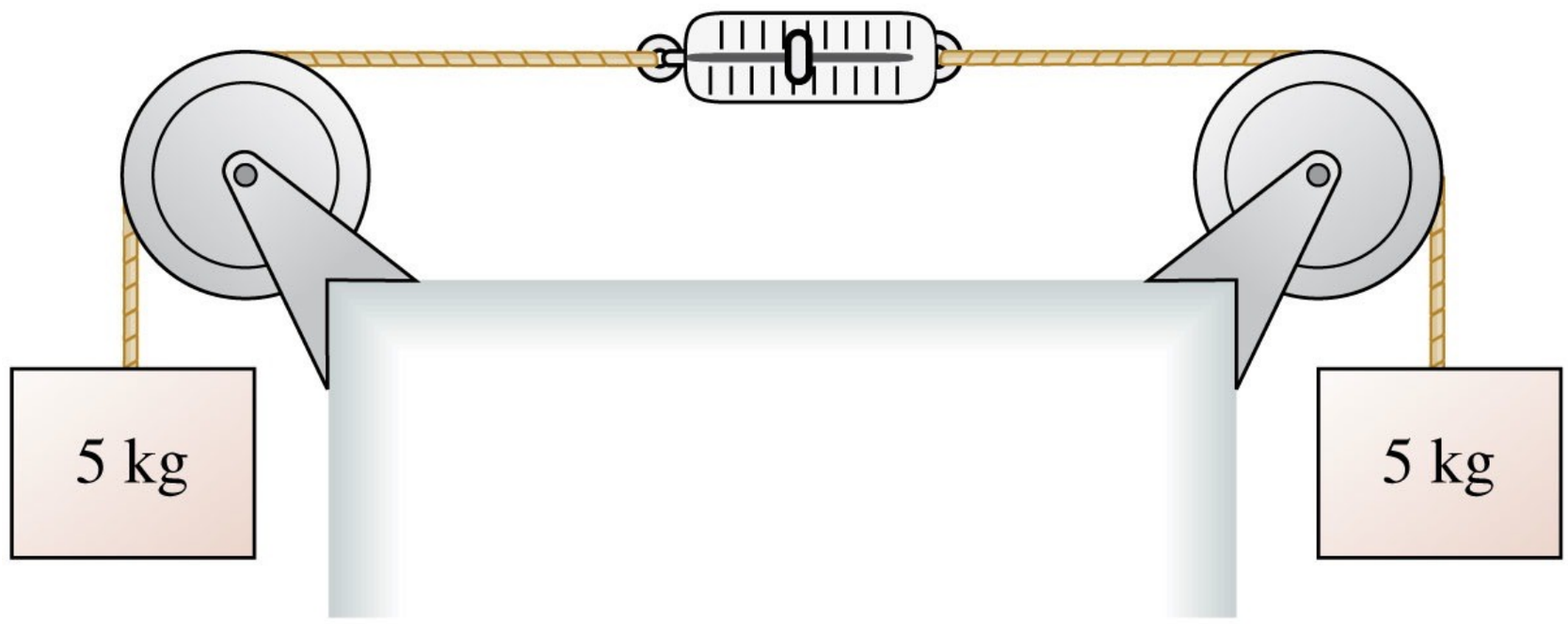
e. $F_{\text{B on H}} = F_{\text{H on B}} > F_{\text{A on B}} = F_{\text{B on A}}$



Question #13

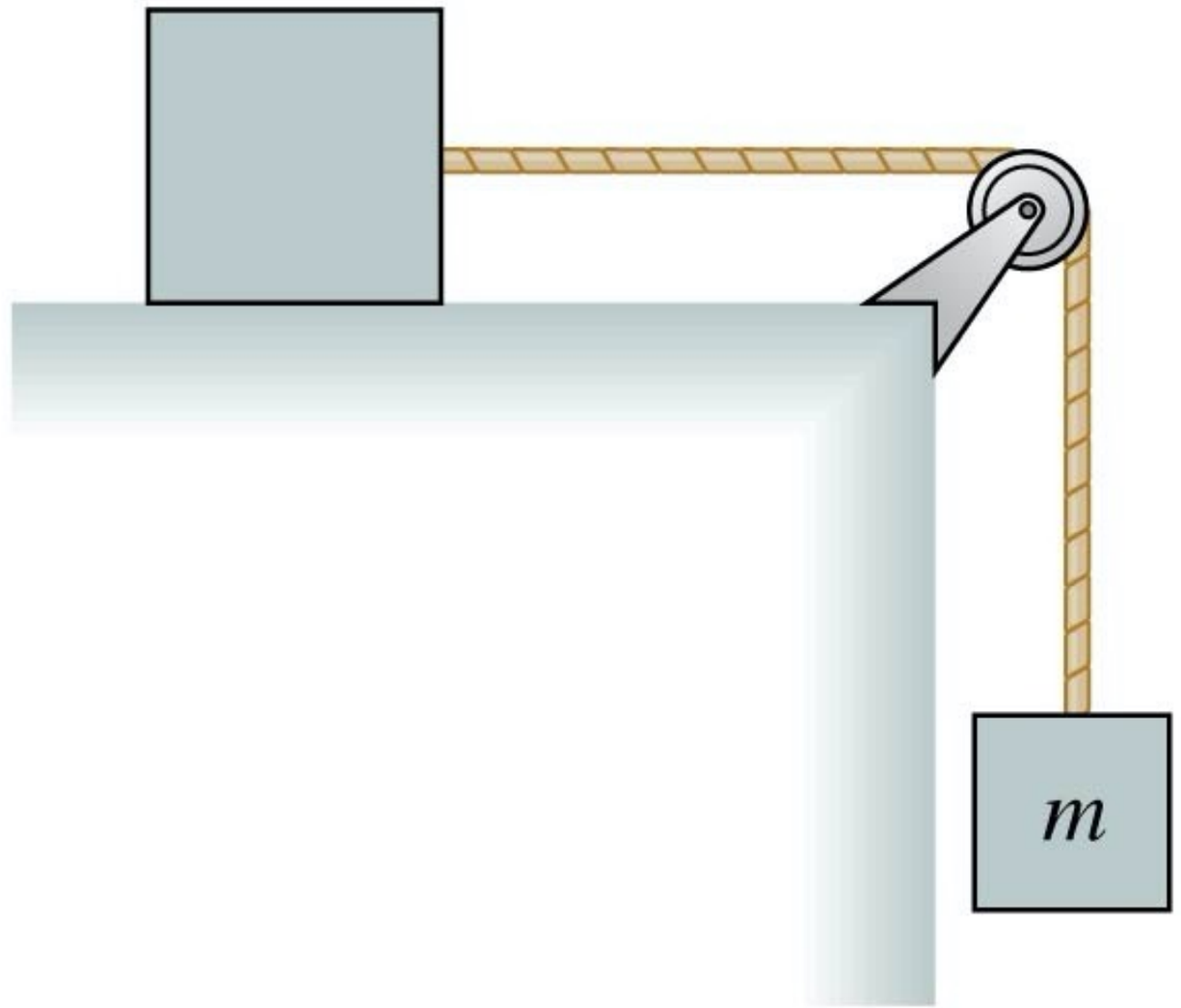
The two masses are at rest. The pulleys are frictionless. The scale is in kg. The scale reads

A. 0 kg.
B. 5 kg.
C. 10 kg.



Question #14

The top block is accelerated across a <u>frictionless</u> table by the falling mass *m*. The string is massless, and the pulley is both massless and frictionless. The tension in the string is



a..

b. $T = mg.$

c. $T > mg.$

d. $T < mg.$

Question #15

Block A is accelerated across a <u>frictionless</u> table. The string is massless, and the pulley is both massless and frictionless. Which is true?

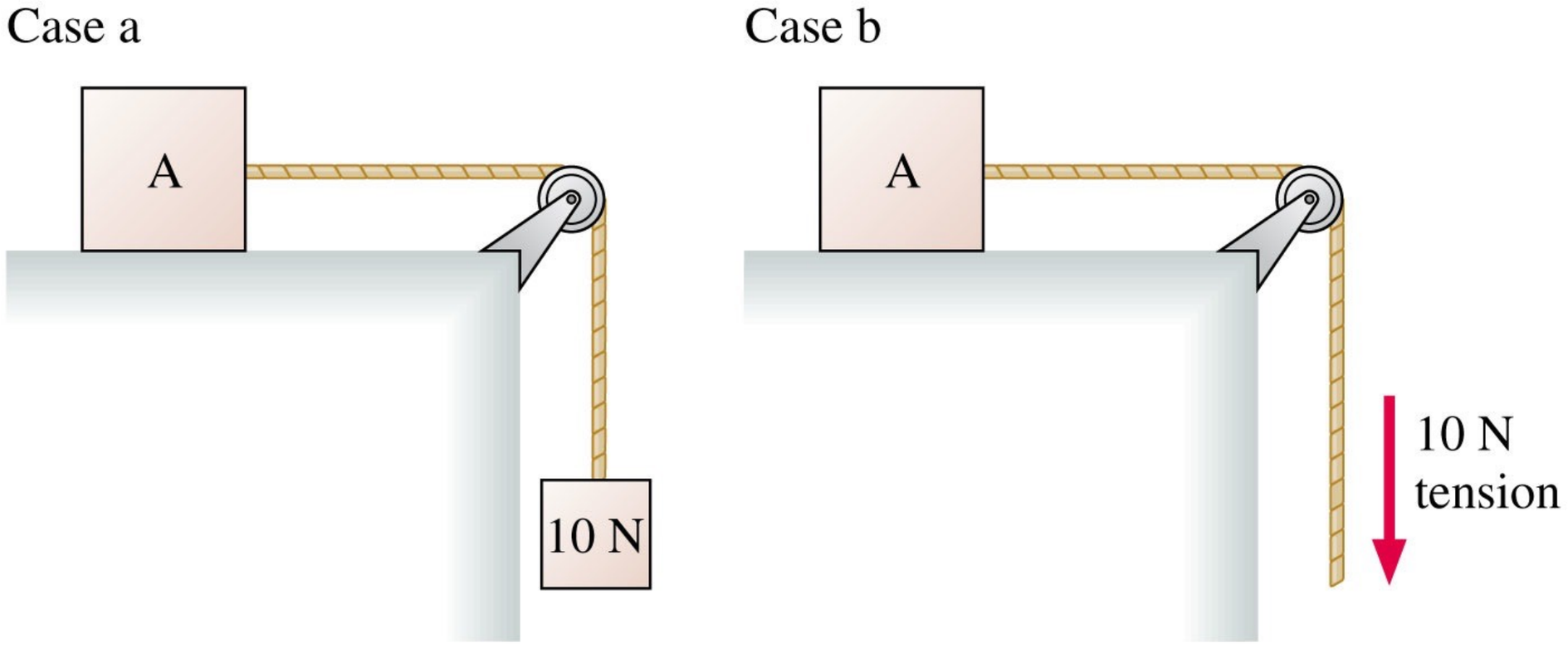
A. .

B. .

C. Block A has the same acceleration in case a and case b.

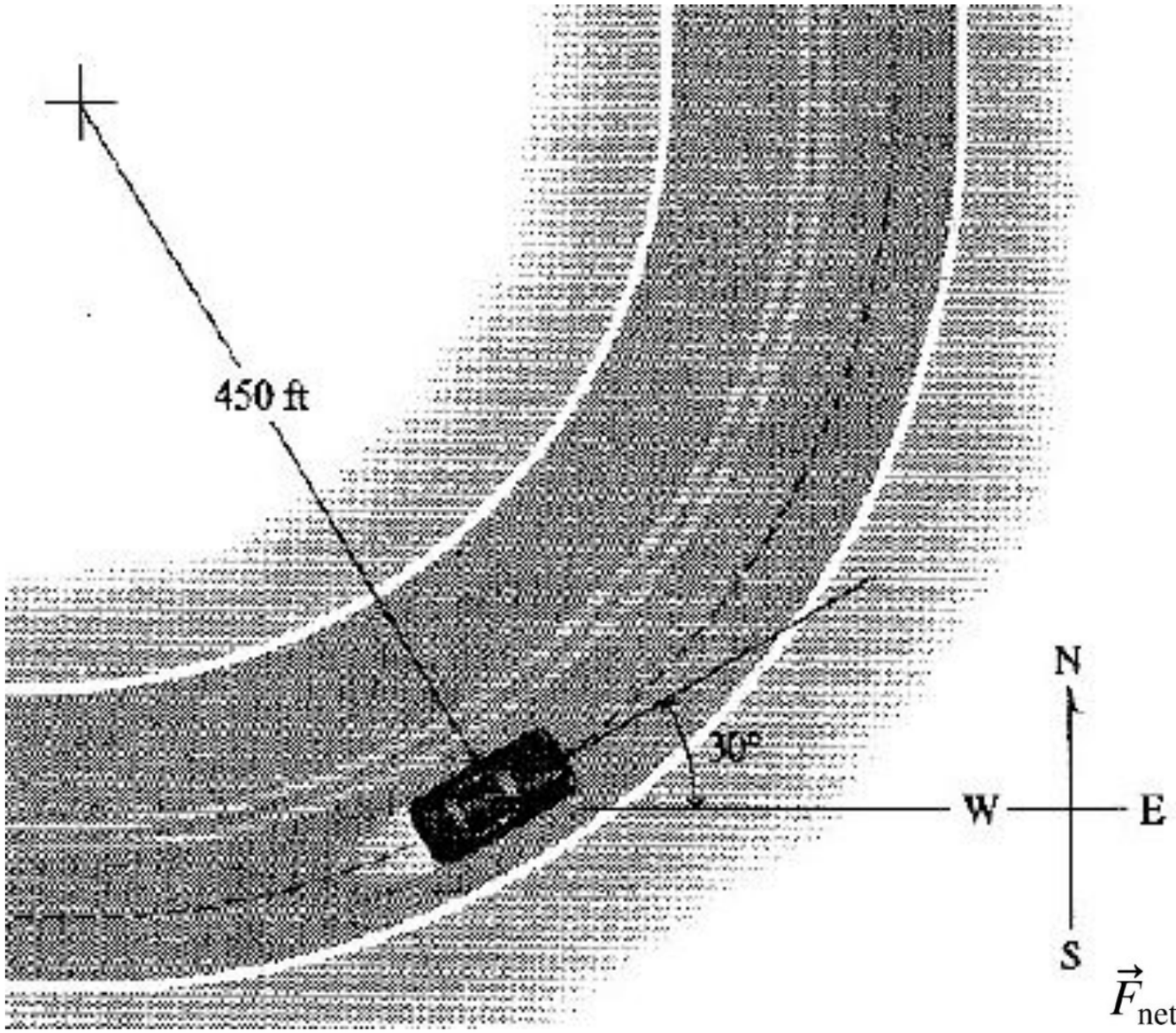
D. Block A accelerates faster in case b than in case a.

E. Block A accelerates faster in case a than in case b.



Question #16

A car travels around a curve at constant speed without sliding. What force is responsible for the acceleration of the car?



a) Tension
b) Normal Force
c) Static Friction
d) Kinetic Friction
e) Thrust

$$\vec{F}_{\text{net}} = m\vec{a} = \left(\frac{mv^2}{r}, \text{ toward center of circle}\right)$$

Question #17

A satellite orbits the earth. What force is responsible for the acceleration of the satellite?

a) Gravity
b) Static Friction
c) Tension
d) Kinetic Friction
e) Thrust

Question #18

A little girl holds tight to the bars on a merry-go-round as it rotates steadily. What force is responsible for the acceleration of the girl?

a) Static Friction between shoes and floor
b) Gravity
c) a) and d)
d) Tension in arms
e) Thrust

Quiz

Question #19

An ice hockey puck is tied by a string to a stake in the ice. The puck is then swung in a circle. What force is producing the centripetal acceleration of the puck?

A. Gravity

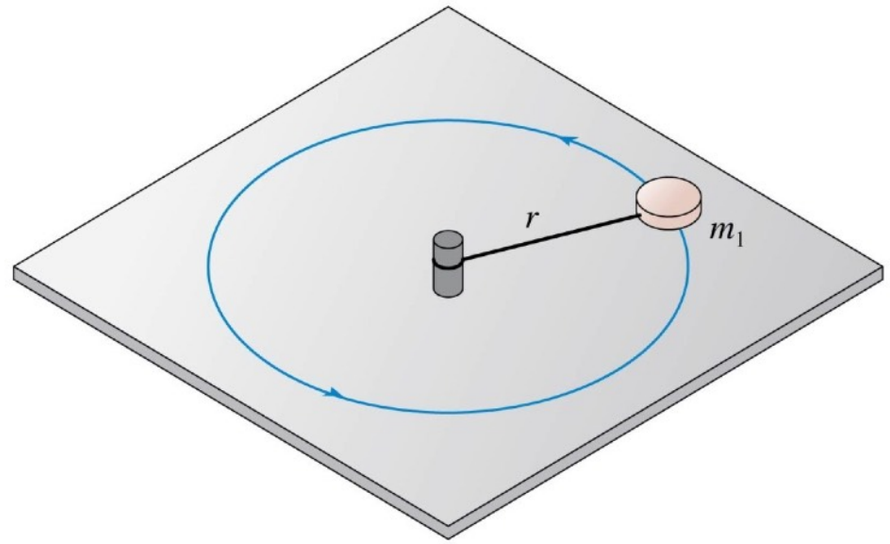
B. Tension in the string

C. Friction

D. Normal force

E. Air resistance

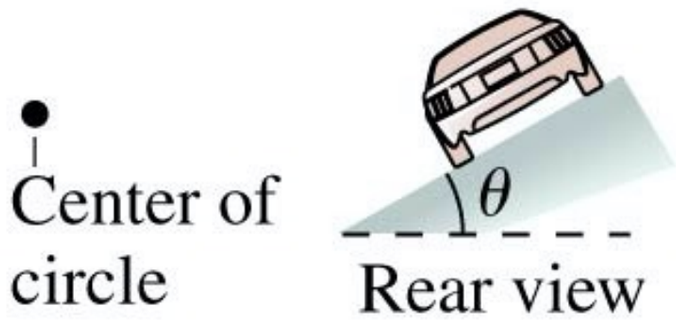
F. A new force: the centrifugal force.

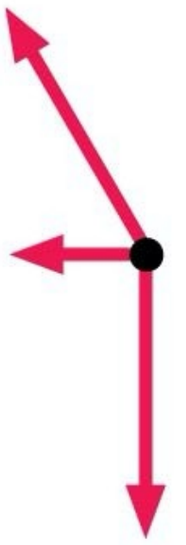


Quiz

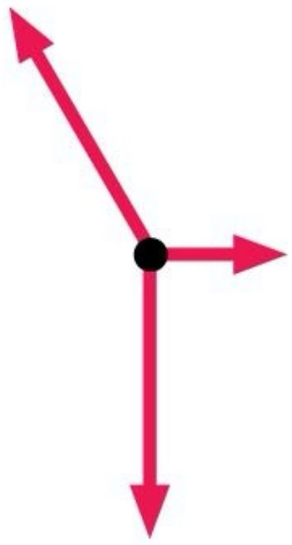
Question #20

A car turns a corner on a banked road. Which of the diagrams could be the car's free-body diagram?

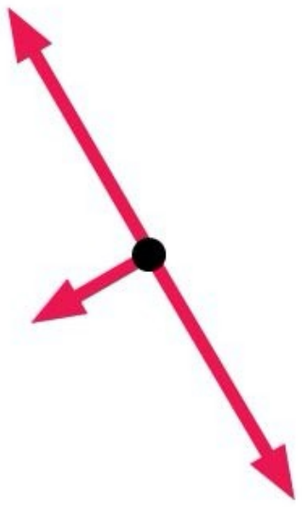




C



B



D

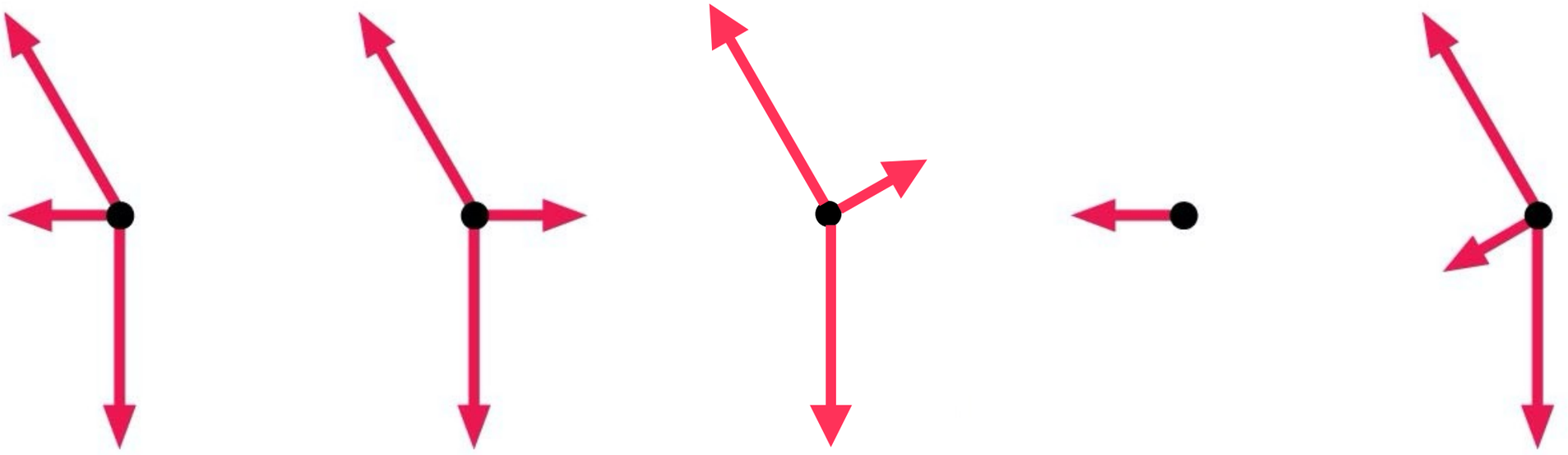
A

E

Banked Curves **Question #21**

If you travel faster than this speed, what must the free-body diagram look like?

$$v_0 = \sqrt{rg \tan\theta}$$

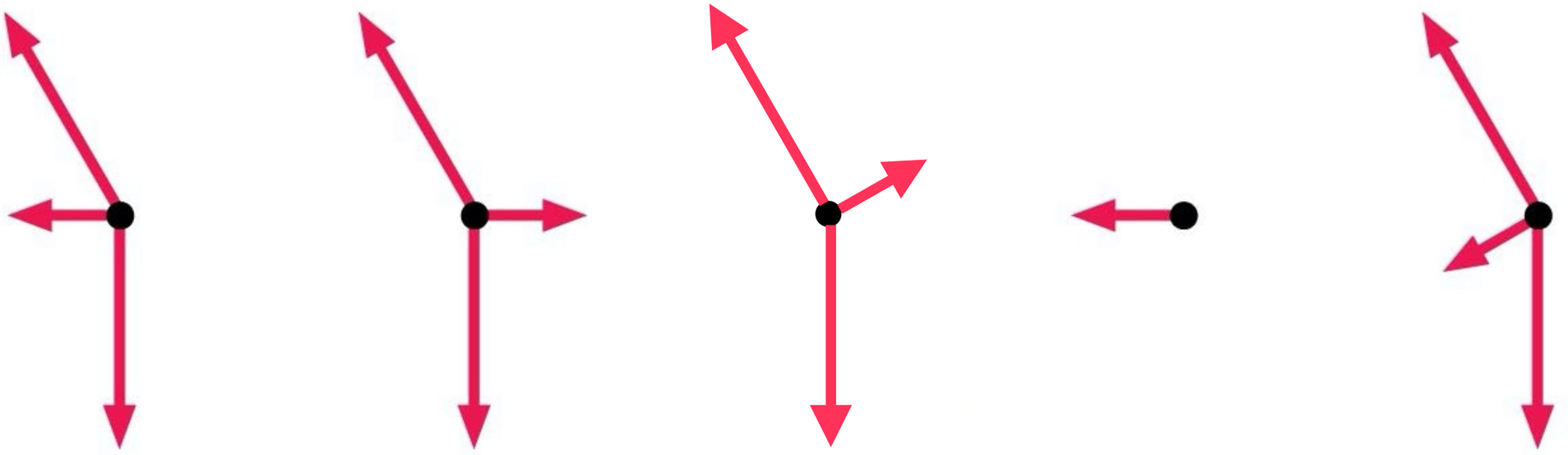


B D E C A

Banked Curves **Question #22**

If you travel slower than this speed, what must the free-body diagram look like?

