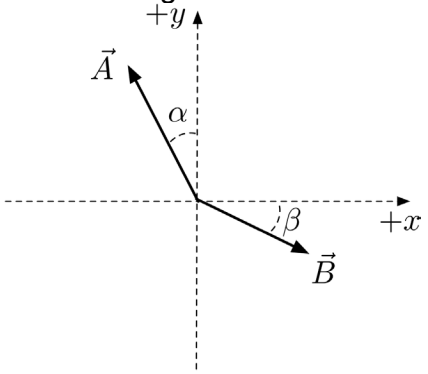
Supplementary Resource Document for Bego et al. (2024) “Single-Paper Meta-Analyses of the Effects of Spaced Retrieval Practice in Nine Introductory STEM Courses: Is the Glass Half Full or Half Empty?”

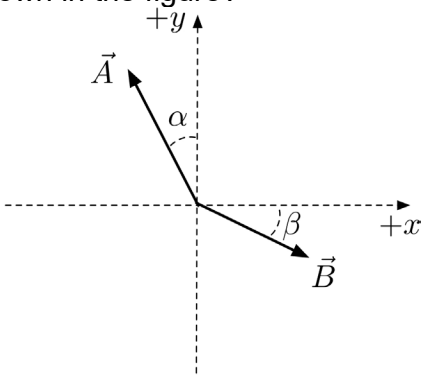
Assessment Items for Fundamentals of Physics I, exported from Blackboard

1. Which choice below shows the correct expression for calculating the *x* and *y* components of vector **A** shown in the figure?



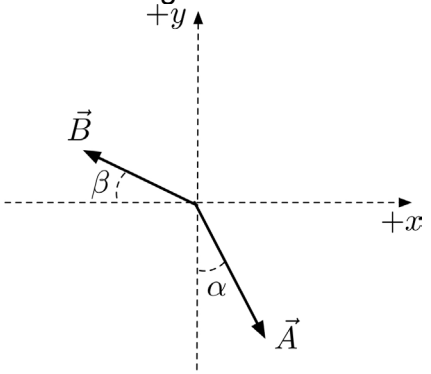
*a. -**A**sin*α*, +**A**cos*α*
b. -**A**cos*α*, +**A**sin*α*
c. +**A**sin*α*, +**A**cos*α*
d. +**A**cos*α* , +**A**sin*α*

2. Which choice below shows the correct expression for calculating the *x* and *y* components of vector **B** shown in the figure?



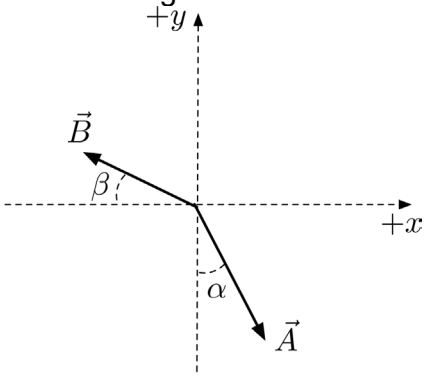
*a. +**B**cos*β*, -**B**sin*β*
b. +**B**sin*β*, -**B**cos*β*
c. +**B**cos*β*, +**B**sin*β*
d. +**B**sin*β*, +**B**cos*β*

3. Which choice below shows the correct expression for calculating the *x* and *y* components of vector **A** shown in the figure?



*a. +**A**sin*α*, -**A**cos*α*
b. +**A**cos*α*, -**A**sin*α*
c. -**A**sin*α*, +**A**cos*α*
d. -**A**cos*α*, +**A**sin*α*

4. Which choice below shows the correct expression for calculating the *x* and *y* components of vector **B** shown in the figure?



*a. -**B**cos*β*, +**B**sin*β*
b. -**B**sin*β*, +**B**cos*β*
c. +**B**cos*β*, -**B**sin*β*
d. +**B**sin*β*, -**B**cos*β*

5. Vector **A** has an *x* component of 12.0 m and a *y* component of 18.0 m. What is the magnitude of vector **A**?

*a. 21.6 m
b. 30.0 m
c. 46.8 m
d. 24.0 N

6. Vector **B** has an *x* component of 150 N and a *y* component of 100 N. What is the magnitude of vector **B**?

*a. 180 N
b. 250 N
c. 325 N
d. 200 N

7. Vector **C** has an *x* component of 60.0 m and a *y* component of 68.0 m. What is the magnitude of vector **C**?

*a. 90.7 m
b. 128 m
c. 82.2 m
d. 76.0 m

8. Vector **D** has an *x* component of 640 N and a *y* component of 520 N. What is the magnitude of vector **D**?

*a. 825 N
b. 1160 N
c. 680 N
d. 740 N

9. A vector has an *x* component of 120 m and a *y* component of -180 m. What is the direction of the vector relative to the *x*-axis?

*a. 56.3° below +x-axis
b. 56.3° above -x-axis
c. 33.7° below +x-axis
d. 33.7° above -x-axis

10. A vector has an *x* component of -24.0 m and a *y* component of -18.0 m. What is the direction of the vector relative to the *x*-axis?

*a. 36.9° below -x-axis
b. 36.9° below +x-axis
c. 53.1° below -x-axis
d. 53.1° below +x-axis

11. A vector has an *x* component of -350 m and a *y* component of 300 m. What is the direction of the vector relative to the *x*-axis?

*a. 40.6° above -x-axis
b. 40.6° below -x-axis
c. 49.4° above -x-axis
d. 49.4° below -x-axis

12. A vector has an *x* component of 42.0 m and a *y* component of -48.0 m. What is the direction of the vector relative to the *x*-axis?

