Unit Three: Practice Problems and Independent Work					
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Topic 3B: Friction, Springs, Circular Motion and Gravity	Skill 23: Coefficient of friction	134-143	144-161	Pg 32-33	Lab 12: Friction
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PLEASE USE ED-LINE – "Unit Resources – Unit 3" to access:

- Answer Keys
- Supplemental Videos
- Web Links to interactive activities etc.

Skill 20 – Inertia, Momentum, Impulse, Newton's Laws Practice Questions:

1. A skateboarder is moving with a constant velocity of 2m/s. What is the net force acting on the object? How do you know?

2. In a weightless environment a force of 5 Newtons is applied horizontally to the right on a rock with a mass of 1 kg and to a pebble with a mass of 0.1 kg.
   a. Which object is easier to start moving?

   b. Determine the acceleration of the rock while acted upon by the 5N force?

   c. Determine the acceleration of the pebble while acted upon by the 5 N force?

   d. Review: Determine the speed of each if the 5N force (and acceleration) act on each for 0.5 seconds.

      Rock Pebble

   e. What will happen to the objects after they are no longer acted upon by the 5 Newton force?

   f. Which object will be easier to stop moving?

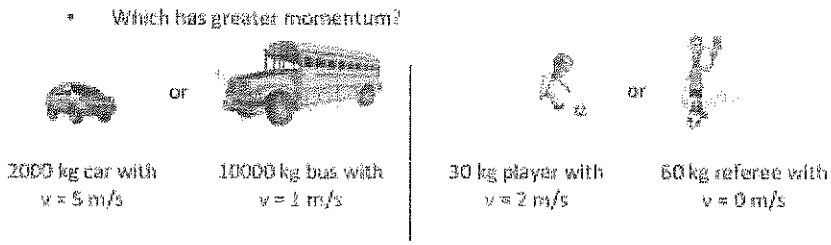
   g. What must happen for the motion to stop?

3. Two rocks are rolling at constant speed: A 2kg rock rolling with a speed of 4m/s and a 4 kg rock rolling with a speed of 2m/s.

   a. Compare the momentum of each rock.

b. Compare the inertia of each rock.

4. Which has greater momentum



5. A 0.1kg egg moving with a velocity of 5 m/s is brought to a rest.
   a) What is the change in momentum or impulse experienced by the egg?

   b) What is the force if the change in momentum occurs in 0.5 s?

   c) What is the force if the change in momentum occurs in 1 s?

   d) How does the impulse experienced by the egg change between the 0.5s stop and the 1 second stop?

6. 10 kg object begins from rest and accelerates to a speed of 2.0 meters per second. What is the initial momentum, the final momentum, the change in momentum and the impulse?

7. A 15 kg object is moving east at 1.0 meters per second and is subjected to a net force of 10 newtons east for 3 seconds.

    a. What is the initial momentum?

    b. What is the final momentum?

    c. What is the impulse?

    d. What is the acceleration?

    e. What is the final velocity of the object?

8. A 2kg object is moving west at 4 m/s and slowed to 0.5 m/s in a time of 1.75 seconds. What is the net force experienced by the object?

9. If the amount of time it takes to bring an object to rest is halved when all other factors remain the same, the net force acting on the object will _____. Show the equation that guides your thought process.

10. A 0.2kg baseball moving at 8 m/s east makes contact with a swinging baseball bat for a time of 0.2 seconds. The baseball leaves the bat with a velocity of 10 m/s west.

    a. What is the change in momentum of the baseball?

    b. What is the acceleration of the baseball?

    c. What is the net force acting on the baseball?

    d. What is the impulse acting on the baseball?

11. A falling pumpkin with a mass of 0.5 kg has a speed of 15 m/s just before it hits the ground. The pumpkin is brought a rest in 0.1 seconds.

    a. What is the acceleration of the pumpkin during the impact?

    b. What is the net force acting on the pumpkin during the impact?

    c. If the time of impact were cut in half, what would happen to the magnitude of the **impulse**?

    d. If the time of impact were cut in half, what would happen to the magnitude of the **net force** acting on the pumpkin?

Skill 20-Newton's Laws
Inertia and Momentum

12. A 15-kilogram cart is at rest on a horizontal surface. A 5-kilogram box is placed in the cart. Compared to the mass and inertia of the cart, the cart-box system has

    A) more mass and more inertia
    B) more mass and the same inertia
    C) the same mass and more inertia
    D) less mass and more inertia

13. Which object has the greatest inertia?

    A) a 0.010-kg bullet traveling at 90. m/s
    B) a 30.-kg child traveling at 10. m/s on her bike
    C) a 490-kg elephant walking with a speed of 1.0 m/s
    D) a 1500-kg car at rest in a parking lot

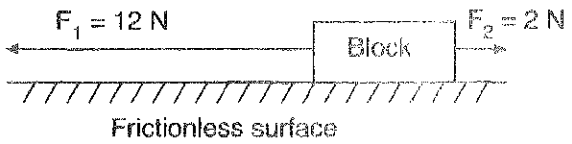
14. Which situation describes an object that has *no* unbalanced force acting on it?

    A) an apple in free fall
    B) a satellite orbiting Earth
    C) a hockey puck moving at constant velocity across ice
    D) a laboratory cart moving down a frictionless 30.° incline

15. Cart *A* has a mass of 2 kilograms and a speed of 3 meters per second. Cart *B* has a mass of 3 kilograms and a speed of 2 meters per second. Compared to the inertia and magnitude of momentum of cart *A*, cart *B* has

    A) the same inertia and a smaller magnitude of momentum
    B) the same inertia and the same magnitude of momentum
    C) greater inertia and a smaller magnitude of momentum
    D) greater inertia and the same magnitude of momentum

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



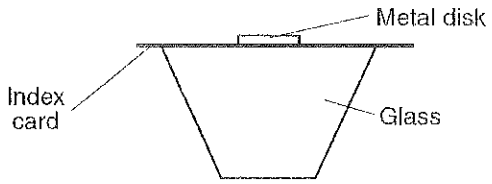
    If the magnitude of the block's acceleration is 2.0 meters per second^2, what is the mass of the block?

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

17. Which mass would have the greatest acceleration if the same unbalanced force was applied to each?

    A) 1 kg B) 2 kg C) 3 kg D) 4 kg

18. Base your answer to the following question on the diagram below, which shows a 1.0-newton metal disk resting on an index card that is balanced on top of a glass.

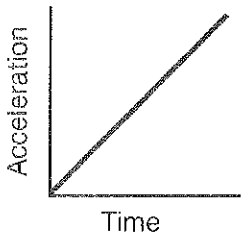


When the index card is quickly pulled away from the glass in a horizontal direction, the disk falls straight down into the glass. This action is a result of the disk's

A) inertia B) charge C) shape D) temperature

19. A constant unbalanced force is applied to an object for a period of time. Which graph best represents the acceleration of the object as a function of elapsed time?

A)



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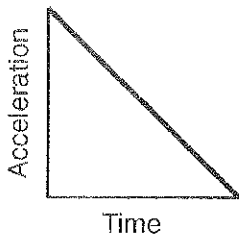

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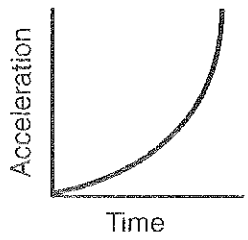
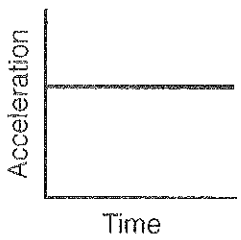


D)



20. A cart is uniformly accelerating from rest. The net force acting on the cart is

A) decreasing B) zero
C) constant D) increasing

21. A net force of 25 Newtons is applied horizontally to a 10.-kilogram block resting on a table. What is the magnitude of the acceleration of the block?

A) 0.0 m/s^2 B) 0.26 m/s^2
C) 0.40 m/s^2 D) 2.5 m/s^2

22. An unbalanced force is applied to a mass, producing an acceleration. If the same unbalanced force is applied to a mass one-half as large, the resulting acceleration will be

A) the same
B) twice as great
C) one-half as great
D) four times as great

23. What force is needed to give an electron an acceleration of 1.00×10^{10} m/s^2?

A) 9.11×10^{-41} N B) 9.11×10^{-31} N
C) 9.11×10^{-21} N D) 1.10×10^{43} N

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

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

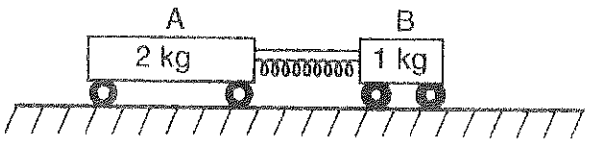
25. An object with a mass of 0.5 kilogram starts from rest and achieves a maximum speed of 20 meters per second in 0.01 second. What average unbalanced force accelerates this object?

A) 1,000 N B) 10 N
C) 0.1 N D) 0.001 N

26. 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

27. The diagram below shows a compressed spring between two carts initially at rest on a horizontal, frictionless surface. Cart *A* has a mass of 2 kilograms and cart *B* has a mass of 1 kilogram. A string holds the carts together



The string is cut and the carts move apart. Compared to the magnitude of the force the spring exerts on cart *A*, the magnitude of the force the spring exerts on cart *B* is

A) the same
B) half as great
C) twice as great
D) four times as great

28. A carpenter hits a nail with a hammer. Compared to the magnitude of the force the hammer exerts on the nail, the magnitude of the force the nail exerts on the hammer during contact is

A) less B) greater
C) the same

29. Which is a unit of momentum?

A) N-m/s^2 B) kg-m/s^2
C) N-m/s D) kg-m/s

30. Earth's mass is approximately 81 times the mass of the Moon. If Earth exerts a gravitational force of magnitude F on the Moon, the magnitude of the gravitational force of the Moon on Earth is

A) F B) $\frac{F}{81}$ C) $9F$ D) $81F$

31. What is the speed of a 1.5×10^3-kilogram car that has a momentum of 3.0×10^5 kilogram • meters per second east?

A) 5.0×10^{-3} m/s B) 2.0×10^2 m/s
C) 4.5×10^8 m/s D) 2.0×10^7 m/s

32. 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

33. What is the momentum of a 1,200-kilogram car traveling at 15 meters per second due east?

A) 1.8×10^4 kg•m/s due east
B) 1.8×10^4 kg•m/s due west
C) 80. kg•m/s due east
D) 80. kg•m/s due west

34. Which of the following objects has the greatest momentum?

A) a 1-kg object moving at 200 m/sec
B) a 10-kg object moving at 30 m/sec
C) a 20-kg object moving at 20 m/sec
D) a 100-kg object moving at 2 m/sec

35. If the direction of the momentum of an object is west, the direction of the velocity of the object is

A) north B) south
C) east D) west

36. The product of an object's mass and velocity is equal to

A) force B) weight
C) kinetic energy D) momentum

37. What is the momentum of a 30-kilogram cart moving with a speed of 10 meters per second?

A) 20 kg-m/sec B) 40 kg-m/sec
C) 3 kg-m/sec D) 300 kg-m/sec

38. A force of 6.0 newtons changes the momentum of a moving object by 1.5 kilogram•meters per second. How long did the force act on the mass?

A) 1.0 s B) 4.0 s
C) 0.25 s D) 0.50 s

39. Which quantity has both a magnitude and a direction?

A) inertia B) impulse
C) speed D) time

40. Which situation will produce the greatest change of momentum for a 1.0-kilogram cart?

A) accelerating it from rest to 3.0 m/s
B) accelerating it from 2.0 m/s to 4.0 m/s
C) applying a net force of 5.0 N for 2.0 s
D) applying a net force of 10.0 N for 0.5 s

41. A force of 6.0 newtons changes the momentum of a moving object by 3.0 kilogram•meters per second. How long did the force act on the mass?

A) 1.0 s B) 2.0 s
C) 0.25 s D) 0.50 s

42. In an automobile collision, a 44-kilogram passenger moving at 15 meters per second is brought to rest by an air bag during a 0.10-second time interval. What is the magnitude of the average force exerted on the passenger during this time?

A) 440 N B) 660 N
C) 4400 N D) 6600 N

43. A 2,400-kilogram car is traveling at a speed of 20. meters per second. Compared to the magnitude of the force required to stop the car in 12 seconds, the magnitude of the force required to stop the car in 6.0 seconds is

A) half as great
B) twice as great
C) the same
D) four times as great

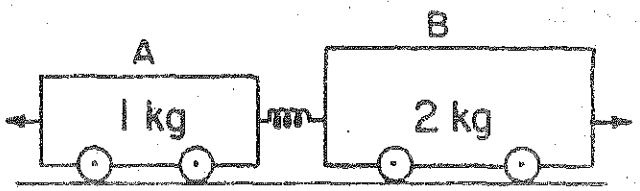
44. A 0.025-kilogram bullet is fired from a rifle by an unbalanced force of 200 Newtons. If the force acts on the bullet for 0.1 second, what is the maximum speed attained by the bullet?

A) 5 m/s B) 20 m/s
C) 400 m/s D) 800 m/s

45. A net force of 12 Newtons acting north on an object for 4.0 seconds will produce an impulse of

A) 48 kg-m/sec north
B) 48 kg-m/sec south
C) 3.0 kg-m/sec north
D) 3.0 kg-m/sec south

46. Base your answer to the following question on the diagram below which represents carts *A* and *B* being pushed apart by a spring which exerts an average force of 50. Newtons for a period of 0.20 second. [Assume friction-less conditions.]

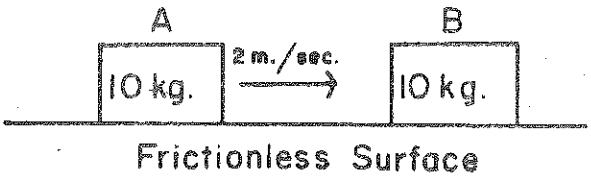


Compared to the total momentum of the carts before the spring is released, the total momentum of the carts after the spring is released is

A) one-half as great
B) twice as great
C) the same
D) four times as great

47. Base your answer to the following question on the information and diagram below.

Block *A* moves with a velocity of 2 meters per second to the right, as shown in the diagram, and then collides elastically with block *B*, which is at rest. Block *A* stops moving, and block *B* moves to the right after the collision.



If block *A* is stopped in 0.1 second, the average force acting on block *A* is

A) 50 N
B) 100 N
C) 200 N
D) 400 N

Skill 21 – Force Vectors, Resultant, Equilibrant - Practice Questions

48. 2kg object experiences three concurrent forces.

    5N to the right 10N to the left 3N to the right

    a. What is the net force acting on the 2 kg object?

    b. What is the magnitude and direction of the acceleration?

49. A force of 20 N acts at an angle of 30 degrees. What are the horizontal and vertical components of the force?

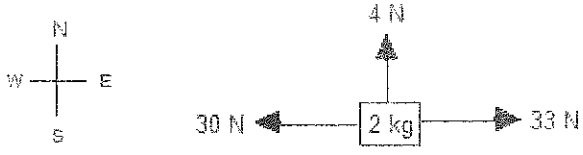
50. A force acts at an angle of 60 degrees. The horizontal component of the force is 20N. What is the magnitude of the applied force (resultant)?

51. A 5N force east and 10N force west act concurrently on an object. What is the net force acting on the object?

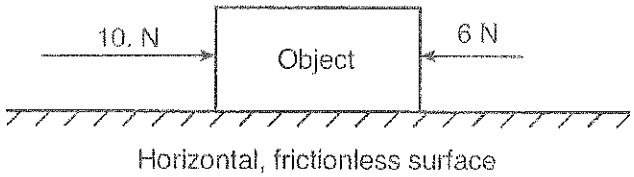
52. A force of 10 N north and 3 N west act concurrently on an object. What is the resultant of these forces? What is the equilibrant of these forces?

53. If a pair of dogs on leashes pull on the person they are walking, with a force of 100N west and 150N north, what is the equilibrant force required to keep the person at rest?

54. The following diagram (**an overhead view**) shows 3 forces acting on a block having a mass of **2 kg**. Determine the acceleration (magnitude and direction) of the mass as a result of the 3 forces.