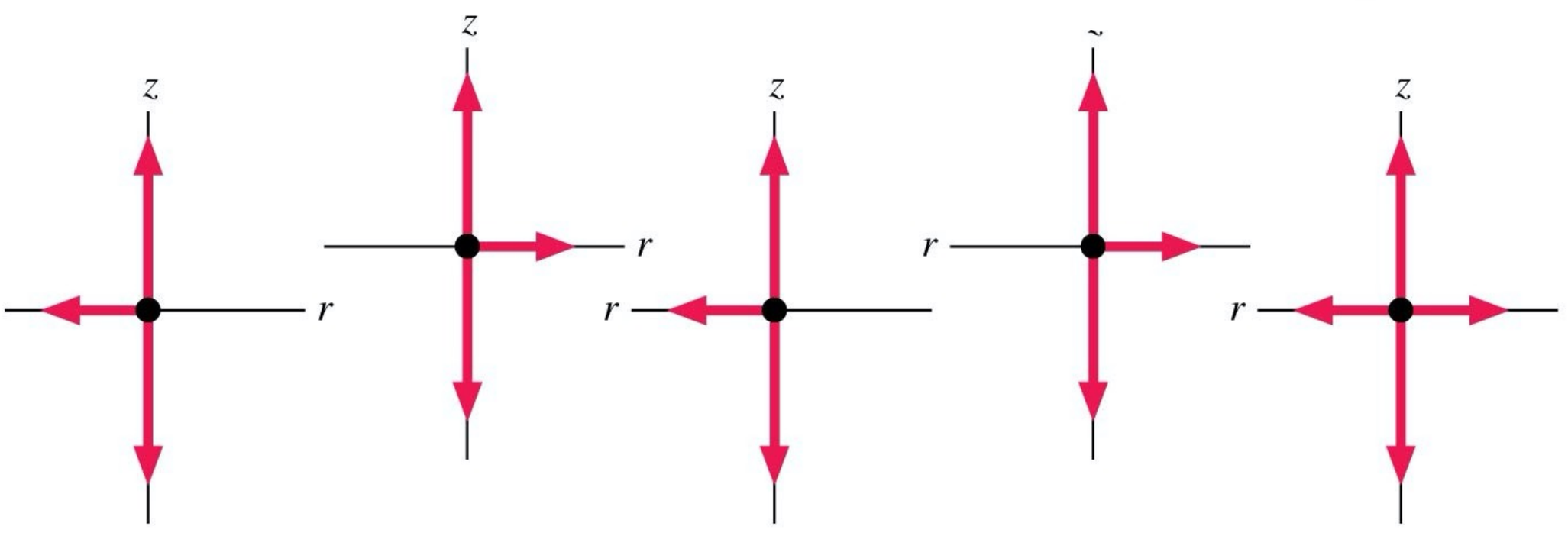
$$v_0 = \sqrt{rg \tan\theta}$$



E B C A D

Question #9

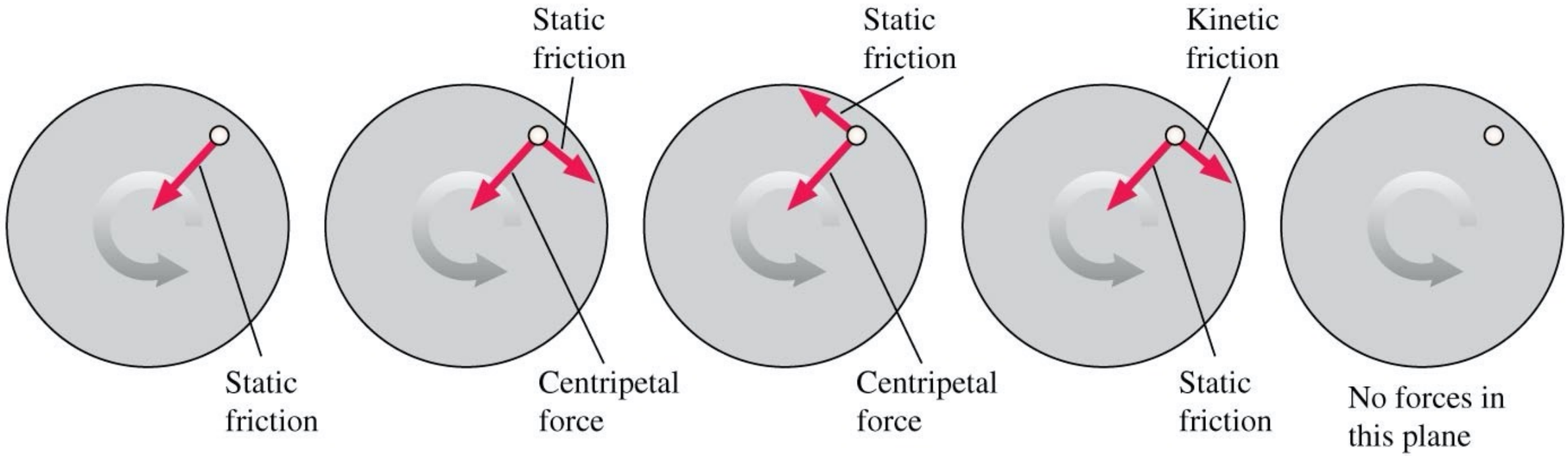
A coin sits on a turntable as the table steadily rotates ccw. The free-body diagrams below show the coin from behind, moving away from you. Which is the correct diagram?



C E A B D

Question #10

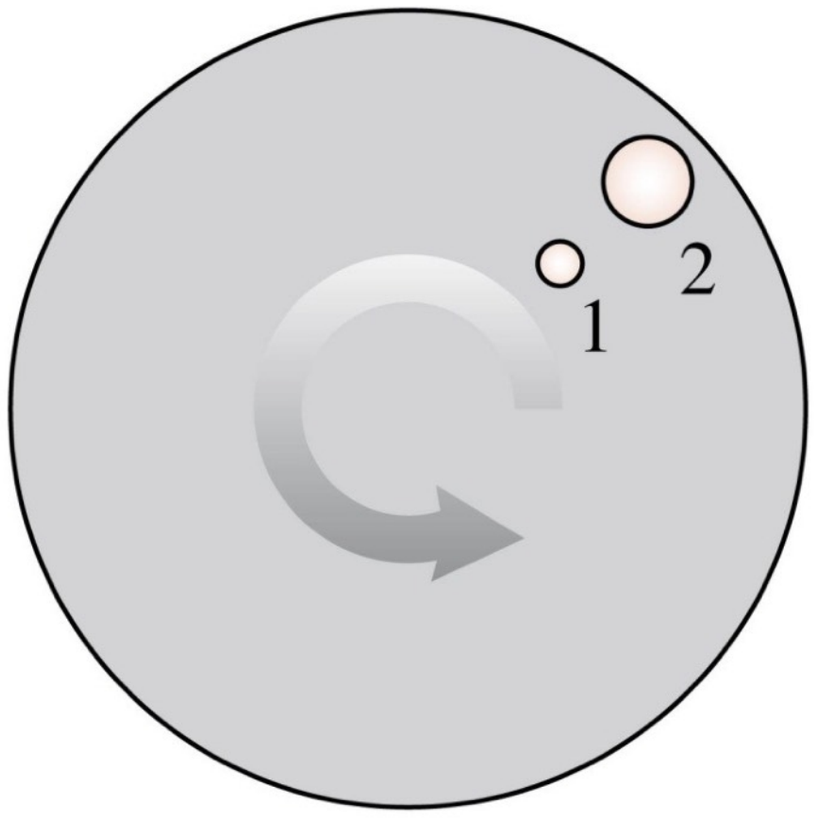
A coin sits on a turntable as the table **<u>steadily</u>** rotates ccw. What force or forces act in the plane of the turntable?



D E C A B

Question #11

Two coins are on a turntable that steadily speeds up, starting from rest, with a ccw rotation. Which coin flies off the turntable first?



B Both coins fly off at the same time.

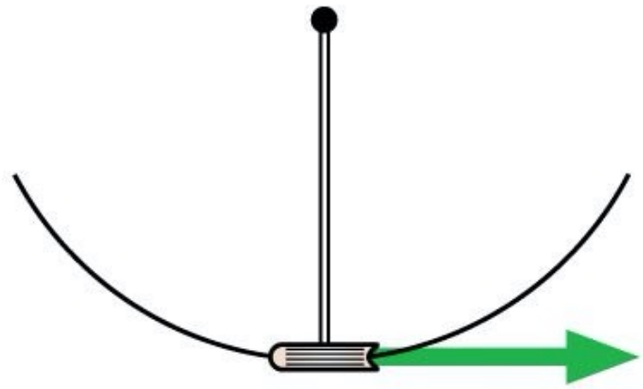
C Coin 1 flies off first.

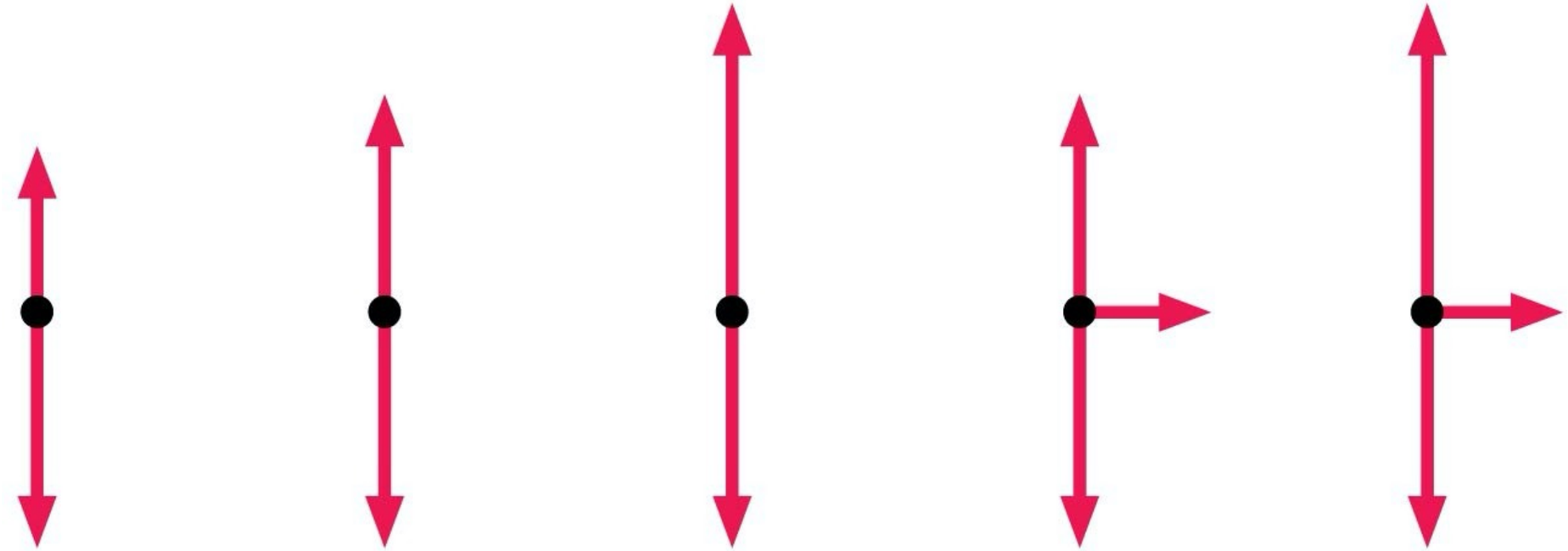
E Coin 2 flies off first.

D We can't say without knowing their masses.

Question #12

A physics textbook swings back and forth as a pendulum. Which is the correct free-body diagram when the book is at the bottom and moving to the right?

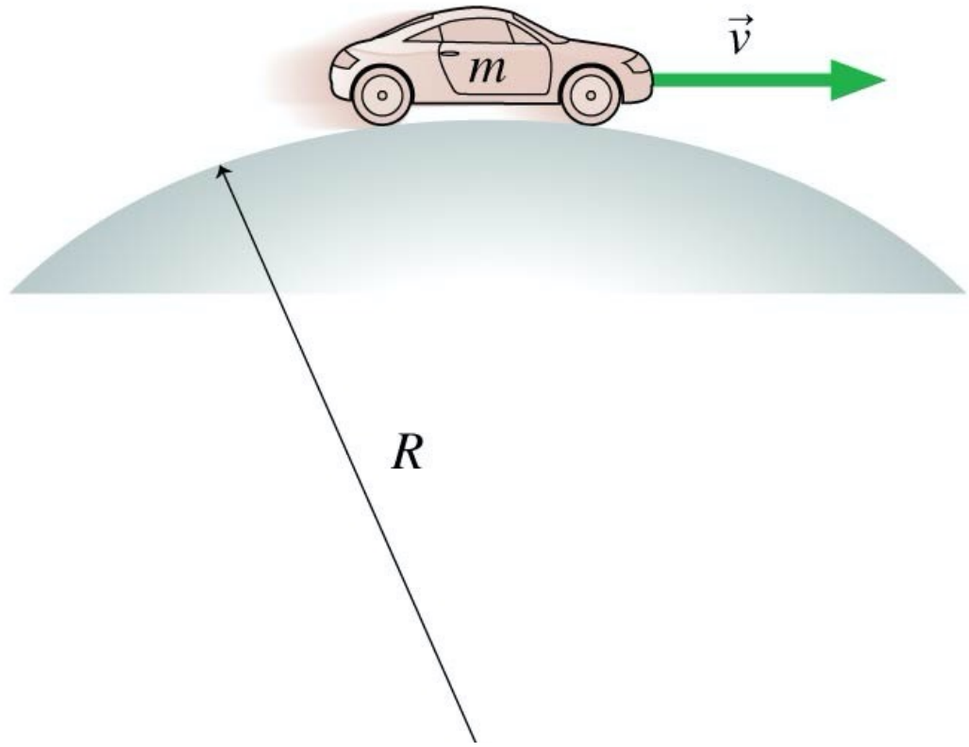


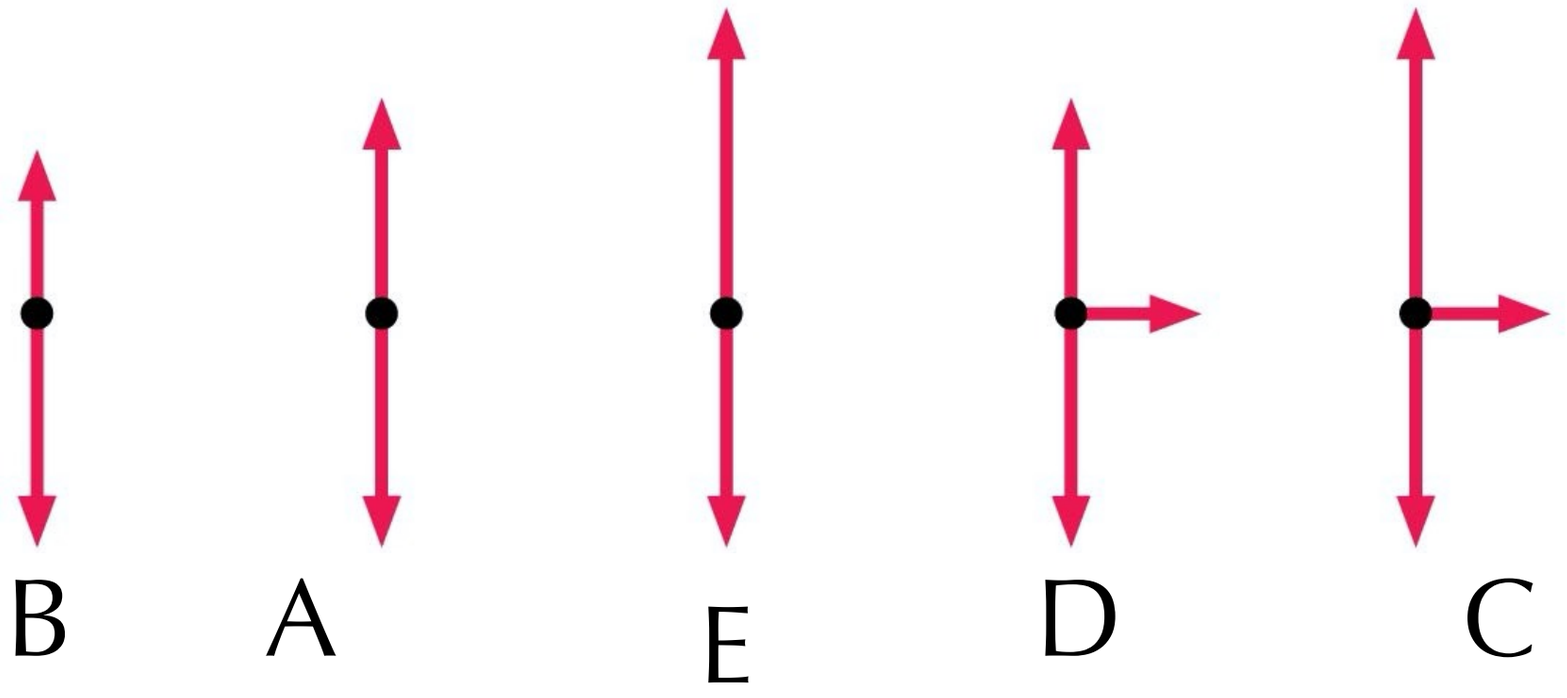


E A B D C

Question #13

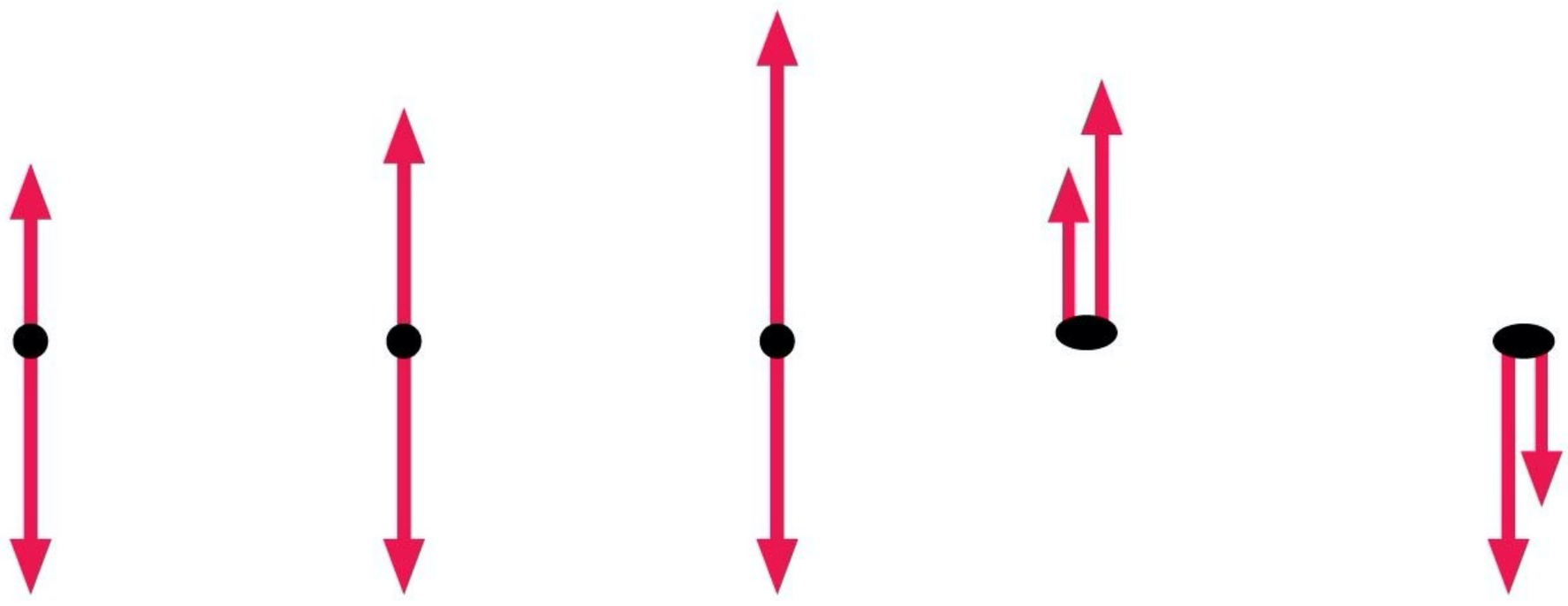
A car that's out of gas coasts over the top of a hill at a steady 20 m/s. Assume air resistance is negligible. Which free-body diagram describes the car at this instant?





Question #15

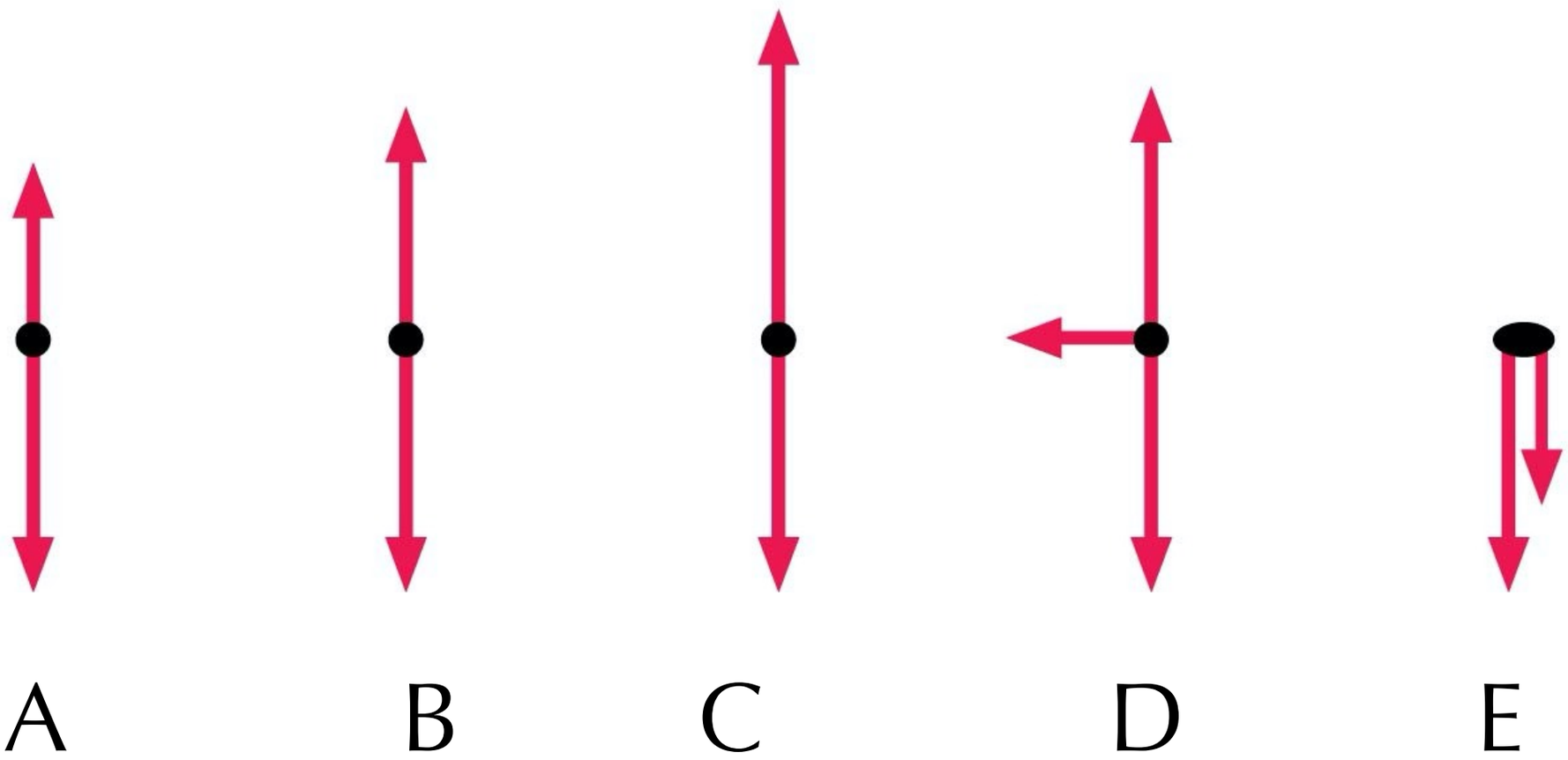
A roller coaster car does a loop-the-loop. Which of the free-body diagrams shows the forces on the car at the bottom of the loop? Rolling friction can be neglected.



E C A D B

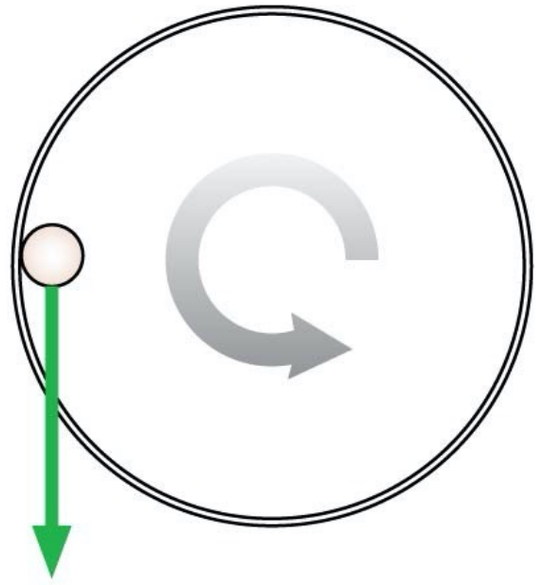
Question #16

A roller coaster car does a loop-the-loop. Which of the free-body diagrams shows the forces on the car at the top of the loop? Rolling friction can be neglected.



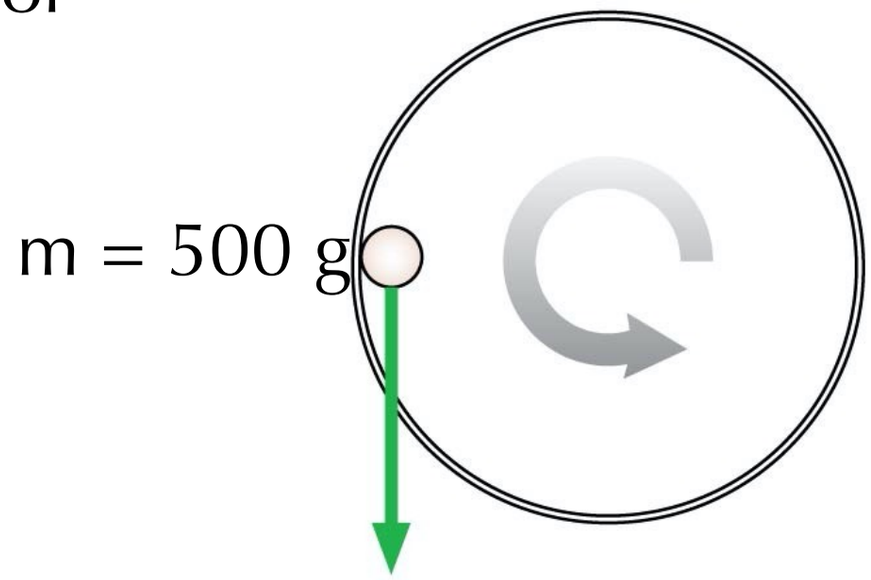
Question #17

A ball rolls ccw around the inside of a horizontal pipe. The ball is fastest at the lowest point, slowest at the highest point. At the point shown, with the ball moving down, what is the direction of the net force on the ball?



Question #18

If the ball were traveling at 3 m/s at this instant in time and the radius of the tube were 25 cm, what is the <u>magnitude</u> of the **<u>net force</u>** on the ball?



a) 9.8 N
b) 37.3 N
c) 187 N
d) 18.7 N
e) 4.9 N

Question #1

a) Kinetic to Potential
b) Potential to Kinetic
c) Work to Kinetic
d) Work to Potential

What energy transfer is taking place?

Question #2

a) Work to Kinetic
b) Work to Potential and Kinetic
c) Work to Potential
d) Potential to Kinetic

What energy transfer is taking place?

Question #3

A tow rope pulls a skier up a **rough** slope at **constant speed**. What energy transfer (or transfers) is taking place?

a. $W \rightarrow U_g$

b. Both A and E

c. $W \rightarrow E_{th}$

d. Both A and C.

e. $W \rightarrow K$.

Quiz

A tow rope pulls a skier up a rough slope at constant speed. What energy transfer (or transfers) is taking place?

a. $W \rightarrow U_g$

b. Both A and C

c. $W \rightarrow E_{th}$

d. Both A and B.

e. $W \rightarrow K$.

Question #4

A child is on a playground swing, motionless at the highest point of his arc. What energy transformation takes place as he swings back down to the lowest point of his motion?

a. $K \rightarrow Ug$
b. $E_{th} \rightarrow K$
c. $K \rightarrow E_{th}$
d. $Ug \rightarrow E_{th}$
e. $Ug \rightarrow K$

Question #5

A skier is gliding down a slope at a constant speed.
What energy transformation is taking place?