*a. 48.8° below +x-axis
b. 48.8° below -x-axis
c. 41.2° below +x-axis
d. 41.2° below -x-axis

13. The expression $\frac{\boldsymbol{r}_\mathbf{f} - \boldsymbol{r}_\mathbf{i}}{t_f - t_i}$ calculates which of the following physical quantities?

*a. Average velocity
b. Average acceleration
c. Average position

14. Which of the following equations gives the correct definition for the average acceleration?

*a. $\frac{\boldsymbol{v}_\mathbf{f} - \boldsymbol{v}_\mathbf{i}}{t_f - t_i}$
b. $\frac{\boldsymbol{r}_\mathbf{f} - \boldsymbol{r}_\mathbf{i}}{t_f - t_i}$
c. $\boldsymbol{v}_\mathbf{f} - \boldsymbol{v}_\mathbf{i}$
d. $\boldsymbol{r}_\mathbf{f} - \boldsymbol{r}_\mathbf{i}$

15. The expression $\frac{\boldsymbol{v}_\mathbf{f} - \boldsymbol{v}_\mathbf{i}}{t_f - t_i}$ calculates which of the following physical quantities?

*a. Average acceleration
b. Average velocity
c. Average position

16. Which of the following equations gives the correct definition for the average velocity?

*a. $\frac{\mathbf{r_f} - \mathbf{r_i}}{t_f - t_i}$

b. $\frac{\mathbf{v_f} - \mathbf{v_i}}{t_f - t_i}$

c. $\mathbf{r_f} - \mathbf{r_i}$

d. $\mathbf{v_f} - \mathbf{v_i}$

17. A block is pushed across a rough horizontal surface. The surface exerts a normal force with a magnitude of 120 N on the block. If the coefficient of kinetic friction between the block and the surface is 0.400, what is the magnitude of the force of kinetic friction exerted on the block?

*a. 48.0 N
b. 300 N
c. 0.400 N
d. 30.0 N

18. A block is pushed across a rough horizontal surface. The surface exerts a normal force with a magnitude of 200 N on the block. If the magnitude of the force of kinetic friction exerted on the block by the surface is 80.0 N, what is the coefficient of kinetic friction between the block and the surface?

*a. 0.4
b. 0.6
c. 1.67
d. 2.5

19. A block is pushed across a rough horizontal surface. The surface exerts a force of kinetic friction with a magnitude of 120 N on the block. If the coefficient of kinetic friction between the block and the surface is 0.400, what is the magnitude of the normal force exerted on the block?

*a. 300 N
b. 48.0 N
c. 2.50 N
d. 480 N

20. A block is pushed across a surface that is inclined at an angle above the horizontal. The surface exerts a normal force with a magnitude of 240 N on the

block. If the coefficient of kinetic friction between the block and the surface is 0.400, what is the magnitude of the force of kinetic friction exerted on the block?

*a. 96.0 N
b. 600 N
c. 0.400 N
d. 60.0 N

22. A toy car is initially at rest at the bottom of a track that runs up a ramp. You release the car and it moves up the ramp with increasing speed. Once it reaches the end of the track, the car flies off the ramp and lands back on the ground 2.00 m away from the ramp. Which statement below correctly describes the acceleration of the car on its way up the ramp?

*a. The acceleration of the car points up the ramp.
b. The acceleration of the car points down the ramp.
c. The acceleration of the car points vertically downward.
d. The acceleration of the car is zero.

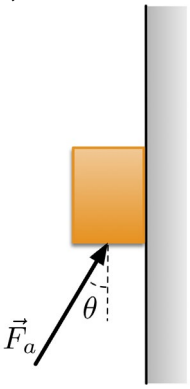
23. A 2.50 kg box is released at the top of a frictionless ramp that is inclined at an angle of 20.0° with the horizontal. The box slides 1.50 m down the ramp before you catch it and bring it to a stop in 0.400 m. Which statement below correctly describes the box's acceleration after you catch it but before it comes to a stop?

*a. The acceleration of the box points up the incline.
b. The acceleration of the box points down the incline.
c. The acceleration of the box points vertically downward.
d. The acceleration of the box is zero.

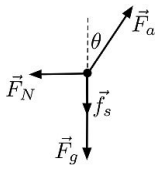
24. A rope is tied to one end of a 20.0 kg box that is initially at rest as it sits on a horizontal surface. The coefficient of friction between the box and the surface is 0.400. You pull on the rope with a 75.0 N force at an angle of 30.0° above the horizontal for 5.00 m, dragging the box to the right with an increasing speed before releasing the rope. Once you let go of the rope, the box slows to a stop. Which statement below accurately describes the box's acceleration before you let go of the rope?

*a. The acceleration of the box points to the right.
b. The acceleration of the box points to the left.
c. The acceleration of the box points at an angle of 30.0° above the horizontal.
d. The acceleration of the box is zero.

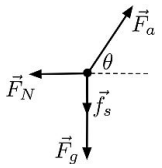
25. You push on a block that is in contact with a rough vertical wall. You push as hard as you can while the block remains stationary. If the force that you push the block with makes an angle θ with the vertical, which of the images below shows the correct free-body diagram for the block?