55. Two forces act concurrently on an object on a horizontal, frictionless surface, as shown in the diagram below.



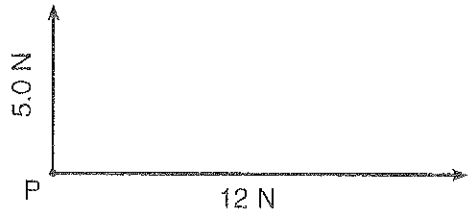
What additional force, when applied to the object, will establish equilibrium?

A) 16 N toward the right
B) 16 N toward the left
C) 4 N toward the right
D) 4 N toward the left

56. 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.°

57. The diagram below represents a 5.0-newton force and a 12-newton force acting on point P.

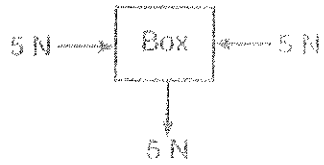


The resultant of the two forces has a magnitude of

A) 5.0 N
B) 7.0 N
C) 12 N
D) 13 N

58. Which diagram represents a box in equilibrium?

A)



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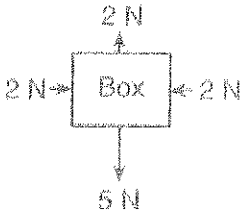

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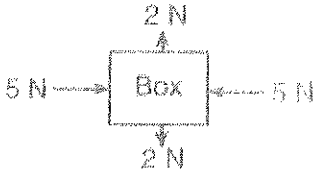
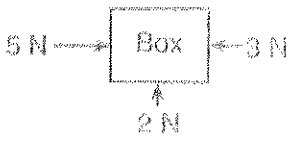


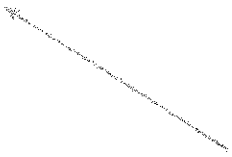
D)



59. The diagram below represents two concurrent forces.

Which vector represents the force that will produce equilibrium with these two forces?

A)



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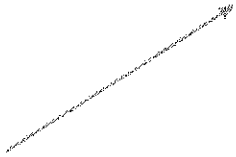
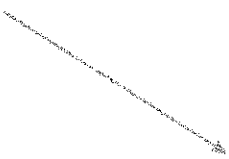


C)



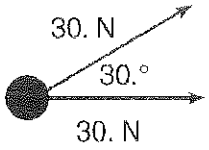
D)

60. Which combination of three concurrent forces acting on a body could *not* produce equilibrium?

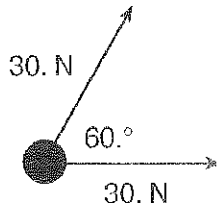
A) 1 N, 3 N, 5 N
B) 2 N, 2 N, 2 N
C) 3 N, 4 N, 5 N
D) 4 N, 4 N, 5 N

61. Two 30.-newton forces act concurrently on an object. In which diagram would the forces produce a resultant with a magnitude of 30. newtons?

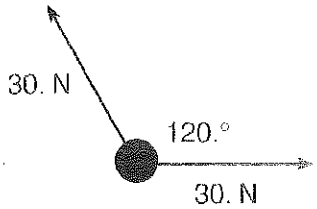
A)



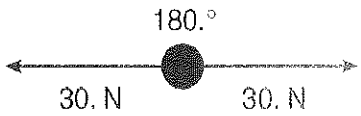
B)



C)



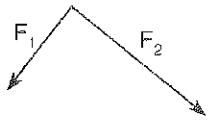
D)



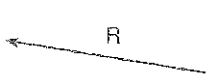
62. Which pair of concurrent forces could produce a resultant force having a magnitude of 10. Newtons?

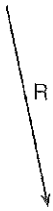
A) 10. N, 10. N
B) 10. N, 30. N
C) 4.7 N, 4.7 N
D) 4.7 N, 5.0 N

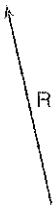
63. The vector diagram below represents two forces, F_1 and F_2 simultaneously acting on an object.

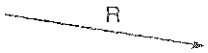


Which vector best represents the resultant of the two forces?

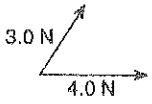
A) 

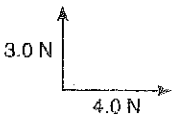
B) 

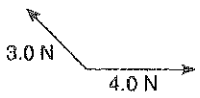
C) 

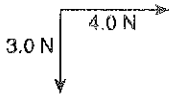
D) 

64. 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?

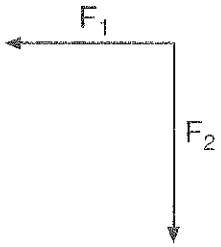
A) 

B) 

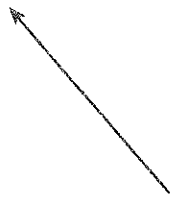
C) 

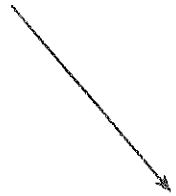
D) 

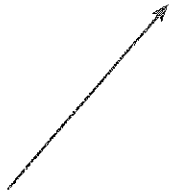
65. A force vector was resolved into two perpendicular components, F_1 and F_2, as shown in the diagram below.



Which vector best represents the original force?

A) 

B) 

C) 

D) 

66. If two 10.-newton concurrent forces have a resultant of zero, than the angle between the forces must be

A) 0° B) 45° C) 90° D) 180°

67. Two concurrent forces act at right angles to each other. If one of the forces is 40 Newtons and the resultant of the two forces is 50 Newtons, the magnitude of the other force must be

A) 10 N B) 20 N C) 30 N D) 40 N

68. Forces *A* and *B* have a resultant *R*. Force *A* and resultant *R* are shown in the diagram below.

Which vector below best represents force *B*?

A) 

B) 

C) 

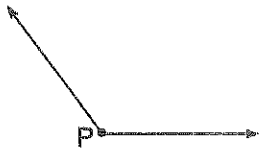
D) 

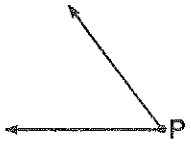
69. The vector below represents the resultant of two velocities acting concurrently on an object at point *P*.

Which pair of vectors best represents two concurrent velocities that combine to produce this resultant vector?

A) 

B) 

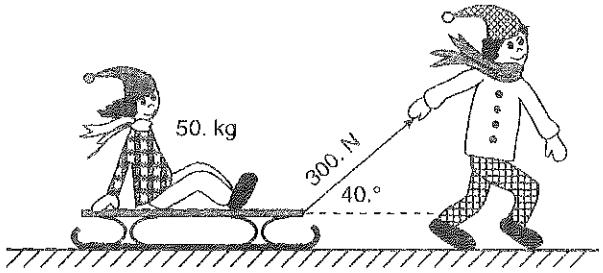
C) 

D) 

70. A 5.0-newton force could have perpendicular components of

A) 1.0 N and 4.0 N B) 2.0 N and 3.0 N
C) 3.0 N and 4.0 N D) 5.0 N and 5.0 N

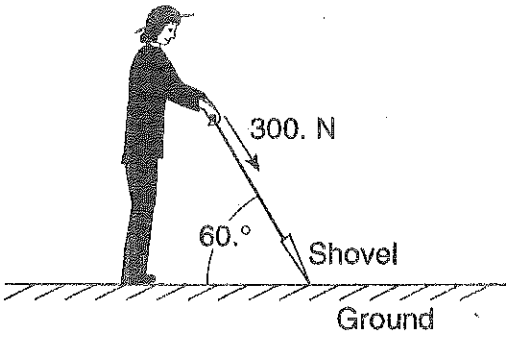
71. The diagram below shows a child pulling a 50.-kilogram friend on a sled by applying a 300.-newton force on the sled rope at an angle of 40.° with the horizontal.



The vertical component of the 300.-newton force is approximately

A) 510 N
B) 230 N
C) 190 N
D) 32 N

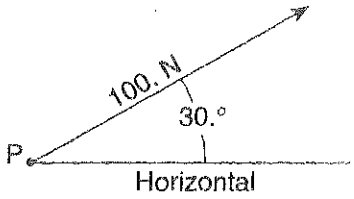
72. The diagram below shows a person exerting a 300.-newton force on the handle of a shovel that makes an angle of 60.° with the horizontal ground.



The component of the 300.-newton force that acts perpendicular to the ground is approximately

A) 150. N
B) 260. N
C) 300. N
D) 350. N

73. A 100.-newton force acts on point P, as shown in the diagram below.



The magnitude of the vertical component of this force is approximately

A) 30. N
B) 50. N
C) 71 N
D) 87 N

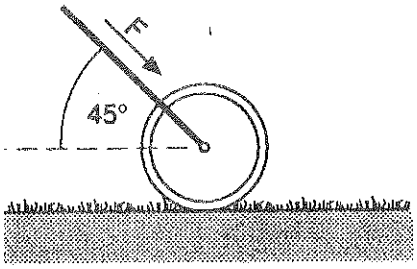
74. As the angle between a force and level ground decreases from 60° to 30°, the vertical component of the force

A) decreases
B) increases
C) remains the same

75. A resultant force of 10. Newtons is made up of two component forces acting at right angles to each other. If the magnitude of one of the components is 6.0 Newtons, the magnitude of the other component must be

A) 16 N
B) 8.0 N
C) 6.0 N
D) 4 N

76. The handle of a lawn roller is held at 45° from the horizontal. A force, F, of 28.0 Newtons is applied to the handle as the roller is pushed across a level lawn, as shown in the diagram below.



What is the magnitude of the force moving the roller forward?

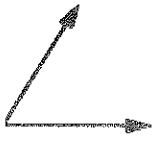
A) 7.00 N
B) 14.0 N
C) 19.8 N
D) 39.0 N

77. If the force vector shown in the diagram above is resolved into two components, these two components could best be represented by which diagram below?

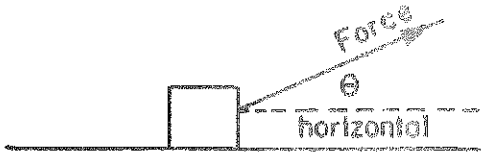
A)


B)


C)


D)


78. A constant force is exerted on a box as shown in the diagram.



As the angle θ decreases to 0° , the magnitude of the horizontal component of the force

A) decreases
B) increases
C) remains the same

79. Which quantity is scalar?

A) mass
B) force
C) momentum
D) acceleration

80. Which pair of terms are vector quantities?

A) force and mass
B) distance and displacement
C) momentum and acceleration
D) speed and velocity

Skill 22 – Identifying Forces, Horizontal, Vertical and Inclined Plane Scenarios - Practice Questions

81. A 60 kg person on Earth feels a force due to the Earth's gravitational field.
    a) What is the magnitude and direction of the force?

    b) What do we call the force of the Earth or any gravitational field pulling on an object?

    c) What is the force of the person on the Earth? (How do we know this force must exist?)

    d) What is the acceleration of the Earth due to the force of the person? Explain why the accelerations are not equal.

82. What is the weight of a 5kg dog on Earth? If the object is in equilibrium on a level surface, what is the normal force acting on the object?

83. A rock is thrown straight up into the air. At the highest point of the rock's path, the magnitude of the net force acting on the rock is known as _____. (Actually along the entire projectile path)

84. What is the net force acting on an object that is being pulled by a force of 5 N at 30^0, 10N at 180^0 and 6N at 270^0?

85. A mass of 3kg is at rest on a horizontal surface. What is the normal force acting on the box?

86. A mass of 3kg is a rest on a surface inclined at 30 degrees. What is the normal force acting on the box?

87. A sled with a mass of 40kg is accelerating at $2m/s^2$ **east** while being pulled with a force of 200N applied at an angle of 30 degrees. What is the frictional force acting on the sled? THIS IS A HORIZONTAL AXIS PROBLEM NOT AN INCLINED PLANE.

Equilibrium Yes or No so $F_{net} =$

$\Sigma F_x =$ $\Sigma F_y =$

88. A cart having a mass of 15 kg, rolling from ***left to right*** on a horizontal surface, is acted on by a 30 Newton friction force. The cart will be brought to rest by the friction force in 5.0 s.

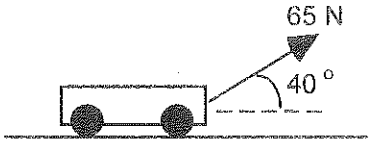
(a) On the diagram below, draw an arrow to identify the direction of each force acting on the cart while it is still moving, but is being slowed by the friction force. Identify each force by appropriately labeling the arrow that represents its vector direction. (draw a free-body diagram)

(b) Determine the acceleration of the cart as it is brought to rest by friction.

(c) What is the weight of the cart?

(d) What was the initial speed of the cart?

89. **A 25 kg** cart is being pulled along a level **frictionless** surface by a 65 N force at 40 degrees to the horizontal as shown in the diagram below.



(a) What is the horizontal acceleration of the wagon? Complete the free-body diagram.

(b) Suppose that this cart is now pulled across a muddy field with the same force at the same angle. The mud causes a resistive (frictional) force of 15 newtons to act on the cart. Find the new acceleration of the cart.

90. A monkey with a mass of 10kg hangs from a rope.

a. What is the magnitude of the tension force supporting the monkey?

b. If the monkey were pulled upward from rest to a speed of 1 m/s in a time of 0.5 s. What is the acceleration of the monkey?

c. During the acceleration phase, what is the magnitude of the tension force supporting the monkey?

d. The monkey continues to be pulled upward at 1 m/s. What is the magnitude of the tension force at this point?

91. On the surface of Earth, a spacecraft has a mass of 2.00×10^4 kilograms. What is the mass of the spacecraft at a distance of one Earth radius above Earth's surface?

A) 5.00×10^3 kg B) 2.00×10^4 kg
C) 4.90×10^4 kg D) 1.96×10^5 kg

92. A person weighing 785 newtons on the surface of Earth would weigh 298 newtons on the surface of Mars. What is the magnitude of the gravitational field strength on the surface of Mars?

A) 2.63 N/kg B) 3.72 N/kg
C) 6.09 N/kg D) 9.81 N/kg

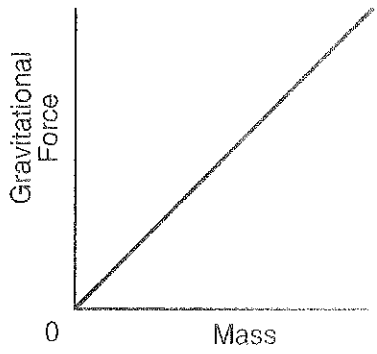
93. What is the weight of a 2.00-kilogram object on the surface of Earth?

A) 4.91 N B) 2.00 N
C) 9.81 N D) 19.6 N

94. What is the acceleration due to gravity at a location where a 15.0-kilogram mass weighs 45.0 newtons?

A) 675 m/s^2 B) 9.81 m/s^2
C) 3.00 m/s^2 D) 0.333 m/s^2

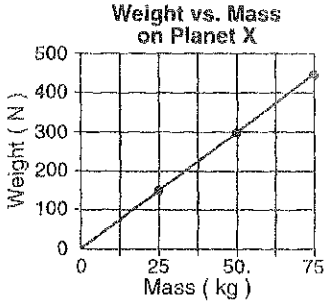
95. Base your answer to the following question on The graph below represents the relationship between gravitational force and mass for objects near the surface of Earth.



The slope of the graph represents the

A) gravitational field strength
B) universal gravitational constant
C) momentum of objects
D) weight of objects

96. The graph below shows the weight of three objects on planet X as a function of their mass.

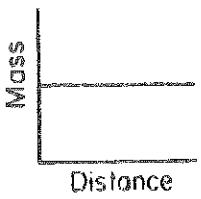


The acceleration due to gravity on planet X is

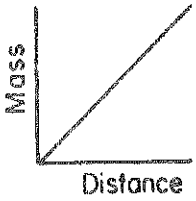
A) 0.17 m/s^2 B) 6.0 m/s^2
C) 9.8 m/s^2 D) 50. m/s^2

97. Which graph represents the relationship between the mass of an object and its distance from the Earth's surface?

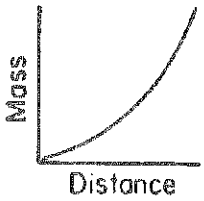
A)



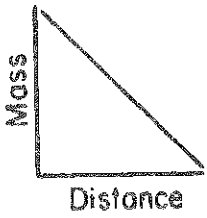
B)



C)



D)

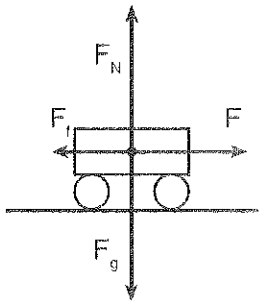


98. At a certain location, a gravitational force with a magnitude of 350 newtons acts on a 70.-kilogram astronaut. What is the magnitude of the gravitational field strength at this location?

