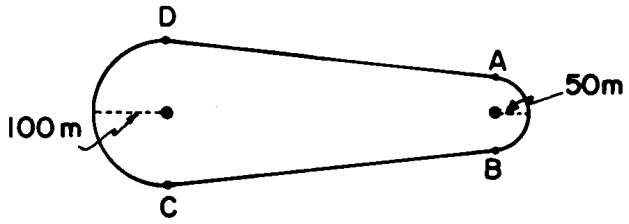
1. Base your answer to the following question on the diagram below which represents a flat racetrack as viewed from above, with the radii of its two curves indicated. A car with a mass of 1,000 kilograms moves counterclockwise around the track at a constant speed of 20 meters per second.



Compared to the kinetic energy of the car while moving from *A* to *D*, the kinetic energy of the car while moving from *D* to *C* is

A) less B) greater **C) the same**

2. If a car is traveling at an average speed of 60 kilometers per hour, how long does it take to travel 12 kilometers?

A) 0.2 hour B) 0.5 hour
C) 0.72 hour D) 5.0 hours

3. Without air resistance, a kicked ball would reach a maximum height of 6.7 meters and land 38 meters away. With air resistance, the ball would travel

A) 6.7 m vertically and more than 38 m horizontally
B) 38 m horizontally and less than 6.7 m vertically
C) more than 6.7 m vertically and less than 38 m horizontally
D) less than 38 m horizontally and less than 6.7 m vertically

4. The average speed of a plane was 600 kilometers per hour. How long did it take the plane to travel 120 kilometers?

A) 0.2 hour B) 0.5 hour
C) 0.7 hour D) 5 hours

5. An object starts from rest and accelerates uniformly down an incline. If the object reaches a speed of 40 meters per second in 5 seconds, its average speed is

A) 8 m/sec B) 10 m/sec
C) 20 m/sec D) 30 m/sec

6. An object initially at rest accelerates at 5 meters per second^2 until it attains a speed of 30 meters per second. What distance does the object move while accelerating?

A) 30 m **B) 90 m**
C) 3 m D) 600 m

7. A car accelerates uniformly from rest at 3.2 m/s^2. When the car has traveled a distance of 40. meters, its speed will be

A) 8.0 m/s B) 12.5 m/s
C) 16 m/s D) 128 m/s

8. A rocket initially at rest on the ground lifts off vertically with a constant acceleration of 2.0×10^1 meters per second^2. How long will it take the rocket to reach an altitude of 9.0×10^3 meters?

A) 3.0×10^1 s B) 4.3×10^1 s
C) 4.5×10^2 s D) 9.0×10^2 s

9. A truck, initially traveling at a speed of 22 meters per second, increases speed at a constant rate of 2.4 meters per second ^{2} for 3.2 seconds. What is the total distance traveled by the truck during this 3.2-second time interval?

A) 12 m B) 58 m C) 70. m **D) 83 m**

10. The speed of a car is decreased uniformly from 30. meters per second to 10. meters per second in 4.0 seconds. The magnitude of the car's acceleration is

A) 5.0 m/s^2 B) 10. m/s^2
C) 20. m/s^2 D) 40. m/s^2

11. An object originally at rest is uniformly accelerated along a straight-line path to a speed of 8.0 meters per second in 2.0 seconds. What was the acceleration of the object?

A) 0.25 m/s^2 B) 10. m/s^2
C) 16 m/s^2 **D) 4.0 m/s^2**

12. Objects *A* and *B* are dropped from rest near Earth's surface. Object *A* has mass m and object *B* has mass 2m. After 2 seconds of free fall, object *A* has a speed *v* and has fallen a distance *d*. What are the speed and distance of fall of object *B* after 2 seconds of free fall?

A) speed = v/2; distance = d/2
B) speed = v; distance = d
C) speed = v/2; distance = 2d
D) speed = 2v; distance = 2d

13. A ball is thrown vertically upward with an initial velocity of 29.4 meters per second. What is the maximum height reached by the ball? [Neglect friction.]

A) 14.7 m B) 29.4 m
C) 44.1 m D) 88.1 m

14. A book of mass *m* falls freely from rest to the floor from the top of a desk of height *h*. What is the speed of the book upon striking the floor?