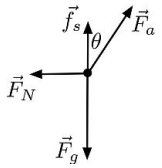
*a. FBD:



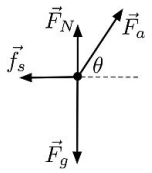
b. FBD:



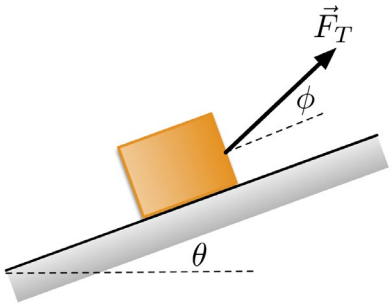
c. FBD:



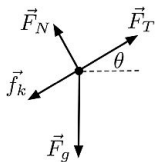
d. FBD:



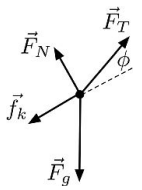
26. You use a rope to pull a box up a ramp that is inclined at an angle θ above the horizontal. The rope is not parallel to the ramp, but is angled at φ degrees above the ramp. If the ramp is rough, which of the images below shows the correct free-body diagram for the box?



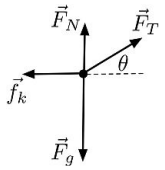
*a. FBD:



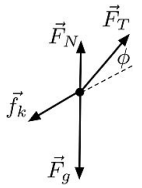
b. FBD:



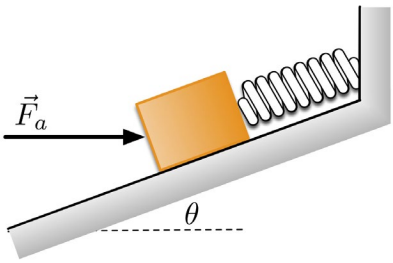
c. FBD:



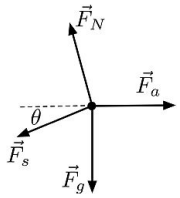
d. FBD:



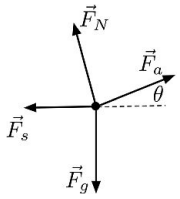
27. A block sits on a frictionless ramp that is inclined at an angle *θ* above the horizontal, as shown in the figure below. The block is connected to a spring. You push horizontally on the block, compressing the spring. Which of the images below shows the correct free-body diagram for the block?



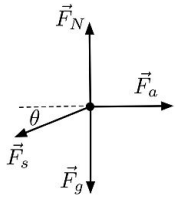
*a. FBD:



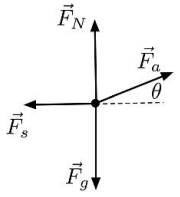
b. FBD:



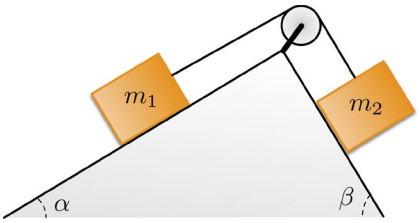
c. FBD:



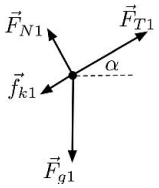
d. FBD:



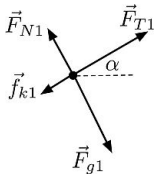
28. Two blocks are connected by a massless string that runs across a massless, frictionless pulley. Block 1 sits on a rough surface that is inclined at an angle *α* above the horizontal. When the blocks are released, block 1 slides up the surface and block 2 slides down. Which of the images below shows the correct free-body diagram for block 1?



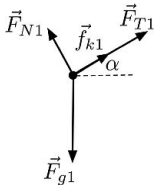
*a. FBD:



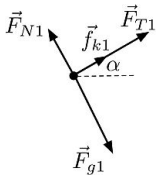
b. FBD:



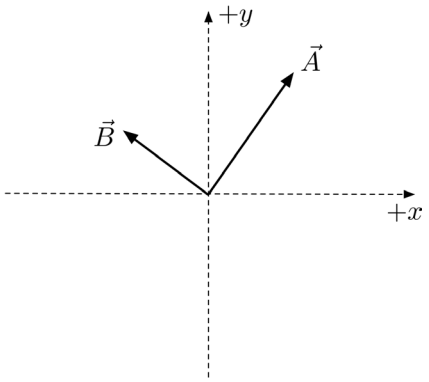
c. FBD:



d. FBD:



29. Two vectors are shown in the figure below. In which direction would a third vector **C** point if **A**+**B**+**C**=0?



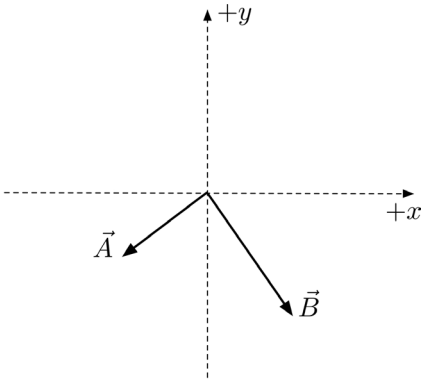
*a. Vector:

b. Vector:

c. Vector:

d. Vector:

30. Two vectors are shown in the figure below. In which direction would a third vector **C** point if **A+B+C**=0?



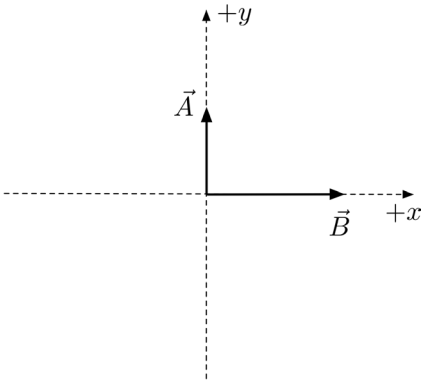
*a. Vector:

b. Vector:

c. Vector:

d. Vector:

31. Two vectors are shown in the figure below. In which direction would a third vector **C** point if **A**+**B**+**C**=0?