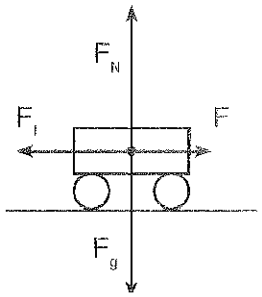
A) 0.20 kg/N
B) 5.0 N/kg
C) 9.8 m/s^2
D) 25 000 Nkg

99. Which vector diagram best represents a cart slowing down as it travels to the right on a horizontal surface?

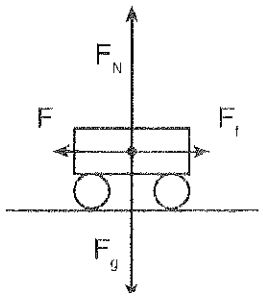
A)



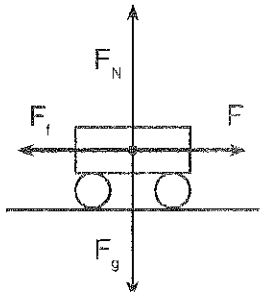
B)



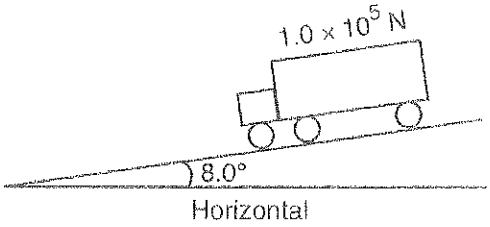
C)



D)



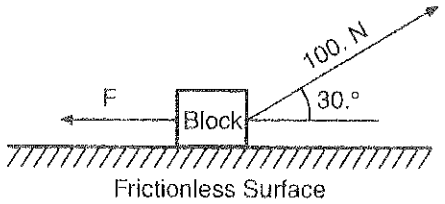
100. The diagram below shows a 1.0×10^5-newton truck at rest on a hill that makes an angle of 8.0° with the horizontal.



What is the component of the truck's weight parallel to the hill?

A) 1.4×10^3 N B) 1.0×10^4 N
C) 1.4×10^4 N D) 9.9×10^4 N

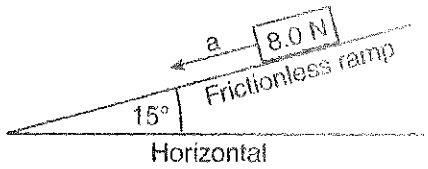
101. The diagram below shows a 25 kg block on a horizontal frictionless surface. A 100.- newton force acts on the block at an angle of 30.° above the horizontal.



What is the magnitude of *normal force acting on the block*?

A) 50.0 N B) 195 N
C) 86.6. N D) 245 N

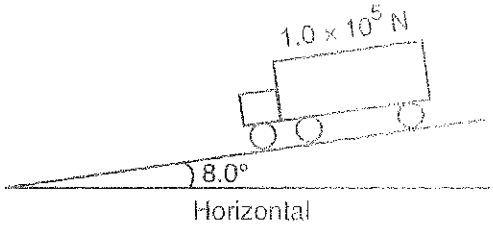
102. An 8.0-newton block is accelerating down a frictionless ramp inclined at 15° to the horizontal, as shown in the diagram below.



What is the magnitude of the net force causing the block's acceleration?

A) 0 N B) 2.1 N
C) 7.7 N D) 8.0 N

103. The diagram below shows a 1.0×10^5-newton truck at rest on a hill that makes an angle of 8.0° with the horizontal.



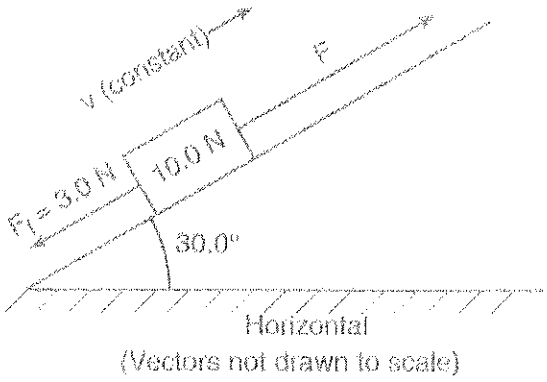
What is the component of the truck's weight parallel to the hill?

A) 1.4×10^3 N B) 1.0×10^4 N
C) 1.4×10^4 N D) 9.9×10^4 N

104. The force required to accelerate a 2.0-kilogram mass at 4.0 meters per second^2 is

A) 6.0 N B) 2.0 N
C) 8.0 N D) 16 N

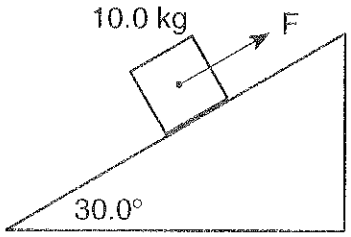
105. A block weighing 10.0 newtons is on a ramp inclined at 30.0° to the horizontal. A 3.0-newton force of friction, F_f, acts on the block as it is pulled up the ramp at constant velocity with force F, which is parallel to the ramp, as shown in the diagram below.



What is the magnitude of force F?

A) 7.0 N B) 8.0 N
C) 10 N D) 13 N

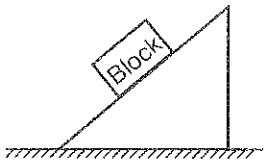
106. The diagram below shows a 10.0-kilogram mass held at rest on a frictionless 30.0° incline by force F.



What is the approximate magnitude of force F?

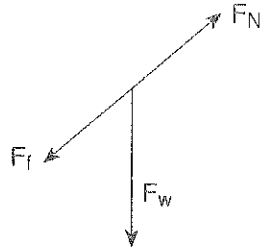
A) 9.81 N B) 49.1 N
C) 85.0 N D) 98.1 N

107. The diagram below represents a block at rest on an incline.

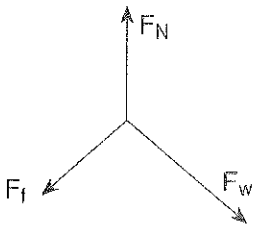


Which diagram best represents the forces acting on the block? (F_f = frictional force, F_N = normal force, and F_w = weight.)

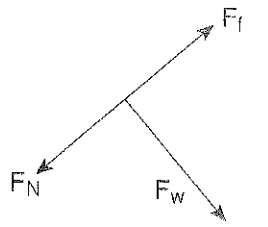
A)



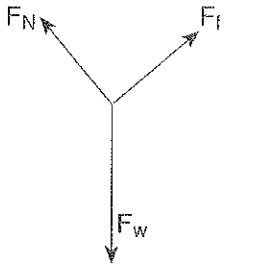
B)



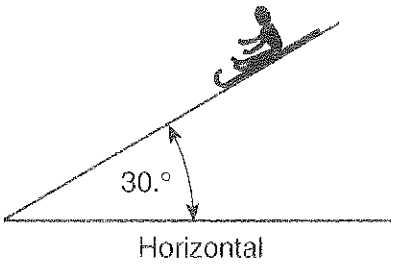
C)



D)

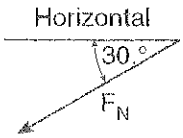


108. The diagram below shows a sled and rider sliding down a snow-covered hill that makes an angle of 30.° with the horizontal.

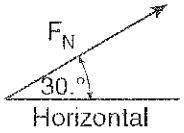


Which vector best represents the direction of the normal force, F_N, exerted by the hill on the sled?

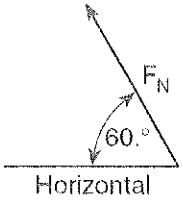
A)



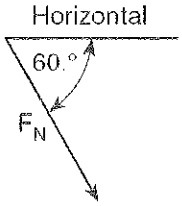
B)



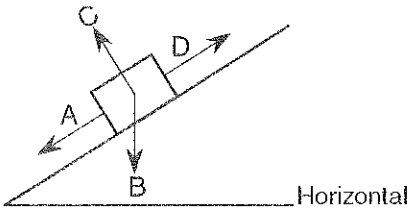
C)



D)



109. In the diagram below, a box is at rest on an inclined plane.



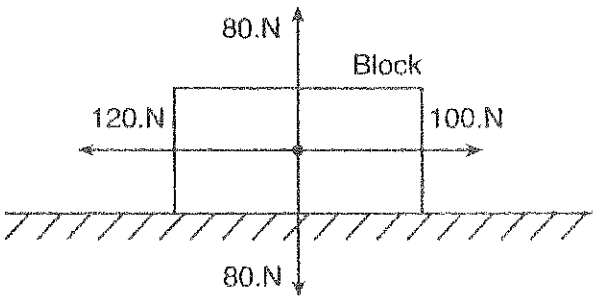
Which vector best represents the direction of the normal force acting on the box?

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

110. 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

111. Four forces act concurrently on a block on a horizontal surface as shown in the diagram below.



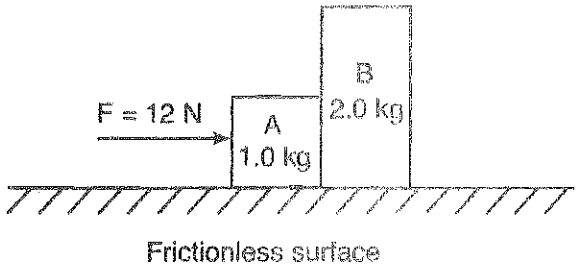
As a result of these forces, the block

A) moves at constant speed to the right
B) moves at constant speed to the left
C) accelerate to the right
D) accelerate to the left

112. A student is standing in an elevator that is accelerating downward. The force that the student exerts on the floor of the elevator must be

A) less than the weight of the student when at rest
B) greater than the weight of the student when at rest
C) less than the force of the floor on the student
D) greater than the force of the floor on the student

113. The diagram below shows a horizontal 12-newton force being applied to two blocks, A and B, initially at rest on a horizontal, frictionless surface. Block A has a mass of 1.0 kilogram and block B has a mass of 2.0 kilograms.



The magnitude of the acceleration of block B is

A) 6.0 m/s^2 B) 2.0 m/s^2
C) 3.0 m/s^2 D) 4.0 m/s^2

114. A 60-kilogram student jumps down from a laboratory counter. At the instant he lands on the floor, his speed is 3 meters per second. If the student stops in 0.2 seconds, what is the average force on the student?

A) 1×10^{-2} N B) 1×10^{2} N
C) 9×10^{2} N D) 4 N

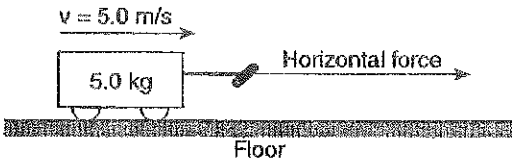
115. If the magnitude of the gravitational force of Earth on the Moon is F, the magnitude of the gravitational force of the Moon on Earth is

A) smaller than F B) larger than F
C) equal to F

116. A man weighs 900 Newtons standing on a scale in a stationary elevator. If some time later the reading on the scale is 1200 Newtons, the elevator must be moving with

A) constant acceleration downward
B) constant speed downward
C) constant acceleration upward
D) constant speed upward

117. A horizontal force is used to pull a 5.0-kilogram cart at a constant speed of 5.0 meters per second across the floor, as shown in the diagram below.



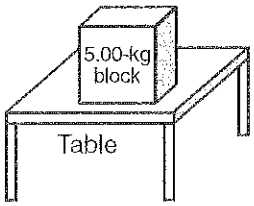
If the force of friction between the cart and the floor is 10. Newtons, the magnitude of the horizontal force along the handle of the cart is

A) 5.0 N
B) 10. N
C) 25 N
D) 50. N

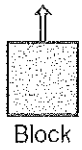
118. An elevator containing a man weighing 800 Newtons is rising at a constant speed. The force exerted by the man on the floor of the elevator is

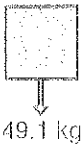
A) less than 80 N
B) between 80 and 800 N
C) 800 N
D) more than 800 N

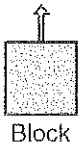
119. The diagram below shows a 5.00-kilogram block at rest on a horizontal, frictionless table.



Which diagram best represents the force exerted on the block by the table?

A) 49.1 N


B) Block


C) 5.00 kg


D) Block


120. A ball having mass m is struck by a bat having mass 9 m. Compared to the magnitude of the force exerted by the bat on the ball, the magnitude of the force exerted by the ball on the bat is

A) less
B) greater
C) the same

121. A table exerts a 2.0-newton force on a book lying on the table. The force exerted by the book on the table is

A) 20. N
B) 2.0 N
C) 0.20 N
D) 0 N

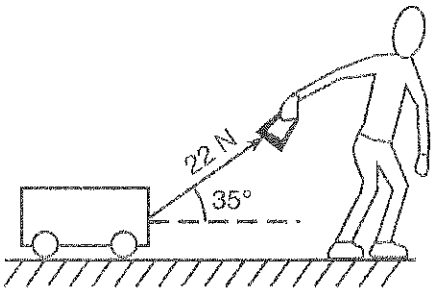
122. A rocket engine thrusts the rocket into space because

A) the exhaust pushes against the ground
B) the exhaust pushes against the air
C) every action produces an equal and opposite reaction
D) matter and energy are conserved

123. A 30-kilogram boy exerts a force of 100 Newtons on a 50-kilogram object. The force that the object exerts on the boy is

A) 0 N
B) 100 N
C) 980 N
D) 1,500 N

124. A child pulls a wagon at a constant velocity along a level sidewalk. The child does this by applying a 22-newton force to the wagon handle, which is inclined at 35° to the sidewalk as shown below.



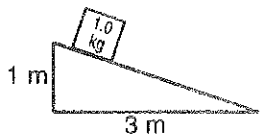
What is the magnitude of the force of friction on the wagon?

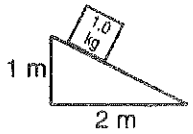
A) 11 N
B) 13 N
C) 18 N
D) 22 N

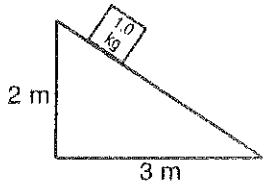
125. A 750-newton person stands in an elevator that is accelerating downward. The upward force of the elevator floor on the person must be

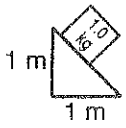
A) equal to 0 N
B) less than 750 N
C) equal to 750 N
D) greater than 750 N

126. A 1.0-kilogram block is placed on each of four frictionless planes inclined at different angles. On which inclined plane will the acceleration of the block be greatest?

A)


B)


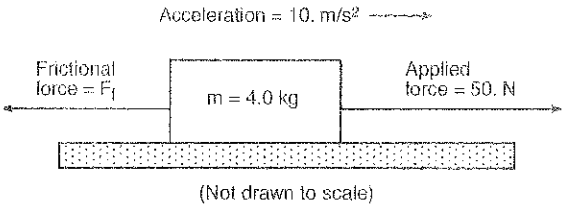
C)


D)


127. An 800-newton person is standing in an elevator. If the upward force of the elevator on the person is 600 Newtons, the person is

A) at rest
B) accelerating upward
C) accelerating downward
D) moving downward at constant speed

128. The diagram below shows a 4.0-kilogram object accelerating at 10. meters per second^2 on a rough horizontal surface.



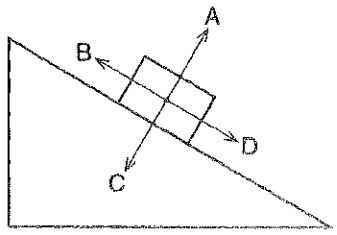
What is the magnitude of the frictional force F_f acting on the object?

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

129. A box is pushed toward the right across a classroom floor. The force of friction on the box is directed toward the

A) left
B) right
C) ceiling
D) floor

130. The diagram below represents a block sliding down an incline.



Which vector best represents the frictional force acting on the block?