E $K \rightarrow U$

B $U \rightarrow K$

A $E_{\text{th}} \rightarrow K$

C $U \rightarrow E_{\text{th}}$

D $K \rightarrow E_{\text{th}}$

Question #6

A crane lowers a girder into place at constant speed. Consider the work W_g done by gravity and the work W_T done by the tension in the cable. Which is true?

a. $W_g > 0$ and $W_T > 0$

b. $W_g < 0$ and $W_T > 0$

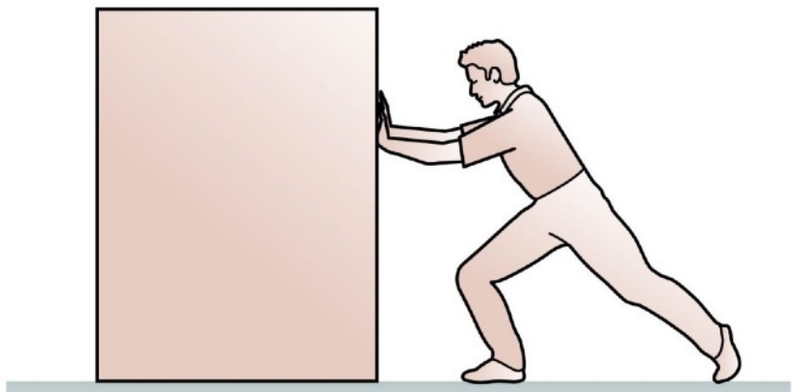
c. $W_g = 0$ and $W_T = 0$

d. $W_g < 0$ and $W_T < 0$

e. $W_g > 0$ and $W_T < 0$

Question #7

Robert pushes the box to the left at constant speed. In doing so, Robert does _____ work on the box.



c) negative

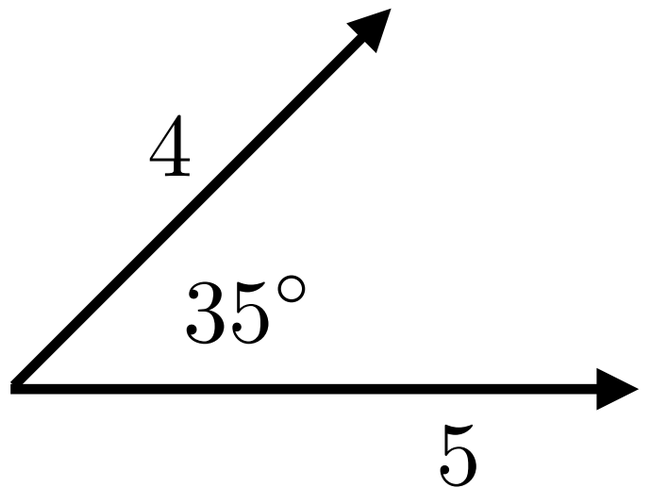
d) zero

e) positive

Question #8

Compute the dot product of the two vectors

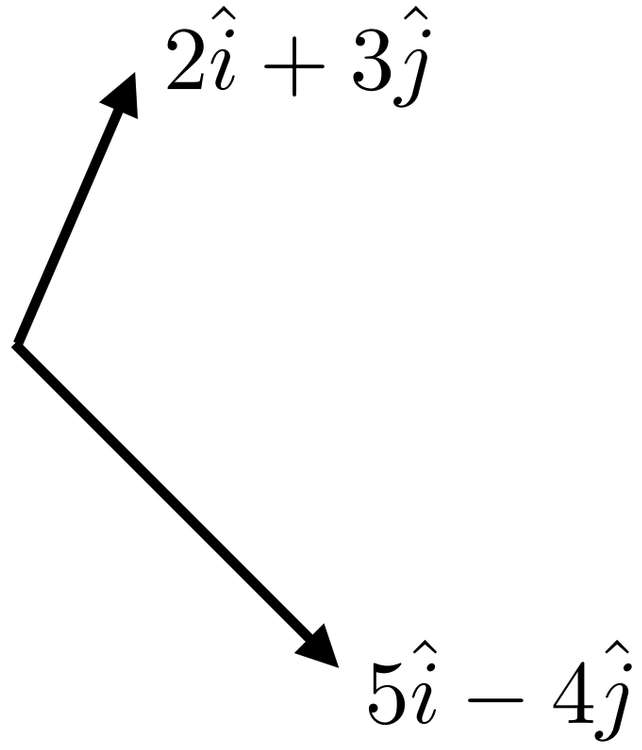
a) 12
b) -18
c) 16
d) 11



Question #9

Compute the dot product of the two vectors

a) 12
b) -2
c) -22
d) 16
e) 22



Using the dot product to compute work

Question #12

A 70-kg skier is gliding at 2.0 m/s when he starts down a very slippery 50-m long, 10 degree slope. What is his speed at the bottom?

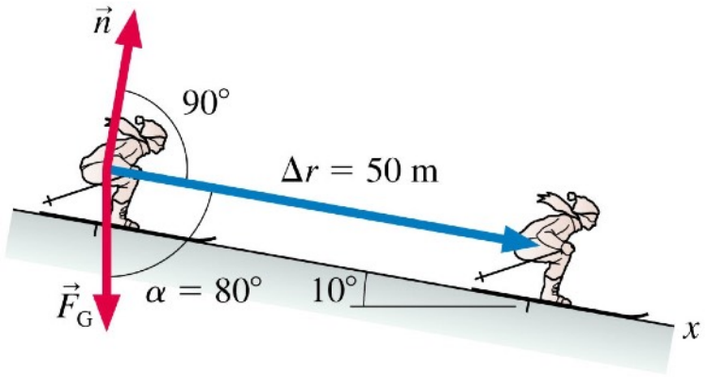
How much work does gravity do?

a) $-mg\Delta r$

b) $-mg\sin\theta$

c) $-mg\sin\theta\Delta r$

d) $mg\sin\theta\Delta r$



Question #13

Pushing horizontally, you move a box a distance “d” up an incline.

How much work is done by this push force?

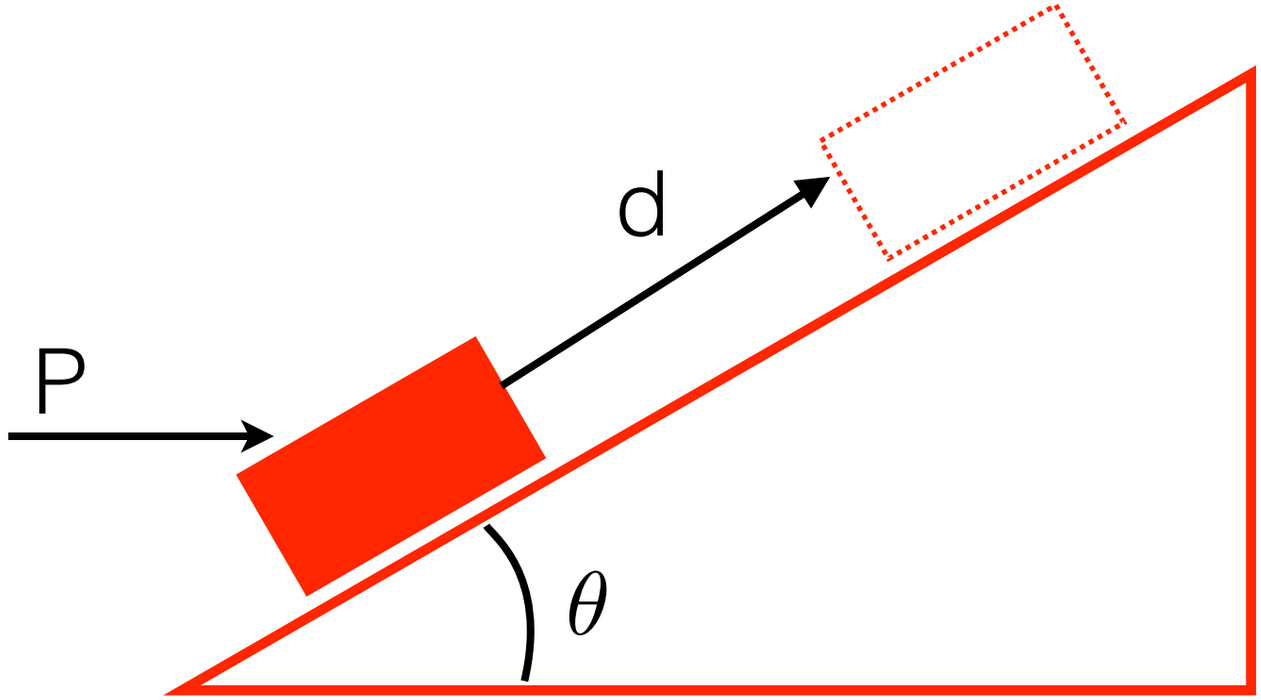
a) $-P\sin\theta d$

b) $P\cos\theta d$

c) $-P\cos\theta d$

d) $P\cos\theta$

e) $P\sin\theta d$



Question #14

Pushing horizontally, you move a box a distance "d" up an incline.

How much work is done by **gravity**?

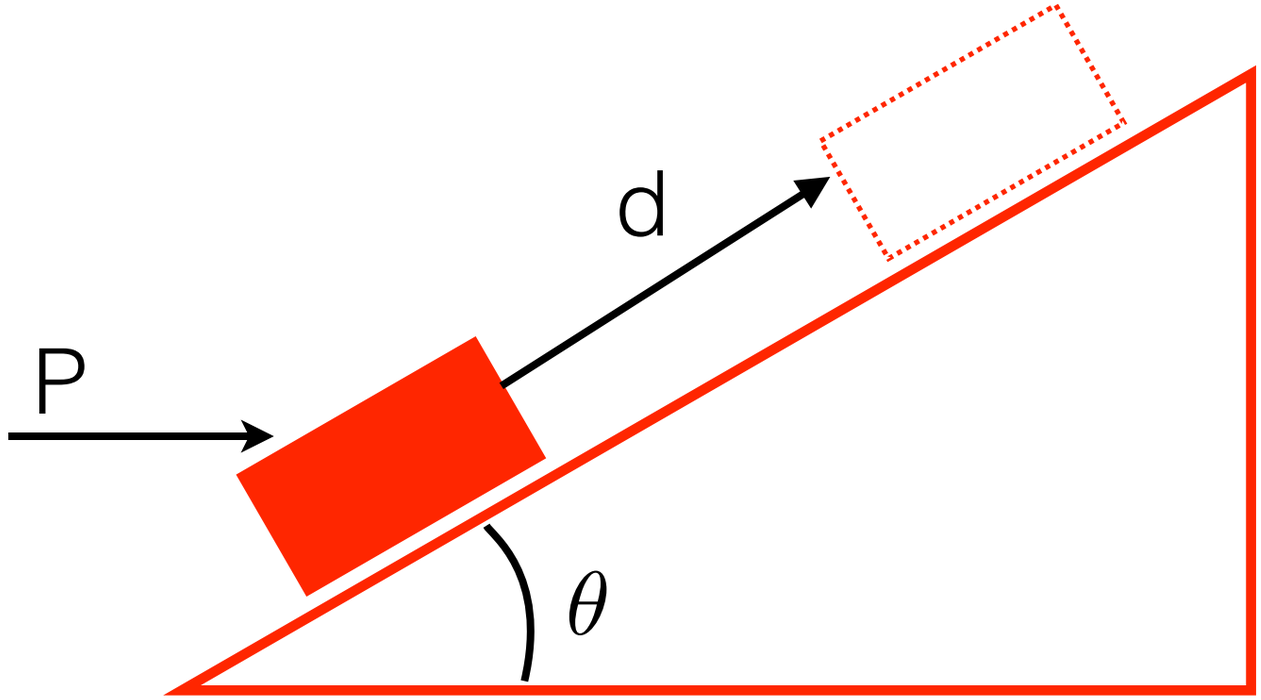
a) $mg\sin\theta d$

b) $-mg\sin\theta d$

c) $mg\cos\theta d$

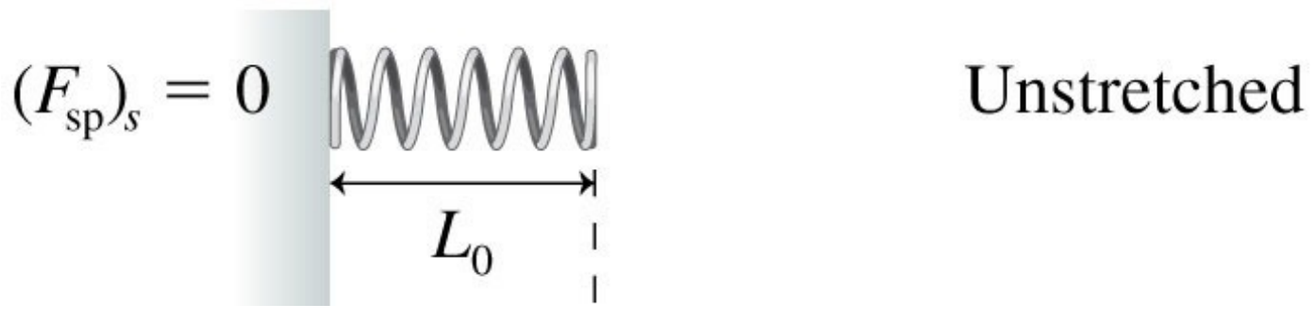
d) $-mg\cos\theta d$

e) $-mg\sin\theta$



Why the negative sign?

$$F_{\text{sp}} = -k\Delta s$$



Question #16

If I compress this spring (push on it to the left), what will be the direction of the force on my hand?

a) left b) right

Question #17

If I stretch this spring (pull on it to the right), what will be the direction of the force on my hand?

d) right e) left

A box is pushed up against a spring and compresses it a distance d. When the box is released the box shoots up the hill (frictionless). What is the speed of the box at the moment it loses contact with the spring?

Question #18

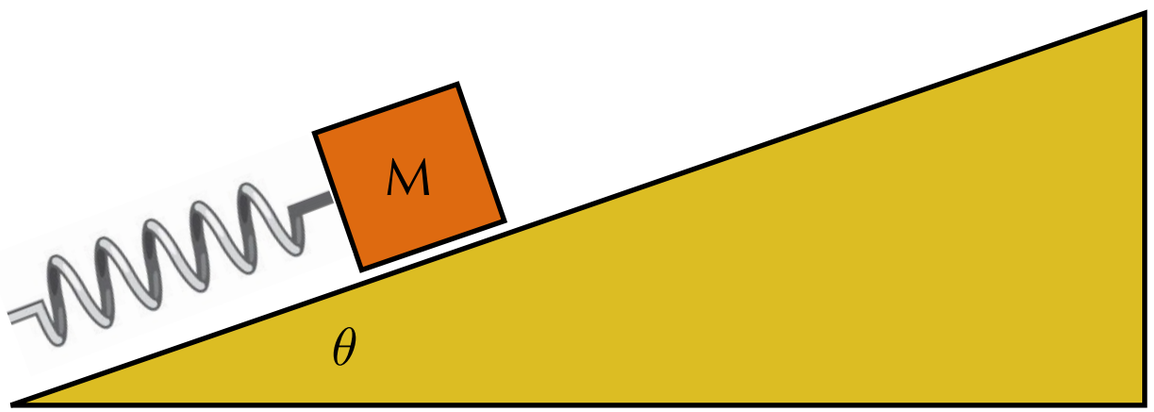
Which is a correct statement of the work-kinetic energy theorem for this problem

b) $\frac{1}{2}kd^2 - mg\sin\theta = \frac{1}{2}mv_f^2$

c) $-\frac{1}{2}kd^2 + mg\sin\theta d = \frac{1}{2}mv_f^2$

d) $\frac{1}{2}kd^2 - mg\cos\theta d = \frac{1}{2}mv_f^2$

e) $\frac{1}{2}kd^2 - mg\sin\theta d = \frac{1}{2}mv_f^2$



A box is pushed up against a spring and compresses it a distance d. When the box is released the box shoots up the hill (rough). What is the speed of the box at the moment it loses contact with the spring?

Question #19

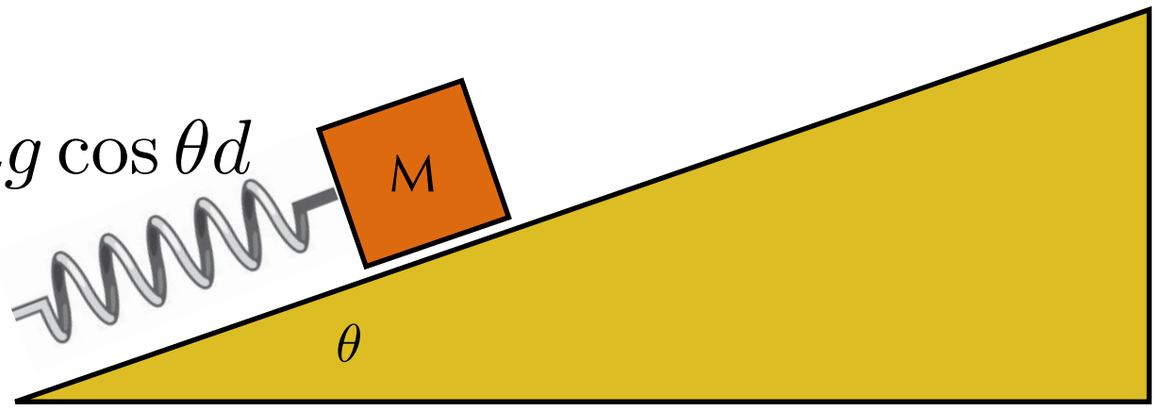
Which is a correct statement of the work-kinetic energy theorem for this problem?

b) $\frac{1}{2}kd^2 - mg\cos\theta d = \frac{1}{2}mv_f^2 - \mu_k mg\sin\theta d$

c) $-\frac{1}{2}kd^2 + mg\cos\theta d = \frac{1}{2}mv_f^2 + \mu_k mg\sin\theta d$

d) $\frac{1}{2}kd^2 - mg\sin\theta d = \frac{1}{2}mv_f^2 - \mu_k mg\cos\theta d$

e) $\frac{1}{2}kd^2 - mg\sin\theta d = \frac{1}{2}mv_f^2 + \mu_k mg\cos\theta d$



Question #20

If it takes 2 minutes to lift this 1,000 N object (at constant speed) a distance of 100 m, what is the rate at which the crane does work on the object?

a) 830 Watts
b) 50,000 J/min
c) a) and b)
d) 50,000 Watts
e) 830 J/min

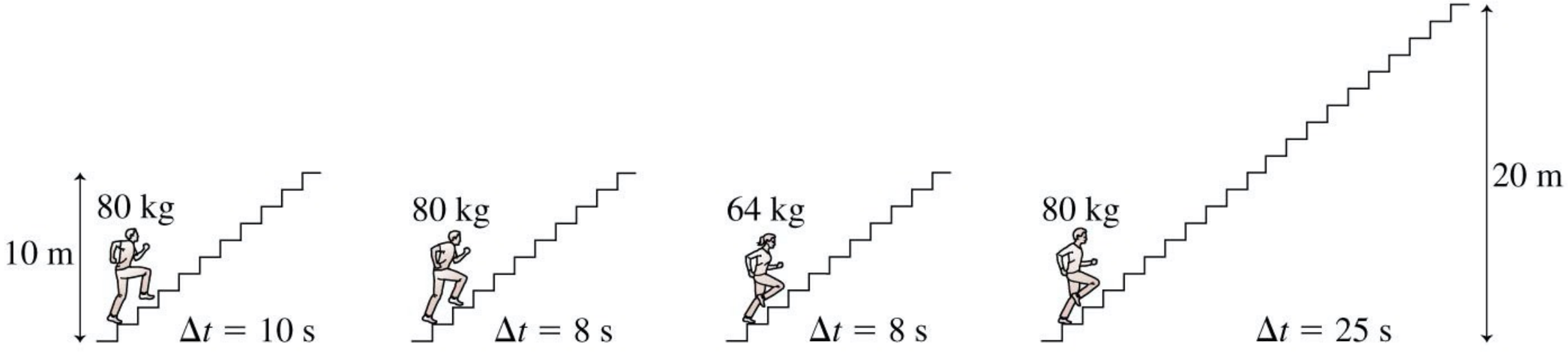
$$P \equiv \frac{dE_{\text{sys}}}{dt}$$

1 watt = 1 W = 1 J/s

1 hp = 746 W

Question #2

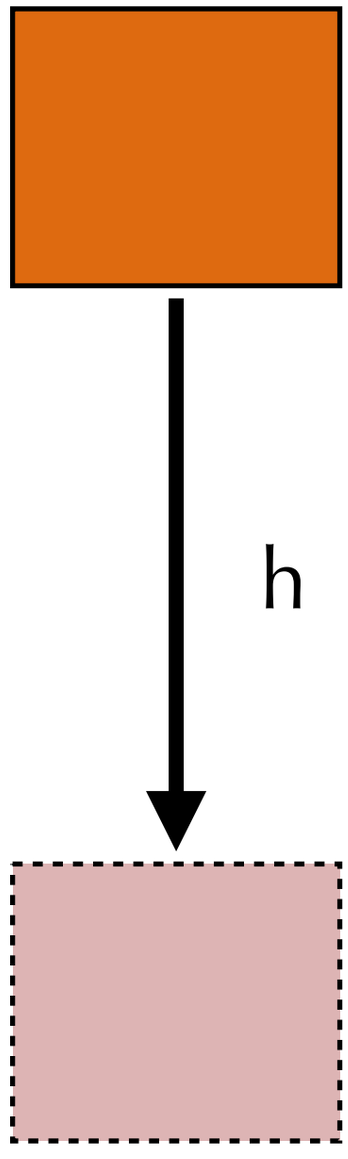
Four students run up the stairs in the time shown.
Which student has the largest power output?



C A D B

Question #22

How much work does gravity do as this box falls vertically a distance h?



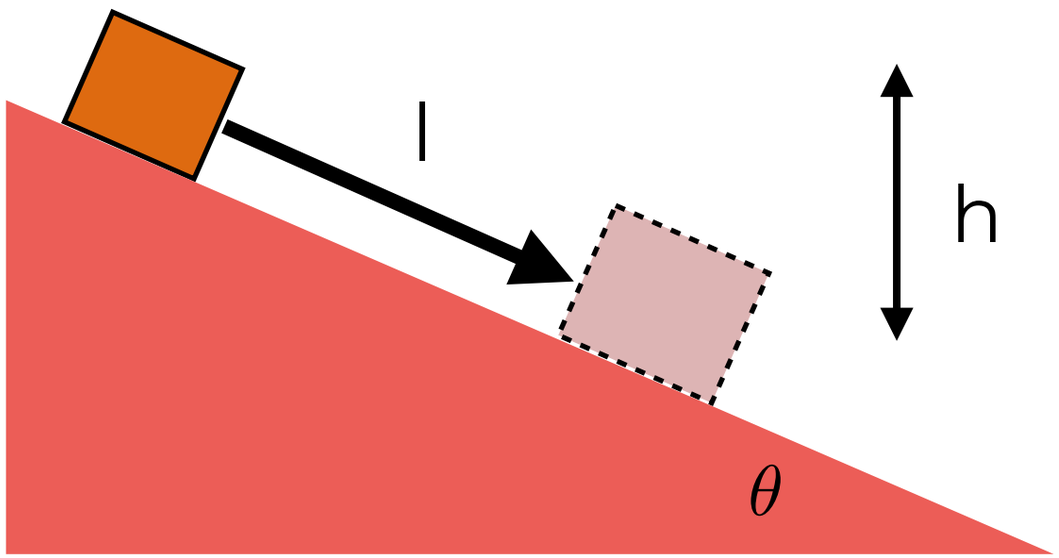
B $W = -mgh$

C $W = -\frac{mgh}{2}$

D $W = mgh$

Question #23

How much work does gravity do as the box slides down the incline?



$$W = -\Delta U$$

$$U_g = mgy$$

A $W = -mgh$

B $W = mgh$

C. Both b) and e) are correct.

D $W = -mgl\sin\theta$

E $W = mgl\sin\theta$

Using Work and Potential Energy

Question #24

A 70-kg skier is gliding at 2.0 m/s when he starts down a very slippery 50-m long, 10 degree slope. What is his speed at the bottom if the wind exerts a steady 50 N **horizontal** retarding force?

Which equation is a correct statement of conservation of energy for this problem?

B. $mg\Delta r\sin\theta + \frac{1}{2}mv_i^2 - F_{\rm W}\Delta r\cos\theta = \frac{1}{2}mv^2$

D $mg\Delta r\cos\theta + \frac{1}{2}mv_i^2 + F_{\rm W}\Delta r\cos\theta = \frac{1}{2}mv^2$

C $mg\Delta r\sin\theta + \frac{1}{2}mv_i^2 + F_{\rm W}\Delta r\cos\theta = \frac{1}{2}mv^2$

E $mg\Delta r\sin\theta + \frac{1}{2}mv_i^2 - F_{\rm W}\Delta r\sin\theta = \frac{1}{2}mv^2$

$$U_i + K_i + W_{\rm ext} = U_f + K_f + \Delta E_{\rm th}$$

A problem

Question #25

A 20-kg person slides down a **rough** 3.0-m-high playground slide. She **starts from rest**, and her speed at the bottom is 2.0 m/s.

Which is a correct statement of conservation of energy for this situation?

E $mgh - mgl\sin\theta = \frac{1}{2}mv_f^2 + \Delta E_{\text{th}}$

A $mgh = \frac{1}{2}mv_f^2 + \Delta E_{\text{th}}$

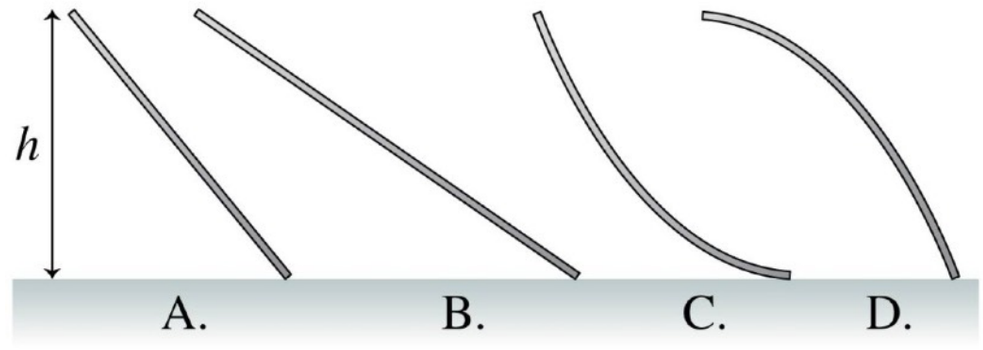
C $mgh + \frac{1}{2}mv_i^2 = \frac{1}{2}mv_f^2 + \Delta E_{\text{th}}$

B. $mgh\cos\theta = \frac{1}{2}mv_f^2 + \Delta E_{\text{th}}$

$$U_i + K_i + W_{\text{ext}} = U_f + K_f + \Delta E_{\text{th}}$$

Question #26

A small child slides down the four frictionless slides A–D. Rank in order, from largest to smallest, her speeds at the bottom.



a. $v_D > v_A > v_B > v_C$

b. $v_D > v_A = v_B > v_C$

c. $v_A = v_B = v_C = v_D$

d. $v_C > v_A > v_B > v_D$

$$U_i + K_i + W_{\text{ext}} = U_f + K_f + \Delta E_{\text{th}}$$

cons. of energy applet

Another Problem

Question #27

A horizontal spring with a spring constant of 100 N/m is compressed 20 cm and used to launch a 2.5 kg box across a frictionless, horizontal surface. After the box travels some distance the surface becomes rough. The coefficient of kinetic friction of the box on the surface is 0.15. Use work and energy to find how far the box slides across the rough surface before stopping.