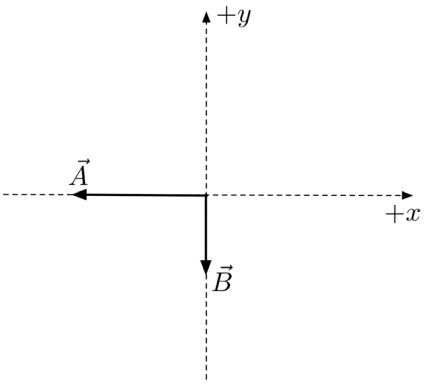
*a. Vector:

b. Vector:

c. Vector:

d. Vector:

32. Two vectors are shown in the figure below. In which direction would a third vector **C** point if **A**+**B**+**C**=0?



*a. Vector:

b. Vector:

c. Vector:

d. Vector:

33. A car and truck drive towards each other on a straight stretch of highway that runs east and west. The truck is traveling east at a constant speed. The car is traveling west, slowing down as it approaches the truck. Which two vectors point in the same direction as the car and truck approach each other?

*a. The velocity of the truck and the acceleration of the car
b. The velocity of the car and the acceleration of the truck
c. The displacement of the car and the velocity of the truck
d. The displacement of the truck and the velocity of the car

34. A cyclist rides her bike for 200 m. Starting from rest, she slowly accelerates over the first 100 m until she reaches a maximum speed of 15.0 m/s. Once she passes the 100m mark, she begins to slow back down, coming to a stop as she reaches the 200m mark. Which vectors point in opposite directions during the cyclist's ride?

*a. The cyclist's acceleration over the first 100 m and her acceleration over the second 100 m
b. The cyclist's displacement during the first 100 m and her displacement during the second 100 m

c. The cyclist's velocity during the first 100 m and her velocity during the second 100 m
d. The cyclist's displacement over the first 100 m and her velocity during the second 100 m

35. You throw a ball straight up in the air. It rises to its maximum height then falls back down until you catch it. Which vectors point in the same direction during the ball's flight?

*a. The acceleration of the ball on its way up and the displacement of the ball on its way down
b. The displacement of the ball on its way up and the acceleration of the ball on its way down
c. The displacement of the ball on its way up and the velocity of the ball on its way down
d. The velocity of the ball on its way up and the displacement of the ball on its way down

36. A car and truck are both traveling north on a straight road. The truck is initially 30.0 m ahead of the car, traveling at a constant speed that is slower than the speed of the car. To avoid hitting the truck, the car slows down at at constant rate until it is 10.0 m behind the truck and both vehicles are traveling at the same speed. Which vectors point is the opposite directions as the car slows down?

*a. The acceleration of the car and the velocity of the truck
b. The velocity of the car and the velocity of the truck
c. The displacement of the car and the velocity of the truck
d. The velocity of the car and the acceleration of the truck

37. A ball is thrown from the top of a 15.0 m tall building. The ball is initially released with a speed of 25.0 m/s in the direction 30.0 degrees above the horizontal. 1.00 second after it was released, the ball is traveling with a speed of 21.8 m/s in the direction 7.11 degrees above the horizontal. Using a coordinate system where $+x$ points in the direction the ball was released and $+y$ points up, what is the y component of the ball's motion after 1.00 seconds?

*a. +2.70 m/s
b. -2.70 m/s
c. +21.7 m/s
d. -21.7 m/s

38. A ball is thrown from the top of a 15.0 m tall building. The ball is initially released with a speed of 25.0 m/s in the direction 30.0 degrees above the horizontal. 2.00 seconds after it was released, the ball is traveling with a speed of

22.8 m/s in the direction 18.2 degrees below the horizontal. Using a coordinate system where +*x* points in the direction the ball was released and +*y* points up, what is the *y* component of the ball's motion after 2.00 seconds?

*a. -7.10 m/s
b. +7.10 m/s
c. +21.7 m/s
d. -21.7 m/s

39. A ball is thrown from the top of a 15.0 m tall building. The ball is initially released with a speed of 25.0 m/s in the direction 30.0 degrees above the horizontal. 2.50 seconds after it was released, the ball is traveling with a speed of 24.8 m/s in the direction 29.0 degrees below the horizontal. Using a coordinate system where +*x* points in the direction the ball was released and +*y* points up, what is the *y* component of the ball's motion after 2.50 seconds?

*a. -12.0 m/s
b. +12.0 m/s
c. +21.7 m/s
d. -21.7 m/s

40. A ball is thrown from the top of a 15.0 m tall building. The ball is initially released with a speed of 25.0 m/s in the direction 30.0 degrees above the horizontal. 3.00 seconds after it was released, the ball is traveling with a speed of 27.5 m/s in the direction 38.0 degrees below the horizontal. Using a coordinate system where +*x* points in the direction the ball was released and +*y* points up, what is the *y* component of the ball's motion after 3.00 seconds?

*a. -16.9 m/s
b. +16.9 m/s
c. +21.7 m/s
d. -21.7 m/s

41. A small object sits on a turn table that spins at a constant rate. It takes 5.00 s for the object to spin entirely around the circle. If the object sits 8.00 cm away from the center of the turn table, what is the speed at which the object travels?

*a. 0.101 m/s
b. 0.0503 m/s
c. 0.0320 m/s
d. 0.0160 m/s

42. A ball tied to the end of a 0.75 m long string swings in a horizontal circle at a constant speed. If it takes 1.40 s for the ball to travel completely around the circle, what is the speed of the ball?