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

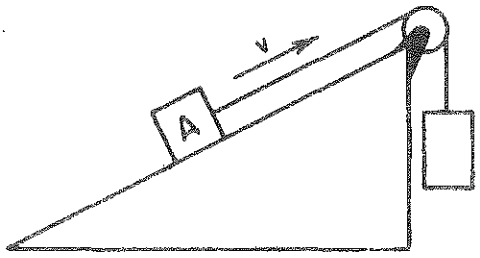
131. A 50.-Newton horizontal force is needed to keep an object weighing 500. Newtons moving at a constant velocity of 2.0 meters per second across a horizontal surface. The magnitude of the frictional force acting on the object is

A) 500. N
B) 450. N
C) 50. N
D) 0 N

132. 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

133. Block *A* is pulled with constant velocity up an incline as shown in the diagram below.



Which arrow best represents the direction of the force of friction acting on block *A*?

A) 

B) 

C) 

D) 

Skill 23: Coefficient of Friction

134. A 5kg block is on a frictionless slope inclined at 30°. Determine the acceleration of block.

135. A 10kg block slides at a constant velocity down a ramp with an incline of 25 degrees. What is the frictional force acting on the block?

136. A 3kg block is pulled at constant velocity up a ramp inclined at 30° with a force of 20N. What is the force of friction acting between the block and the ramp?

137. What is the frictional force on a 5 kg wooden block at rest on a horizontal wooden surface?

138. What is the frictional force on a 2kg copper block sliding on a horizontal steel surface?

139. What is the frictional force acting on a 2 kg steel block sliding down a steel ramp inclined at 20 degrees?

140. What is the frictional force acting on a 40kg skier on waxed ski's at rest on a snow covered hill with an incline of 40 degrees?

141. For each of the following state whether the relationship between the force of friction on object 1 vs. 2 as 1 >2 ; 1=2 ; 1< 2 briefly state your reason.

a. Object 1: A 2kg steel block at rest on a level steel surface
Object 2: A 2kg steel block in motion on a level steel surface

b. Object 1: A 3 kg rubber brick at rest on a dry asphalt surface
Object 2: A 3kg rubber brick at rest on a wet asphalt surface

c. Object 1: A 3kg copper block in motion on a steel surface
Object 2: A 2kg copper block in motion on a steel surface

d. Object 1: A 5kg wooden block moving on a horizontal wooden surface with a speed of 4 m/s
Object 2: A 5kg wooden block moving on a horizontal wooden surface with a speed of 1 m/s

e. Object 1: A waxed ski at rest on a snow covered inclined surface
Object 2: A waxed ski at rest on a snow covered horizontal surface

To find the coefficient of **static** friction between two surfaces, determine the minimum angle at which an object starts to slide on a ramp. The tangent of that angle is equal to the coefficient of static friction.

$$\mu_s = \frac{F_f}{F_N} = \frac{F_g \sin\theta}{F_g \cos\theta} = \tan\theta$$

142. A rubber duck is a rest on a ramp of unknown material. The ramp is then lifted so that the duck begins to slide when the angle is 34 degrees. What is the coefficient of static friction?

143. Coefficient of friction is very important to the design of shoes. A shoe designed for basketball must have a coefficient with the court that is high enough to stop sliding but not so high as to impede movement. In order to determine the coefficient of static friction between a basketball shoe and the gymnasium floor a student placed a shoe on a ramp made of a material matching the floor. The shoe began to slide at an angle of 50 degree. What is the coefficient of friction?

144. An 8.0-newton wooden block slides across a horizontal wooden floor at constant velocity. What is the magnitude of the force of kinetic friction between the block and the floor?

A) 2.4 N B) 3.4 N
C) 8.0 N D) 27 N

145. The force required to start an object sliding across a uniform horizontal surface is larger than the force required to keep the object sliding at a constant velocity. The magnitudes of the required forces are different in these situations because the force of kinetic friction

A) is greater than the force of static friction
B) is less than the force of static friction
C) increases as the speed of the object relative to the surface increases
D) decreases as the speed of the object relative to the surface increases

146. When a 12-newton horizontal force is applied to a box on a horizontal tabletop, the box remains at rest. The force of static friction acting on the box is

A) 0 N
B) between 0 N and 12 N
C) 12 N
D) greater than 12 N

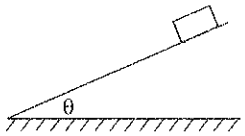
147. A wooden block is at rest on a horizontal steel surface. If a 10.-Newton force applied parallel to the surface is required to set the block in motion, how much force is required to keep the block moving at constant velocity?

A) less than 10. N
B) greater than 10. N
C) 10. N

148. Sand is often placed on an icy road because the sand

A) decreases the coefficient of friction between the tires of a car and the road
B) increases the coefficient of friction between the tires of a car and the road
C) decreases the gravitational force on a car
D) increases the normal force of a car on the road

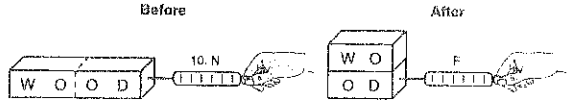
149. The diagram below shows a block sliding down a plane inclined at angle θ with the horizontal.



As angle θ *is increased, the coefficient of kinetic friction between the bottom surface of the block and the surface of the incline will*

A) decrease B) increase
C) remain the same

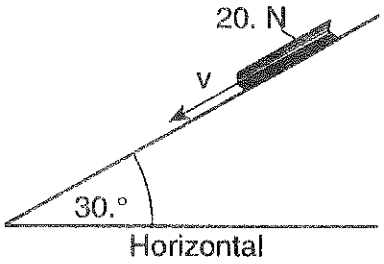
150. The diagram below shows a student applying a 10.-newton force to slide a piece of wood at constant speed across a horizontal surface. After the wood is cut in half, one piece is placed on top of the other, as shown.



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

151. A book weighing 20. Newtons slides at constant velocity down a ramp inclined 30.° to the horizontal as shown in the diagram below.



What is the force of friction between the book and the ramp?

A) 10. N up the ramp
B) 17 N up the ramp
C) 10. N down the ramp
D) 17 N down the ramp

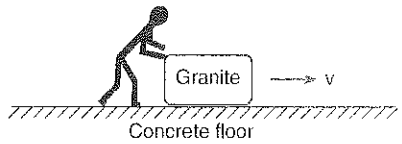
152. The table below lists the coefficients of kinetic friction for four materials sliding over steel.

Material	Coefficient of Kinetic Friction
Aluminum	0.47
Brass	0.44
Copper	0.36
Steel	0.57

A 10.-kilogram block of each of these materials is pulled horizontally across a steel floor at constant velocity. Which block requires the *smallest* applied force to keep it moving at constant velocity?

A) aluminum
B) brass
C) copper
D) steel

153. The diagram below shows a granite block being slid at constant speed across a horizontal concrete floor by a force parallel to the floor.



Which pair of quantities could be used to determine the coefficient of friction for the granite on the concrete?

A) mass and speed of the block
B) mass and normal force on the block
C) frictional force and speed of the block
D) frictional force and normal force on the block

154. A 0.50-kilogram puck sliding on a horizontal shuffleboard court is slowed to rest by a frictional force of 1.2 newtons. What is the coefficient of kinetic friction between the puck and the surface of the shuffleboard court?

A) 0.24 B) 0.42 C) 0.60 D) 4.1

155. A car's performance is tested on various horizontal road surfaces. The brakes are applied, causing the rubber tires of the car to slide along the road without rolling. The tires encounter the greatest force of friction to stop the car on

A) dry concrete B) dry asphalt
C) wet concrete D) wet asphalt

156. What is the magnitude of the force needed to keep a 60.-newton rubber block moving across level, dry asphalt in a straight line at a constant speed of 2.0 meters per second?

A) 40. N B) 51 N
C) 60. N D) 120 N

157. What is the minimum horizontal force needed to start a 300. kilogram steel block on a steel table in motion?

A) 5.70 N B) 7.40 N
C) 1710 N D) 2220 N

158. The table below lists the coefficients of kinetic friction for four materials sliding over steel.

Material	Coefficient of Kinetic Friction
aluminum	0.47
brass	0.44
copper	0.36
steel	0.57

A 10.-kilogram block of each of these materials is pulled horizontally across a steel floor at constant velocity. Which block requires the *smallest* applied force to keep it moving at constant velocity?

A) aluminum B) brass
C) copper D) steel

159. According to your reference table, *Approximate Coefficents of Friction,* what is the minimum horizontal force needed to start a 300. N steel block on a steel table in motion?

A) 0.57 N B) 074 N
C) 171 N D) 222 N

160. As more force is applied to a steel box sliding on a steel surface, the coefficent of kinetic friction will

A) decrease B) increase
C) remain the same

161. Jim wishes to push a 100. N wood crate across a wood floor. What is the minimum horizontal force that would be required to start the crate moving?

A) 30. N
B) 42 N
C) 72 N
D) 100 N

Skill 24: Spring Force

162. A spring is stretched from an equilibrium length of 1.5m to 1.75m. What is the elongation of the spring?

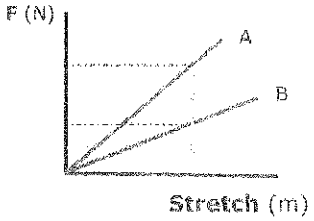
163. A spring is compressed from an equilibrium length of 0.3m to 0.2m. What is the elongation of the spring?

164. A spring with a spring constant of 45N/m is stretched 0.2m. What is the force applied to the spring?

165. A mass of 3kg is applied vertically to a spring causing it to stretch 0.25m. What is the spring constant of the spring?

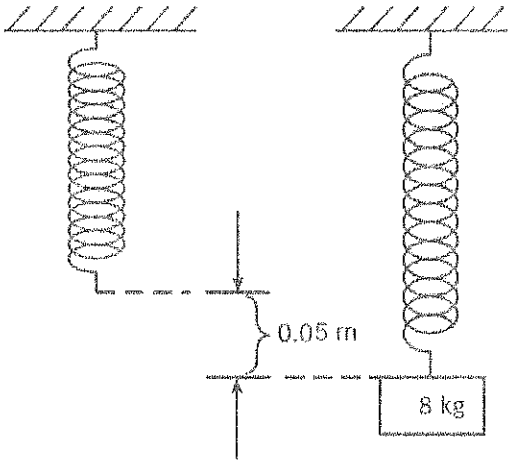
166. A 5kg weight is attached vertically to a series of springs with increasing spring constants. Draw the rough shape of the graph which shows how elongation ("x") responds to the increase in spring constant ("k"). Remember the responding variable is the dependent (y-axis) and the independent variable tells us the function that is being used (x-axis).

167. The graph below shows the relationship between spring force and change in equilibrium length of a two springs A and B.



A. What does the slope of the line represent?
B. Which spring A or B is more difficult to stretch?

168. The diagram above represents a spring hanging vertically that stretches 0.05 meter when an 8.0-kilogram block is attached. The spring-block system is at rest in the position shown.



Determine the value of the spring constant. [Show all work, including equation, substitution and units (3pts)

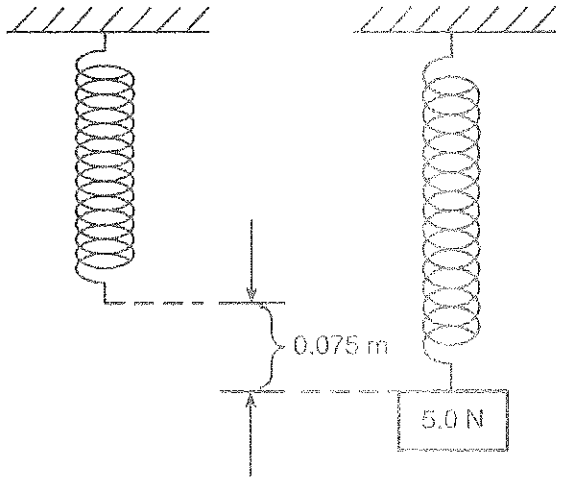
169. An unstretched spring has a length of 10. centimeters. When the spring is stretched by a force of 16 newtons, its length is increased to18 centimeters. What is the spring constant of this spring?

A) 0.89 N/cm B) 2.0 N/cm
C) 1.6 N/cm D) 1.8 N/cm

170. The spring in a scale in the produce department of a supermarket stretches 0.025 meter when a watermelon weighing 1.0×10^2 newtons is placed on the scale. The spring constant for this spring is

A) 3.2×10^5 N/m B) 4.0×10^3 N/m
C) 2.5 N/m D) 3.1×10^{-2} N/m

171. The diagram above represents a spring hanging vertically that stretches 0.075 meter when a 5.0-newton block is attached. The spring-block system is at rest in the position shown.



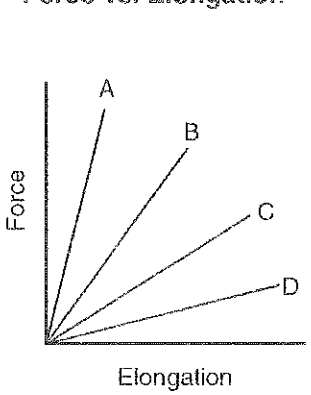
The value of the spring constant is

A) 38 N/m B) 67 N/m
C) 130 N/m D) 650 N/m

172. A vertical spring 0.100 meters long is elongated to a length of 0.119 meters when a 1.00-kilogram mass is attached to the bottom of the spring. The spring constant of this spring is

A) 9.8 N/m B) 82 N/m
C) 98 N/m D) 520 N/m

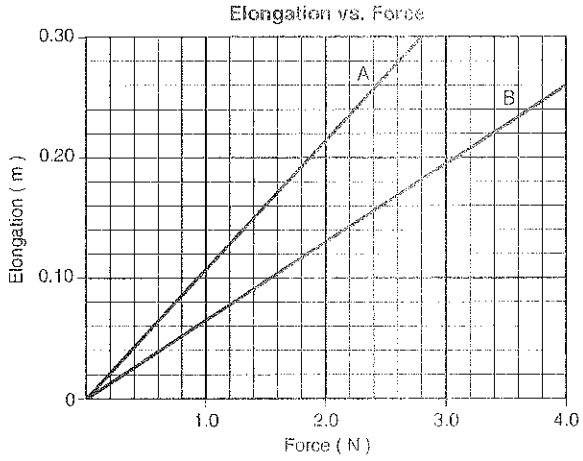
173. The graph below represents the relationship between the force applied to a spring and spring elongation for four different springs.



Which spring has the greatest spring constant?

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

174. The graph below shows elongation as a function of the applied force for two springs, *A* and *B*.

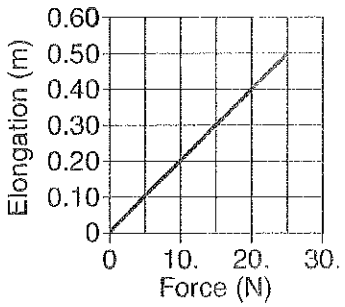


Compared to the spring constant for spring *A*, the spring constant for spring *B* is

A) smaller B) larger

C) the same

175. The graph below shows the relationship between the elongation of a spring and the force applied to the spring causing it to stretch.



What is the spring constant for this spring?

A) 0.020 N/m B) 2.0 N/m

C) 25 N/m D) 50. N/m

Skill 25: Centripetal Motion

176. Determine the centripetal acceleration of a 4kg mass moving at a speed of 3m/s in a circle with a radius of 0.5 m.

177. Determine the centripetal force acting on a 3kg mass which is moving at 2m/s around a circle with a radius of 1 m.

178. Determine the centripetal acceleration of a 5kg mass that completes a rotation around a circle with a radius of 0.75 m every 2 seconds.

179. Name the type of relationship for each of the following pairs.

a. Centripetal force and mass

b. Centripetal acceleration and mass

c. Centripetal force and radius

d. Centripetal acceleration and velocity

e. Centripetal force and velocity

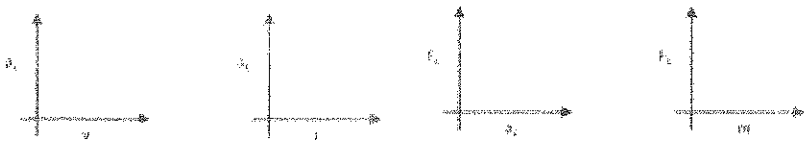
180. If the radius of a circle is doubled and all other factors are held constant, the centripetal acceleration will _____.