D $\frac{1}{2}mv^2 = \mu_k mg\Delta x$

E $\frac{1}{2}kx^2 = \frac{1}{2}mv^2$

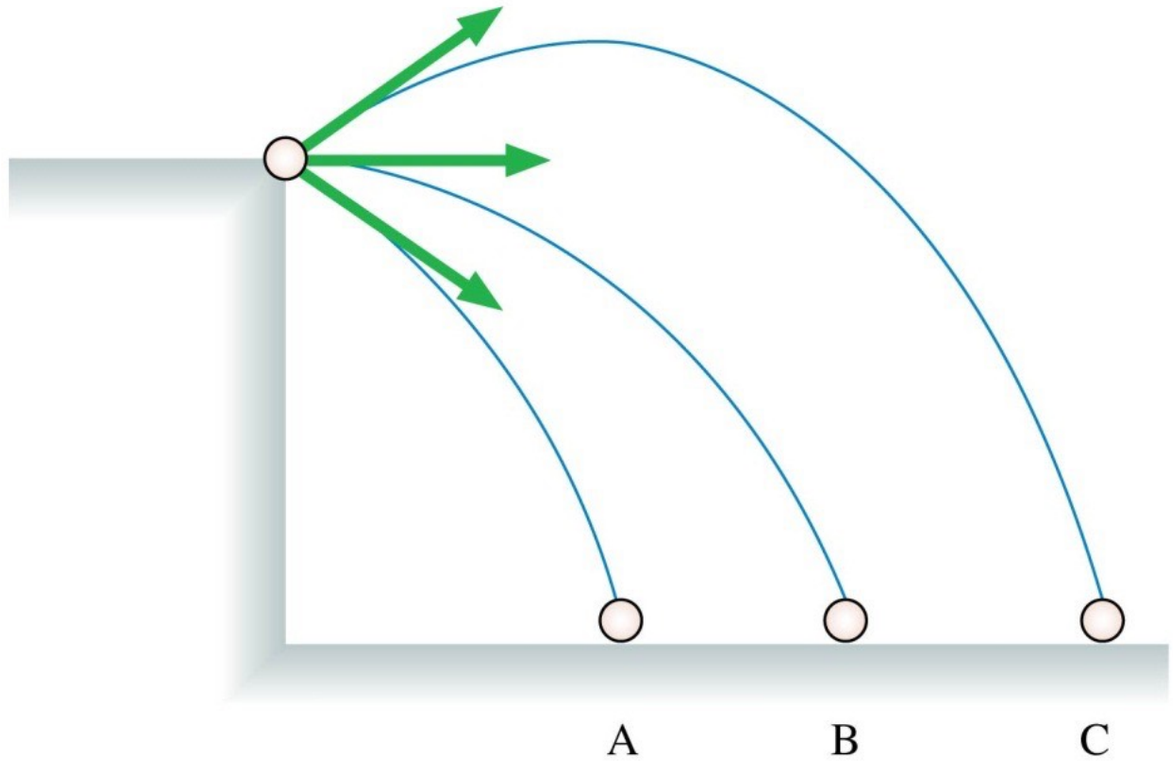
C $\frac{1}{2}kx^2 = \mu_k mg\Delta x$

B. $\frac{1}{2}kx^2 = \frac{1}{2}mv^2 + \mu_k mg\Delta x$

$$U_i + K_i + W_{\text{ext}} = U_f + K_f + \Delta E_{\text{th}}$$

Question #28

Three balls are thrown from a cliff with the same speed but at different angles. Which ball has the greatest speed just before it hits the ground?



cons. of energy applet

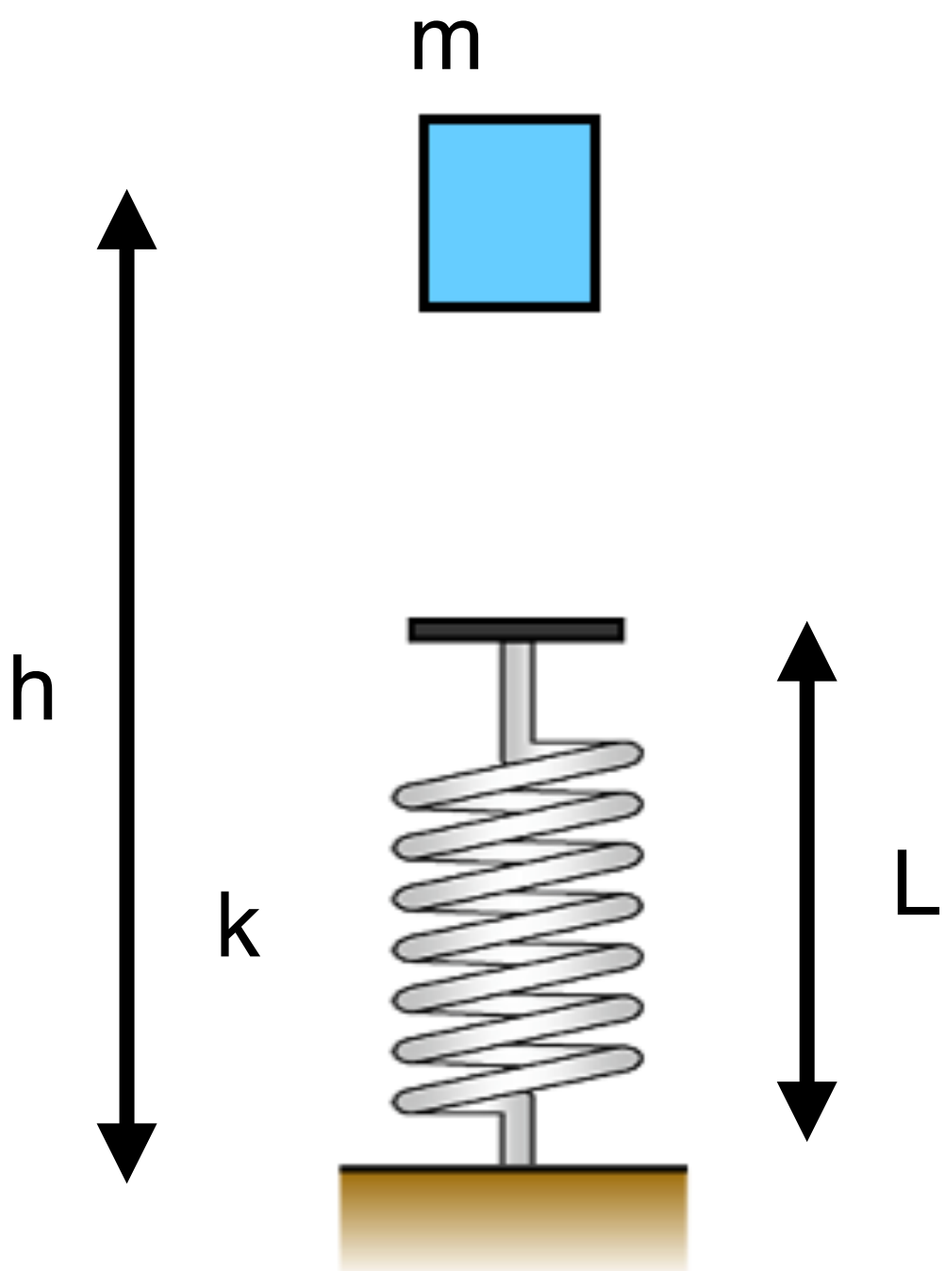
A. Ball A
B. Ball B
C. Ball C
D. All balls have the same speed.

applet

$$U_i + K_i + W_{\text{ext}} = U_f + K_f + \Delta E_{\text{th}}$$

Spring potential energy **Question #29**

Challenge



By how much does the spring compress?

A $mgh = \frac{1}{2}kx^2 + mg(L - x)$

D $mgh = \frac{1}{2}kx^2$

C $mgh = \frac{1}{2}kx^2 + mgx$

B. $mg(h - L + x) = \frac{1}{2}kx^2$

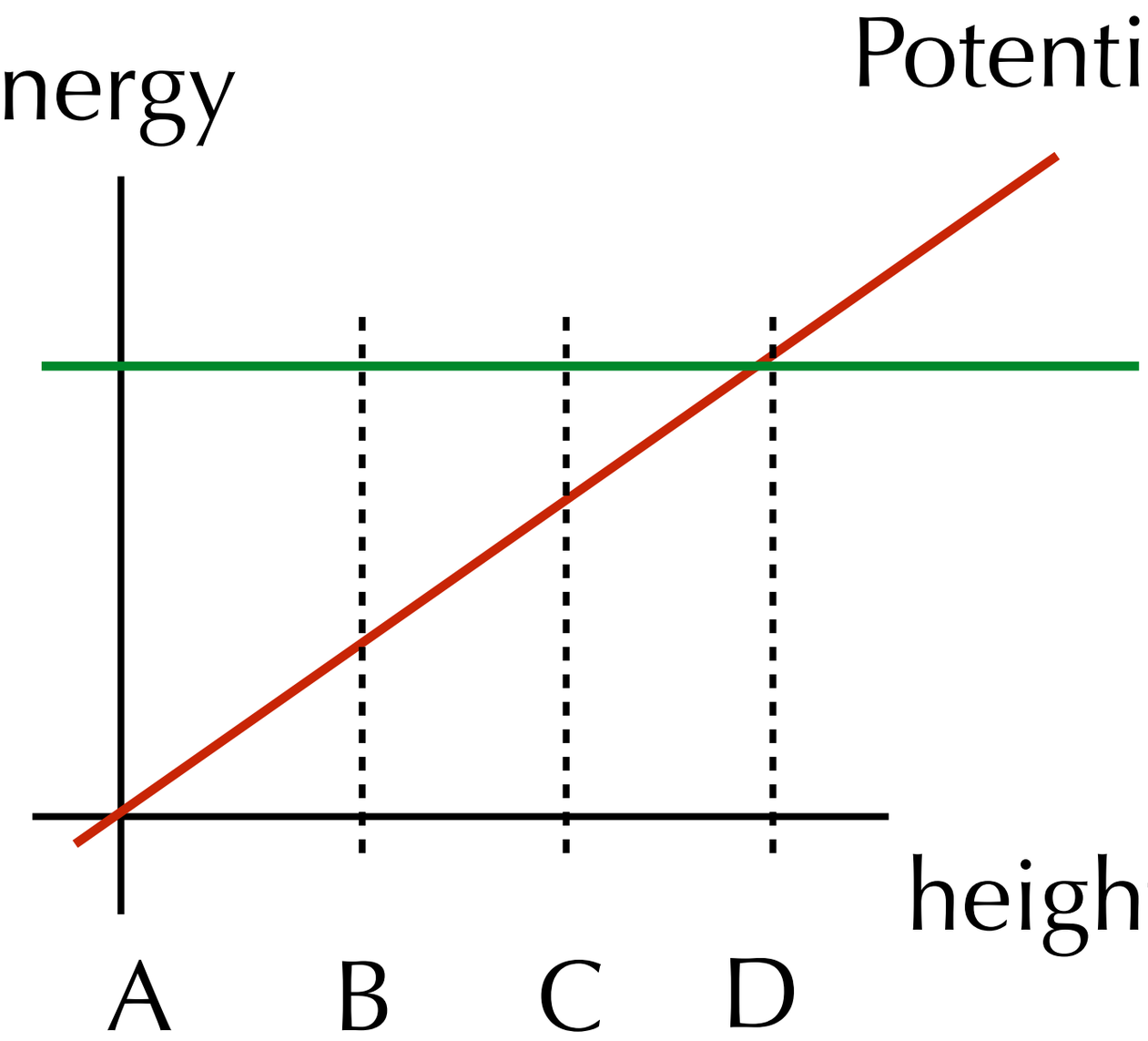
E. Both A and B are correct.

$$U_i + K_i + W_{\text{ext}} = U_f + K_f + \Delta E_{\text{th}}$$

Energy diagram for ball thrown upward

Question #37

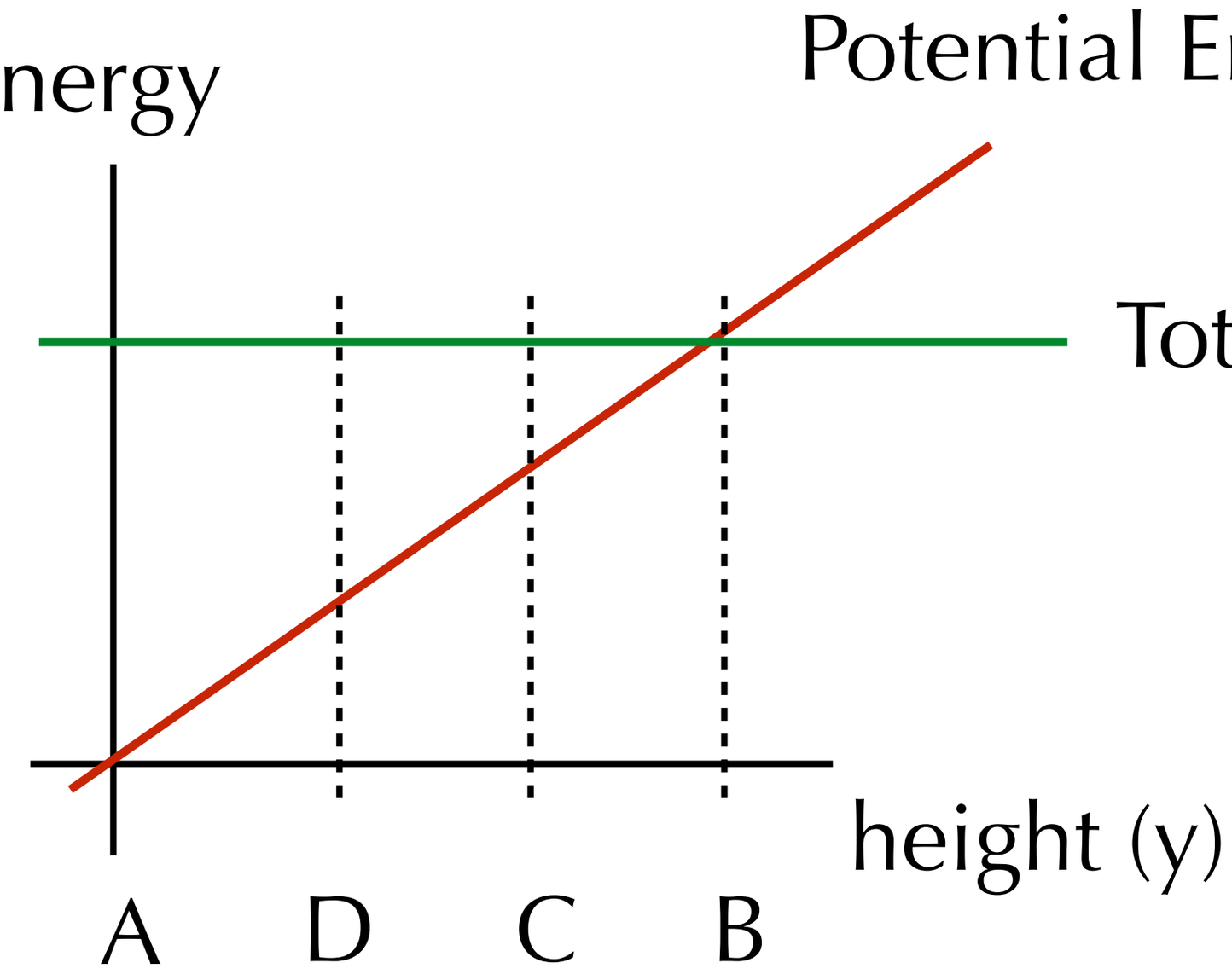
Where is the turning point of the motion?



$$U_g = mgy$$

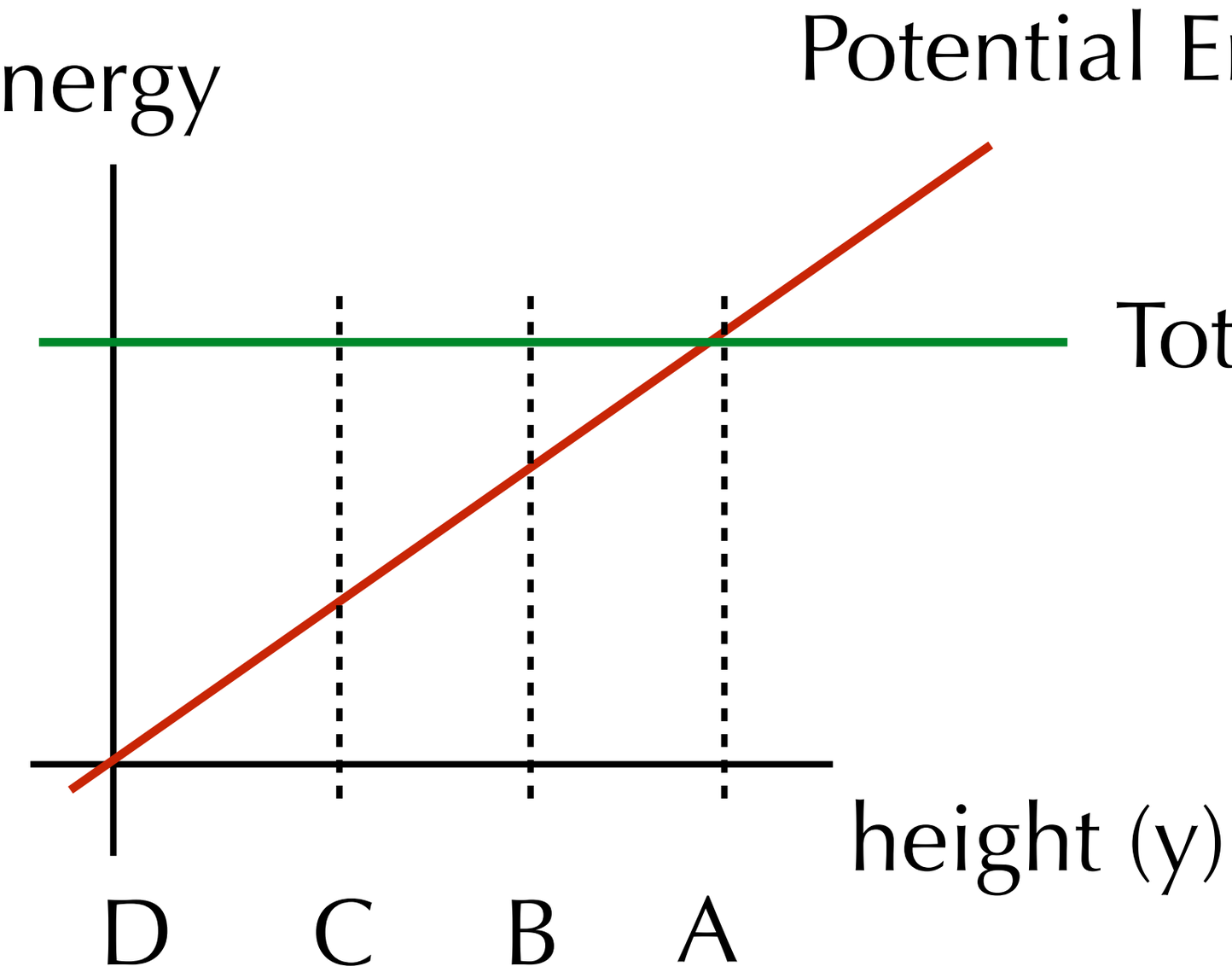
Energy diagram for ball thrown upward

Where does the object have the most potential energy?



Energy diagram for ball thrown upward

Where does the object have the most kinetic energy?

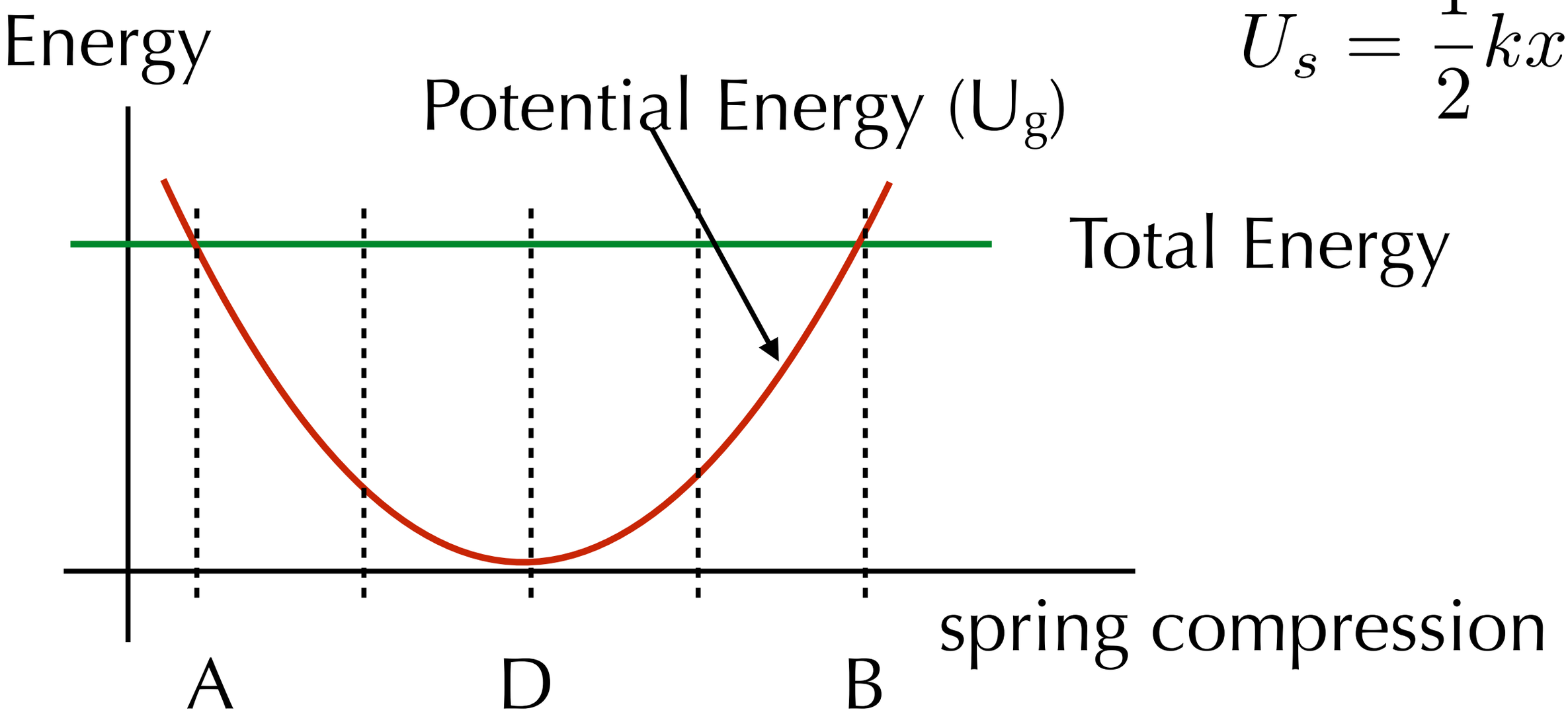


Energy diagram for mass on a spring

Question #38

Where is(are) the turning points of the motion?

$$U_s = \frac{1}{2}kx^2$$

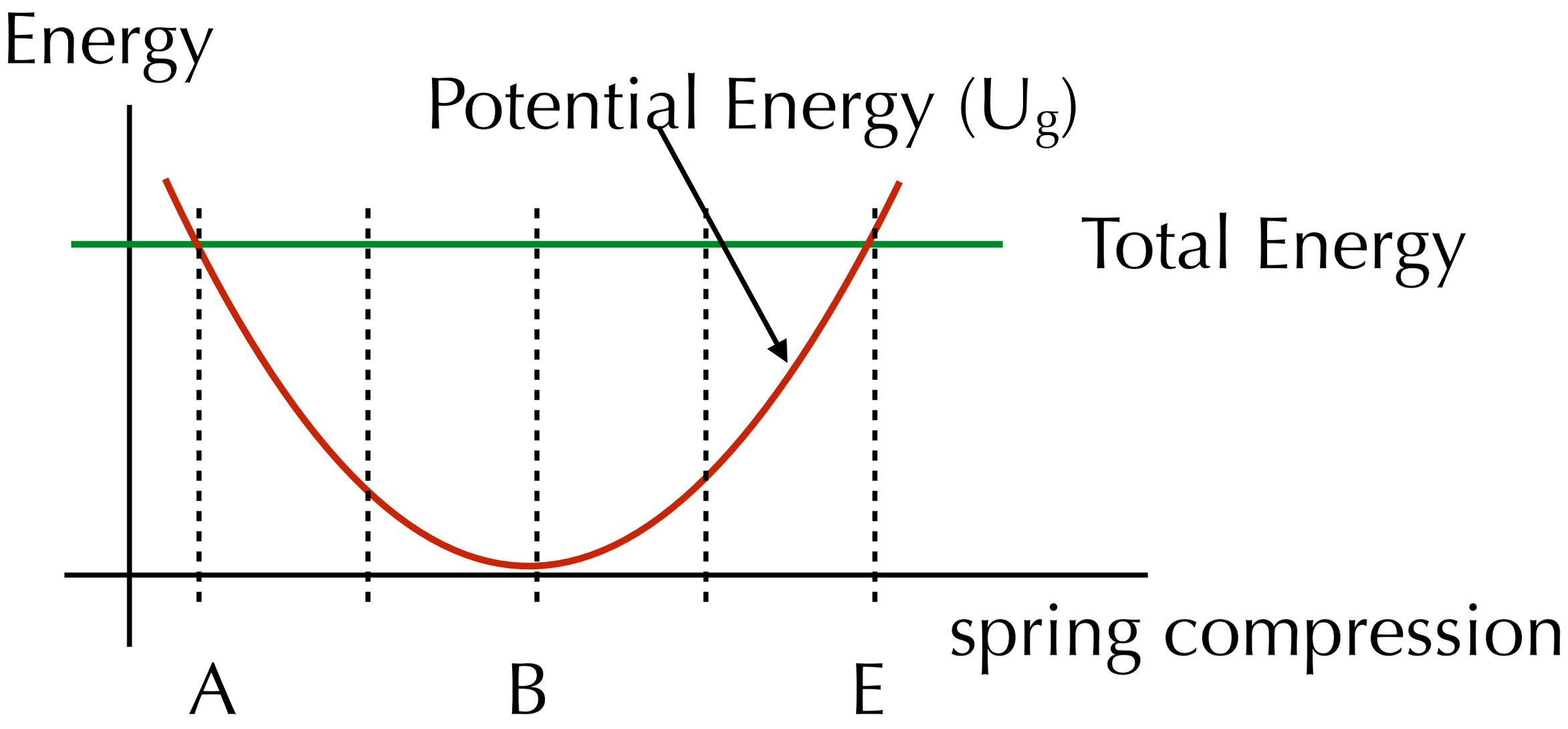


C. A and B are both turning points

E. All three are turning points.

Energy diagram for mass on a spring

Where does the object have the most potential energy?