*a. 3.37 m/s
b. 1.68 m/s
c. 1.07 m/s
d. 0.536 m/s

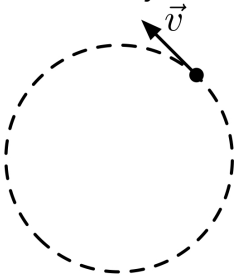
43. A toy car travels at a speed of 3.50 m/s around a circular track. The car goes around the track every 2.50 seconds. What is the diameter of the track?

*a. 2.79 m
b. 1.39 m
c. 8.75 m
d. 4.38 m

44. A ride at a carnival swings riders in a horizontal circle. When they are traveling at the ride's maximum speed, the riders travel with a speed of 15.0 m/s. If riders travel along a circle with a diameter of 20.0 m, what is the period of each rider's motion?

*a. 4.19 s
b. 8.38 s
c. 1.33 s
d. 2.67 s

45. The figure below shows the overhead view of an object as it travels in a horizontal circle. The velocity of the object is shown at a particular instant as the object circles. What is the direction of the object's acceleration?



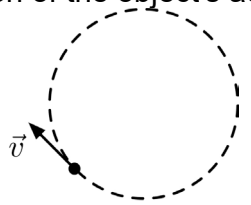
*a. Vector:

b. Vector:

c. Vector:

d. Vector:

46. The figure below shows the overhead view of an object as it travels in a horizontal circle. The velocity of the object is shown at a particular instant as the object circles. What is the direction of the object's acceleration?



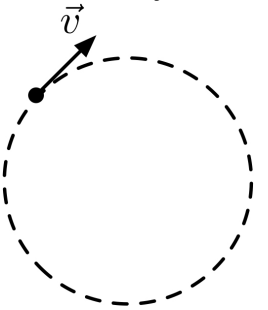
*a. Vector:

b. Vector:

c. Vector:

d. Vector:

47. The figure below shows the overhead view of an object as it travels in a horizontal circle. The velocity of the object is shown at a particular instant as the object circles. What is the direction of the object's acceleration?



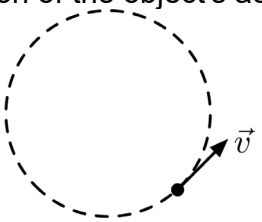
*a. Vector:

b. Vector:

c. Vector: 

d. Vector: 

48. The figure below shows the overhead view of an object as it travels in a horizontal circle. The velocity of the object is shown at a particular instant as the object circles. What is the direction of the object's acceleration?



*a. Vector:

b. Vector:

c. Vector: 

d. Vector: 

49. A 0.350 kg mass tied to the end of a string swings in a horizontal circle with a radius of 120 cm. If the mass travels around the circle with a speed of 4.00 m/s, what is the magnitude of the centripetal force acting on the mass?

*a. 4.67 N
b. 1.17 N
c. 3.43 N
d. 0.660 N

50. A car travels around a circular curve with a radius of 40.0 m. When road conditions are dry, the car can take the curve at a maximum speed of 25.0 m/s. If the mass of the car is 1000 kg, what is the magnitude of the centripetal force exerted on the car as it takes the turn at maximum speed?

*a. 15600 N
b. 625 N
c. 9800 N
d. 10100 N

51. A car with a mass of 1200 kg travels around a banked curve with a radius of 30.0 m. The curve is banked for the car to travel at a speed of 35.0 m/s around the curve. If the car travels around the curve at the intended speed, what is the magnitude of the centripetal force exerted on the car as it rounds the curve?

*a. 49000 N
b. 1400 N
c. 11800 N
d. 6260 N

52. A Ferris wheel has a diameter of 20.0 m. When the wheel turns at its fastest rate, a child on the ride travels at a constant speed of 1.25 m/s as she goes around the wheel. If the child has a mass of 35.0 kg, what is the magnitude of the centripetal force exerted on the child?

*a. 5.47 N
b. 2.73 N
c. 2.19 N
d. 4.38 N

53. You throw a ball upward from the ground at the base of a building that is 20.0 m tall. The ball rises to a maximum height of 30.0 m before it begins to fall back down. As the ball comes back down, it lands on the top of the building. If we choose up to be the positive vertical direction, which value gives the vertical component of the ball's displacement between the point it is released and when it lands on top of the building?

*a. +20.0 m
b. -10.0 m
c. +30.0 m
d. -20.0 m

54. Standing on top of a cliff that looks out over a lake, you throw a rock upward at an angle of 30.0 degrees above the horizontal. The cliff is 15.0 m above the surface of the lake. Once you release the rock, it rises to a maximum height of 20.0 m before falling back down and hitting the surface of the water. If we choose up to be the positive vertical direction, which value gives the vertical component of the rock's

displacement between the point when it is at its maximum height and when it hits the water?

*a. -20.0 m
b. +5.00 m
c. +15.0 m
d. -15.0 m

55. Standing 10.0 m away from a building that is 12.0 m tall, you throw a ball upward at an angle of 50.0 degrees above the horizontal. The ball rises to a maximum height of 18.0 m before falling and landing on top of the building. If we choose up to be the positive vertical direction, which value gives the vertical component of the ball's displacement between the point it is released and when it reaches its maximum height?

*a. +18.0 m
b. +20.6 m
c. +12.0 m
d. +10.0

56. Standing at the edge of the roof of a 25.0 m tall building, you throw a rock straight up. The rock reaches a maximum height of 32.0 m before it begins to fall back down. On its way back down, it just misses the roof and falls all the way to the ground below. If we choose up to the positive vertical direction, which value gives the vertical component of the rock's displacement between the point when it is at its maximum height and when it hits the ground?

*a. -32.0 m
b. -7.0 m
c. -25.0 m
d. +25.0 m

57. The image below shows a rear-view picture of a car that is turning to the left on a horizontal surface. Which of the vectors shown below indicate the direction of the centripetal force acting on the car as it turns?