181. If the speed of an object is a circular path is tripled and all other factors are held constant, the centripetal acceleration will _____

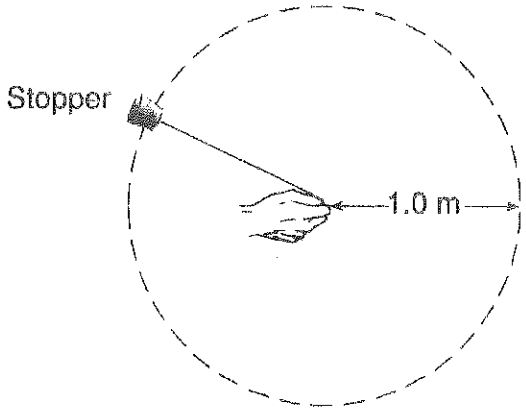
182. If the mass of an object traveling in a circular path is doubled and all other factors are held constant, the centripetal force will.

183. If the radius of a circular path is halved and all other factors are held constant the force required to keep the object on the circular path will be _____.

184. Sketch the relationship between the variables for the following axes.



185. In an experiment, a 0.028-kilogram rubber stopper is attached to one end of a string. A student whirls the stopper overhead in a horizontal circle with a radius of 1.0 meter. The stopper completes 1 revolution in 0.5 seconds.



(Not drawn to scale)

Determine the speed of the whirling stopper.

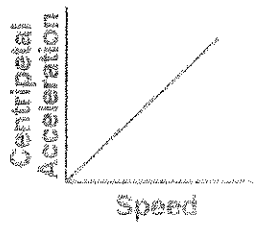
186. A 1.0×10^3-kilogram car travels at a constant speed of 20. meters per second around a horizontal circular track. The diameter of the track is 1.0×10^2meters. The magnitude of the car's centripetal acceleration is

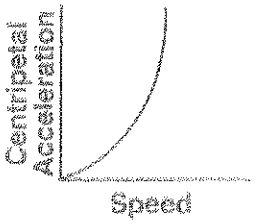
A) $0.20\,\mathrm{m/s^2}$ B) $2.0\,\mathrm{m/s^2}$
C) $8.0\,\mathrm{m/s^2}$ D) $4.0\,\mathrm{m/s^2}$

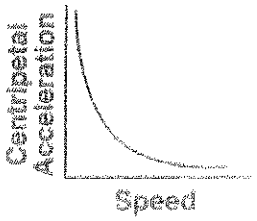
187. A 0.50-kilogram object moves in a horizontal circular path with a radius of 0.25 meter at a constant speed of 4.0 meters per second. What is the magnitude of the object's acceleration?

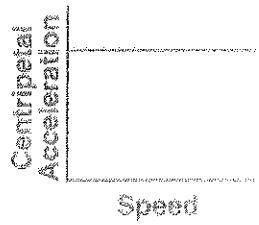
A) 8.0 m/s^2 B) 16 m/s^2
C) 32 m/s^2 D) 64 m/s^2

188. 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)


B)


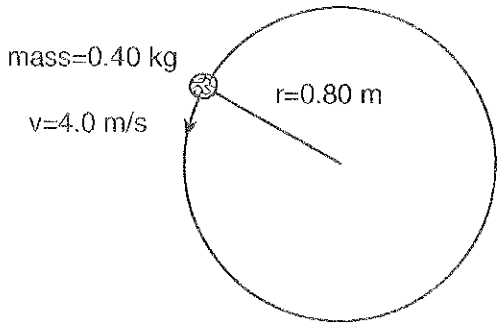
C)


D)


189. An object travels in a circular orbit. If the speed of the object is doubled, its centripetal acceleration will be

A) halved B) doubled
C) quartered D) quadrupled

190. The diagram below represents a 0.40-kilogram stone attached to a string. The stone is moving at a constant speed of 4.0 meters per second in a horizontal circle having a radius of 0.80 meter.



The magnitude of the centripetal acceleration of the stone is

A) 0.0 m/s^2 B) 2.0 m/s^2
C) 5.0 m/s^2 D) 20. m/s^2

191. What is the centripetal acceleration of a ball traveling at 6.0 meters per second in a circle whose radius is 9.0 meters?

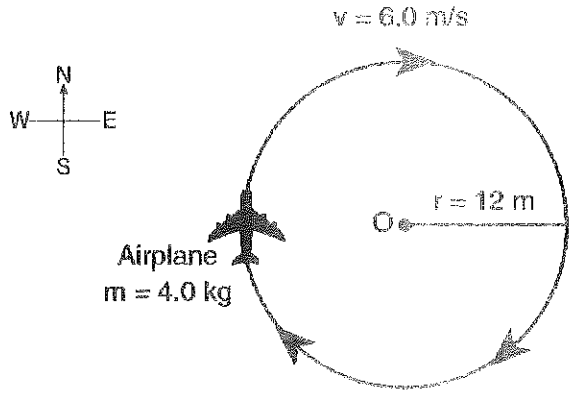
A) 0.66 m/s^2 B) 1.5 m/s^2
C) 15 m/s^2 D) 4.0 m/s^2

192. 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

193. Base your answer to the following question on the information and diagram below.

A 4.0-kilogram model airplane travels in a horizontal circular path of radius 12 meters at a constant speed of 6.0 meters per second.



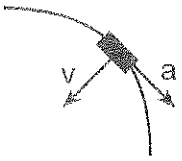
What is the magnitude of the centripetal acceleration of the airplane?

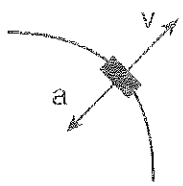
A) 0.50 m/s^2 B) 2.0 m/s^2
C) 3.0 m/s^2 D) 12 m/s^2

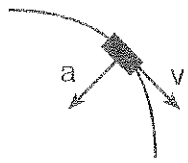
194. A 1750-kilogram car travels at a constant speed of 15.0 meters per second around a horizontal, circular track with a radius of 45.0 meters. The magnitude of the centripetal force acting on the car is

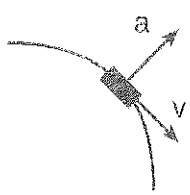
A) 5.00 N B) 583 N
C) 8750 N D) 3.94×10^5 N

195. A car rounds a horizontal curve of constant radius at a constant speed. Which diagram best represents the directions of both the car's velocity, v, and acceleration, a?

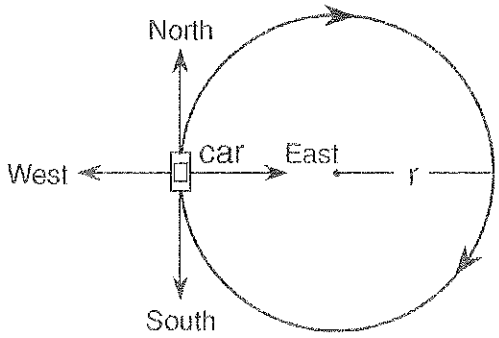
A) 

B) 

C) 

D) 

196. A car moves with a constant speed in a clockwise direction around a circular path of radius r, as represented in the diagram above.

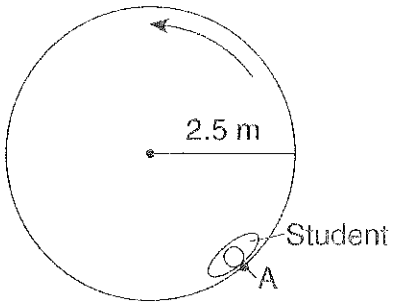


When the car is in the position shown, its acceleration is directed toward the

A) north B) west
C) south D) east

197. Base your answer to the following question on the information and diagram below.

The diagram shows the top view of a 65-kilogram student at point A on an amusement park ride. The ride spins the student in a horizontal circle of radius 2.5 meters, at a constant speed of 8.6 meters per second. The floor is lowered and the student remains against the wall without falling to the floor.



Which vector best represents the direction of the centripetal acceleration of the student at point A.

A) 

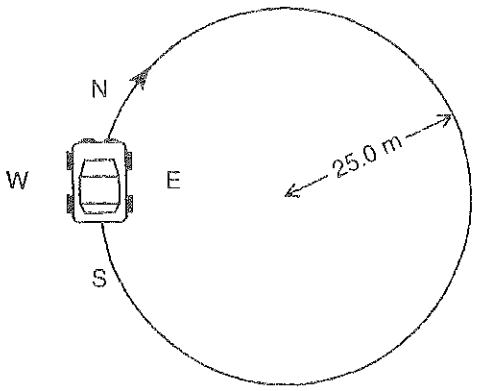
B) 

C)

D)

198. Base your answer to the following question on the information and diagram below.

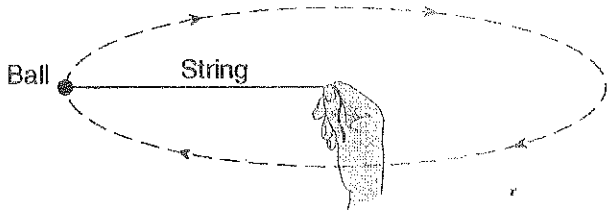
A 1.00×10^3 -kilogram car is driven clockwise around a flat circular track of radius 25.0 meters. The speed of the car is a constant 10.00 meters per second.



What minimum friction force must exist between the tires and the road to prevent the car from skidding as it rounds the curve?

A) 1.25×10^5 N B) 9.80×10^4 N
C) 4.00×10^2 N D) 4.00×10^3 N

Base your answers to questions **199** and **200** on the diagram below. 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.]



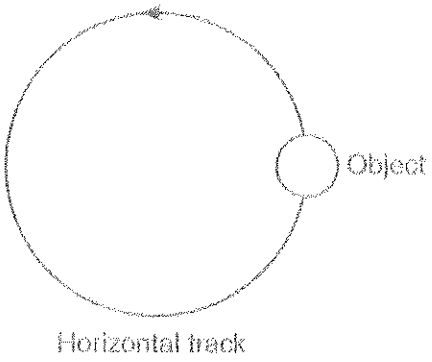
199. If the magnitude of the force applied to the string by the student's hand is increased, the magnitude of the acceleration of the ball in its circular path will

A) decrease B) increase
C) remain the same

200. Which is the best description of the force keeping the ball in the circular path?

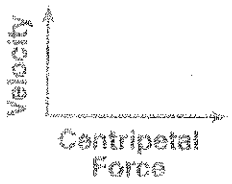
A) perpendicular to the circle and directed toward the center of the circle
B) perpendicular to the circle and directed away from the center of the circle
C) tangent to the circle and directed in the same direction that the ball is moving
D) tangent to the circle and directed opposite to the direction that the ball is moving

201. The diagram below shows an object moving counterclockwise around a horizontal, circular track.

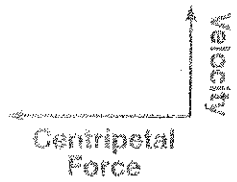


Which diagram represents the direction of both the object's velocity and the centripetal force acting on the object when it is in the position shown?

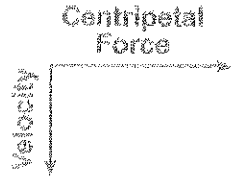
A)



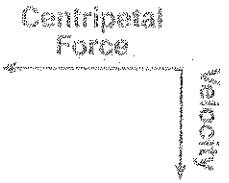
B)



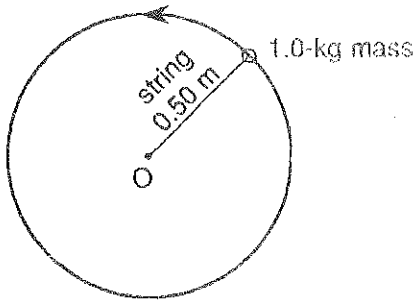
C)



D)



202. Base your answer to the following question on the diagram below which shows an object with a mass of 1.0 kilogram attached to a string 0.50 meter long. The object is moving at a constant speed of 5.0 meters per second in a horizontal circular path with center at point *O*.



If the string is cut when the object is at the position shown, the path the object will travel from this position will be

A) toward the center of the circle
B) a curve away from the circle
C) a straight line tangent to the circle

Skill 26: Universal Gravitation

203. Solve for the strength of the gravitation field "g" for any object on Earth by combining these two equations for Force due to gravity. For m_1 you may use the mass of any object on the Earth. The mass of the Earth (m_2) and the radius of the Earth (r) can be found on the reference table.

$F_g=mg$ and $F_g = G\frac{m_1 m_2}{r^2}$

To find F_g when the gravitational field strength "g" is known.	To find F_g when the distance between centers is large; find F_g when the object is outside of the uniform gravitational field.

$$m_1 g = G\frac{m_1 m_2}{r^2}$$

204. Determine the force of gravitational attraction between 2 protons separated by a distance of 1m.

205. What is the force of gravitational attraction between two asteroids separated by 3000 meters if they have masses of 4×10^5kg and 6×10^6kg?

206. The equation $F_g = G\frac{m_1 m_2}{r^2}$ reveals a _____ relationship between F_g and the product of the masses and a _____ relationship between F_g and the distance between the centers of two masses (r).

207. What is the effect on the gravitational force if

a. Both masses are multiplied by 3

b. The distance between centers is X4

c. One mass is X2 and the other X3

d. The distance is divided by 2

e. The distance is divided by 2 and one mass X3

208. Two masses are attracted by a force of 20N.

a. What would the force between them be if both masses were tripled?

b. What would the force between them be if the distance separating them were doubled?

209. An astronaut with a mass of 50 kg is standing on the Earth's surface.

a. Calculate her weight while on the Earth's surface.

b. The astronaut moves to an altitude that is one Earth radius above the surface of the Earth. Calculate her weight at this altitude.

210. Which diagram best represents the gravitational forces, F_g, between a satellite, S, and Earth?

A) 

B) 

C) 

D) 

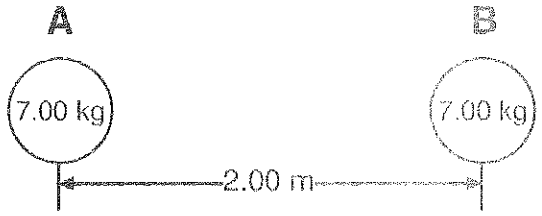
211. Gravitational forces differ from electrostatic forces in that gravitational forces are

A) attractive, only
B) repulsive, only
C) neither attractive nor repulsive
D) both attractive and repulsive

212. If the mass of one of two objects is increased, the force of attraction between them will

A) decrease B) increase
C) remain the same

213. The diagram shows two bowling balls, A and B, each having a mass of 7.00 kilograms, placed 2.00 meters apart.



What is the magnitude of the gravitational force exerted by ball A on ball B?

A) 8.17×10^{-9} N B) 1.63×10^{-9} N
C) 8.17×10^{-10} N D) 1.17×10^{-10} N

214. The centers of two 15.0-kilogram spheres are separated by 3.00 meters. The magnitude of the gravitational force between the two spheres is approximately

A) 1.11×10^{-10} N B) 3.34×10^{-10} N
C) 1.67×10^{-9} N D) 5.00×10^{-9} N

215. The radius of Mars is approximately one-half the radius of Earth, and the mass of Mars is approximately one-tenth the mass of Earth. Compared to the acceleration due to gravity on the surface of Earth, the acceleration due to gravity on the surface of Mars is

A) smaller B) larger
C) the same

216. Gravitational force F exists between point objects A and B separated by distance R. If the mass of A is doubled and distance R is tripled, what is the new gravitational force between A and B?

A) $\frac{2F}{9}$
B) $\frac{2F}{3}$
C) $\frac{3F}{2}$
D) $\frac{9F}{2}$

217. What is the magnitude of the gravitational force between two 5.0-kilogram masses separated by a distance of 5.0 meters?