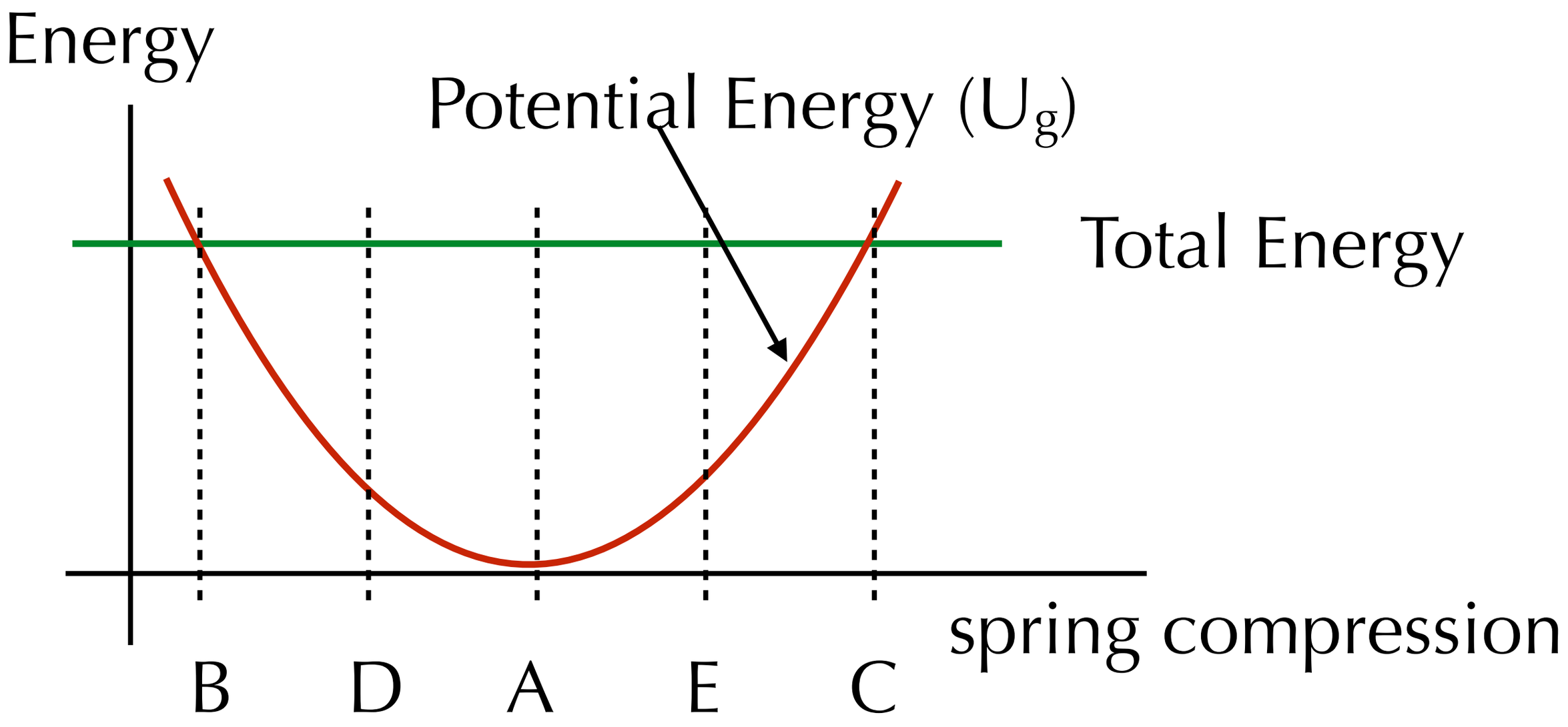


C. At points A and E

D. At points A and C

Energy diagram for mass on a spring

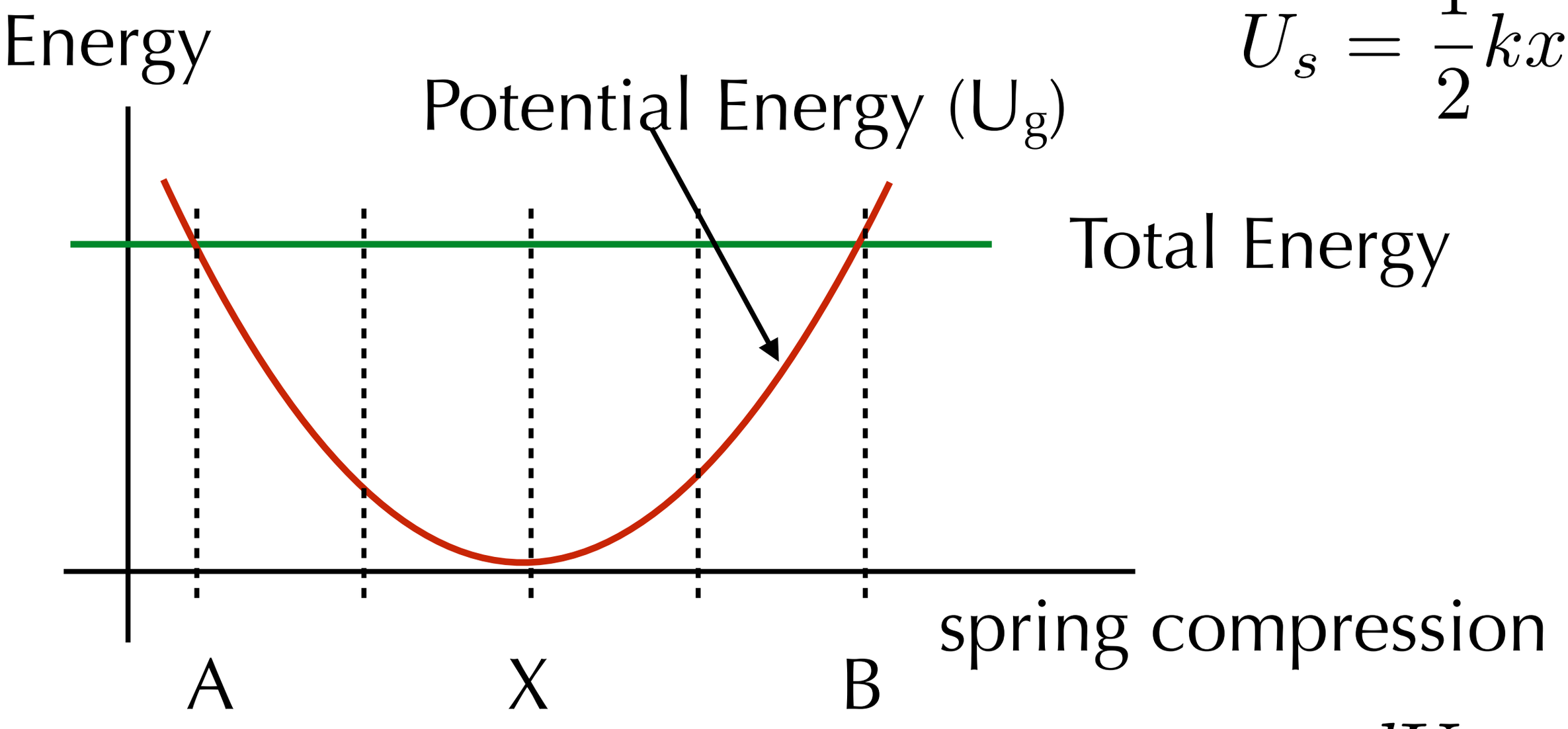
Where does the object have the most kinetic energy?



Question #39

Where is the force of the spring on the object negative (left pointing)?

$$U_s = \frac{1}{2}kx^2$$



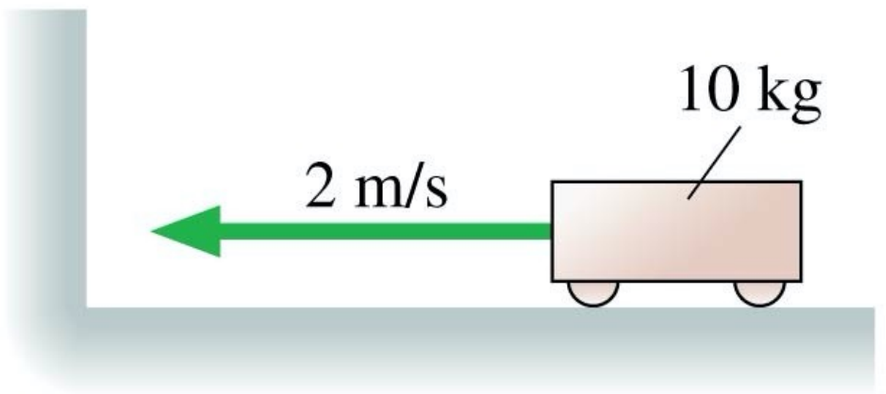
D) anywhere to the **left** of point X.
E) anywhere to the **right** of point X

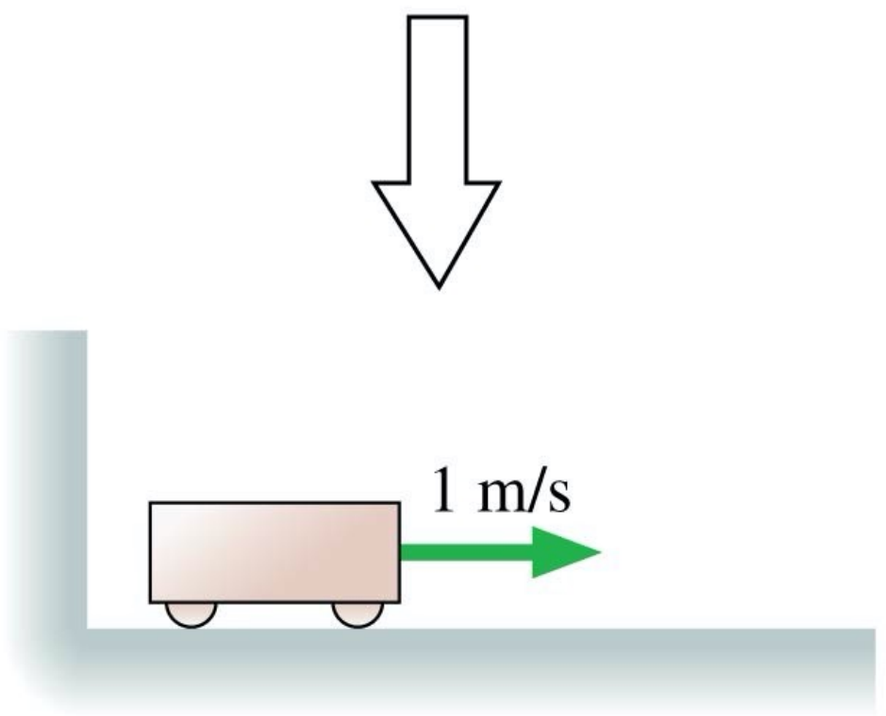
$$F = -\frac{dU}{ds}$$

Question #40

The cart's <u>change</u> of momentum Δp_x is

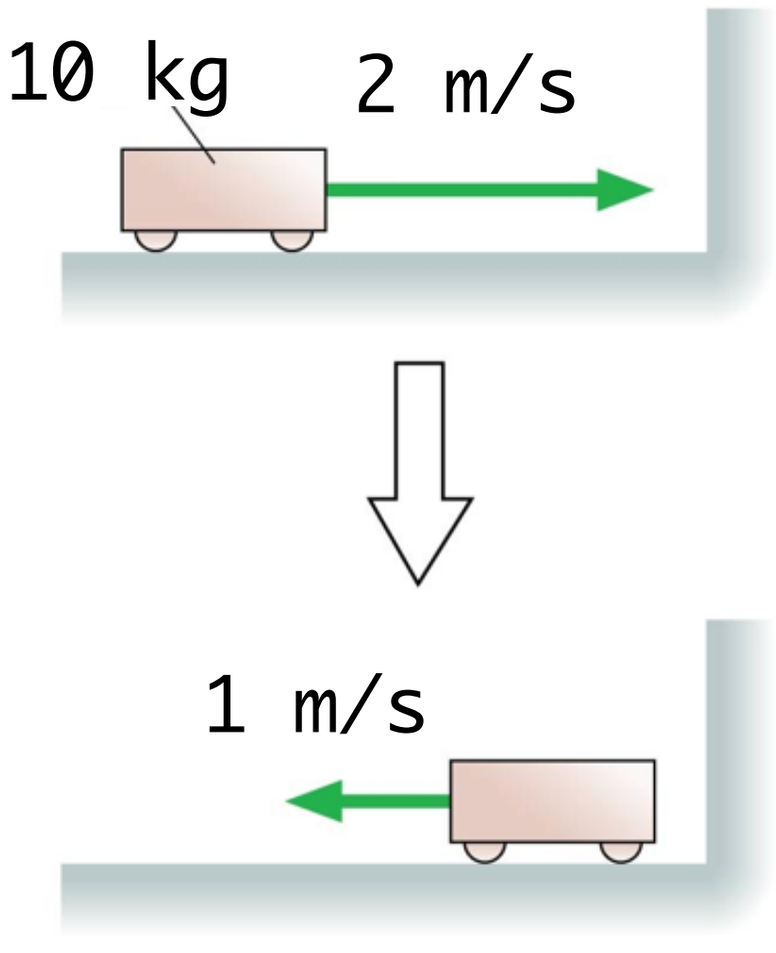
a. –20 kg m/s.
b. 10 kg m/s.
c. 0 kg m/s.
d. 30 kg m/s.
e. -10 kg m/s.





Question #41

The cart's <u>change</u> of momentum Δp_x is



a. -20 kg m/s.
b. -10 kg m/s.
c. 30 kg m/s.
d. 10 kg m/s.
e. -30 kg m/s.

Question #42

You and your friend drop eggs from a very high distance. Your egg hits the surface of the asphalt. Your friend's egg lands in an enormous box of packing peanuts.

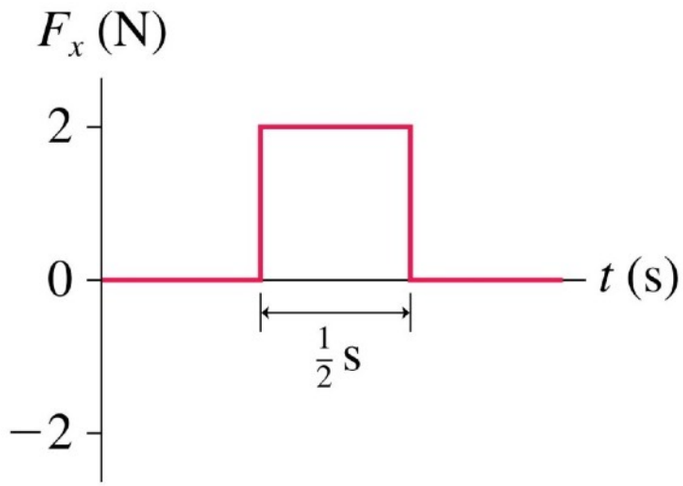
Which of the three quantities listed below are **the same** for the two scenarios?

1. Peak force on egg
2. collision time
3. change in momentum

a) 3 only
b) 1 and 2
c) 1 and 3
d) 2 only
e) 1 only

Question #44

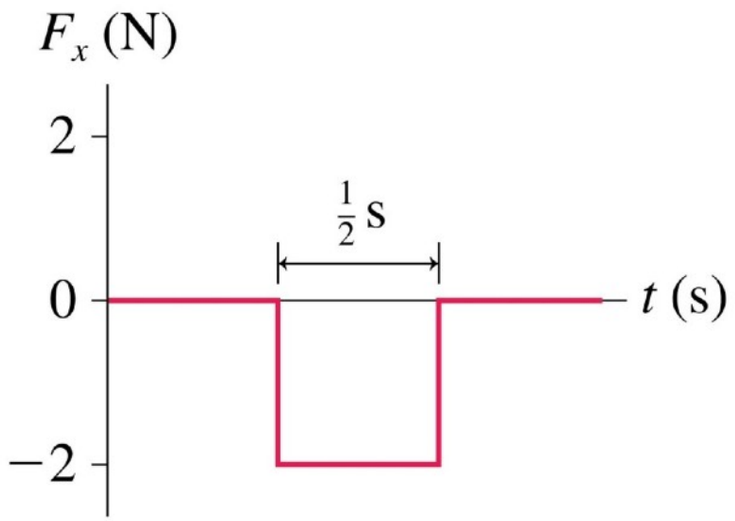
A 2.0 kg object moving to the right with speed 0.50 m/s experiences the force shown. What are the object's speed and direction after the force ends?



a. 0.50 m/s left.
b. At rest.
c. 0.50 m/s right.
d. 2.0 m/s right.
e. 1.0 m/s right.

Question #45

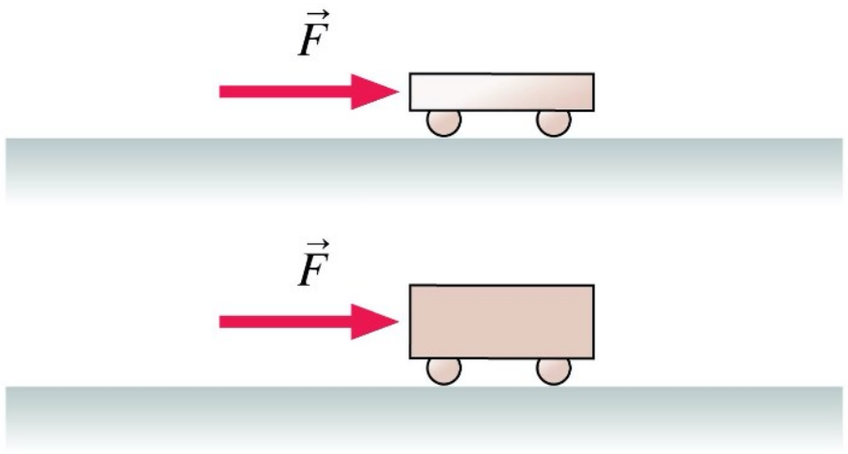
A 2.0 kg object moving to the right with speed 0.50 m/s experiences the force shown. What are the object's speed and direction after the force ends?



a. 0.50 m/s left.
b. At rest.
c. 0.50 m/s right.
d. 1.0 m/s right.
e. 2.0 m/s right.

Question #46

A light plastic cart and a heavy steel cart are both pushed with the same force for 1.0 s, starting from rest. After the force is removed, the momentum of the light plastic cart is _____ that of the heavy steel cart.



a. less than

b. greater than

c. equal to

d. Can't say. It depends on how big the force is.

Question #47

You awake in the night to find that your living room is on fire. Your one chance to save yourself is to throw something that will hit the back of your bedroom door and close it, giving you a few seconds to escape out the window. You happen to have both a sticky ball of clay and a super-bouncy Superball next to your bed, both the same size and same mass. You've only time to throw one. Which will it be? Your life depends on making the right choice!

B. It doesn't matter. Throw either.

C. Throw the ball of clay.

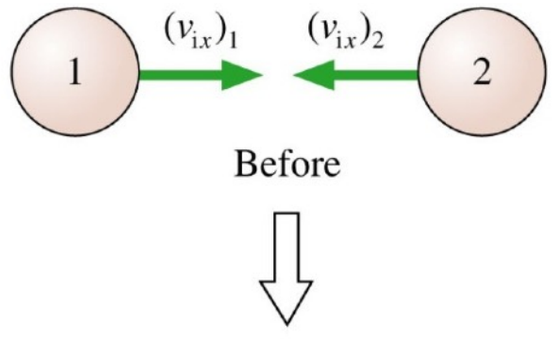
D. Throw the Superball.

Happy/Sad Pendulum Demo

Conservation of momentum

Question worth pondering: How does the impulse on ball 1 compare to the impulse on ball 2?

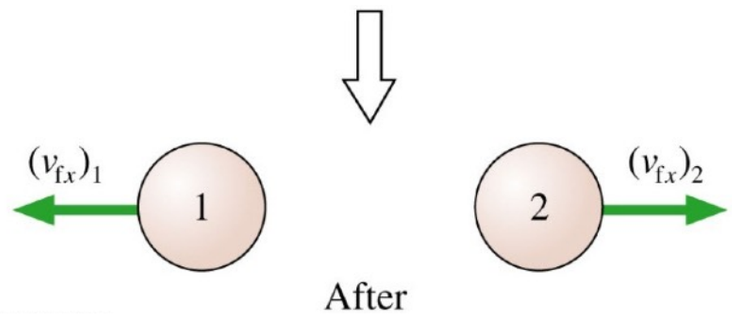
$$\text{Impulse} = J_x \equiv \int_{t_i}^{t_f} F_x(t)dt$$



a) Impulse on ball 1 is greater than impulse on ball 2.
b) Impulse on ball 2 is greater than impulse on ball 1
c) Impulses are equal.

Conservation Law

$$(p_{fx})_1 + (p_{fx})_2 = (p_{ix})_1 + (p_{ix})_2$$



http://serc.carleton.edu/dmvideos/videos.html

Example

Question #2

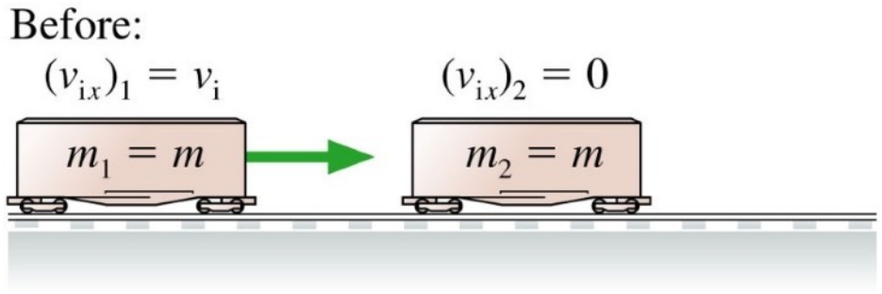
A train car moves to the right with initial speed vi. It collides with a stationary train car of equal mass. After the collision the two cars are stuck together. What is the train cars' final velocity?

b) $v_f = v_i$

d) $v_f = 4v_i$

c) $v_f = 2v_i$

e) $v_f = \frac{1}{2}v_i$

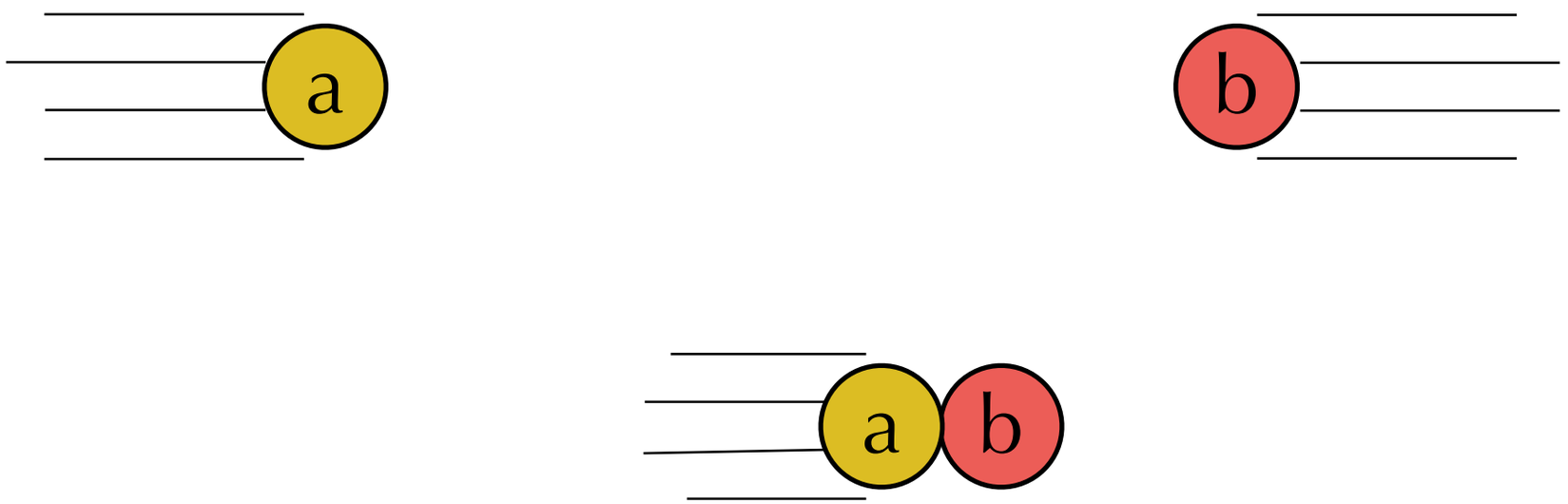


$$m_1 v_{1f} + m_2 v_{2f} = m_1 v_{1i} + m_2 v_{2i}$$

$$2mv_f = mv_i + 0$$

$$v_f = \frac{1}{2}v_i$$

Two balls are moving towards each other and collide. After the collision they stick together and move to the right. Which ball had the larger **speed** before the collision?

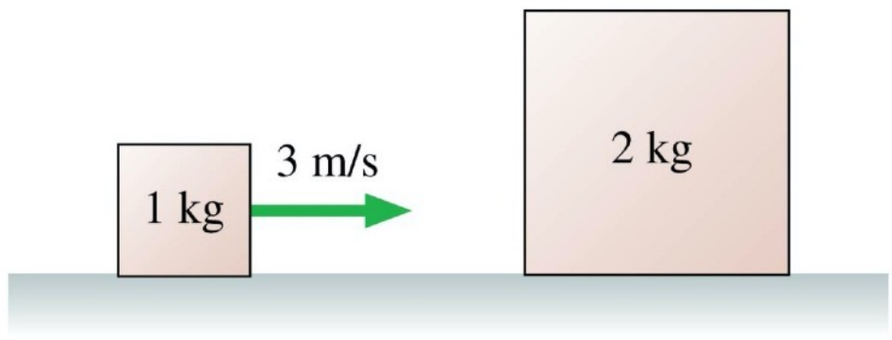


a. No way of knowing without knowing the masses.
b. ball a
c. ball b
d. they had the same speed

Collision applet

Question #5

The 1 kg box is sliding along a frictionless surface. It collides with and sticks to the 2 kg box. Afterward, the speed of the two boxes is



a. There's not enough information to tell.

b. 2 m/s.