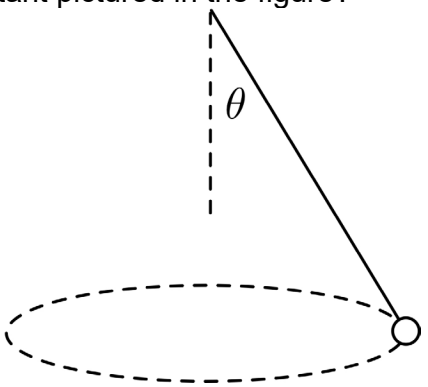
*a. Vector:

b. Vector:

c. Vector:

d. Vector:

58. A ball is attached to the end of a massless string. The other end of the string is attached to a point on the ceiling. You push the ball so that it swings in a horizontal circle, as shown in the figure below. What is the direction of the centripetal force acting on the ball at the instant pictured in the figure?



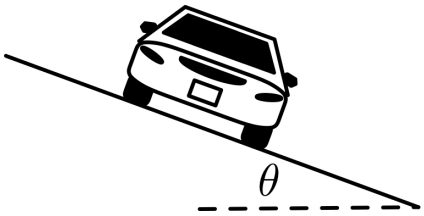
*a. Vector:

b. Vector:

c. Vector:

d. Vector:

59. The image below shows a rear-view picture of a car that is turning to the right on a banked curve. Which of the vectors below indicate the direction of the centripetal force acting on the car as it turns?



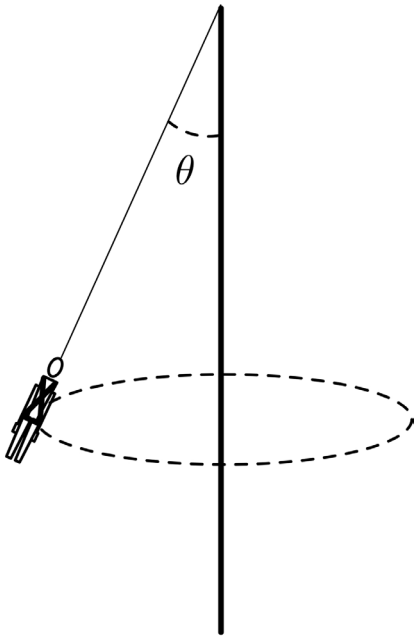
*a. Vector:

b. Vector:

c. Vector:

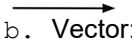
d. Vector:

60. A child rides on a carnival ride by sitting in a seat that is attached to the end of a long rope. The ride then swings the child and seat around in a horizontal circle. At the instant shown in the figure below, what is the direction of the centripetal force acting on the child?

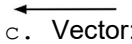


*a. Vector:

b. Vector:



c. Vector:



d. Vector:

61. Two blocks are connected by a massless string that runs across a pulley. Block 2 is heavier than block 1 and begins to fall when the two blocks are released. If the pulley is massless, which statement below correctly describes the magnitudes of the accelerations of both blocks after they have been released?

*a. The magnitude of block 1's acceleration is the same as the magnitude of block 2's acceleration
b. The magnitude of block 1's acceleration is greater than the magnitude of block 2's acceleration
c. The magnitude of block 1's acceleration is less than the magnitude of block 2's acceleration

62. Two blocks are connected by a massless string that runs across a pulley. Block 2 sits on a frictionless horizontal surface and begins to slide to the right when the two blocks are released. If the pulley is massless, which statement below correctly describes the magnitudes of the accelerations of both blocks after they have been released?

*a. The magnitude of block 1's acceleration is the same as the magnitude of block 2's acceleration
b. The magnitude of block 1's acceleration is greater than the magnitude of block 2's acceleration
c. The magnitude of block 1's acceleration is less than the magnitude of block 2's acceleration

63. Two blocks are connected by a massless string that runs across a pulley. Block 2 sits on a frictionless ramp and begins to slide down the ramp when the two blocks are released. If the pulley is massless, which statement below correctly describes the magnitudes of the accelerations of both blocks after they have been released?

*a. The magnitude of block 1's acceleration is the same as the magnitude of block 2's acceleration
b. The magnitude of block 1's acceleration is greater than the magnitude of block 2's acceleration
c. The magnitude of block 1's acceleration is less than the magnitude of block 2's acceleration

64. Two blocks are connected by a massless string that runs across a pulley. Block 1 sits on a frictionless ramp and begins to slide up the ramp when the two blocks are released. If the pulley is massless, which statement below correctly describes the magnitudes of the accelerations of both blocks after they have been released?

*a. The magnitude of block 1's acceleration is the same as the magnitude of block 2's acceleration
b. The magnitude of block 1's acceleration is greater than the magnitude of block 2's acceleration
c. The magnitude of block 1's acceleration is less than the magnitude of block 2's acceleration

65. A block is pushed to the right across a rough horizontal surface by an applied force. Does the normal force do positive work, negative work, or zero work on the block as it slides across the surface?

*a. Zero work
b. Positive work
c. Negative work

66. A block is pulled up a rough incline by a string. Does the gravitational force do positive work, negative work, or zero work on the block as it is pulled up the incline?

*a. Negative work
b. Positive work
c. Zero work

67. A block slides down a rough inclined plane. Does the friction force do positive work, negative work, or zero work on the block as it slides down the plane?

*a. Negative work
b. Positive work
c. Zero work

68. A heavy crate is lowered down a rough ramp by a rope. Does the tension force do positive work, negative work, or zero work on the crate as it slides down the ramp?