A) 5.0×10^{0} N
B) 3.3×10^{-10} N
C) 6.7×10^{-11} N
D) 1.3×10^{-11} N

218. The gravitational force of attraction between two objects would be increased by

A) doubling the mass of both objects, only
B) doubling the distance between the objects, only
C) doubling the mass of both objects and doubling the distance between the objects
D) doubling the mass of one object and doubling the distance between the objects

219. The magnitude of the gravitational force between two objects is 20. Newtons. If the mass of each object were doubled, the magnitude of the gravitational force between the objects would be

A) 5.0 N
B) 10. N
C) 20. N
D) 80 N

220. Compared to the mass of an object at the surface of the Earth, the mass of the object a distance of two Earth radii from the center of the Earth is

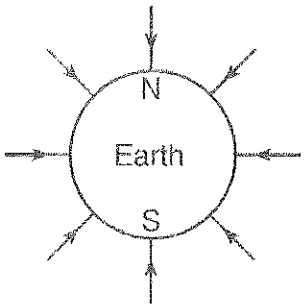
A) the same
B) twice as great
C) one-half as great
D) one-fourth as great

221. As a meteor moves from a distance of 16 Earth radii to a distance of 2 Earth radii from the center of Earth, the magnitude of the gravitational force between the meteor and Earth becomes

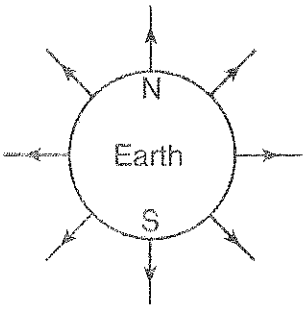
A) $\frac{1}{8}$ as great
B) 8 times as great
C) 64 times as great
D) 4 times as great

222. In which diagram do the field lines best represent the gravitational field around Earth?

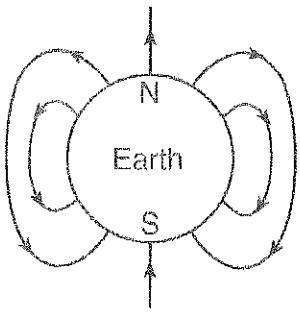
A)



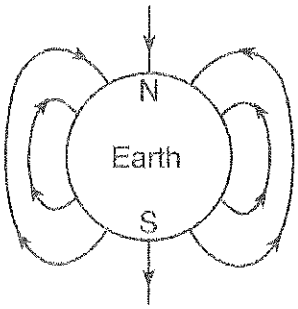
B)



C)

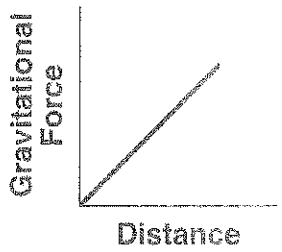


D)

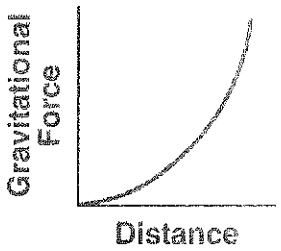


223. Which graph represents the relationship between the magnitude of the gravitational force exerted by Earth on a spacecraft and the distance between the center of the spacecraft and center of Earth? [Assume constant mass for the spacecraft.]

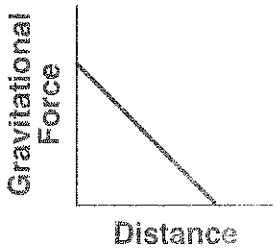
A)



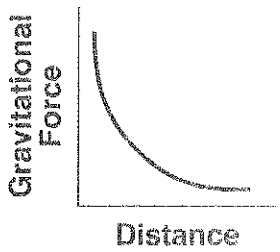
B)



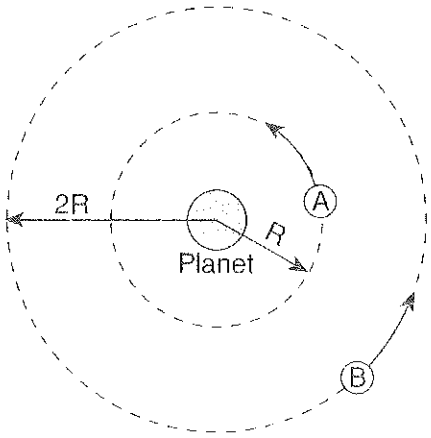
C)



D)



224. The diagram below represents two satellites of equal mass, *A* and *B*, in circular orbits around a planet.



Compared to the magnitude of the gravitational force of attraction between satellite *A* and the planet, the magnitude of the gravitational force of attraction between satellite *B* and the planet is

A) half as great
B) twice as great
C) one-fourth as great
D) four times as great

225. An object weighs 200. Newtons at a distance of 100. kilometers above the center of a small uniform planet. How much will the object weigh 200. kilometers above the planet's center?

A) 400. N B) 100. N
C) 50.0 N D) 25.0 N

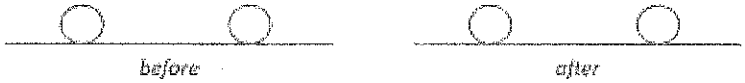
226. What is the magnitude of the gravitational force between an electron and a proton separated by a distance of 1.0×10^{-10} meter?

A) 1.0×10^{-47} N B) 1.5×10^{-46} N
C) 1.0×10^{-37} N D) 1.5×10^{-36} N

227. If the distance between a spaceship and the center of the Earth is increased from one Earth radius to 4 Earth radii, the gravitational force acting on the spaceship becomes approximately

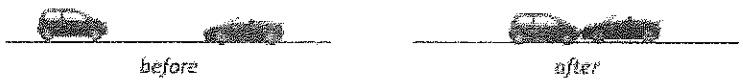
A) 1/16 as great B) 1/4 as great
C) 16 times greater D) 4 times greater

228. A 2kg ball moving at 3 m/s collides with a 3 kg ball at rest. Assuming that the 2.0 kg ball stops after the collision, what is the velocity of the 3 kg ball after the collision



229. A 50 kg football player moving at 2 m/s east collides with a 70kg player moving at 4 m/s west. At what speed will the two players be moving if they are locked together after they collide?

230. A 1000 kg car moving at 3.0 m/s east collides with a 1500 kg car moving west. If the two cars stop after the collision, what velocity did the 1500 kg car have before the collision?



231. A 100 kg cannon has a 5.0 kg cannon ball ready for launch. If the cannonball is fired with an initial velocity of 20 m/s, what is the recoil velocity of the cannon?

232. The magnitude of the momentum of an object is 64.0 kilogram•meter per second. If the velocity of the object is doubled, the magnitude of the momentum of the object will be

A) 32.0 kg•m/s B) 64.0 kg•m/s
C) 128 kg•m/s D) 256 kg•m/s

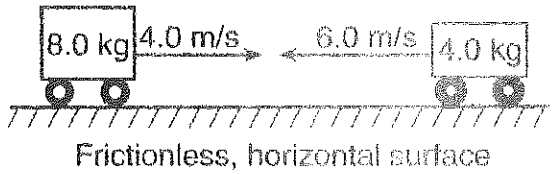
233. Which quantity has both a magnitude and a direction?

A) inertia B) impulse
C) speed D) time

234. An air bag is used to safely decrease the momentum of a driver in a car accident. The air bag reduces the magnitude of the force acting on the driver by

A) increasing the length of time the force acts on the driver
B) decreasing the distance over which the force acts on the driver
C) increasing the rate of acceleration of the driver
D) decreasing the mass of the driver

235. 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

236. 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

237. In the diagram below, scaled vectors represent the momentum of each of two masses, *A* and *B*, sliding toward each other on a frictionless, horizontal surface.

Which scaled vector best represents the momentum of the system after the masses collide?

A)

B)

C)

D)

238. A 0.050-kilogram bullet is fired from a 4.0 kilogram rifle that is initially at rest. If the bullet leaves the rifle with momentum having a magnitude of 20. kilogram•meters per second, the rifle will recoil with a momentum having a magnitude of

A) 1,600 kg•m/s B) 80. kg•m/s
C) 20. kg•m/s D) 0.25 kg•m/s

239. The total momentum of a system that consists of a moving rocket and its exhaust gases will

A) decrease B) increase
C) remain the same

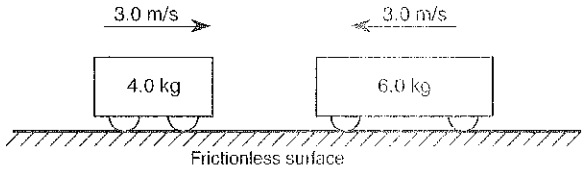
240. A 2-kilogram object traveling 10 meters per second north has a perfect elastic collision with a 5-kilogram object traveling 4 meters per second south. What is the total momentum after collision?

A) 0 kg-m/s B) 20 kg-m/s north
C) 20 kg-m/s south D) 40 kg-m/s east

241. 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

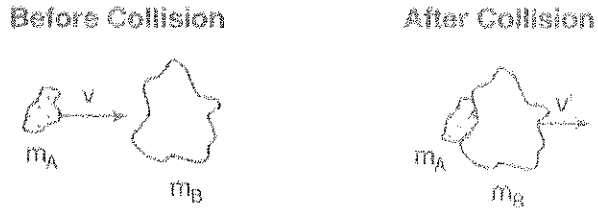
242. The diagram below shows a 4.0-kilogram cart moving to the right and a 6.0-kilogram cart moving to the left on a horizontal frictionless surface.



When the two carts collide they lock together. The magnitude of the total momentum of the two-cart system after the collision is

A) 0.0 kg•m/s B) 6.0 kg•m/s
C) 15 kg•m/s D) 30. kg•m/s

243. 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.

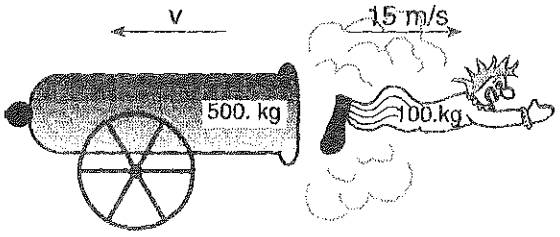


Which expression represents the speed, v', of the masses after the collision? [Assume no outside forces are acting on m_A or m_B.]

A) $\frac{m_A + m_B v}{m_A}$ B) $\frac{m_A + m_B}{m_A v}$

C) $\frac{m_B v}{m_A + m_B}$ D) $\frac{m_A v}{m_A + m_B}$

244. In the diagram below, a 100.-kilogram clown is fired from a 500.-kilogram cannon.

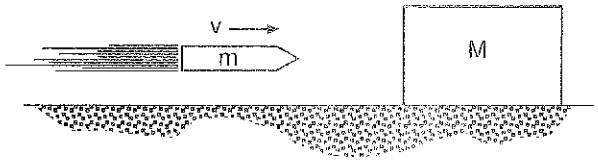


If the clown's speed is 15 meters per second after the firing, the recoil speed (v) of the cannon is

A) 75 m/s B) 15 m/s

C) 3.0 m/s D) 0 m/s

245. In the diagram below, a block of mass M initially at rest on a frictionless horizontal surface is struck by a bullet of mass 1 moving with horizontal velocity v.



What is the velocity of the bullet-block system after the bullet embeds itself in the block?

A) $\left(\frac{M+v}{M}\right)m$

B) $\left(\frac{m+M}{m}\right)v$

C) $\left(\frac{m+v}{M}\right)m$

D) $\left(\frac{m}{m+M}\right)v$

246. A 20-kilogram cart traveling east with a speed of 6 meters per second collides with a 30-kilogram cart traveling west. If both carts come to rest immediately after the collision, what was the speed of the westbound cart before the collision?

A) 6 m/s B) 2 m/s

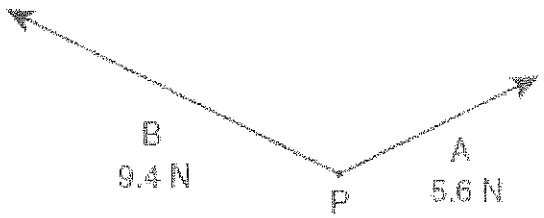
C) 3 m/s D) 4 m/s

247. Two carts resting on a frictionless surface are forced apart by a spring. One cart has a mass of 2 kilograms and moves to the left at a speed of 3 meters per second. If the second cart has a mass of 3 kilograms, it will move to the right at a speed of

A) 1 m/s B) 2 m/s
C) 3 m/s D) 6 m/s

Skills 20-27 Review
Long Answer Questions

248. On the diagram below, use a ruler and protractor to construct a vector representing the resultant of forces A and B.



249. Base your answer to the following question on the information below.

A 1200-kilogram car moving at 12 meters per second collides with a 2300-kilogram car that is waiting at rest at a traffic light. After the collision, the cars lock together and slide. Eventually, the combined cars are brought to rest by a force of kinetic friction as the rubber tires slide across the dry, level, asphalt road surface.

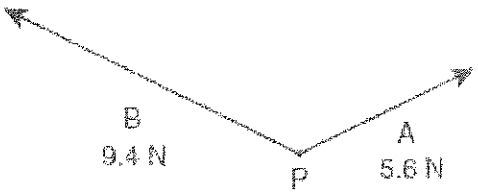
Calculate the speed of the locked-together cars immediately after the collision. [Show all work, including the equation and substitution with units.]

250. Calculate the magnitude of the impulse applied to a 0.75-kilogram cart to change its velocity from 0.50 meter per second east to 2.00 meters per second east. [Show all work, including the equation and substitution with units.]

251. A 10.-kilogram rubber block is pulled horizontally at constant velocity across a sheet of ice. Calculate the magnitude of the force of friction acting on the block. [Show all work, including the equation and substitution with units.]

Base your answers to questions **252** and **253** on the information and diagram below.

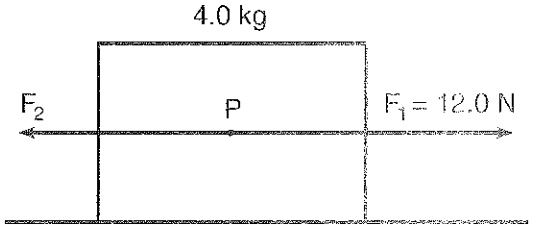
Force *A* with a magnitude of 5.6 newtons and force *B* with a magnitude of 9.4 newtons act concurrently on point *P*.



252. Determine the magnitude of the resultant force.

Base your answers to questions **253** through **255** on the information and diagram below.

In the scaled diagram, two forces, F_1 and F_2, act on a 4.0-kilogram block at point *P*. Force F_1 has a magnitude of 12.0 newtons, and is directed toward the right.



(Drawn to scale)

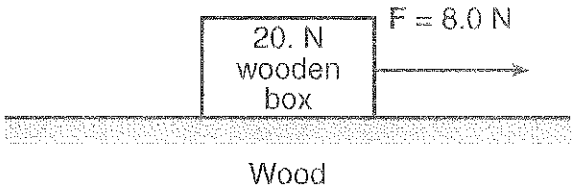
253. Calculate the magnitude of the acceleration of the block.

254. Determine the magnitude of the net force acting on the block.

255. Using a ruler and the scaled diagram, determine the magnitude of F_2 in newtons.

Base your answers to questions **256** through **258** on the information below.

A horizontal force of 8.0 newtons is used to pull a 20.-newton wooden box moving toward the right along a horizontal, wood surface, as shown.



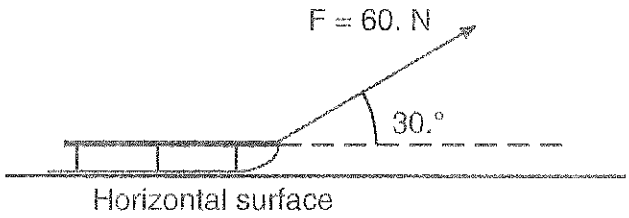
256. Calculate the magnitude of the acceleration of the box. [Show all work, including the equation and substitution with units.]

257. Determine the mass of the box.

258. Determine the magnitude of the net force acting on the box.

Base your answers to questions **259** and **260** on the information below.

A force of 60. newtons is applied to a rope to pull a sled across a horizontal surface at a constant velocity. The rope is at an angle of 30. degrees above the horizontal.



259. Determine the magnitude of the frictional force acting on the sled.

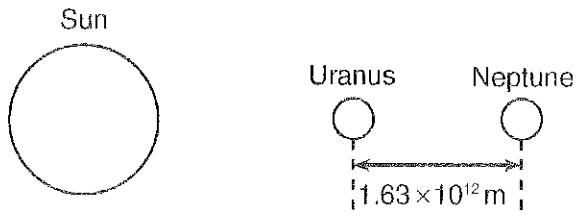
260. Calculate the magnitude of the component of the 60.-newton force that is parallel to the horizontal surface. [Show all work, including the equation and substitution with units.]