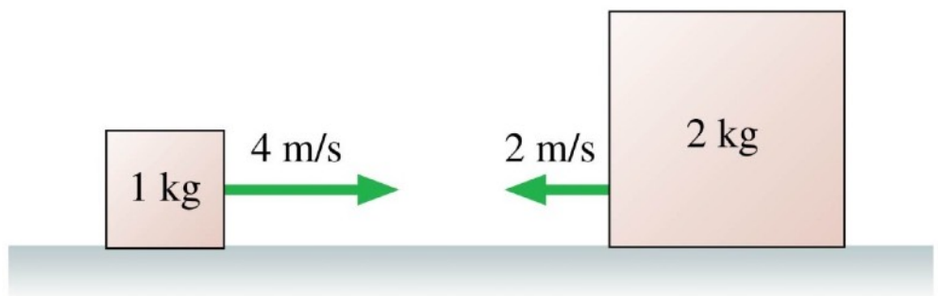
c. 0 m/s.

d. 3 m/s.

e. 1 m/s.

Question #6

The two boxes are sliding along a frictionless surface. They collide and stick together. Afterward, the velocity of the
two boxes is



a. 1 m/s to the right.

b. 1 m/s to the left.

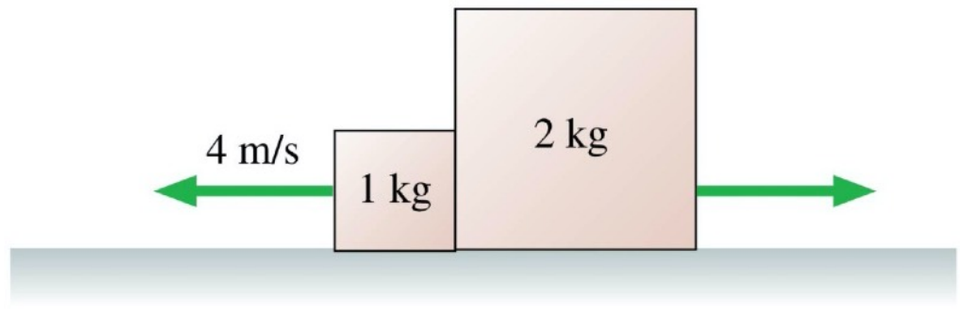
c. 2 m/s to the left.

d. 0 m/s, at rest.

e. 2 m/s to the right.

Question #7

The two boxes are on a frictionless surface. They had been sitting together at rest, but an explosion between them has just pushed them apart. How fast is the 2 kg box going?



A. 4 m/s.

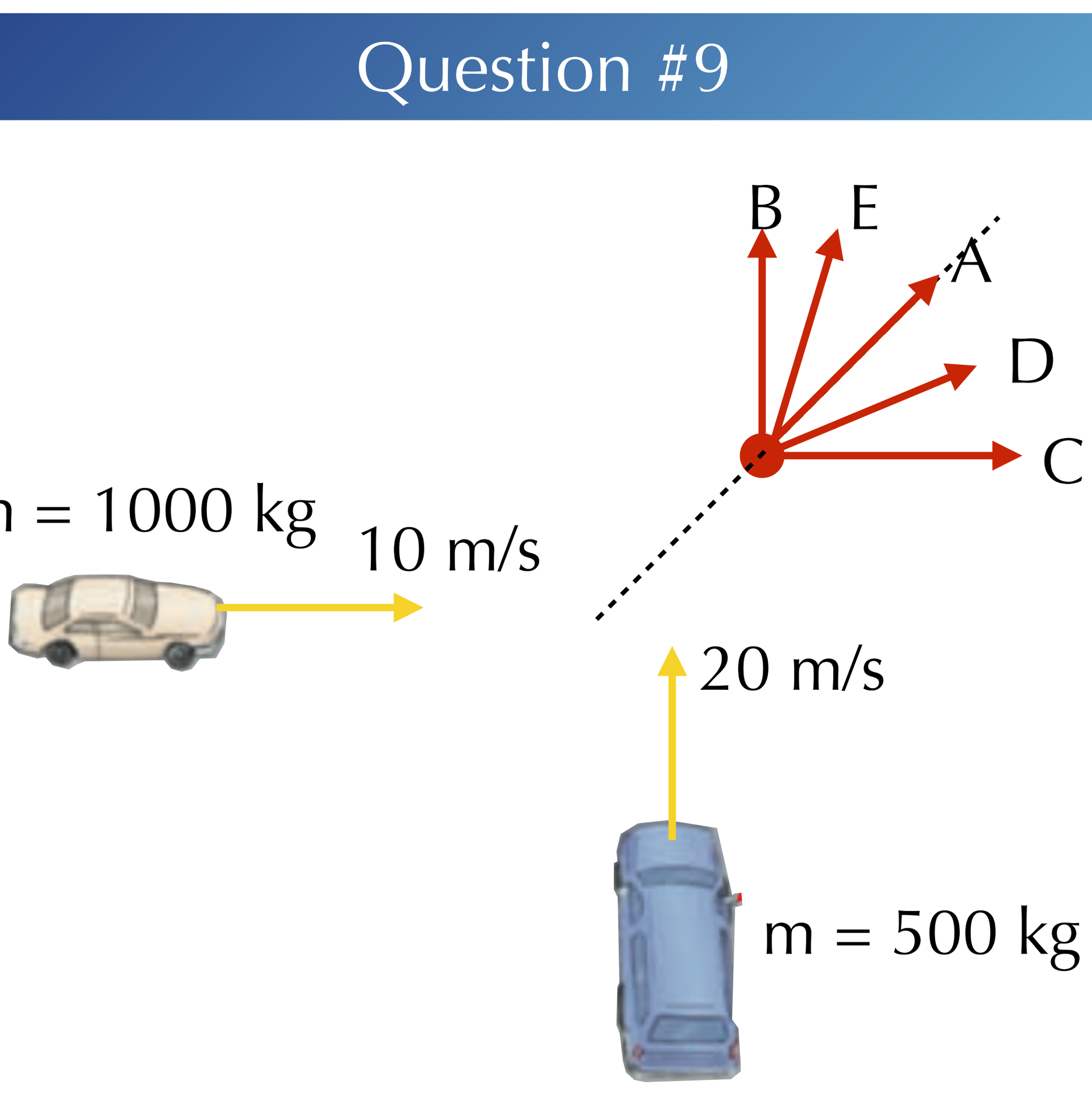
B. 2 m/s.

C. 1 m/s.

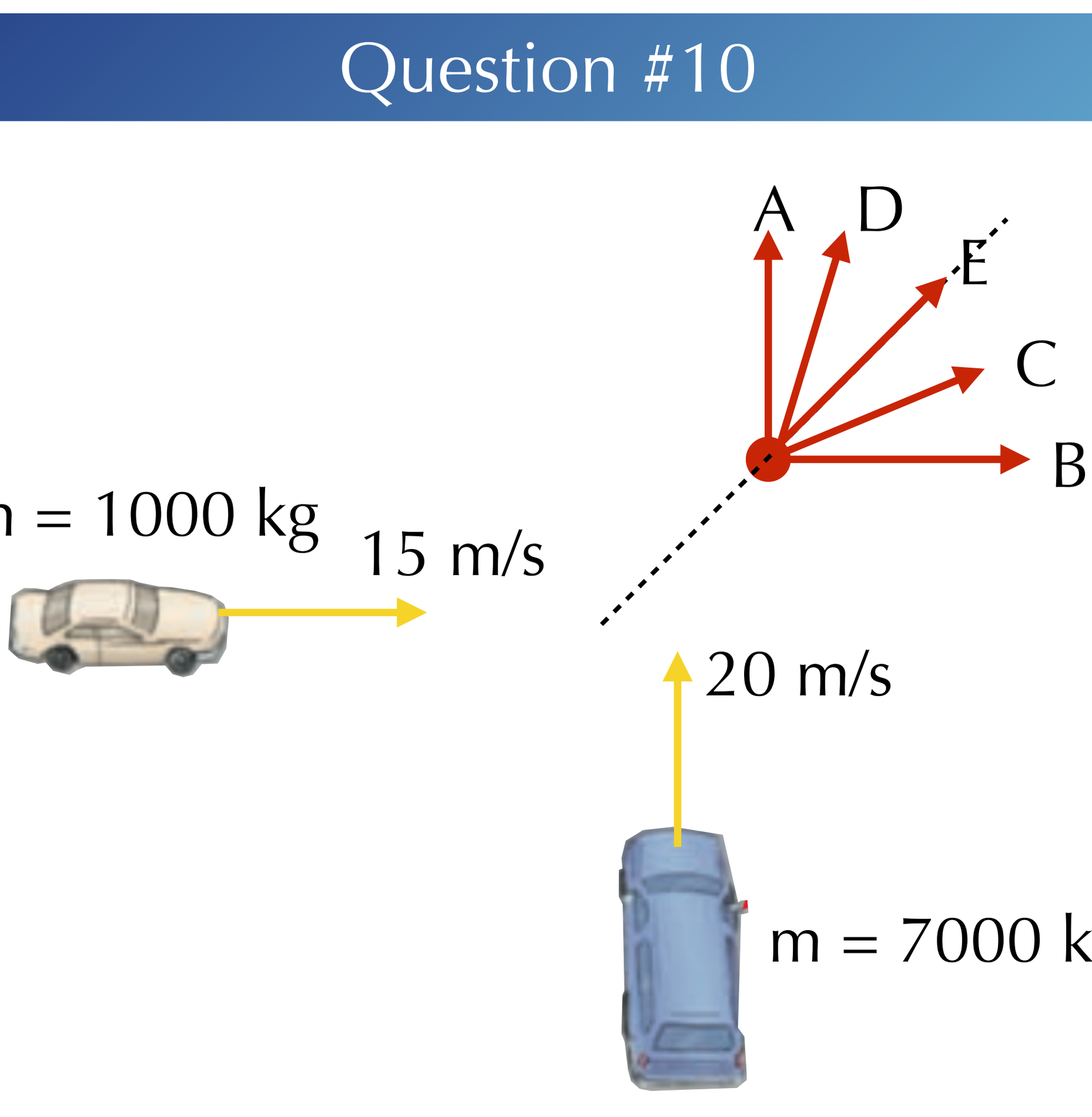
D. 8 m/s.

E. There's not enough information to tell.

Question #9

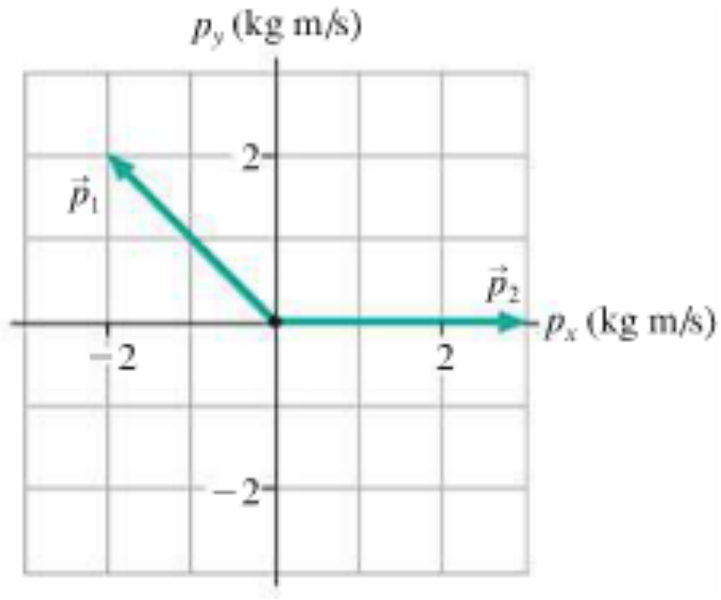


Question #10



Question #8

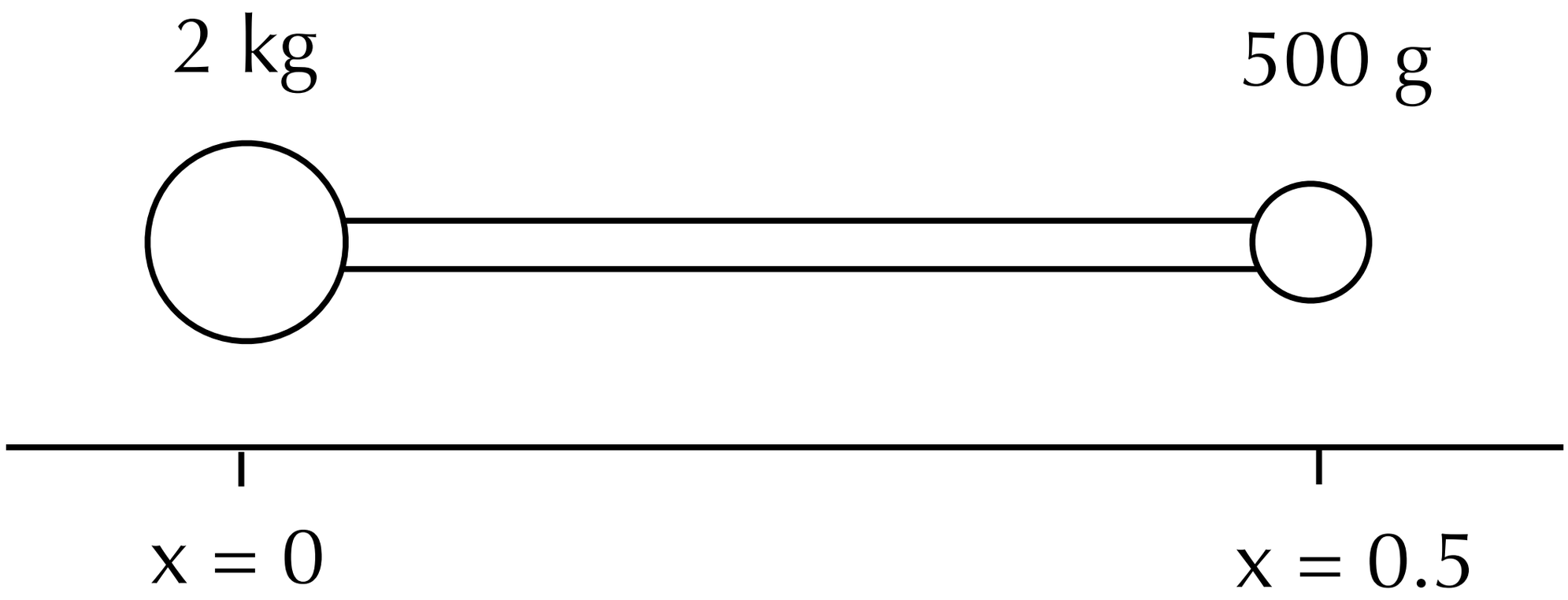
An object at rest explodes into three fragments. The figure shows the momentum vectors of two of the fragments. What are p_x and p_y of the third fragment?



a. $p_x = -1$, $p_y = -2$
b. $p_x = 1$, $p_y = 2$
c. $p_x = -2$, $p_y = -1$
d. $p_x = 2$, $p_y = 3$
e. $p_x = 2$, $p_y = 1$

What is the center of mass for this system?

Question #1



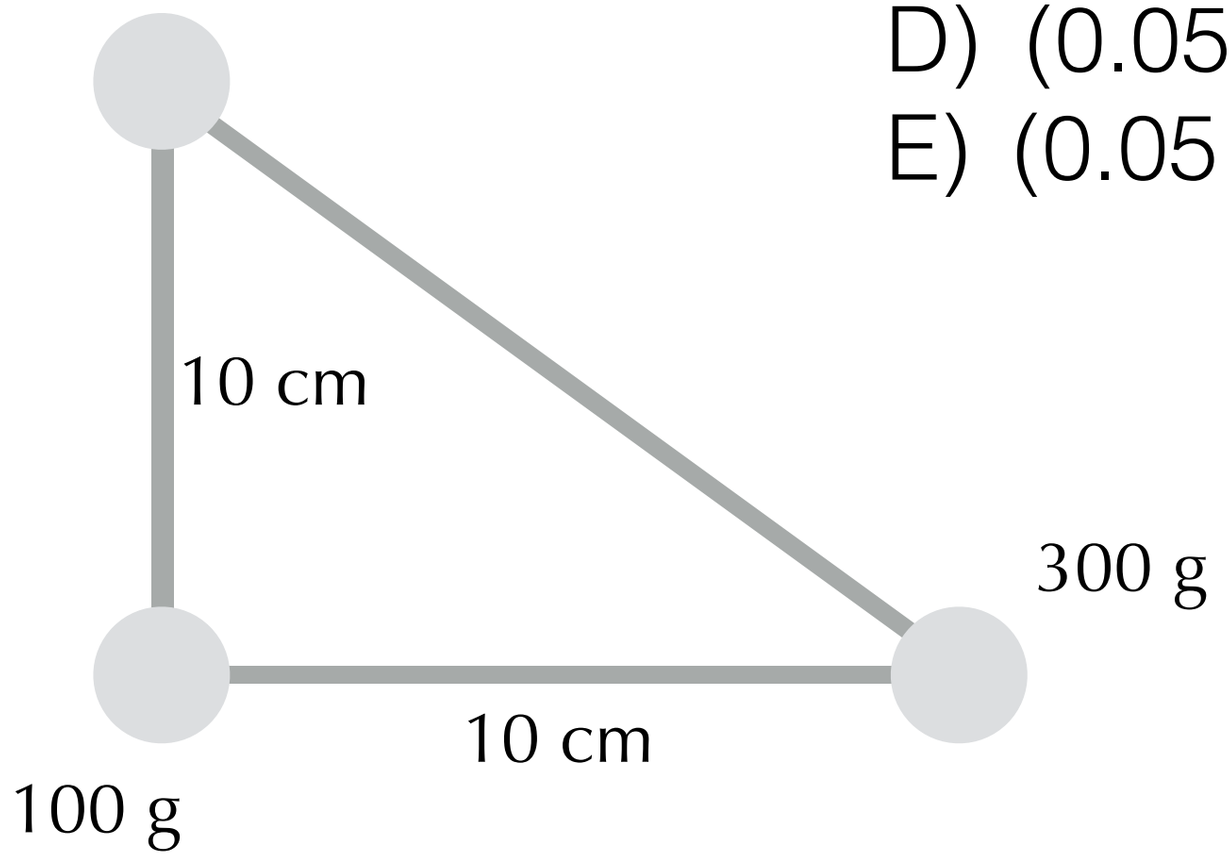
A) 0.05 m
B) 0.25 m
C) 0.1 m
D) 0.5 m
E) 0.75 m

Two-Dimensional Problem

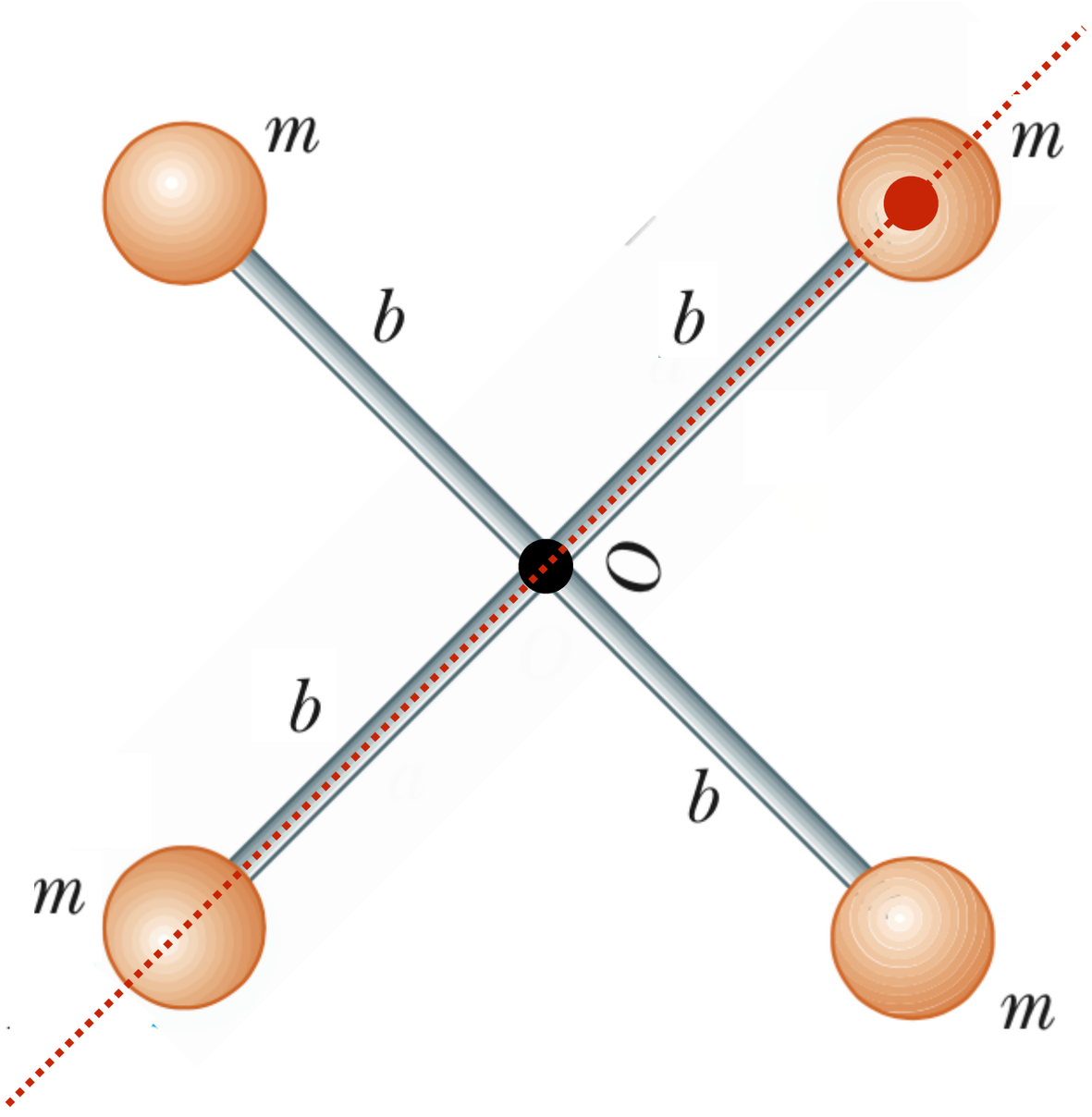
Question #2

The three balls shown are connected by massless, rigid rods. What are the coordinates of the center of mass?

A) (0.05, 0.05) m
B) (0.1, 0.03) m
C) (0.1, 0.05) m
D) (0.05,0.075)m
E) (0.05 , 0.03) m



Question #3



$$I = \sum mr^2$$

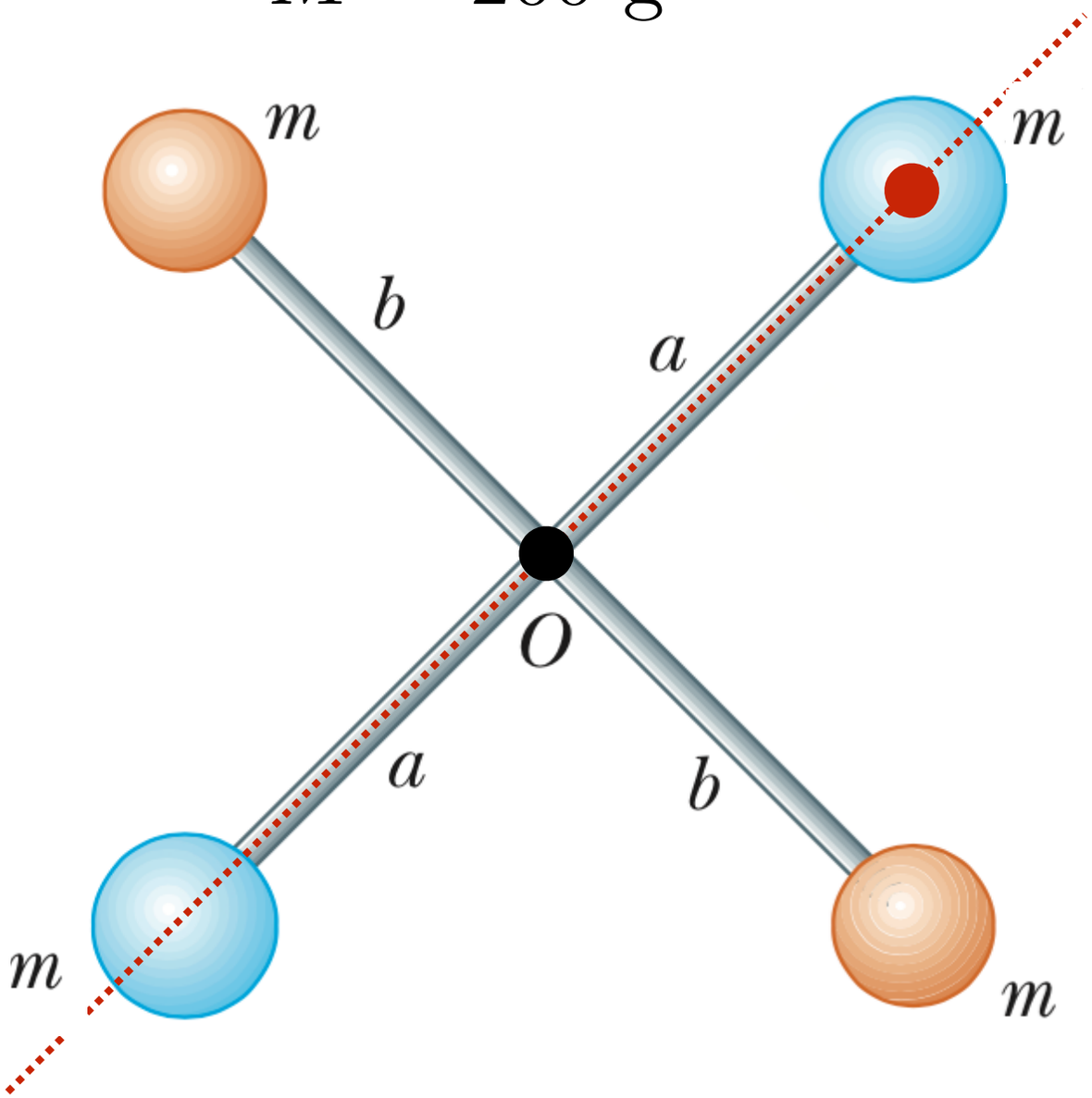
The moment of inertia about which axis will be greatest?

a) red dot
b) black dot
c) red dotted line.