*a. Negative work
b. Positive work
c. Zero work

69. A child with a mass of 30.0 kg stands at the top of a slide. The slide is 2.50 m long and makes an angle of 35.0 degrees with the horizontal. If the child slides all the way to the bottom of the slide, how much work was done by the gravitational force?

*a. 422 J
b. -422 J
c. 602 J
d. -602 J

70. You stand on top of a 15.0 m high cliff and throw a rock with a mass of 0.250 kg at an upward angle. The rock rises 5.00 additional meters before falling back to the ground below the cliff. How much work did gravity do on the rock between the point you released it and the moment it reached the highest point in its trajectory?

*a. -12.3 J
b. 12.3 J
c. -36.8 J
d. 36.8 J

71. You push a box with a mass of 30.0 kg up a rough incline that makes an angle of 40.0 degrees with the horizontal. If you pushed the box 2.00 m up the incline, how much work did the gravitational force do on the box as it moved?

*a. -378 J
b. 378 J
c. -450 J
d. 450 J

72. You push a 25.0 kg box 3.00 m up a rough incline. If the gravitational force did -420 J of work on the box as it moved, what was the angle of the incline?

*a. 34.8 degrees
b. 55.2 degrees
c. 29.7 degrees

d. 37.2 degrees

73. A 0.100 kg mass is attached to one end of a horizontal spring so that it can bounce back and forth across a horizontal frictionless surface. The spring constant of the spring is 500 N/m. The mass is initially pulled a distance of 5.00 cm away from equilibrium and released. How much work has the spring done on the mass when it is only 3.00 cm away from equilibrium?

*a. 0.400 J
b. -0.400 J
c. 0.100 J
d. -0.100 J

74. A 0.150 kg mass is attached to one end of a horizontal spring that has a spring constant of 750 N/m. The mass is pulled away from equilibrium and released so that it bounces back and forth on a frictionless horizontal surface. In moving from point A to point B, 0.515 J of work is done on the mass. If point A is 4.00 cm away from equilibrium, how far away from equilibrium is point B?

*a. 1.50 cm
b. 3.70 cm
c. 5.45 cm

75. A block with a mass of 0.250 kg is attached to the end of a spring. Initially the block is 2.00 cm away from equilibrium. You pull on the block until it is 5.00 cm away from equilibrium. If -0.750 J of work was done on the block by the spring as you pulled it, what is the spring constant of the spring?

*a. 714 N/m
b. 167 N/m
c. 375 N/m
d. 600 N/m

76. A 0.500 kg mass is attached to one end of a horizontal spring that has a spring constant of 900 N/m. The mass is pulled away from equilibrium and released so that it bounces back and forth on a frictionless horizontal surface. In moving from point A to point B, -0.750 J of work is done on the mass. If point A is 3.00 cm away from equilibrium, how far away from equilibrium is point B?

*a. 5.07 cm
b. 2.77 cm
c. 4.08 cm
d. 4.48 cm

77. A box is released at the top of a ramp and slides down the incline. Has the gravitational potential energy of the box increased, decreased, or remained the same?

*a. The gravitational potential energy has decreased
b. The gravitational potential energy has increased
c. The gravitational potential energy remains the same

78. You throw a ball straight up from the ground right next to a building that is 15.0 m high. The ball flies up in the air until it reaches a maximum height 20.0 m above the ground then falls back down and lands on the building. Between which two points listed below does the gravitational potential energy of the ball decrease?

*a. Between the moment the ball reaches its highest point and the moment it lands on the roof
b. Between the moment you release the ball and the moment it reaches its highest point
c. Between the moment you release the ball and the moment it lands on the roof of the building

79. If the gravitational potential energy of an object has increased, which of the following statements are true?

*a. The object's final position is higher than its initial position.
b. The object's initial position is higher than its final position.
c. The object's final and initial positions are at the same height.

80. You push a box across a horizontal surface with increasing speed. Does the gravitational potential energy of the box increase, decrease, or remain the same as you push it?

*a. The gravitational potential energy remains the same
b. The gravitational potential energy has decreased
c. The gravitational potential energy has increased

81. If the elastic potential energy of an object attached to a spring has increased, which of the following statements are true?

*a. The object has moved away from equilibrium.
b. The object has moved towards equilibrium.
c. The object's distance from equilibrium hasn't changed.

82. A mass is attached to one end of a horizontal spring. Initially the mass is located at point A, 3.50 cm away from the equilibrium point of the spring. If the elastic potential energy of the mass increases as it moves to point B, what can you conclude about the distance point B is away from equilibrium?

*a. Point B is more than 3.50 cm away from equilibrium
b. Point B is less than 3.50 cm away from equilibrium
c. Point B is also 3.50 cm away from equlibrium

83. If the elastic potential energy of a mass attached to a spring decreases, which statement accurately describes how the mass moved?

*a. The mass moved back towards equilibrium
b. The mass moved away from equilibrium

84. You attach a mass to one end of a horizontal spring so that the mass will bounce back and forth across a frictionless surface. You pull the mass out to its initial amplitude and release it. Between which pair of points listed below does the elastic potential energy of the mass decreases?

*a. From the moment you release the mass until it returns to equilibrium
b. From the moment it passes through equilibrium until it reaches amplitude on the other side
c. From the moment you release the mass until it reaches amplitude on the other side

85. A ball with a mass of 0.800 kg is attached to the end of a 1.20 m long string. You swing the string around so that the ball moves in a vertical circle. At the top of the circle, the ball is traveling with a speed of 9.00 m/s. If the gravitational potential energy is zero at the bottom of the circle the ball travels, what is the total mechanical energy of the ball at the top of the circle?