Base your answers to questions 261 and 262 on the passage and data table below.

The net force on a planet is due primarily to the other planets and the Sun. By taking into account all the forces acting on a planet, investigators calculated the orbit of each planet. A small discrepancy between the calculated orbit and the observed orbit of the planet Uranus was noted. It appeared that the sum of the forces on Uranus did not equal its mass times its acceleration, unless there was another force on the planet that was not included in the calculation. Assuming that this force was exerted by an unobserved planet, two scientists working independently calculated where this unknown planet must be in order to account for the discrepancy. Astronomers pointed their telescopes in the predicted direction and found the planet we now call Neptune.

Data Table

Mass of the Sun	1.99×10^{30} kg
Mass of Uranus	8.73×10^{25} kg
Mass of Neptune	1.03×10^{26} kg
Mean distance of Uranus to the Sun	2.87×10^{12} m
Mean distance of Neptune to the Sun	4.50×10^{12} m



(Not drawn to scale)

261. The magnitude of the force the Sun exerts on Uranus is 1.41×10^{21} newtons. Explain how it is possible for the Sun to exert a greater force on Uranus than Neptune exerts on Uranus.

262. The diagram represents Neptune, Uranus, and the Sun in a straight line. Neptune is 1.63×10^{12} meters from Uranus.

Calculate the magnitude of the interplanetary force of attraction between Uranus and Neptune at this point. [Show all work, including the equation and substitution with units.]

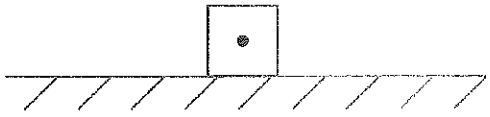
263. Base your answer to the following question on the information below.

A manufacturer's advertisement claims that their 1,250-kilogram (12,300-newton) sports car can accelerate on a level road from 0 to 60.0 miles per hour (0 to 26.8 meters per second) in 3.75 seconds.

Calculate the net force required to give the car the acceleration claimed in the advertisement. [Show all work, including the equation and substitution with units.]

264. Base your answer to the following question on the information below.

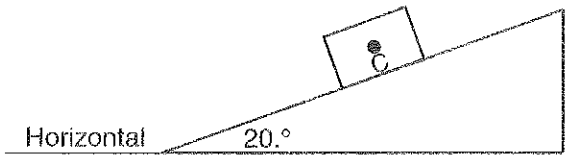
A force of 10. Newtons toward the right is exerted on a wooden crate initially moving to the right on a horizontal wooden floor. The crate weighs 25 Newtons.



a Calculate the magnitude of the force of friction between the crate and the floor.
b On the diagram, draw and label all vertical forces acting on the crate.
c On the diagram,draw and label all horizontal forces acting on the crate.
d What is the magnitude of the net force acting on the crate?
e Is the crate accelerating? Explain your answer.

Base your answers to questions **265** through **267** on the information and diagram below.

The following diagram is provided for practice purposes only. A 10.0-kilogram block slides at constant speed down a plane inclined at 20.° to the horizontal, as shown.

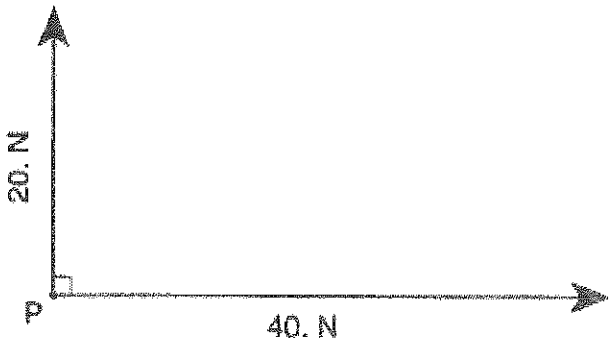


265. In one or more complete sentences, describe the change in the motion of the block as the angle of inclination is increased to 30.°.

266. Determine the weight of the block. [Show all calculations, including the equation and substitution with units.]

267. On the diagram above, draw an arrow to represent and identify the direction of each of the three forces (weight, friction, normal force) acting on the block. Begin each arrow at point *C* and label each arrow with the force that it represents.

Base your answers to questions **268** through **271** on the information and vector diagram below.



268. Calculate the magnitude of the acceleration of the object. [Show all calculations, including the equation and substitution with units.]

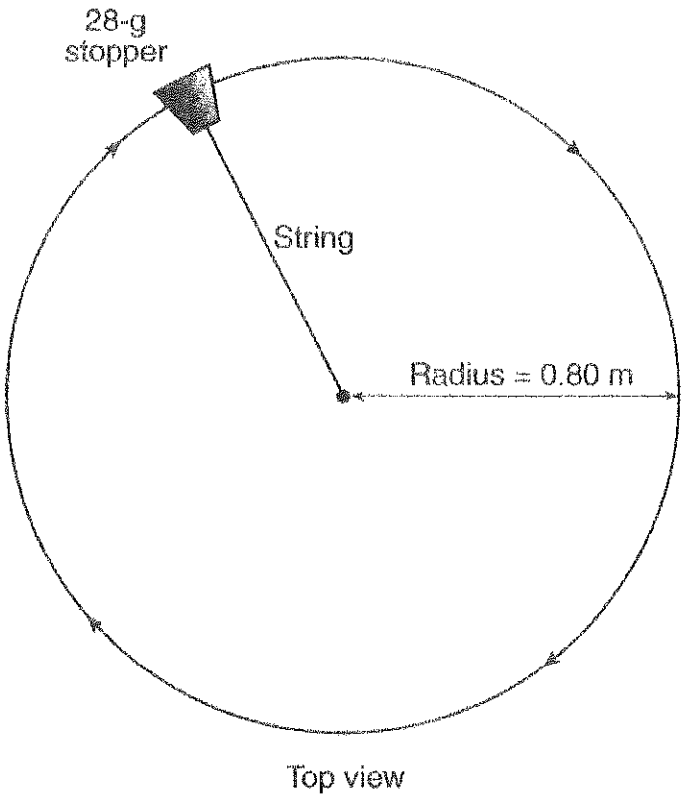
269. What is the measure of the angle (in degrees) between east and the resultant force?

270. What is the magnitude of the resultant force?

271. On the vector diagram above, use a ruler and protractor to construct the vector that represents the resultant force.

Base your answers to questions 272 and 273 on the information below.

A 28-gram rubber stopper is attached to a string and whirled clockwise in a horizontal circle with a radius of 0.80 meter. The diagram below represents the motion of the rubber stopper. The stopper maintains a constant speed of 2.5 meters per second.



Top view

272. On the diagram above, draw an arrow showing the direction of the centripetal force acting on the stopper when it is at the position shown.

273. Calculate the magnitude of the centripetal acceleration of the stopper. [Show all work, including the equation and substitution with units.]

274. Which is a unit of momentum?

A) N-m/s^2 B) kg-m/s^2
C) N-m/s D) kg-m/s

275. Which quantity has both a magnitude and a direction?

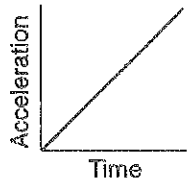
A) inertia B) impulse
C) speed D) time

276. A rocket engine acquires motion by ejecting hot gases in the opposite direction. This is an example of the law of

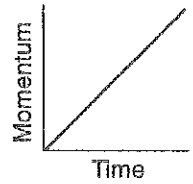
A) conservation of heat
B) conservation of energy
C) conservation of momentum
D) conservation of mass

277. Which graph best represents the motion of an object that has *no* unbalanced force acting on it?

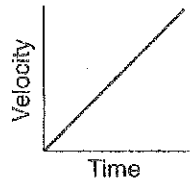
A)



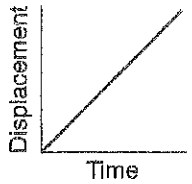
B)



C)

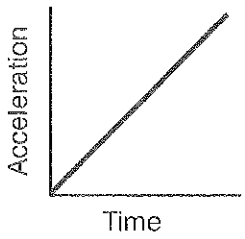


D)

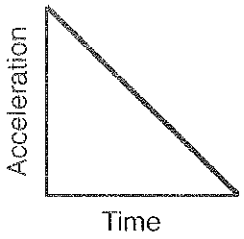


278. A constant unbalanced force is applied to an object for a period of time. Which graph best represents the acceleration of the object as a function of elapsed time?

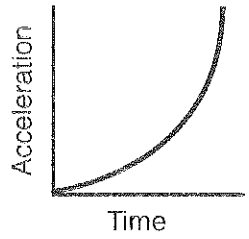
A)



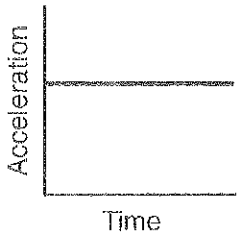
B)



C)



D)



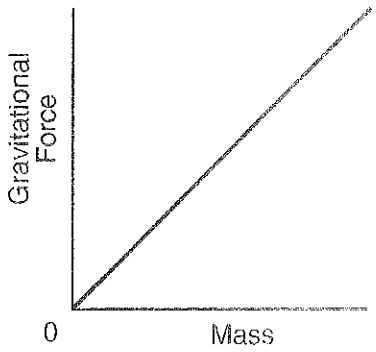
279. A man weighs 900 Newtons standing on a scale in a stationary elevator. If some time later the reading on the scale is 1200 Newtons, the elevator must be moving with

A) constant acceleration downward
B) constant speed downward
C) constant acceleration upward
D) constant speed upward

280. A cart is uniformly accelerating from rest. The net force acting on the cart is

A) decreasing
B) zero
C) constant
D) increasing

281. Base your answer to the following question on The graph below represents the relationship between gravitational force and mass for objects near the surface of Earth.

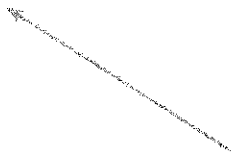


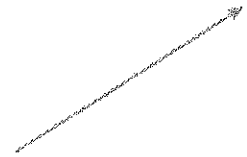
The slope of the graph represents the

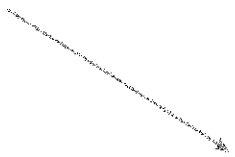
A) gravitational field strength
B) universal gravitational constant
C) momentum of objects
D) weight of objects

282. The diagram below represents two concurrent forces.

Which vector represents the force that will produce equilibrium with these two forces?

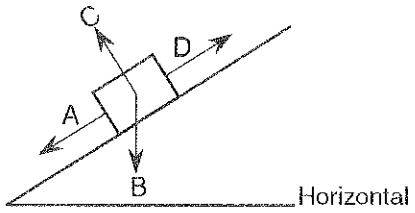
A) 

B) 

C) 

D)

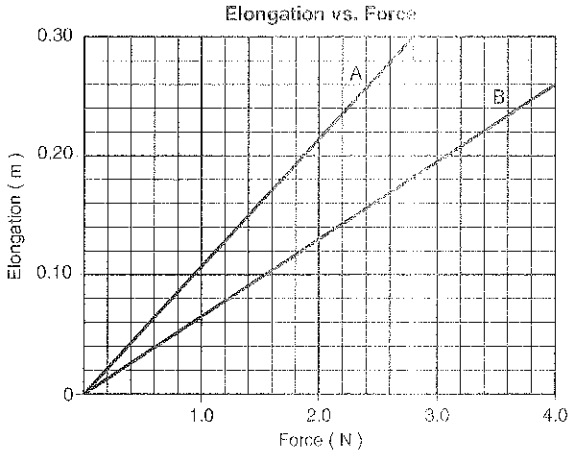
283. In the diagram below, a box is at rest on an inclined plane.



Which vector best represents the direction of the normal force acting on the box?

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

284. The graph below shows elongation as a function of the applied force for two springs, *A* and *B*.



Compared to the spring constant for spring *A*, the spring constant for spring *B* is

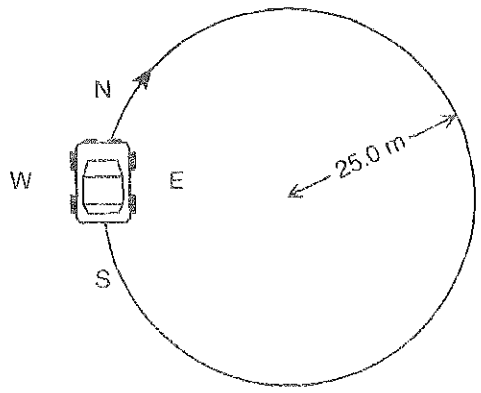
A) smaller B) larger
C) the same

285. A ball of mass *M* at the end of a string is swinging in a horizontal circular path of radius *R* at constant speed *V*. Which combination of changes would require the greatest increase in the centripetal force acting on the ball?

A) doubling *V* and doubling *R*
B) doubling *V* and halving *R*
C) halving *V* and doubling *R*
D) halving *V* and halving *R*

286. Base your answer to the following question on the information and diagram below.

A 1.00×10^3 -kilogram car is driven clockwise around a flat circular track of radius 25.0 meters. The speed of the car is a constant 5.00 meters per second.



If the circular track were to suddenly become frictionless at the instant shown in the diagram, the car's direction of travel would be

A) toward *E*
B) toward *N*
C) toward *W*
D) a clockwise spiral

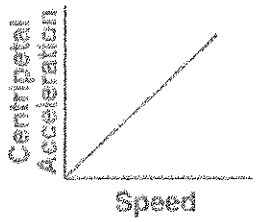
287. Base your answer to the following question on the information below.

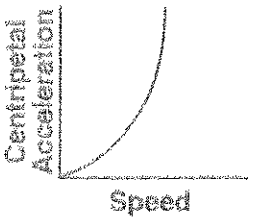
A 2.0×10^3-kilogram car travels at a constant speed of 12 meters per second around a circular curve of radius 30. meters.

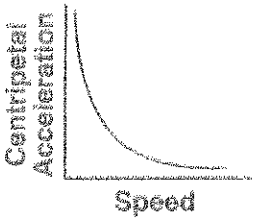
As the car goes around the curve, the centripetal force is directed

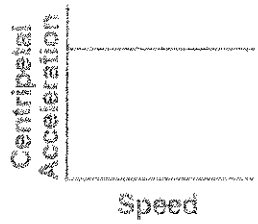
A) toward the center of the circular curve
B) away from the center of the circular curve
C) tangent to the curve in the direction of motion
D) tangent to the curve opposite the direction of motion

288. 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)


B)


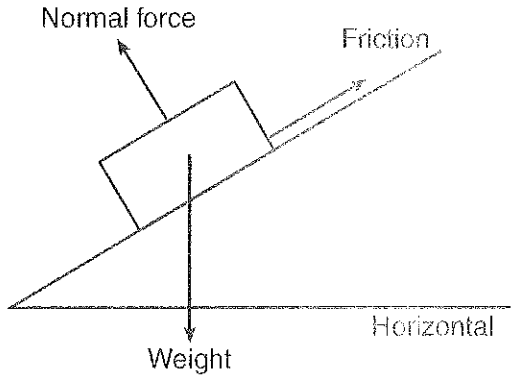
C)


D)


289. Which object has the greatest inertia?

A) a 0.010-kg bullet traveling at 90. m/s
B) a 30.-kg child traveling at 10. m/s on her bike
C) a 490-kg elephant walking with a speed of 1.0 m/s
D) a 1500-kg car at rest in a parking lot

290. Three forces act on a box on an inclined plane as shown in the diagram below. [Vectors are not drawn to scale.]



If the box is at rest, the net force acting on it is equal to

A) the weight
B) the normal force
C) friction
D) zero

291. If the sum of all the forces acting on a moving object is zero, the object will

A) slow down and stop
B) change the direction of its motion
C) accelerate uniformly
D) continue moving with constant velocity

292. A rocket in space can travel without engine power at constant speed in the same direction. This condition is best explained by the concept of

A) gravitation
B) action-reaction
C) acceleration
D) inertia

293. Which of the following is an acceptable unit for a spring constant?

A) Nm
B) N/s
C) N/m
D) kg m/s^2

294. An object is brought to rest by a constant force. Which factor other than the mass and velocity of the object must be known in order to determine the magnitude of the force required to stop the object?

A) the time that the force acts on the object
B) the gravitational potential energy of the object
C) the density of the object
D) the weight of the object

295. The direction of an object's momentum is always the same as the direction of the object's

A) inertia
B) potential energy
C) velocity
D) weight

296. 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

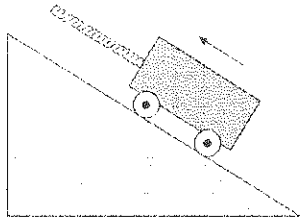
297. A woman with horizontal velocity v_1 jumps off a dock into a stationary boat. After landing in the boat, the woman and the boat move with velocity v_2. Compared to velocity v_1, velocity v_2 has

A) the same magnitude and the same direction
B) the same magnitude and opposite direction
C) smaller magnitude and the same direction
D) larger magnitude and the same direction

298. A 2,400-kilogram car is traveling at a speed of 20. meters per second. Compared to the magnitude of the force required to stop the car in 12 seconds, the magnitude of the force required to stop the car in 6.0 seconds is

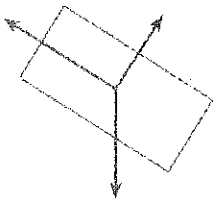
A) half as great
B) twice as great
C) the same
D) four times as great

299. A cart is held at equilibrium on an inclined plane (frictionless surface).

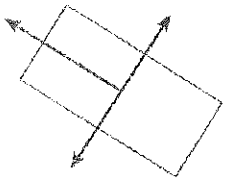


Which of the following correctly represents the forces that act on the cart?

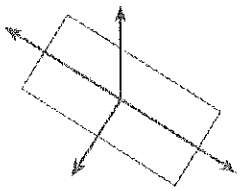
A)



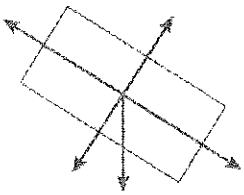
B)



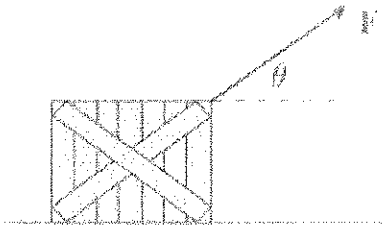
C)



D)



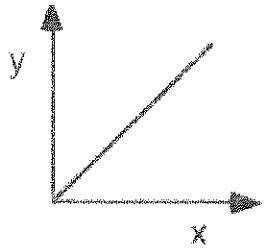
300. The diagram below shows a force of magnitude F applied to a crate at an angle θ relative to a horizontal frictionless surface.

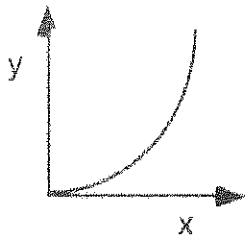


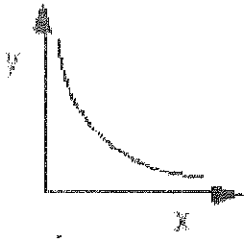
As the angle θ is increased, the horizontal acceleration of the mass

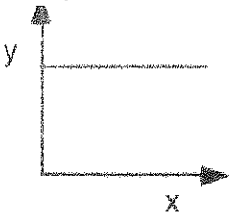
A) increases
B) decreases
C) remains the same

301. In a lab investigation, a student applies a constant net force to a cart and measures the acceleration of the cart in response to an increasing mass. Which of the following graphs shows the correct relationship between the dependent and independent variable in this experiment.

A)


B)


C)


D)


302. Two eggs, A and B, each with a mass of 0.1kg, are dropped for the same distance. If egg A is brought to a rest by the floor in 0.5 seconds and egg B is brought to a rest by a cushion in 1 second, Egg A experiences

A) a greater change in momentum
B) a greater impulse
C) a greater net force
D) a smaller impulse

303. If the Earth were twice as massive as it is now, then the gravitational force between it and the Sun would be

A) the same
B) twice as great
C) half as great
D) four times as great

304. The gravitational force of attraction between two objects would be increased by

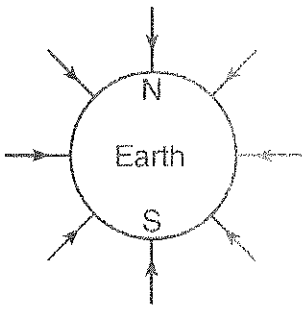
A) doubling the mass of both objects, only
B) doubling the distance between the objects, only
C) doubling the mass of both objects and doubling the distance between the objects
D) doubling the mass of one object and doubling the distance between the objects

305. Two objects of equal mass are a fixed distance apart. If the mass of each object could be tripled, the gravitational force between the objects would

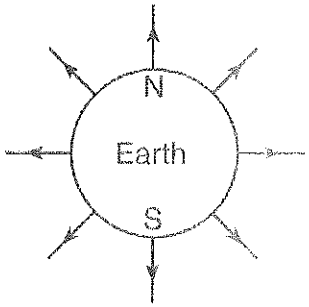
A) decrease by one-third
B) triple
C) decrease by one-ninth
D) increase 9 times

306. In which diagram do the field lines best represent the gravitational field around Earth?

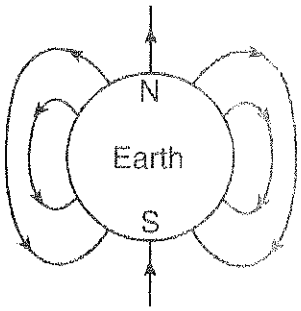
A)



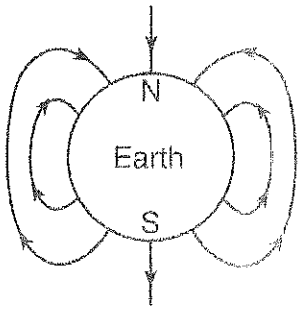
B)



C)

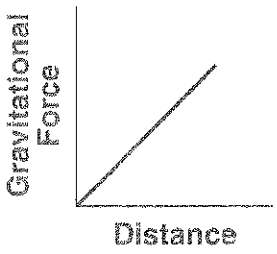


D)

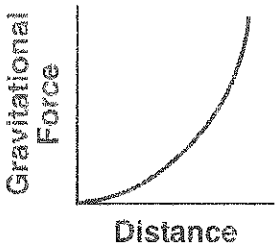


307. Which graph represents the relationship between the magnitude of the gravitational force exerted by Earth on a spacecraft and the distance between the center of the spacecraft and center of Earth? [Assume constant mass for the spacecraft.]

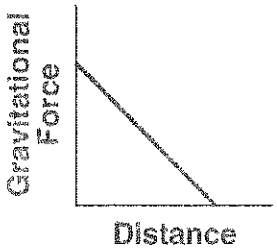
A)



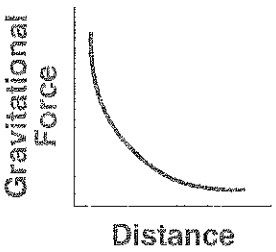
B)



C)



D)



308. Net Force can be defined as

A) the rate of change in position
B) the rate of change in acceleration
C) the rate of change in momentum
D) the rate of change in velocity

309. What is the speed of a 1.5×10^3-kilogram car that has a momentum of 3.0×10^5 kilogram • meters per second east?

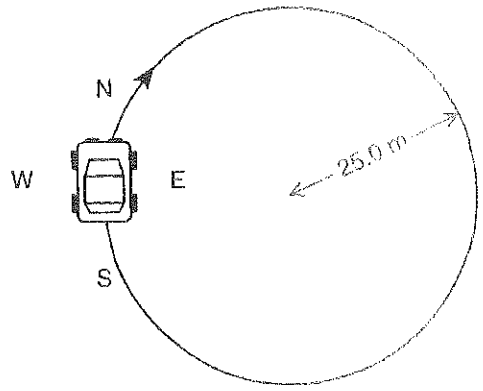
A) 5.0×10^{-3} m/s B) 2.0×10^2 m/s
C) 4.5×10^8 m/s D) 2.0×10^7 m/s

310. A 20kg object accelerates down a frictionless ramp at 7 m/s^2. What is the approximate angle of the ramp?

A) 45 degrees B) 2.9 degrees
C) 30 degrees D) 20.5 degrees

311. Base your answer to the following question on the information and diagram below.

A 1.00×10^3 -kilogram car is driven clockwise around a flat circular track of radius 25.0 meters. The speed of the car is a constant 10.00 meters per second.



What minimum friction force must exist between the tires and the road to prevent the car from skidding as it rounds the curve?

A) 1.25×10^5 N B) 9.80×10^4 N
C) 4.00×10^2 N D) 4.00×10^3 N

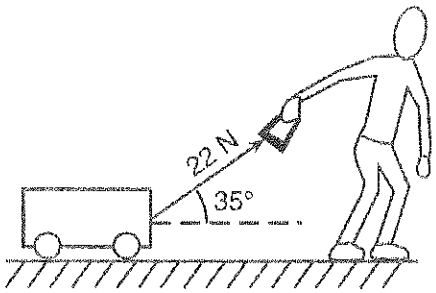
312. A mass of 50 kg is lifted vertically from rest to a velocity of 1 m/s over a time of 0.2 seconds. What is the upward force applied to the cause the acceleration?

A) 250N B) 200N
C) 740N D) 10N

313. A 20-kilogram cart traveling east with a speed of 6 meters per second collides with a 30-kilogram cart traveling west. If both carts come to rest immediately after the collision, what was the speed of the westbound cart before the collision?

A) 6 m/s B) 2 m/s
C) 3 m/s D) 4 m/s

314. A child pulls a wagon at a constant velocity along a level sidewalk. The child does this by applying a 22-newton force to the wagon handle, which is inclined at 35° to the sidewalk as shown below.

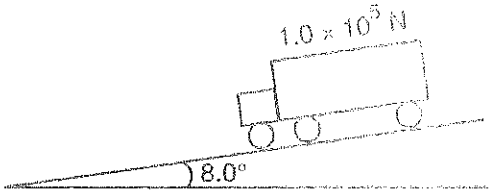


Level sidewalk

What is the magnitude of the force of friction on the wagon?

A) 11 N B) 13 N
C) 18 N D) 22 N

315. The diagram below shows a 1.0×10^5-newton truck at rest on a hill that makes an angle of 8.0° with the horizontal.



Horizontal

What is the component of the truck's weight parallel to the hill?

A) 1.4×10^3 N B) 1.0×10^4 N
C) 1.4×10^4 N D) 9.9×10^4 N

316. A 60 kg passenger traveling in a car experiences an average net force of 1600N when a car is brought to a quick stop in 1s. What would be the force experienced by the passenger if the amount of time to bring the car to rest were increased to 4s while all other factors remain constant?

A) 400N B) 6400 N
C) 28N D) 7N

317. A person kicks a 4.0-kilogram door with a 48-newton force causing the door to accelerate at 12 meters per seconds. What is the magnitude of the force exerted by the door on the person?

A) 48 N B) 24 N
C) 12 N D) 4.0 N

318. A force of 6.0 newtons changes the momentum of a moving object by 1.5 kilogram•meters per second. How long did the force act on the mass?

A) 1.0 s B) 4.0 s
C) 0.25 s D) 0.50 s

319. On the surface of Earth, a spacecraft has a mass of 2.00×10^4 kilograms. What is the mass of the spacecraft at a distance of one Earth radius above Earth's surface?

A) 5.00×10^3 kg B) 2.00×10^4 kg
C) 4.90×10^4 kg D) 1.96×10^5 kg

320. An apple weighing 1 Newton on the surface of Earth has a mass of approximately

A) 1×10^{-1} kg B) 1×10^0 kg
C) 1×10^1 kg D) 1×10^2 kg

321. A 60.-kilogram astronaut weighs 96 Newtons on the surface of the Moon. The acceleration due to gravity on the Moon is

A) 0.0 m/s^2 B) 1.6 m/s^2
C) 4.9 m/s^2 D) 9.8 m/s^2

322. A 50-kilogram woman wearing a seat belt is traveling in a car that is moving with a velocity of 10 meters per second. In an emergency, the car is brought to a stop in 0.5 second. What force does the seat belt exert on the woman so that she remains in her seat?

A) 1000N B) 500N
C) 50N D) 25N

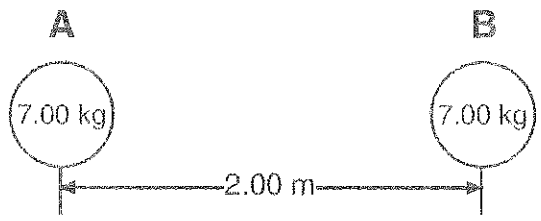
323. A 200 kg crate is lifted by a crane. Determine the force of tension needed to accelerate the crate upward at 0.5m/s^2.

A) 2060N B) 100N
C) 1860N D) 1960N

324. A 1.5 kg ball is kicked into the air at an angle of 30 degrees. While the ball is in the air the magnitude of the net force acting on the ball is equal to

A) 7.4 N B) 0N
C) 1.5 N D) 14.7N

325. The diagram shows two bowling balls, *A* and *B*, each having a mass of 7.00 kilograms, placed 2.00 meters apart.



What is the magnitude of the gravitational force exerted by ball *A* on ball *B*?

A) 8.17×10^{-9} N B) 1.63×10^{-9} N
C) 8.17×10^{-10} N D) 1.17×10^{-10} N

326. Two bodies attract each other with a gravitational force of 10.0 Newtons. What will be the force of attraction if the mass of each body is doubled?

A) 5 N B) 10 N
C) 20 N D) 40 N

327. An astronaut weighs 8.00×10^2 newtons on the surface of Earth. What is the weight of the astronaut 6.37×10^6 meters above the surface of Earth?

A) 0.00 N B) 2.00×10^2N
C) 1.60×10^3 N D) 3.20×10^3 N

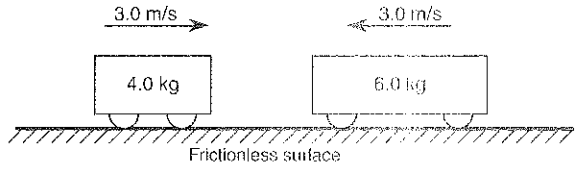
328. A 2.0-kilogram ball traveling north at 4.0 meters per second collides head on with a 1.0-kilogram ball traveling south at 8.0 meters per second. What is the magnitude of the total momentum of the two balls after collision?

A) 0 kg-m/s B) 8.0 kg-m/s
C) 16 kg-m/s D) 32 kg-m/s

329. 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

330. The diagram below shows a 4.0-kilogram cart moving to the right and a 6.0-kilogram cart moving to the left on a horizontal frictionless surface.



When the two carts collide they lock together. The magnitude of the total momentum of the two-cart system after the collision is

A) 0.0 kg•m/s B) 6.0 kg•m/s
C) 15 kg•m/s D) 30. kg•m/s

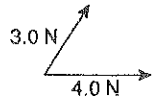
331. A 5.0-newton force and a 7.0-newton force act concurrently on a point. As the angle between the forces is increased from 0° to 180°, the magnitude of the resultant of the two forces changes from

A) 0.0 N to 12.0 N B) 2.0 N to 12.0 N
C) 12.0 N to 2.0 N D) 12.0 N to 0.0 N

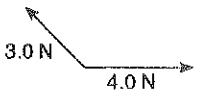
332. Which combination of three concurrent forces acting on a body could *not* produce equilibrium?

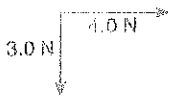
A) 1 N, 3 N, 5 N B) 2 N, 2 N, 2 N
C) 3 N, 4 N, 5 N D) 4 N, 4 N, 5 N

333. 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?

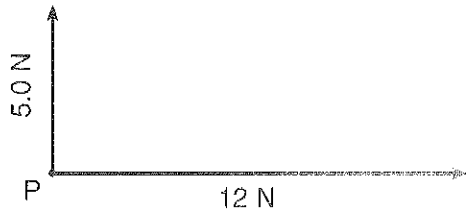
A) 

B) 

C) 

D) 

334. The diagram below represents a 5.0-newton force and a 12-newton force acting on point P.



The resultant of the two forces has a magnitude of

A) 5.0 N B) 7.0 N
C) 12 N D) 13 N