Question #3

$a = 50\ \text{cm} \quad b = 75\ \text{cm} \quad m = 100\ \text{g}$

$M = 200\ \text{g}$



$$I = \sum mr^2$$

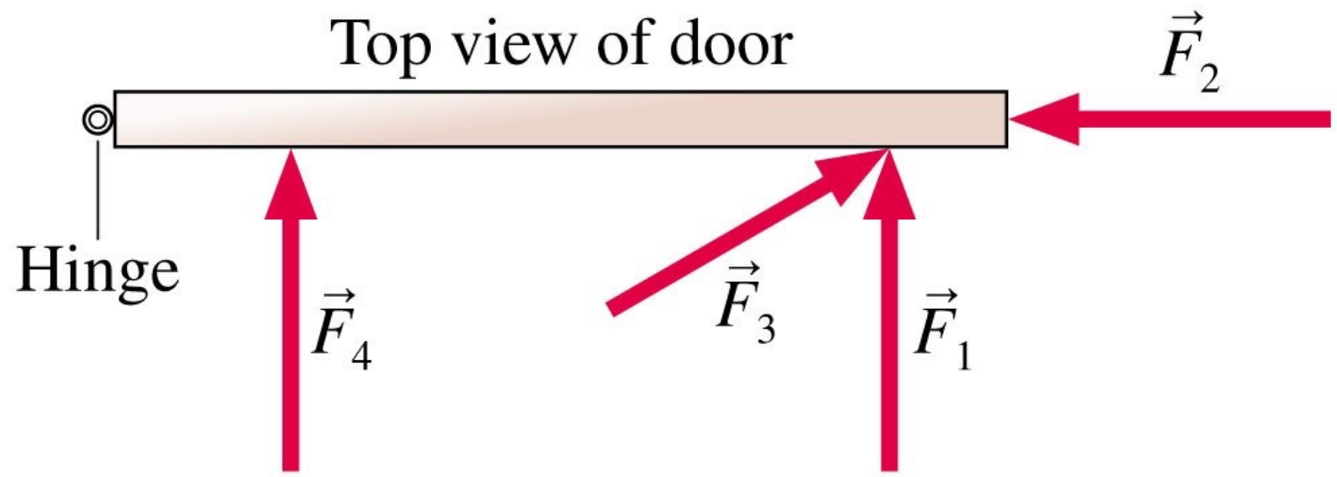
The moment of inertia about which axis will be greatest?

a) red dot
b) black dot
c) red dotted line.

Quiz

Question #4

The four forces shown have the same strength. Which force would be most effective in opening the door?

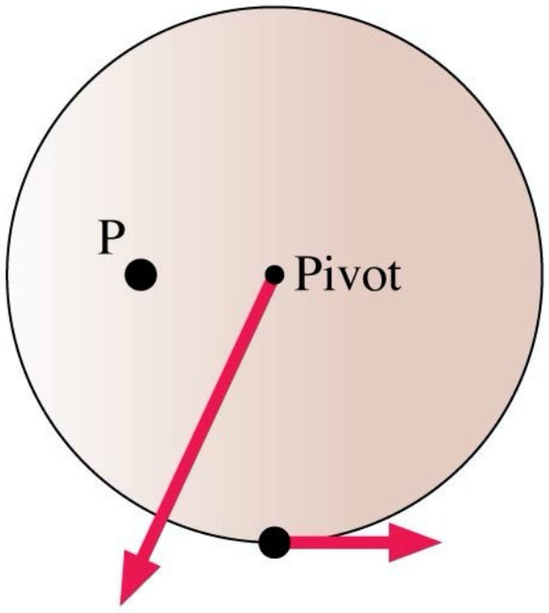


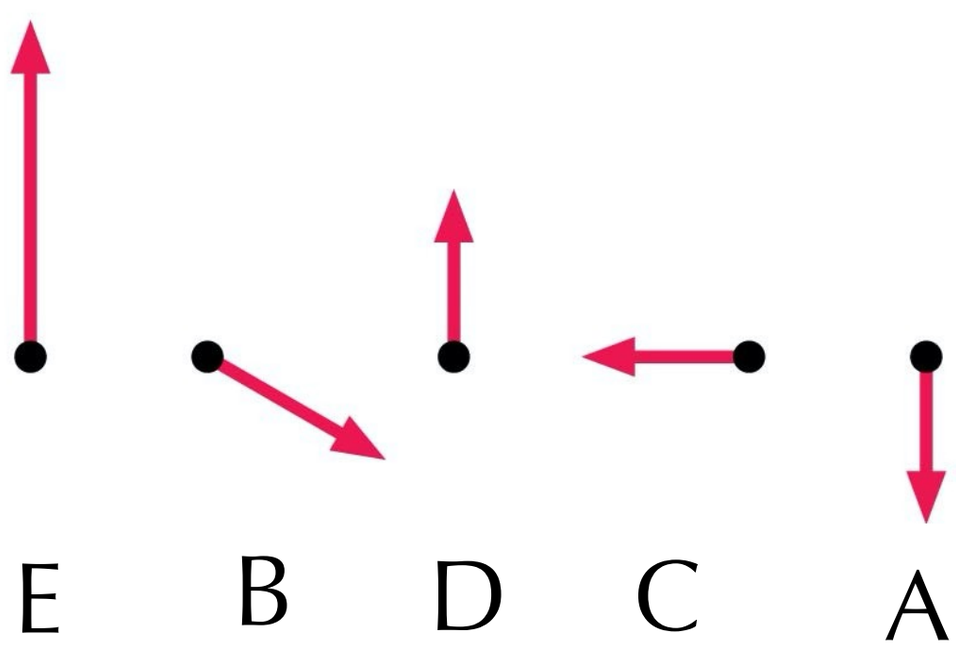
a. Force F_2.
b. Force F_1.
c. Force F_3.
d. Force F_4.
e. Either F_1 or F_3.

Quiz

Question #5

Which third force on the wheel, applied at point P, will make the net torque zero?





E B D C A

Gravitational Torque

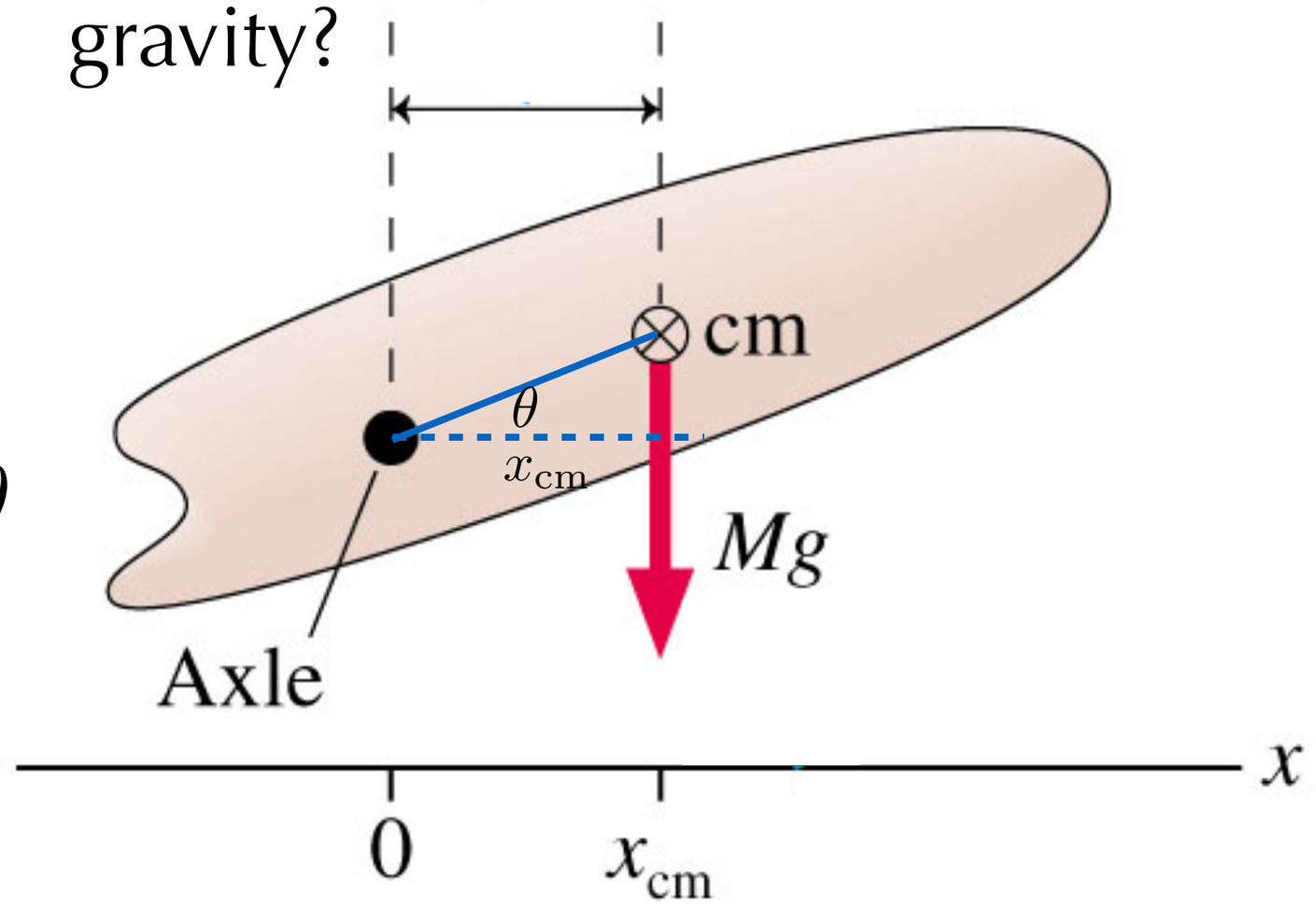
Question #6

Which is the correct expression for the torque produced by gravity?

D $\tau_{\text{grav}} = -Mgx_{\text{cm}}$

C $\tau_{\text{grav}} = -Mgx_{\text{cm}} \sin\theta$

B $\tau_{\text{grav}} = -Mgx_{\text{cm}} \cos\theta$



Question #7

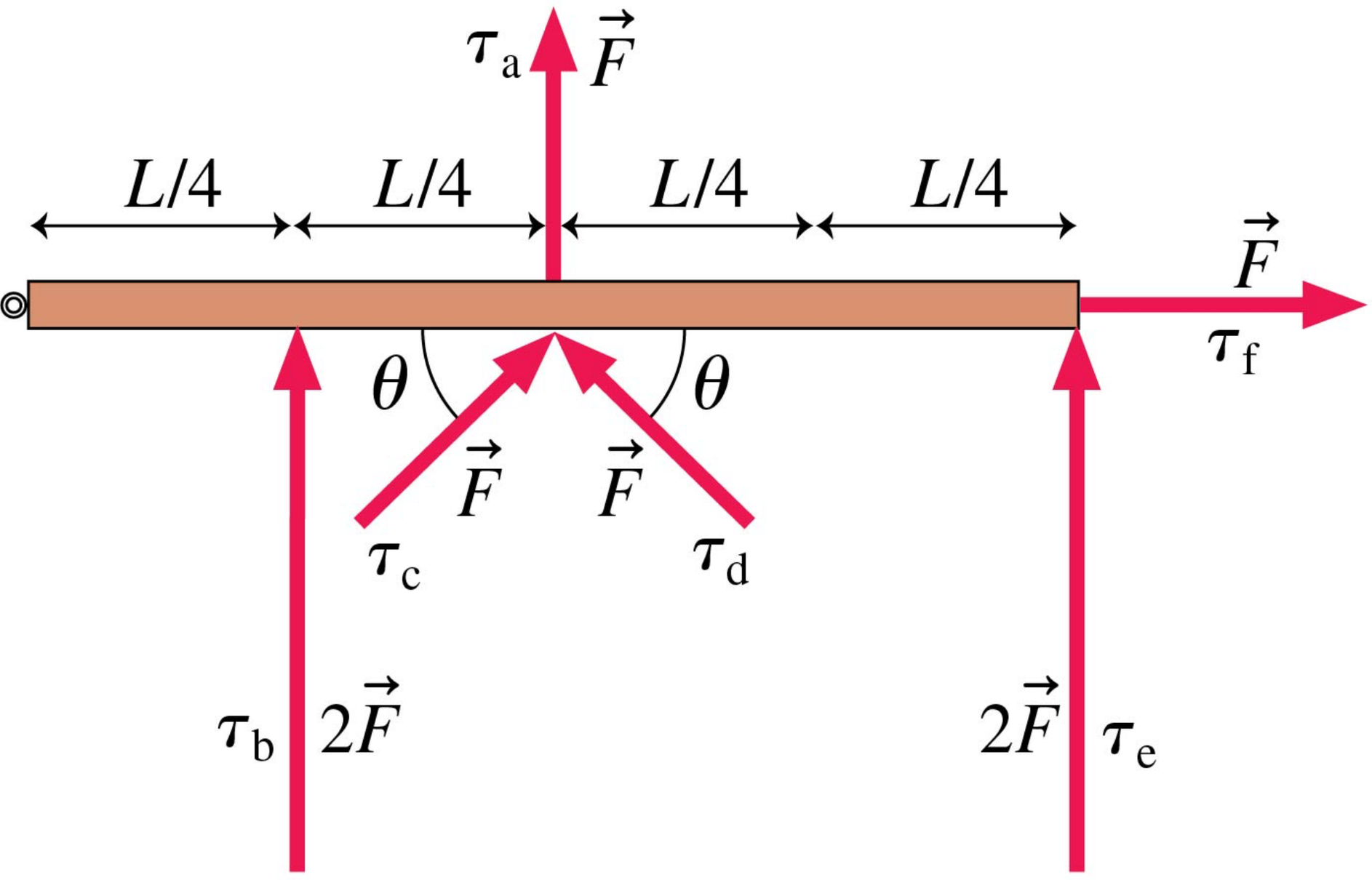
When I release the object what will happen?

A) It will oscillate back and forth. B) Nothing. It will stay where you put it.
C) It will first rotate and then quickly come to rest.

Question #8

Rank the torques

A) e > a = b > c = d > f
B) e = a > b > c > d > f
C) e > b > a > d = c > f

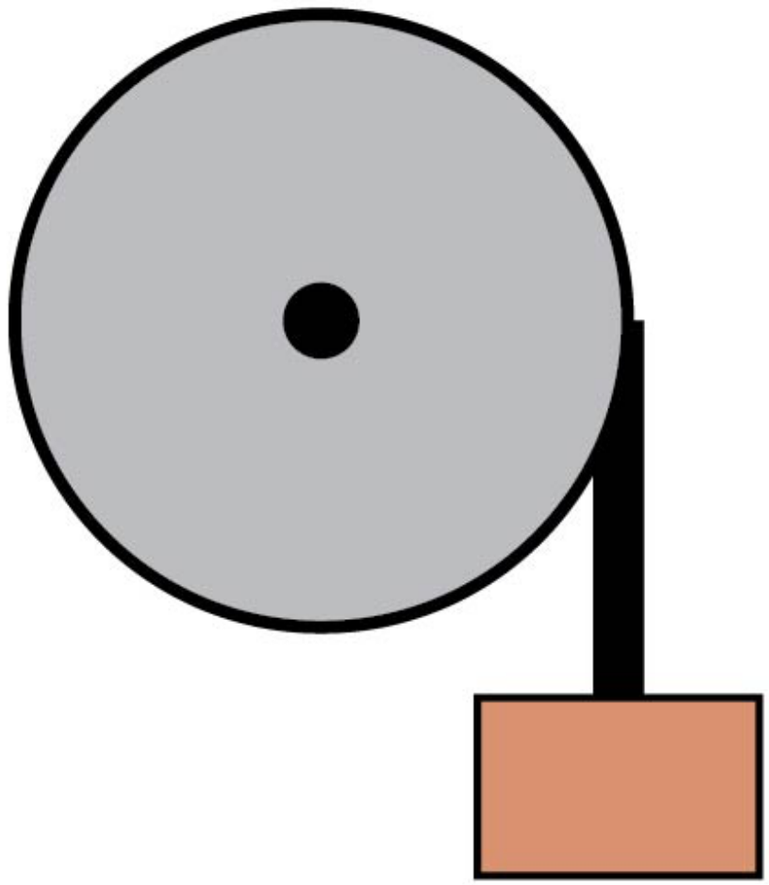


Question # 25

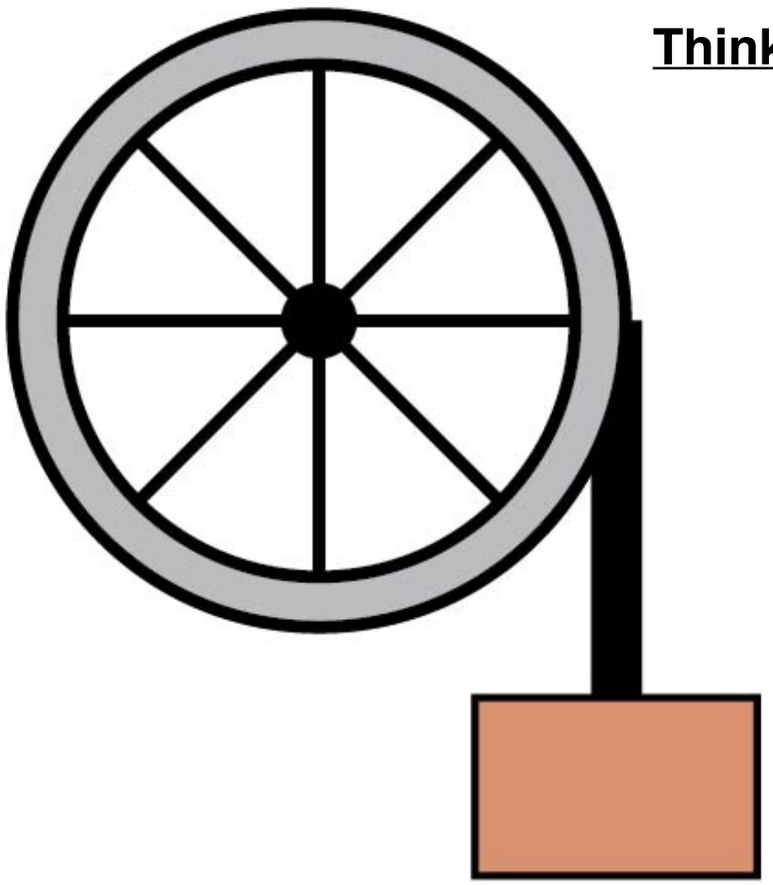
In which case will the block be moving faster just before it hits the floor?

Think energy!!

A



B



Question #20

Which object is in static equilibrium?

A

B

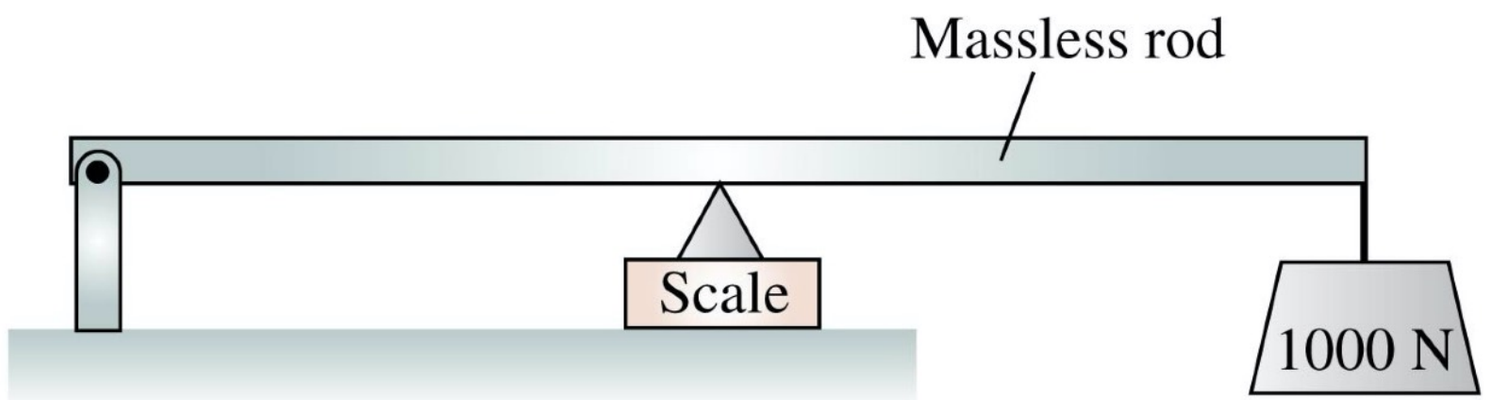
C

D

Question #21

What does the scale read?

a. 2000 N
b. 1000 N
c. 500 N
d. 4000 N



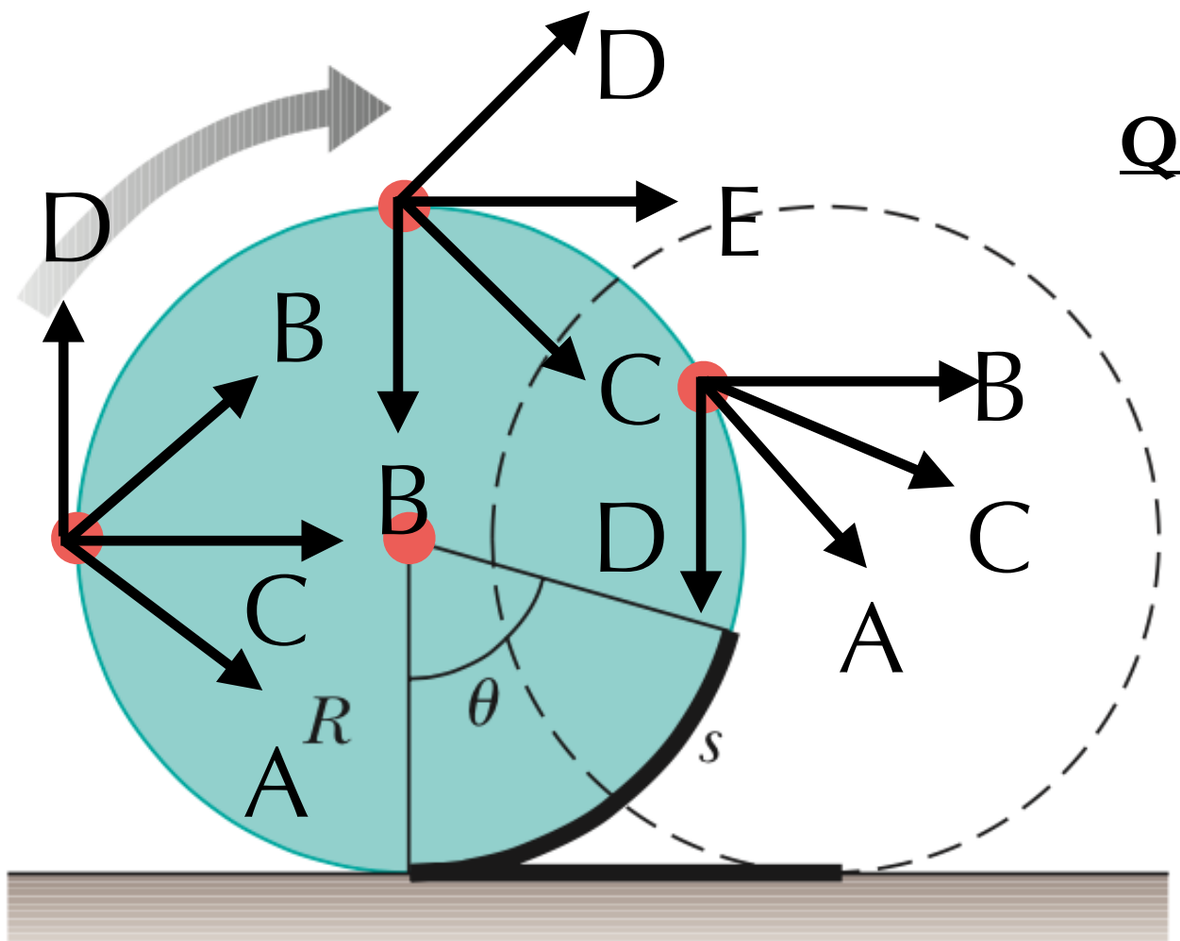
Answering this requires reasoning not calculating.

Rolling Motion

If this disk rolls for one full revolution, how far has the center of mass moved horizontally

$$v_{\mathrm{cm}} = R\omega$$

What is the velocity vector?



Question #18

Question #19

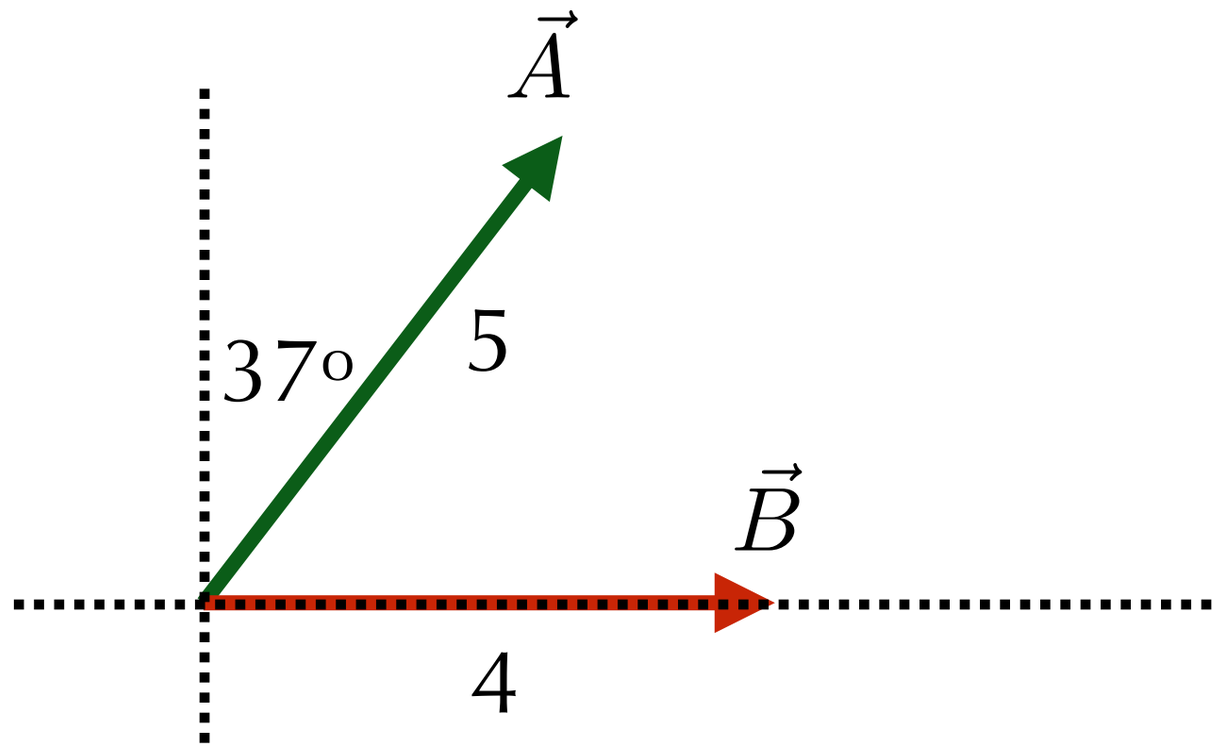
Question #20

Calculating the cross product

Question #21

What is the magnitude of the cross product?

a) 16
b) 12
c) 20
d) 15



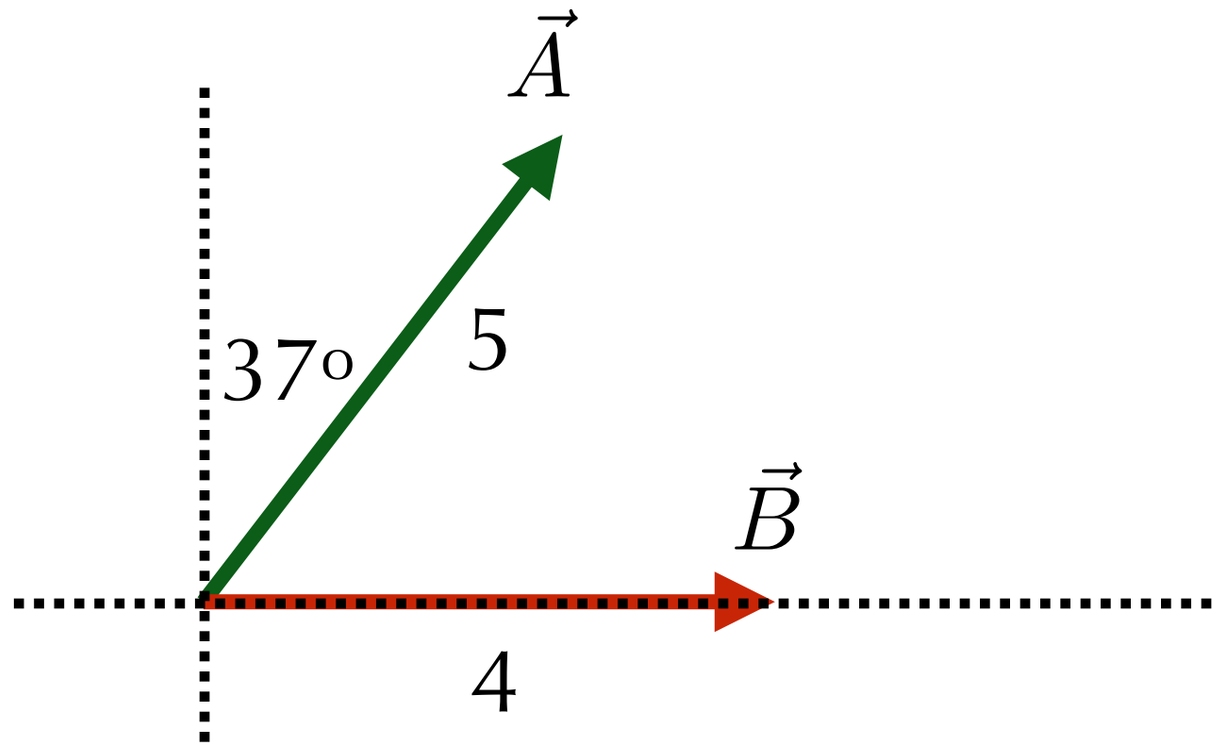
Calculating the cross product

Question #22

What is the direction of the cross product?

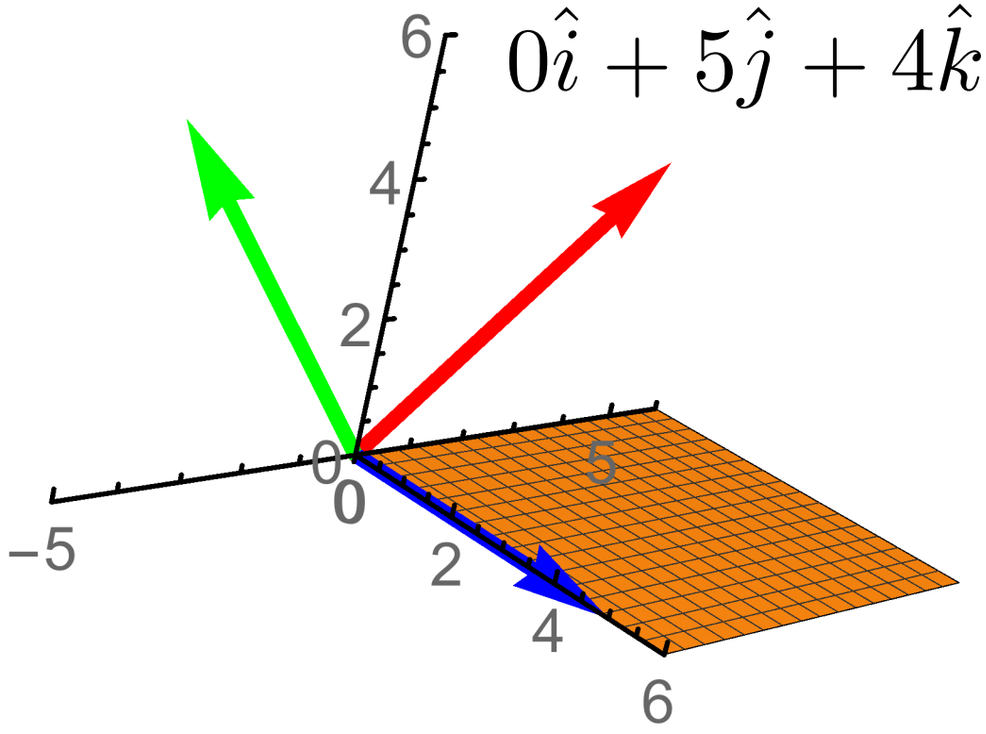
$$\vec{A} \times \vec{B}$$

a) Out of the screen
b) To the right
c) Into the screen
d) To the left



Question #23

What is the cross product of the blue vector with the red vector?



$0\hat{i} + 5\hat{j} + 4\hat{k}$

$5\hat{i} + 0\hat{j} + 0\hat{k}$

b) $20\hat{i} + 0\hat{j} + 25\hat{k}$

c) $0\hat{i} + 20\hat{j} - 25\hat{k}$

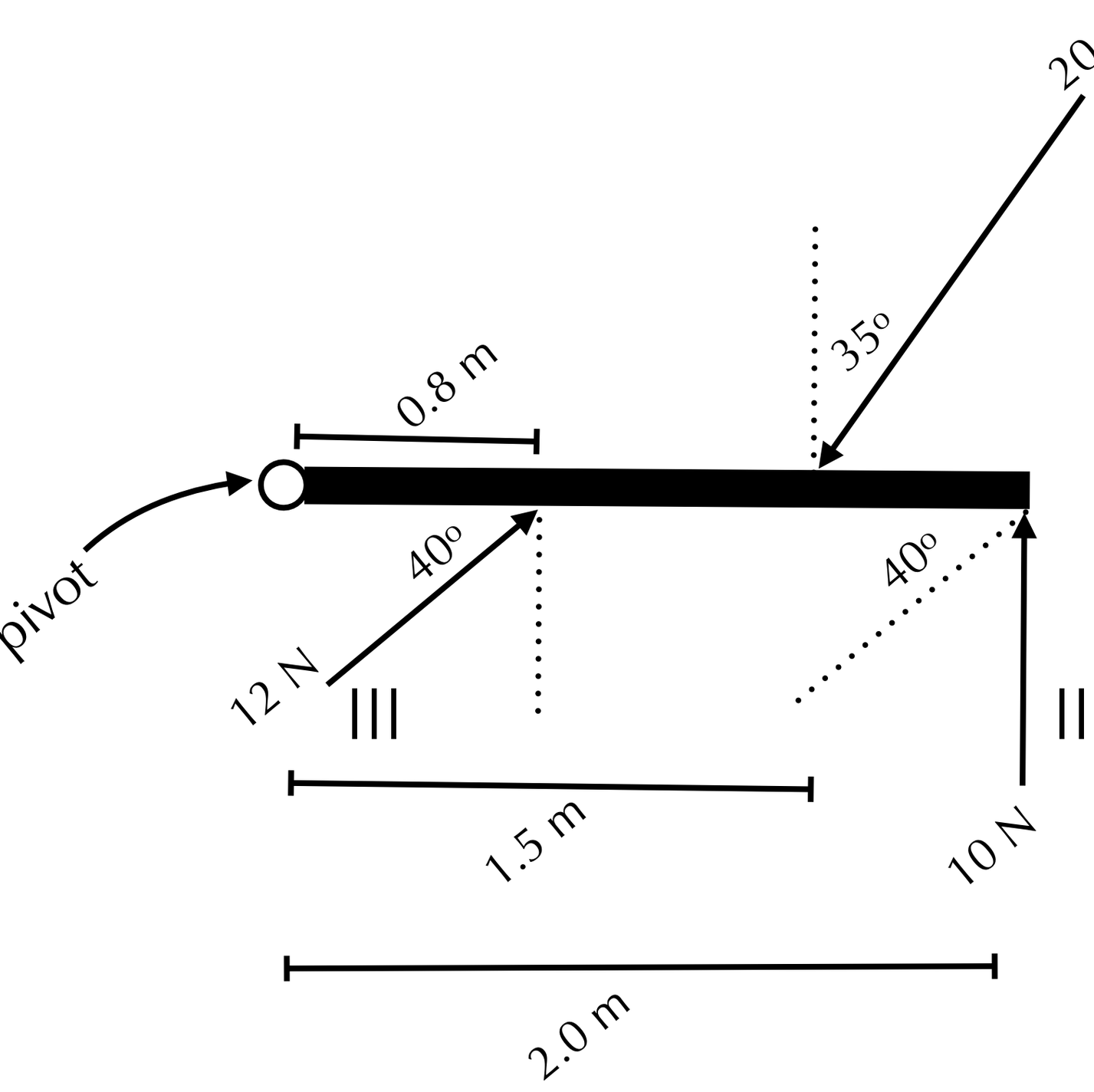
d) $0\hat{i} + 20\hat{j} + 25\hat{k}$

e) $0\hat{i} - 20\hat{j} + 25\hat{k}$

Torque

Which of the torque vectors point out of the screen?

Question #24



A) I and II
B) II and III
C) I and III
D) All three

Two buckets spin around in a horizontal circle on frictionless bearings. Suddenly, it starts to rain. As a result,

a. The buckets slow down because the angular momentum of the bucket + rain system is conserved.
b. The buckets continue to rotate at constant angular velocity because the rain is falling vertically while the buckets move in a horizontal plane.
c. The buckets speed up because the potential energy of the rain is transformed into kinetic energy.
d. The buckets continue to rotate at constant angular velocity because the total mechanical energy of the bucket + rain system is conserved.
e. None of the above.

Question #13

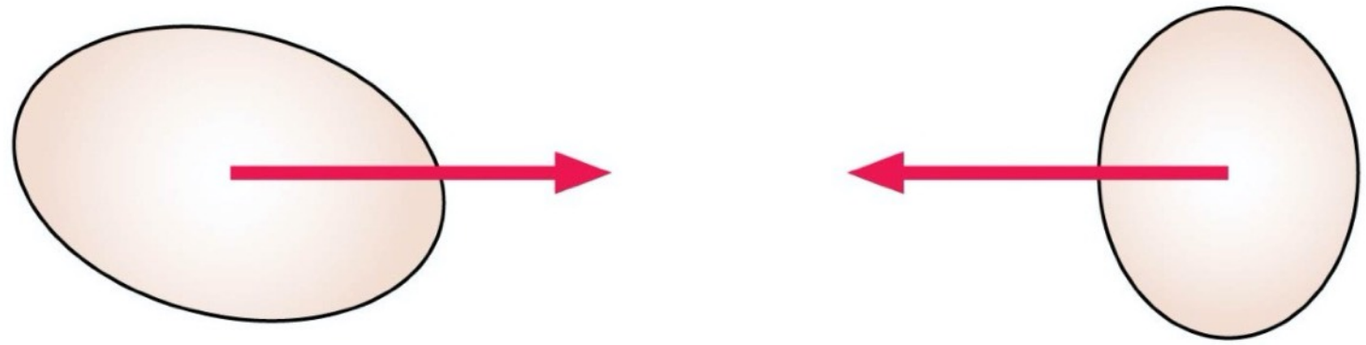
The force of Planet Y on Planet X is ___ the magnitude of $\vec{F}_{\text{X on Y}}$.

a. One quarter.
b. Four times.
c. One half.
d. Twice.
e. The same as.

Question #14

The gravitational force between two asteroids is 1,000,000 N. What will the force be if the distance between the asteroids is doubled?

a. 4,000,000 N.
b. 250,000 N.
c. 1,000,000 N.
d. 500,000 N.
e. 2,000,000 N.



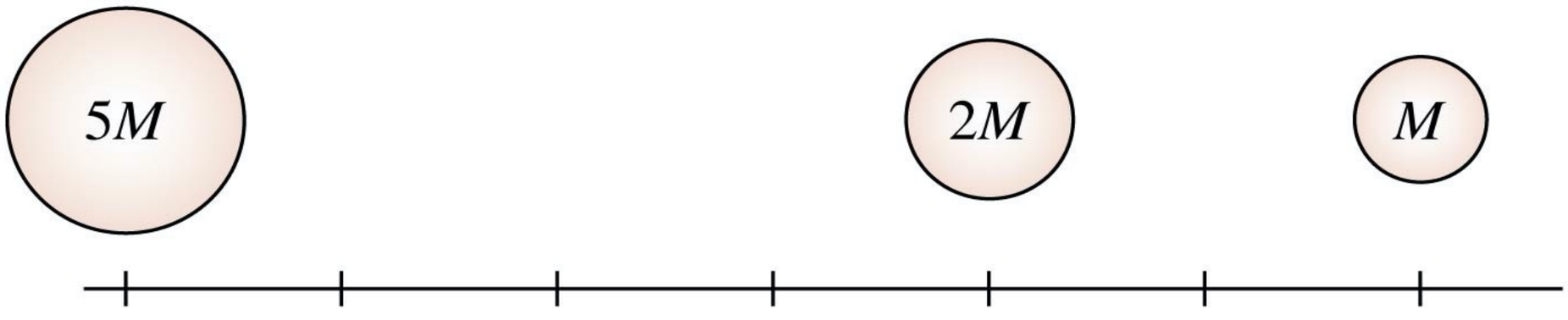
Question #15

Three stars are aligned in a row. The net force on the star of mass $2M$ is

C - To the right.

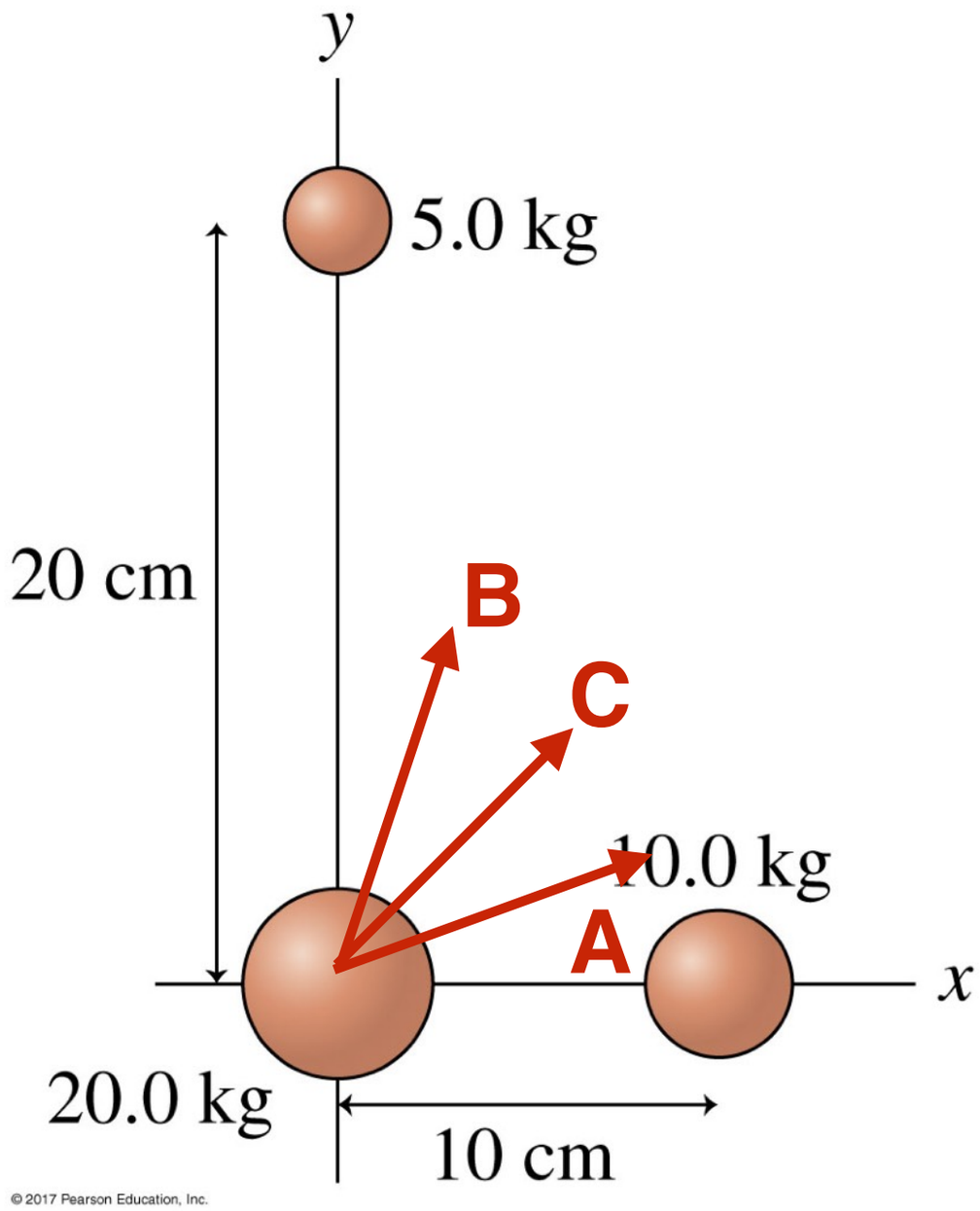
D - Zero.

E - To the left.



Question #16

Which vector best represents the net force on the 20 kg mass?



Question #17

Planet X has free-fall acceleration 8 m/s^2 at the surface. Planet Y has twice the mass and twice the radius of planet X. On Planet Y

a. $g = 2$ m/s^2.
b. $g = 8$ m/s^2.
c. $g = 4$ m/s^2.
d. $g = 16$ m/s^2.
e. $g = 32$ m/s^2.

Question #18

Astronauts on the International Space Station are weightless because

a. There's no gravity in outer space.
b. The net force on them is zero.
c. They are in free fall.
d. g is very small, although not zero.
e. The centrifugal force balances the gravitational force.

Example: Escape Speed

Question # 19

A 1000 kg rocket is fired straight away from the surface of the earth. What speed does the rocket need to "escape" from the gravitational pull of the earth and never return?

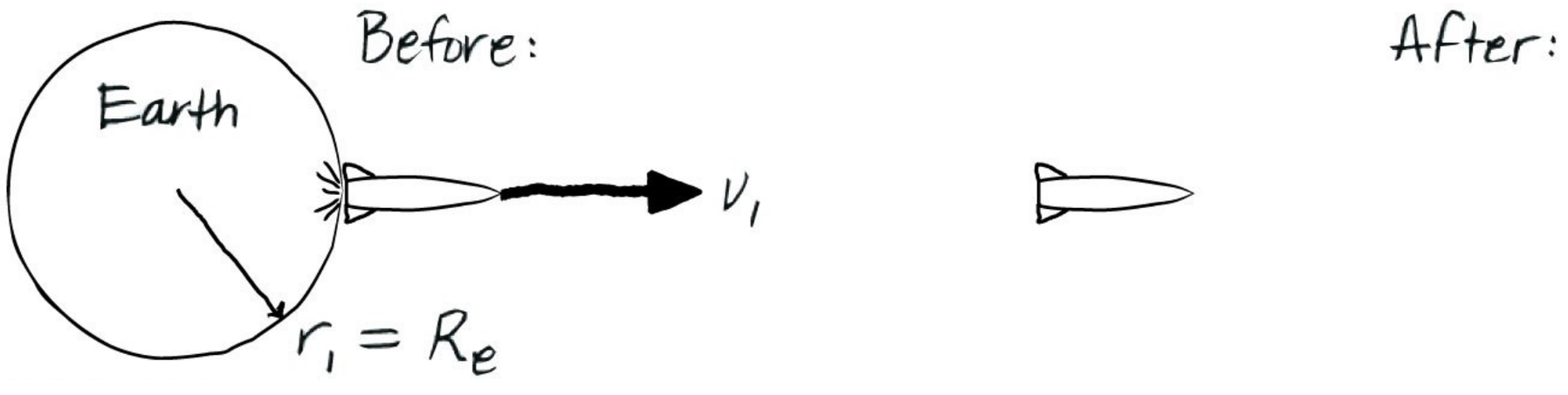
Which equation is a correct statement of conservation of energy?

D $\frac{1}{2}mv_i^2 - \frac{GM_e m_R}{R_e} = 0$

C $\frac{1}{2}mv_i^2 = \frac{1}{2}mv_f^2 + \frac{GM_e m_R}{R_e}$

B $\frac{1}{2}mv_i^2 + \frac{GM_e m_R}{R_e} = 0$

A $\frac{1}{2}mv_i^2 - \frac{GM_e m_R}{R_e} = \frac{1}{2}mv_f^2$



Example Problem **Question # 20**

A less-than-successful inventor wants to launch small satellites into orbit by launching them straight up from the surface of the earth at very high speed.

a)With what speed should he launch the satellite if it is to have a speed of 500 m/s at a height of 400 km?

Which equation is a correct statement of conservation of energy?

D $\frac{1}{2}mv_i^2 - \frac{GM_em_R}{R_e} = \frac{1}{2}mv_f^2 - \frac{GM_em_R}{R_e+h}$

C $\frac{1}{2}mv_i^2 = \frac{1}{2}mv_f^2 - \frac{GM_em_R}{R_e+h}$

B $\frac{1}{2}mv_i^2 = \frac{1}{2}mv_f^2 - \frac{GM_em_R}{R_e}$

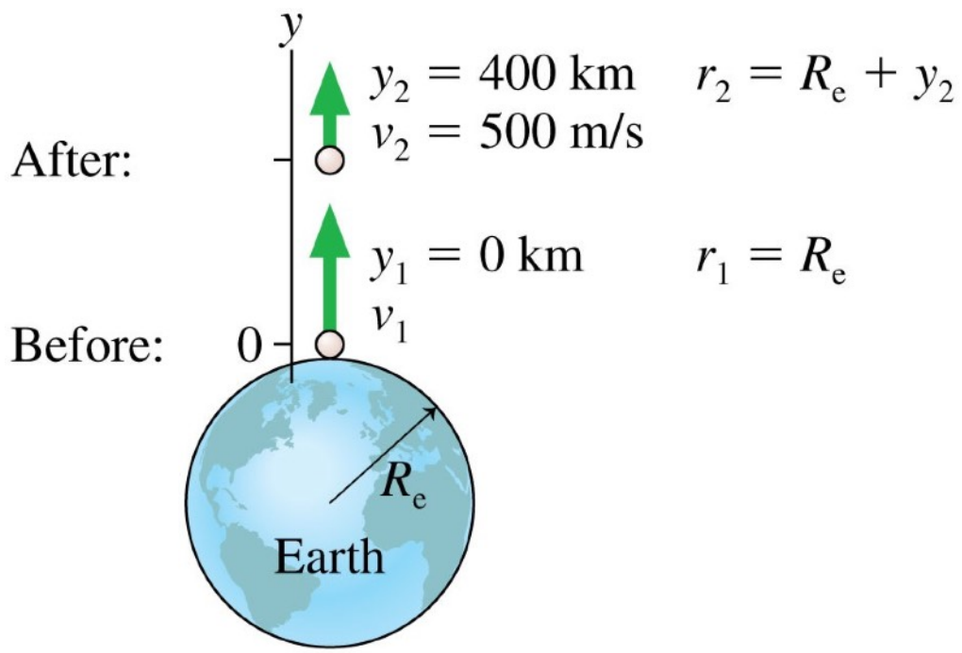
A $\frac{1}{2}mv_i^2 = \frac{1}{2}mv_f^2 + \frac{GM_em_R}{R_e}$

old approach

$v_i = 2844 \text{ m/s}$

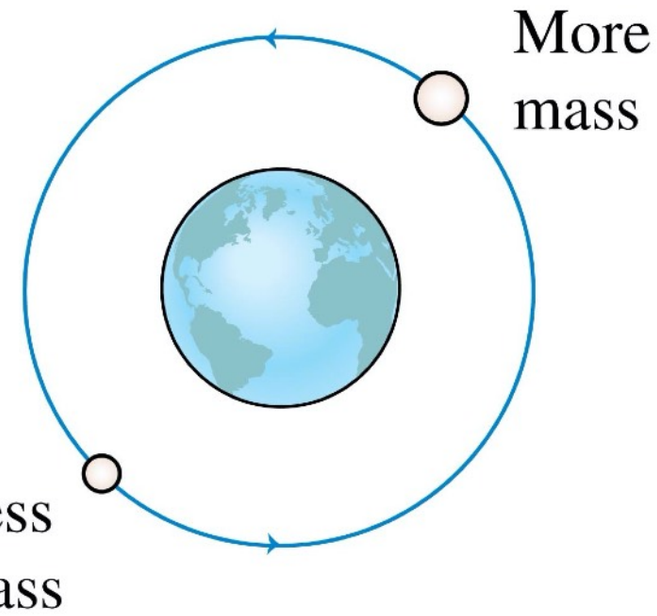
correct way

$v_i = 2763 \text{ m/s}$



Question #21

Two satellites have circular orbits with the same radius. Which has a higher speed?`



B- They have the same speed.

C- The one with less mass.

D- The one with more mass.

Question #22

Two identical satellites have different circular orbits. Which has a higher speed?

a. The one in the larger orbit.
b. They have the same speed.
c. The one in the smaller orbit.