*a. 51.2 J
b. 18.8 J
c. 32.4 J
d. 41.8 J

86. A ball with a mass of 0.500 kg is thrown from the top of a building. The ball is released with a speed of 12.0 m/s at a height of 18.0 m above the ground. If the gravitational potential energy is zero at the ground, what is the total mechanical energy of the ball as it is released?

*a. 124 J
b. 36.0 J

c. 88.2 J
d. 212 J

87. A person with a mass of 60.0 kg rides a roller coaster. As the person crests a hill on the ride that is 20.0 m above the ground, they are traveling with a speed of 15.0 m/s. If the gravitational potential energy is zero at the ground, what is the total mechanical energy of the person?

*a. 18500 J
b. 6750 J
c. 11800 J
d. 30300 J

88. An object with a mass of 1.50 kg is traveling with a speed of 2.50 m/s when it is 1.00 m below the point where the gravitational potential energy equals zero. What is the total mechanical energy of the object?

*a. -10.0 J
b. 19.4 J
c. -5.33 J
d. 16.6 J

89. An object is traveling with a speed of 12.5 m/s. If the object's mass is 20.0 kg, what is the magnitude of the object's momentum?

*a. 250 kg m/s
b. 125 kg m/s
c. 3130 kg m/s
d. 1560 kg m/s

90. A car with a mass of 1200 kg is traveling due north with a momentum of 18,000 kg m/s. What is the speed of the car?

*a. 15.0 m/s
b. 30.0 m/s
c. 5.48 m/s
d. 3.87 m/s

91. An object traveling with a speed of 14.0 m/s has a momentum of 5.00 kg m/s that points due east. What is the mass of the object?

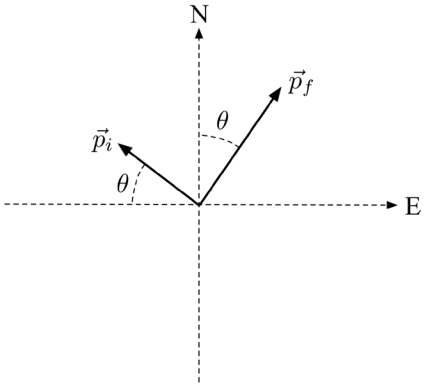
*a. 0.357 kg
b. 2.80 kg

c. 0.0510 kg
d. 0.0255 kg

92. At a certain point during its flight, a 2.00 kg projectile has a momentum of 5.50 kg m/s that points in the direction 10.0 degrees above the horizontal. What is the speed at which the projectile is traveling at that instant?

*a. 2.75 m/s
b. 1.38 m/s
c. 2.35 m/s
d. 1.66 m/s

93. A car is initially traveling in the direction θ =30.0 degrees N of W. It speeds up and turns so that it is traveling 30.0 degrees E of N. Which of the vectors shown below shows the direction of the car's change in momentum during the turn?



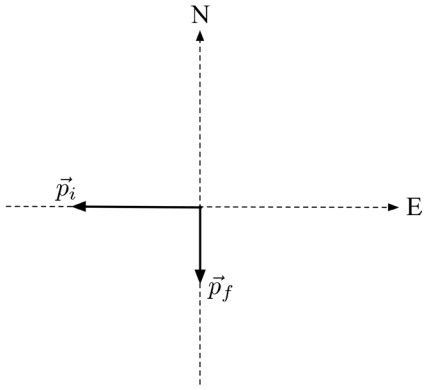
*a. Vector:

b. Vector:

c. Vector:

d. Vector:

94. An object is initially traveling due west. It bounces off a second object and ends up traveling due south as shown in the vector diagram below. Which vector below represents the direction of the object's change in momentum during the collision?



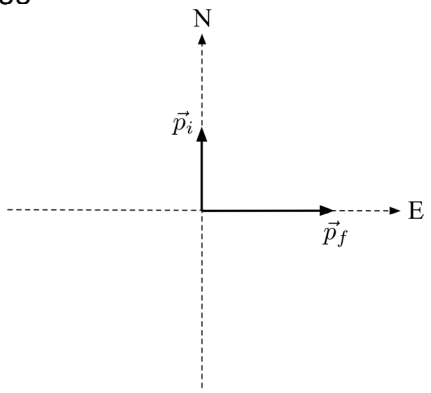
*a. Vector:

b. Vector:

c. Vector:

d. Vector:

95. An child is initially running due north in a game of tag. To avoid another player, she speeds up and changes her direction, so that she is running due east. Which vector shown below shows the direction of the child's change in momentum as she swerves to avoid getting tagged?



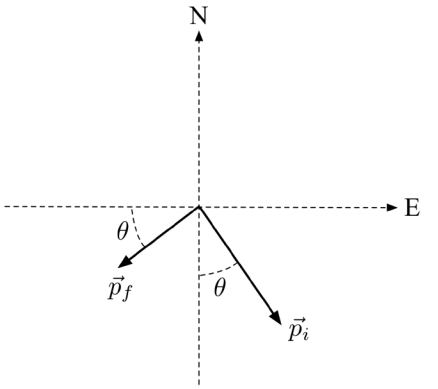
*a. Vector:

b. Vector:

c. Vector:

d. Vector:

96. A truck is initially traveling in the direction θ = 30.0 degrees E of S. To avoid a collision, the driver steps on the brakes and turns the wheel, so that the truck ends up traveling at a slower speed in the direction 30.0 degrees S of W as shown in the diagram below. Which vector below shows the change of the truck's momentum as it avoids the collision?



*a. Vector:

b. Vector:

c. Vector:

d. Vector: