Name: _____

1. If a 30-newton force is required to accelerate a 2-kilogram object at 10 meters per second^2, over a level floor, then the magnitude of the frictional force acting on the object is

A. 0 N
B. 10 N
C. 20 N
D. 30 N

2. A 3.0-kilogram mass weighs 15 newtons at a given point in the Earth's gravitational field. What is the magnitude of the acceleration due to gravity at this point?

A. 45 m/s^2
B. 9.8 m/s^2
C. 5.0 m/s^2
D. 0.20 m/s^2

3. Which wavelength is in the infrared range of the electromagnetic spectrum?

A. 100 nm
B. 100 mm
C. 100 m
D. 100 μm

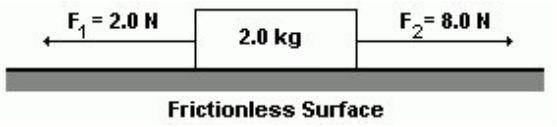
4. Which object has the greatest inertia?

A. a 5.00-kg mass moving at 10.0 m/s
B. a 10.0-kg mass moving at 1.00 m/s
C. a 15.0-kg mass moving at 10.0 m/s
D. a 20.0-kg mass moving at 1.00 m/s

5. A blue lab cart is traveling west on a track when it collides with and sticks to a red lab cart traveling east. The magnitude of the momentum of the blue cart before the collision is 2.0 kilogram • meters per second, and the magnitude of the momentum of the red cart before the collision is 3.0 kilogram • meters per second. The magnitude of the total momentum of the two carts after the collision is

A. 1.0 kg • m/s
B. 2.0 kg • m/s
C. 3.0 kg • m/s
D. 5.0 kg • m/s

6. Two forces are applied to a 2.0-kilogram block on a frictionless, horizontal surface, as shown in the diagram.

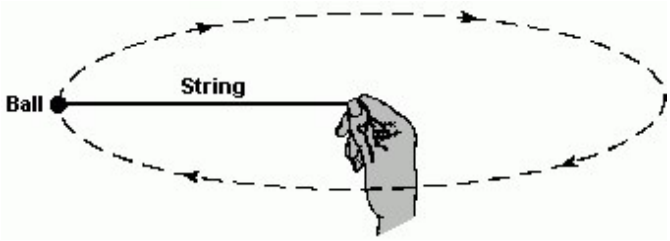


The acceleration of the block is

A. 5.0 m/s^2 to the right
B. 5.0 m/s^2 to the left
C. 3.0 m/s^2 to the right
D. 3.0 m/s^2 to the left

Figure 1

The diagram shows a student spinning a 0.10-kilogram ball at the end of a 0.50-meter string in a horizontal circle at a constant speed of 10. meters per second. [Neglect air resistance.]



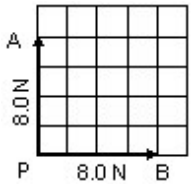
7. **[Refer to figure 1]**
The magnitude of the centripetal force required to keep the ball in this circular path is

A. 5.0 N
B. 10. N
C. 20. N
D. 200 N

8. A ball dropped from a bridge takes 3.0 seconds to reach the water below. How far is the bridge above the water?

A. 15 m
B. 29 m
C. 44 m
D. 88 m

9. Two forces, $\overrightarrow{PA}$ and $\overrightarrow{PB}$, act on point *P* as shown in the diagram.



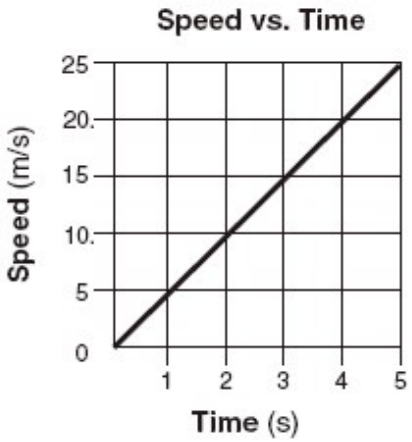
The magnitude of the resultant force is closest to

A. 8.0 N
B. 11 N
C. 15 N
D. 16 N

10. An unbalanced force of 40. newtons keeps a 5.0-kilogram object traveling in a circle of radius 2.0 meters. What is the speed of the object?

A. 8.0 m/s
B. 2.0 m/s
C. 16 m/s
D. 4.0 m/s

11. The graph below represents the relationship between speed and time for an object moving along a straight line.



What is the total distance traveled by the object during the first 4 seconds?

A. 5 m
B. 20 m
C. 40 m
D. 80 m

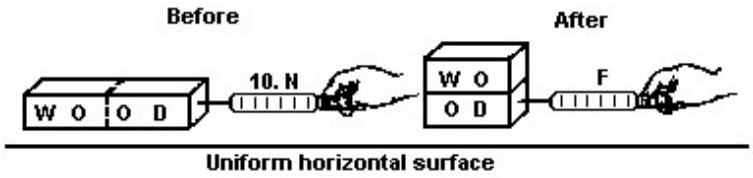
12. The speed of a wagon increases from 2.5 meters per second to 9.0 meters per second in 3.0 seconds as it accelerates uniformly down a hill. What is the magnitude of the acceleration of the wagon during this 3.0-second interval?

A. 0.83 m/s^2
B. 2.2 m/s^2
C. 3.0 m/s^2
D. 3.8 m/s^2

13. A student weighing 500. newtons stands on a spring scale in an elevator. If the scale reads 520. newtons, the elevator must be

A. accelerating upward
B. accelerating downward
C. moving upward at constant speed
D. moving downward at constant speed

14. The diagram below shows a student applying a 10.-newton force to slide a piece of wood at constant speed across a horizontal surface. After the wood is cut in half, one piece is placed on top of the other, as shown.



What is the magnitude of the force, *F*, required to slide the stacked wood at constant speed across the surface?

A. 40. N
B. 20. N
C. 10. N
D. 5.0 N

15. A 1.0-kilogram laboratory cart moving with a velocity of 0.50 meter per second due east collides with and sticks to a similar cart initially at rest. After the collision, the two carts move off together with a velocity of 0.25 meter per second due east. The total momentum of this frictionless system is

A. zero before the collision
B. zero after the collision
C. the same before and after the collision
D. greater before the collision than after the collision

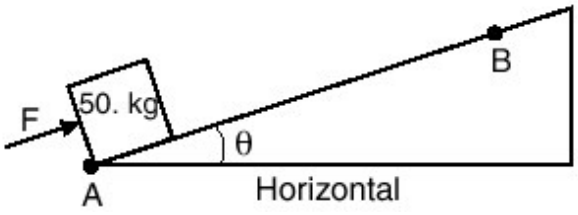
16. When a 1.0-kilogram cart moving with a speed of 0.50 meter per second on a horizontal surface collides with a second 1.0-kilogram cart initially at rest, the carts lock together. What is the speed of the combined carts after the collision? [Neglect friction.]

A. 1.0 m/s
B. 0.50 m/s
C. 0.25 m/s
D. 0 m/s

17. On a small planet, an astronaut uses a vertical force of 175 newtons to lift an 87.5-kilogram boulder at constant velocity to a height of 0.350 meter above the planet's surface. What is the magnitude of the gravitational field strength on the surface of the planet?

A. 0.500 N/kg
B. 2.00 N/kg
C. 9.81 N/kg
D. 61.3 N/kg

18. The diagram below shows a 50-kilogram crate on a frictionless plane at angle θ to the horizontal. The crate is pushed at constant speed up the incline from point *A* to point *B* by force *F*.



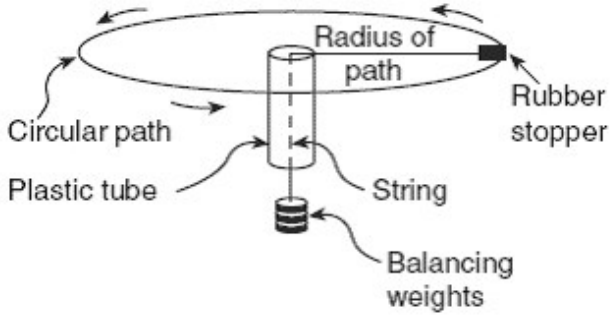
If angle θ were increased, what would be the effect on the magnitude of force *F* and the total work *W* done on the crate as it is moved from *A* to *B*?

A. *W* would remain the same and the magnitude of *F* would decrease.
B. *W* would remain the same and the magnitude of *F* would increase.
C. *W* would increase and the magnitude of *F* would decrease.
D. *W* would increase and the magnitude of *F* would increase.

Figure 2

Base your answer to the question on the information and diagram.

In an experiment, a rubber stopper is attached to one end of a string that is passed through a plastic tube before weights are attached to the other end. The stopper is whirled in a horizontal circular path at constant speed.



19. **[Refer to figure 2]**
What would happen to the radius of the circle if the student whirls the stopper at a greater speed without changing the balancing weights?

A. The radius would increase.
B. The radius would decrease.
C. The radius would remain the same.

20. Which statement best explains why a "wet saw" used to cut through fine optical crystals is constantly lubricated with oil?

A. Lubrication decreases friction and minimizes the increase of internal energy.
B. Lubrication decreases friction and maximizes the increase of internal energy.
C. Lubrication increases friction and minimizes the increase of internal energy.
D. Lubrication increases friction and maximizes the increase of internal energy.

21. A 1.2×10^3-kilogram automobile in motion strikes a 1.0×10^{-4}-kilogram insect. As a result, the insect is accelerated at a rate of 1.0×10^2 m/s^2. What is the magnitude of the force the insect exerts on the car?

A. 1.0×10^{-2} N
B. 1.2×10^{-2} N
C. 1.0×10^1 N
D. 1.2×10^3 N

22. The diagram below represents two masses before and after they collide. Before the collision, mass m_A is moving to the right with speed v, and mass m_B is at rest. Upon collision, the two masses stick together.

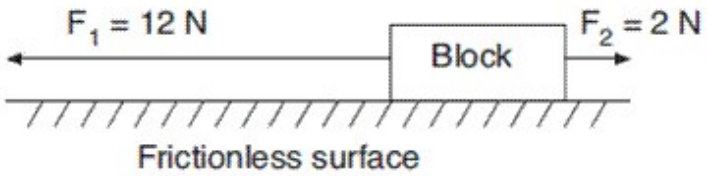
Which expression represents the speed, v', of the masses after the collision? [Assume no outside forces are acting on m_A or m_B.]

A. $\frac{m_A + m_B v}{m_A}$
C. $\frac{m_B v}{m_A + m_B}$
B. $\frac{m_A + m_B}{m_A v}$
D. $\frac{m_A v}{m_A + m_B}$

23. The velocity of a car changes from 60. meters per second north to 45 meters per second north in 5.0 seconds. The magnitude of the car's acceleration is

A. 9.8 m/s^2
B. 15 m/s^2
C. 3.0 m/s^2
D. 53 m/s^2

24. Two forces, F_1 and F_2, are applied to a block on a frictionless, horizontal surface as shown below.



If the magnitude of the block's acceleration is 2.0 meters per second^2, what is the mass of the block?

A. 1 kg
B. 5 kg
C. 6 kg
D. 7 kg

25. Compared to the force needed to start sliding a crate across a rough level floor, the force needed to keep it sliding once it is moving is

A. less
B. greater
C. the same

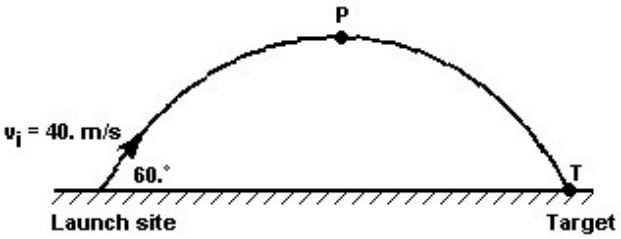
26. A 2.00×10^6-hertz radio signal is sent a distance of 7.30×10^{10} meters from Earth to a spaceship orbiting Mars.

Approximately how much time does it take the radio signal to travel from Earth to the spaceship?

A. 4.11×10^{-3} s
B. 2.43×10^2 s
C. 2.19×10^8 s
D. 1.46×10^{17} s

Figure 3

A projectile is launched at an angle of 60.° above the horizontal at an initial speed of 40. meters per second, as shown in the diagram. The projectile reaches its highest altitude at point *P* and strikes a target at point *T*. [Neglect air resistance.]



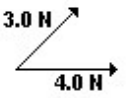
27. **[Refer to figure 3]**
What is the magnitude of the vertical component of the projectile's initial speed?

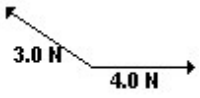
A. 35 m/s
B. 20. m/s
C. 9.8 m/s
D. 4.3 m/s

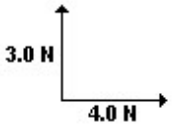
28. A car moving at a speed of 8.0 meters per second enters a highway and accelerates at 3.0 meters per second squared. How fast will the car be moving after it has accelerated for 56 meters?

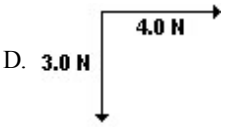
A. 24 m/s
B. 20. m/s
C. 18 m/s
D. 4.0 m/s

29. A 3.0-newton force and a 4.0-newton force act concurrently on a point. In which diagram below would the orientation of these forces produce the greatest net force on the point?

A. 

C. 

B. 

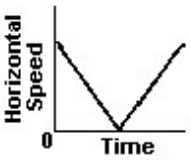
D. 

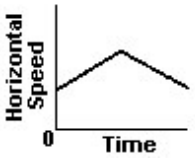
30. A student pulls a 60.-newton sled with a force having a magnitude of 20. newtons. What is the magnitude of the force that the sled exerts on the student?

A. 20. N
B. 40. N
C. 60. N
D. 80. N

31. **[Refer to figure 3]**
Which graph below best represents the horizontal speed of the projectile as a function of time?

A. 

C. 

B. 

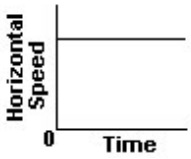
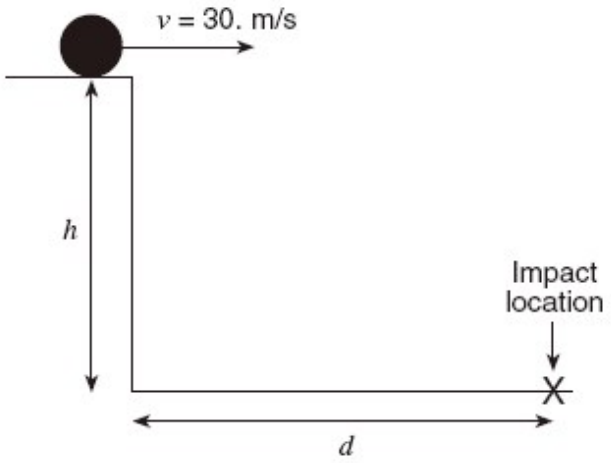
D. 

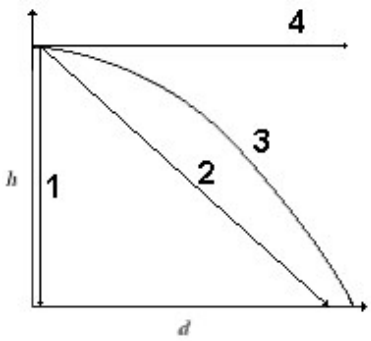
Figure 4

Base your answer to the question on the information and diagram.

A projectile is launched horizontally at a speed of 30. meters per second from a platform located a vertical distance *h* above the ground. The projectile strikes the ground after time *t* at horizontal distance *d* from the base of the platform. [Neglect friction.]



32. **[Refer to figure 4]**
In the diagram below, which line best represents the theoretical path of the projectile?

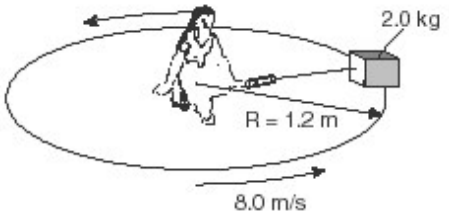


A. line 1
B. line 2
C. line 3
D. line 4

Figure 5

Base your answer on the diagram and information below.

The diagram shows a student seated on a rotating circular platform, holding a 2.0-kilogram block with a spring scale. The block is 1.2 meters from the center of the platform. The block has a constant speed of 8.0 meters per second. [Frictional forces on the block are negligible.]



33. **[Refer to figure 5]**
Which statement best describes the block's movement as the platform rotates?

A. Its velocity is directed tangent to the circular path, with an inward acceleration.
B. Its velocity is directed tangent to the circular path, with an outward acceleration.
C. Its velocity is directed perpendicular to the circular path, with an inward acceleration.
D. Its velocity is directed perpendicular to the circular path, with an outward acceleration.

34. Projectile *A* is launched horizontally at a speed of 20. meters per second from the top of a cliff and strikes a level surface below, 3.0 seconds later. Projectile *B* is launched horizontally from the same location at a speed of 30. meters per second.

Approximately how high is the cliff?

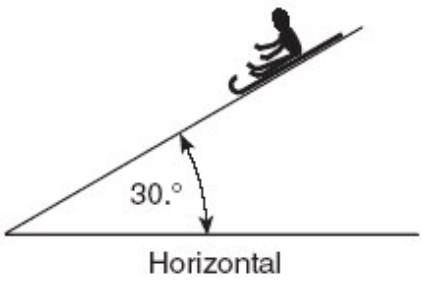
A. 29 m
B. 44 m
C. 60. m
D. 104 m

35. A projectile is fired from the ground with an initial velocity of 250. meters per second at an angle of 60.0° above the horizontal.

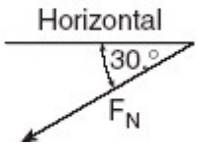
Why does the projectile have *no* acceleration in the horizontal direction? [Neglect air friction.]

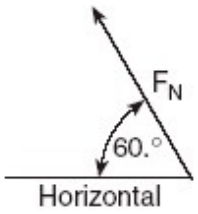
A. The horizontal force is much smaller than the vertical force.
B. There is no force acting on the object in the horizontal direction.
C. The force in the horizontal direction is changing as the object moves.
D. The vertical acceleration hides the horizontal acceleration

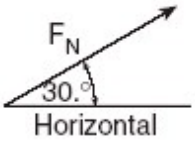
36. The diagram shows a sled and rider sliding down a snow-covered hill that makes an angle of 30.° with the horizontal.

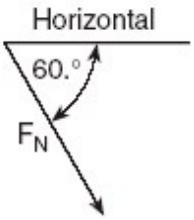


Which vector best represents the direction of the normal force, F_N, exerted by the hill on the sled?

A.


C.


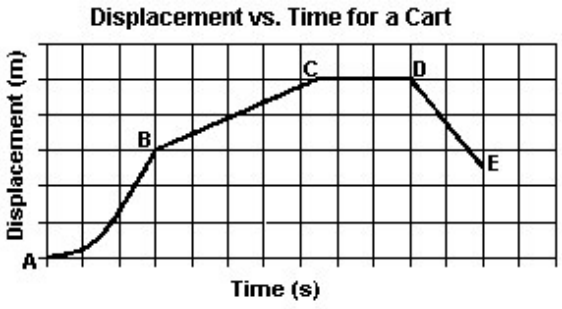
B.


D.


37. Two 20.-newton forces act concurrently on an object. What angle between these forces will produce a resultant force with the greatest magnitude?

A. 0°
B. 45°
C. 90.°
D. 180.°

38. The displacement-time graph elow shows the motion of a cart along a straight line.

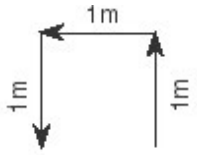


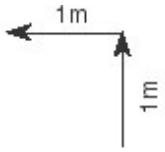
During which interval was the cart accelerating?

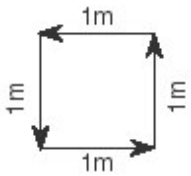
A. *AB*
B. *BC*
C. *CD*
D. *DE*

39. Which vector diagram represents the greatest magnitude of displacement for an object?

A.


C.


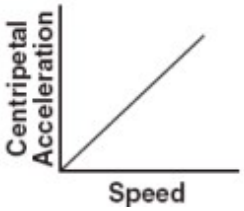
B.


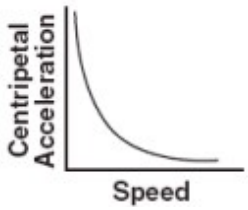
D.


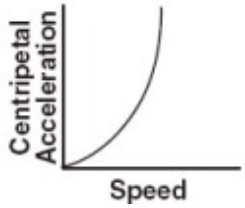
40. A 5.00-kilogram block slides along a horizontal, frictionless surface at 10.0 meters per second for 4.00 seconds. The magnitude of the block's momentum is

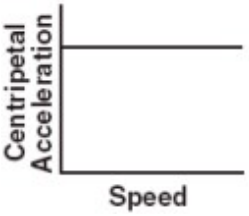
A. 200. kg·m/s
B. 50.0 kg·m/s
C. 20.0 kg·m/s
D. 12.5 kg·m/s

41. Which graph best represents the relationship between the magnitude of the centripetal acceleration and the speed of an object moving in a circle of constant radius?

A.


C.


B.


D.


42. A 3.1-kilogram gun initially at rest is free to move. When a 0.015-kilogram bullet leaves the gun with a speed of 500 meters per second, what is the speed of the gun?

A. 0.0 m/s
B. 2.4 m/s
C. 7.5 m/s
D. 500. m/s

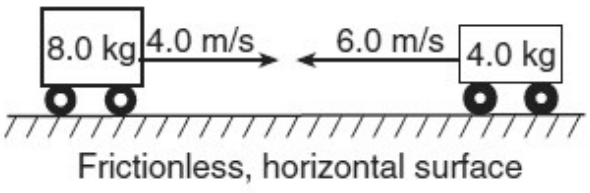
43. A 2.0-kilogram object is falling freely near Earth's surface. What is the magnitude of the gravitational force that Earth exerts on the object?

A. 20. N
B. 2.0 N
C. 0.20 N
D. 0.0 N

44. A 1.2×10^3-kilogram car is accelerated uniformly from 10. meters per second to 20. meters per second in 5.0 seconds. What is the magnitude of the net force acting on the car during this 5.0- second interval?

A. 2.4×10^3 N
B. 4.8×10^3 N
C. 7.2×10^3 N
D. 1.2×10^3 N

45. The diagram below shows an 8.0-kilogram cart moving to the right at 4.0 meters per second about to make a head-on collision with a 4.0-kilogram cart moving to the left at 6.0 meters per second.



After the collision, the 4.0-kilogram cart moves to the right at 3.0 meters per second. What is the velocity of the 8.0-kilogram cart after the collision?

A. 0.50 m/s left
B. 0.50 m/s right
C. 5.5 m/s left
D. 5.5 m/s right

46. A 0.0600-kilogram ball traveling at 60.0 meters per second hits a concrete wall. What speed must a 0.0100-kilogram bullet have in order to hit the wall with the same magnitude of momentum as the ball?

A. 3.60 m/s
B. 6.00 m/s
C. 360. m/s
D. 600. m/s

47. A 50.0-kilogram object in outer space is attracted to a nearby planet with a net force of 400. newtons. What is the magnitude of the object's acceleration?

A. 8.00 m/s/s
B. 9.81 m/s/s
C. 78.4 m/s/s
D. 2,000 m/s/s