A) $\sqrt{2gh}$ B) $2gh$ C) mgh D) mh

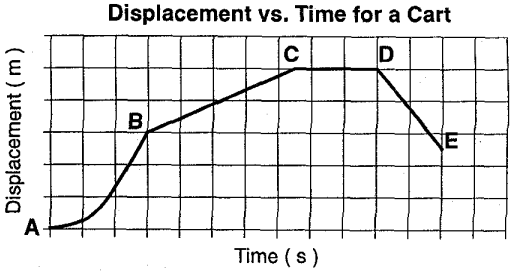
15. An object is allowed to fall freely near the surface of a planet. The object falls 54 meters in the first 3.0 seconds after it is released. The acceleration due to gravity on that planet is

A) 6.0 m/s^2 **B) 12 m/s^2**
C) 27 m/s^2 D) 108 m/s^2

16. An astronaut drops a hammer from 2.0 meters above the surface of the Moon. If the acceleration due to gravity on the Moon is 1.62 meters per second^2, how long will it take for the hammer to fall to the Moon's surface?

A) 0.62 s B) 1.2 s
C) 1.6 s D) 2.5 s

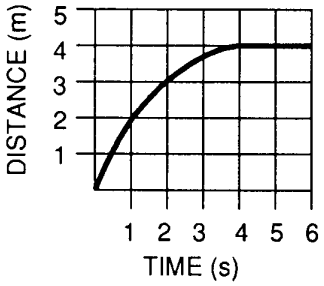
17. The displacement-time graph below represents the motion of a cart along a straight line.



During which interval was the cart accelerating?

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

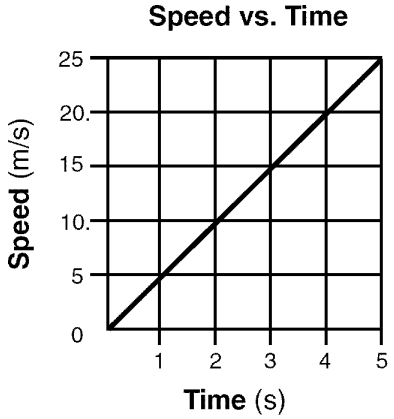
18. The graph below represents the relationship between distance and time for an object.



What is the instantaneous speed of the object at t = 5.0 seconds?

A) 0 m/s B) 2.0 m/s
C) 5.0 m/s D) 4.0 m/s

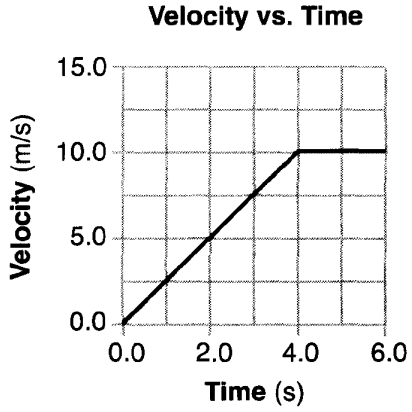
19. The graph below represents the relationship between speed and time for an object moving along a straight line.



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

A) 5 m B) 20 m **C) 40 m** D) 80 m

20. Base your answer to the following question on the graph below, which represents the motion of a car during a 6.0-second time interval.

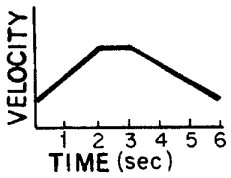


What is the acceleration of the car at t = 5.0 seconds?

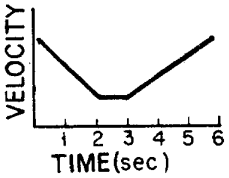
A) 0.0 m/s^2 B) 2.0 m/s^2 C) 2.5 m/s^2 D) 10. m/s^2

21. Which graph best represents the relationship between velocity and time for an object which accelerates uniformly for 2 seconds, then moves at a constant velocity for 1 second, and finally decelerates for 3 seconds?

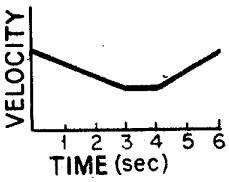
A)



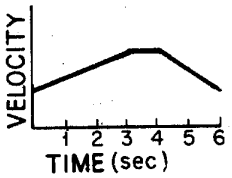
B)



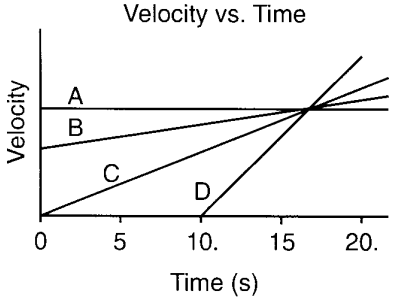
C)



D)



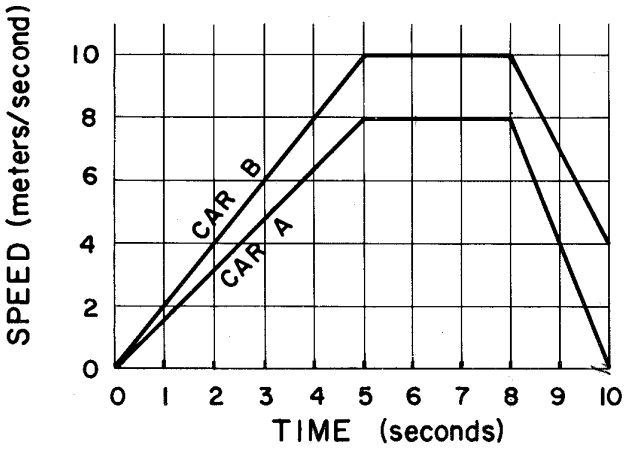
22. The diagram below represents the relationship between velocity and time of travel for four cars, *A*, *B*, *C*, and *D*, in straight-line motion.



Which car has the greatest acceleration during the time interval 10. seconds to 15 seconds?

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

23. Cars *A* and *B* both start from rest at the same location at the same time.



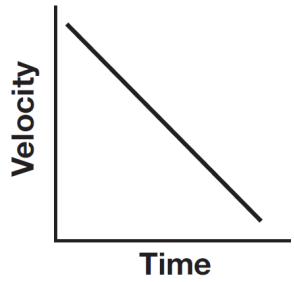
Compared to the speed of car *B* at 6 seconds, the speed of car *A* at 6 seconds is

A) less B) greater
C) the same

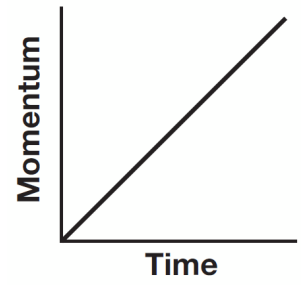
24. Which graph best represents an object in equilibrium moving in a straight line?

A)

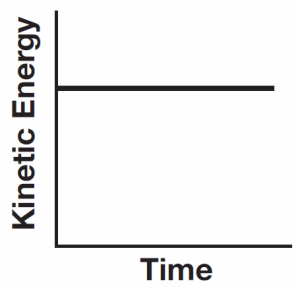
B)



C)



D)



25. 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

26. A 5-newton ball and a 10-newton ball are released simultaneously from a point 50 meters above the surface of the Earth. Neglecting air resistance, which statement is true?

A) The 5-N ball will have a greater acceleration than the 10-N ball.
B) The 10-N ball will have a greater acceleration than the 5-N ball.
C) At the end of 3 seconds of free-fall, the 10-N ball will have a greater momentum than the 5-N ball.
D) At the end of 3 seconds of free-fall, the 5-N ball will have a greater momentum than the 10-N ball.

27. A bicycle and its rider have a combined mass of 80. kilograms and a speed of 6.0 meters per second. What is the magnitude of the average force needed to bring the bicycle and its rider to a stop in 4.0 seconds?

A) 1.2×10^2 N B) 3.2×10^2 N
C) 4.8×10^2 N D) 1.9×10^3 N

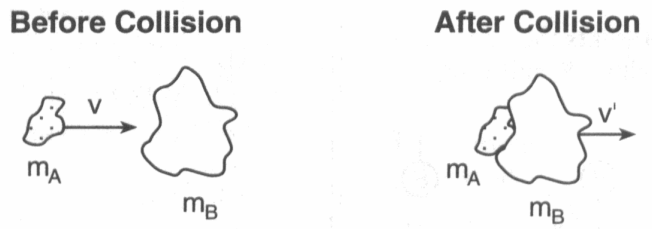
28. A motorcycle being driven on a dirt path hits a rock. Its 60.-kilogram cyclist is projected over the handlebars at 20. meters per second into a haystack. If the cyclist is brought to rest in 0.50 second, the magnitude of the average force exerted on the cyclist by the haystack is

A) 6.0×10^1 N B) 5.9×10^2 N
C) 1.2×10^3 N **D) 2.4×10^3 N**

29. A 6.0-kilogram block, sliding to the east across a horizontal, frictionless surface with a momentum of 30. kilogram•meters per second, strikes an obstacle. The obstacle exerts an impulse of 10. newton•seconds to the west on the block. The speed of the block after the collision is

A) 1.7 m/s **B) 3.3 m/s**
C) 5.0 m/s D) 20. m/s

30. 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) $\frac{m_A + m_B}{m_A v}$

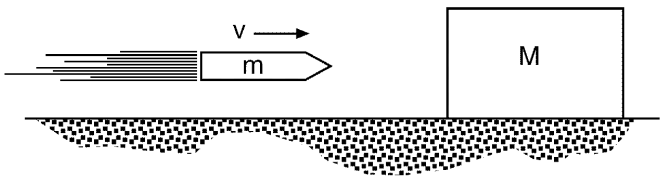
C) $\frac{m_B v}{m_A + m_B}$ **D)** $\frac{m_A v}{m_A + m_B}$

31. 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

32. 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?

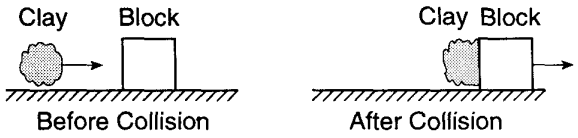
A) $\left(\frac{M+v}{M}\right)m$

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

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

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

33. As shown in the diagrams below, a lump of clay travels horizontally to the right toward a block at rest on a frictionless surface. Upon collision, the clay and the block stick together and move to the right.



Compared to the total momentum of the clay and the block before the collision, the momentum of the clay-block system after the collision is

A) less B) greater

C) the same

34. 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

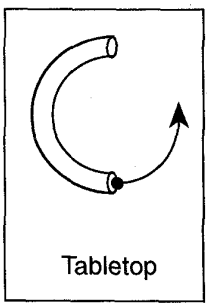
B) the same magnitude and opposite direction

C) smaller magnitude and the same direction

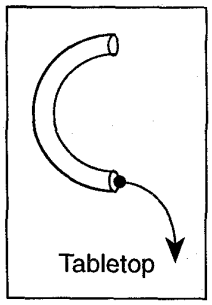
D) larger magnitude and the same direction

35. A ball rolls through a hollow semicircular tube lying flat on a horizontal tabletop. Which diagram best shows the path of the ball after emerging from the tube, as viewed from above?

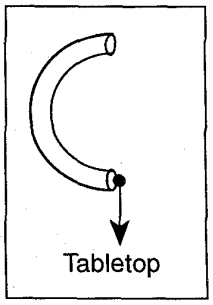
A)



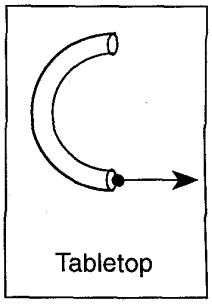
B)



C)



D)



36. 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

37. 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

38. A 25-newton horizontal force northward and a 35-newton horizontal force southward act concurrently on a 15-kilogram object on a frictionless surface. What is the magnitude of the object's acceleration?

A) 0.67 m/s^2 B) 1.7 m/s^2
C) 2.3 m/s^2 D) 4.0 m/s^2

39. A 2.0-kilogram body is initially traveling at a velocity of 40. meters per second east. If a constant force of 10. newtons due east is applied to the body for 5.0 seconds, the final speed of the body is

A) 15 m/s B) 25 m/s
C) 65 m/s D) 130 m/s

40. 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) $81F$

41. 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

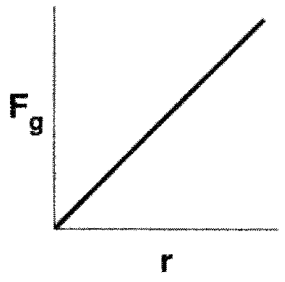
A) the same B) twice as great
C) one-half as great D) one-fourth as great

42. When Earth and the Moon are separated by a distance of 3.84×10^8 meters, the magnitude of the gravitational force of attraction between them is 2.0×10^{20} newtons. What would be the magnitude of this gravitational force of attraction if Earth and the Moon were separated by a distance of 1.92×10^8 meters?

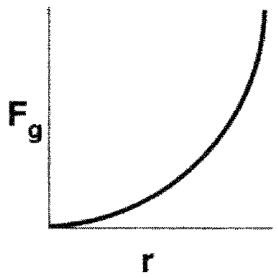
A) 5.0×10^{19} N B) 2.0×10^{20} N
C) 4.0×10^{20} N **D) 8.0×10^{20} N**

43. Which graph represents the relationship between the magnitude of the gravitational force, F_g, between two masses and the distance, r, between the centers of the masses?

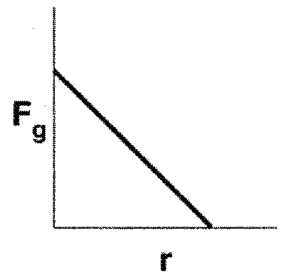
A)



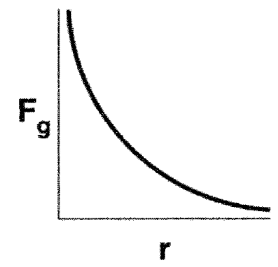
B)



C)



D)



44. 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?

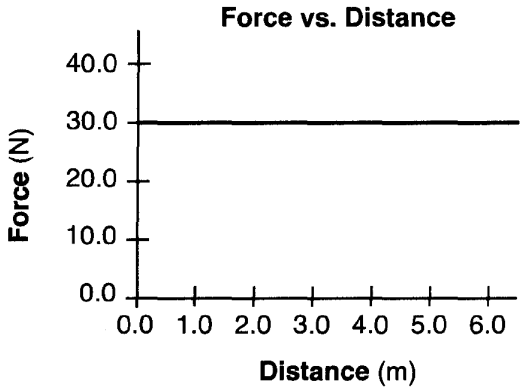
A) 5.00×10^3 kg **B) 2.00×10^4 kg**
C) 4.90×10^4 kg D) 1.96×10^5 kg

45. 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

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

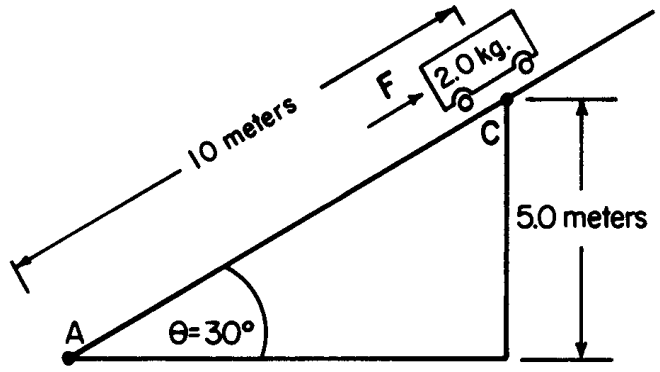
A boy pushes his wagon at constant speed along a level sidewalk. The graph below represents the relationship between the horizontal force exerted by the boy and the distance the wagon moves.



As the boy pushes the wagon, what happens to the wagon's energy?

A) Gravitational potential energy increases. B) Gravitational potential energy decreases.
C) Internal energy increases. D) Internal energy decreases.

Base your answers to questions **47** and **48** on the diagram below which shows a cart held motionless by an external force *F* on a frictionless incline.



47. If the gravitational potential energy of the cart at point *A* is zero, the gravitational potential energy of the cart at point *C* is

A) 4.9 J B) 10 J C) 49 J **D) 98 J**

48. If the cart were allowed to move from point *C* to point *A*, the gravitational potential energy of the cart would

A) decrease B) increase
C) remain the same

49. 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

50. 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

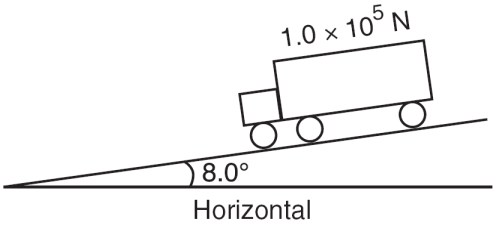
51. As more force is applied to a steel box sliding on a steel surface, the coefficent of kinetic friction will

A) decrease B) increase
C) remain the same

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

A) 0º B) 45º C) 90.º D) 180.º

53. 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

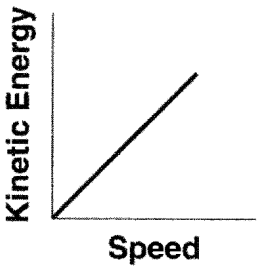
54. Which two terms represent a vector quantity and the scalar quantity of the vector's magnitude, respectively?

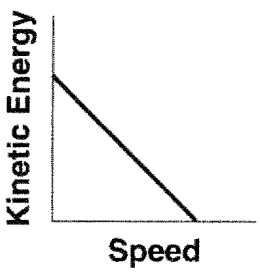
A) acceleration and velocity
B) weight and force
C) speed and time
D) displacement and distance

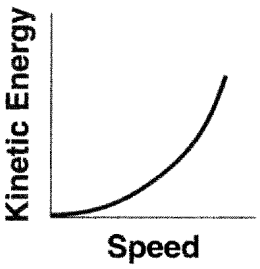
55. If the speed of a moving object is doubled, the kinetic energy of the object is

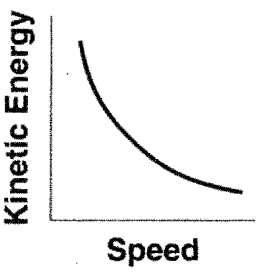
A) halved B) doubled
C) unchanged **D) quadrupled**

56. Which graph represents the relationship between the kinetic energy and the speed of a freely falling object?

A) 

B) 

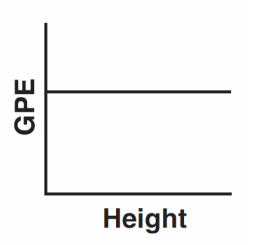
C) 

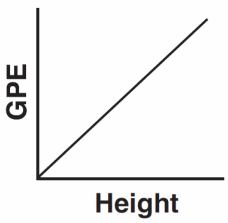
D) 

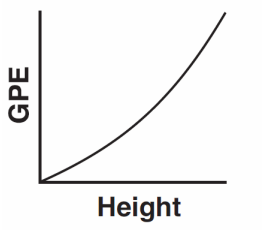
57. Which statement describes the kinetic energy and total mechanical energy of a block as it is pulled at constant speed up an incline?

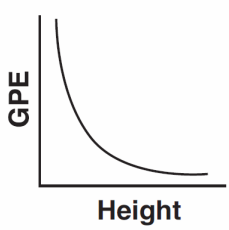
A) Kinetic energy decreases and total mechanical energy increases.
B) Kinetic energy decreases and total mechanical energy remains the same.
C) Kinetic energy remains the same and total mechanical energy increases.
D) Kinetic energy remains the same and total mechanical energy remains the same.

58. Which graph represents the relationship between the gravitational potential energy *(GPE)* of an object near the surface of Earth and its height above the surface of Earth?

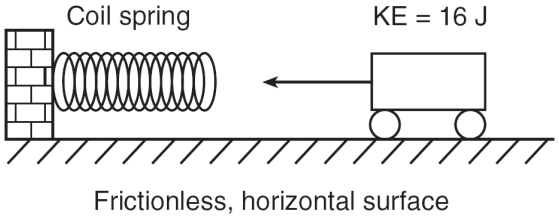
A) 

B) 

C) 

D) 

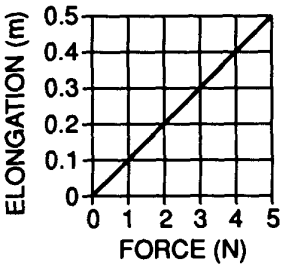
59. The diagram below shows a toy cart possessing 16 joules of kinetic energy traveling on a frictionless, horizontal surface toward a horizontal spring.



If the cart comes to rest after compressing the spring a distance of 1.0 meter, what is the spring constant of the spring?

A) 32 N/m B) 16 N/m
C) 8.0 N/m D) 4.0 N/m

60. Below is a graph representing the elongation of a spring as different forces are added to it.

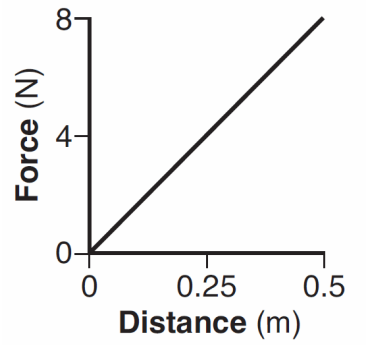


What is the value of the spring constant?

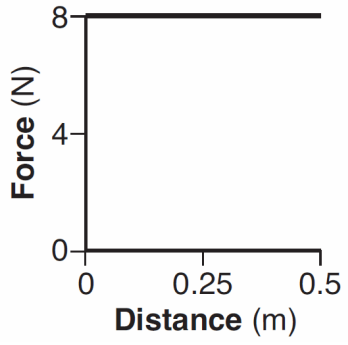
A) 0.1 m/N B) 0.1 N/m
C) 10 m/N **D) 10 N/m**

61. Which graph best represents the greatest amount of work?

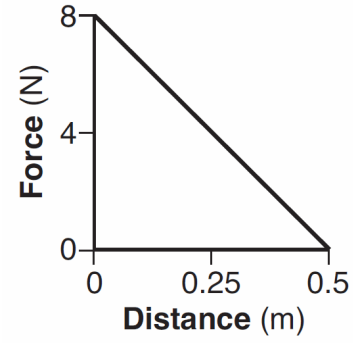
A)



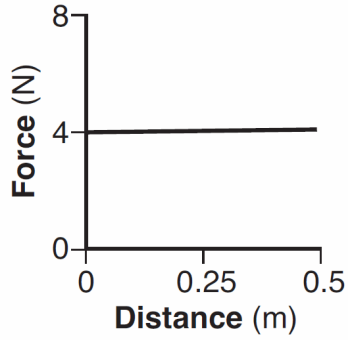
B)



C)



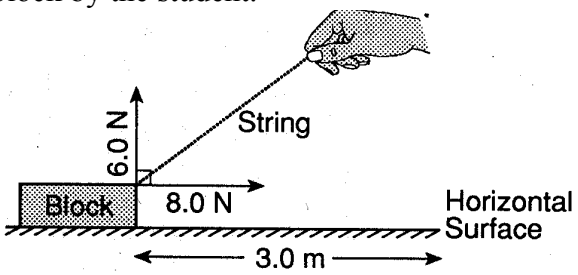
D)



62. A horizontal force of 40 Newtons pushes a block along a level table at a constant speed of 2 meters per second. How much work is done on the block in 6 seconds?

A) 80 J B) 120 J
C) 240 J **D) 480 J**

63. A student pulls a block 3.0 meters along a horizontal surface at constant velocity. The diagram below shows the components of the force exerted on the block by the student.



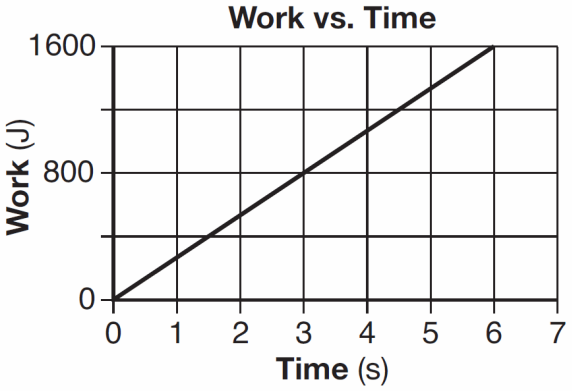
How much work is done against friction?

A) 18 J **B) 24 J** C) 30. J D) 42 J

64. The watt•second is a unit of

A) power
B) energy
C) potential difference
D) electric field strength

65. The graph below represents the work done against gravity by a student as she walks up a flight of stairs at constant speed.



Compared to the power generated by the student after 2.0 seconds, the power generated by the student after 4.0 seconds is

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

66. A 70.-kilogram cyclist develops 210 watts of power while pedaling at a constant velocity of 7.0 meters per second east. What average force is exerted eastward on the bicycle to maintain this constant speed?

A) 490 N **B) 30. N**
C) 3.0 N D) 0 N

67. A girl weighing 500. newtons takes 50. seconds to climb a flight of stairs 18 meters high. Her power output vertically is

A) 9,000 W B) 4,000 W
C) 1,400 W **D) 180 W**

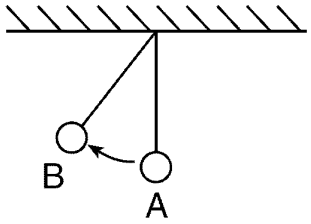
68. A car uses its brakes to stop on a level road. During this process, there must be a conversion of kinetic energy into

A) light energy
B) nuclear energy
C) gravitational potential energy
D) internal energy

69. A 25-gram paper cup falls from rest off the edge of a tabletop 0.90 meter above the floor. If the cup has 0.20 joule of kinetic energy when it hits the floor, what is the total amount of energy converted into internal (thermal) energy during the cup's fall?

A) 0.02 J B) 0.22 J
C) 2.2 J D) 220 J

70. The diagram below shows an ideal simple pendulum.



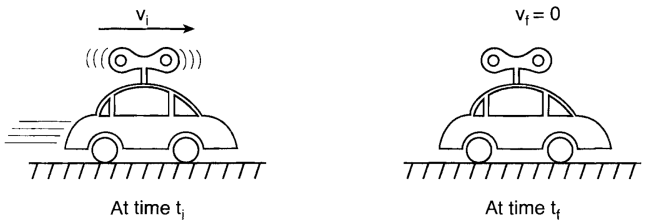
As the pendulum swings from position *A* to position *B*, what happens to its total mechanical energy? [Neglect friction]

A) It decreases.
B) It increases.
C) It remains the same.

71. An electrical generator in a science classroom makes a lightbulb glow when a student turns a hand crank on the generator. During its operation, this generator converts

A) chemical energy to electrical energy
B) mechanical energy to electrical energy
C) electrical energy to mechanical energy
D) electrical energy to chemical energy

72. A wound spring provides the energy to propel a toy car across a level floor. At time t_i,the car is moving-at speed v_i across the floor and the spring is unwinding, as shown below. At time t_f, the spring has fully unwound and the car has coasted to a stop.



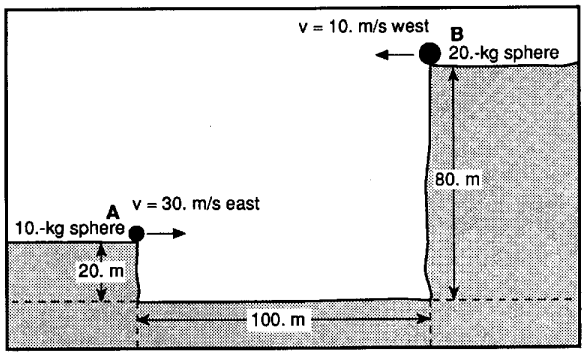
Which statement best describes the transformation of energy that occurs between the t_i and t_f?

A) Gravitational potential energy at t_i is converted to internal energy at t_f.
B) Elastic potential energy at t_i is converted to kinetic energy at t_f.
C) Both elastic potential energy and kinetic energy at t_i are converted to internal energy at t_f.
D) Both kinetic energy and internal energy at t_i are converted to elastic potential energy at t_f.

73. As a pendulum moves from the bottom of its swing to the top of its swing, the

A) kinetic energy of the pendulum increases
B) kinetic energy of the pendulum remains the same
C) potential energy of the pendulum decreases
D) potential energy of the pendulum increases

74. Base your answer to the following question on the following information. In the diagram below, a 10.-kilogram sphere, **A**, is projected horizontally with a velocity of 30. meters per second due east from a height of 20. meters above level ground. At the same instant, a 20.-kilogram sphere, **B**, is projected horizontally with a velocity of 10. meters per second due west from a height of 80. meters above level ground. [Neglect air friction.]



Initially, the spheres are separated by a horizontal distance of 100. meters. What is the horizontal separation of the spheres at the end of 1.5 seconds?

A) 15 m B) 30 m
C) 40. m D) 45 m

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

A ball is projected vertically upward from the surface of the Earth with an initial speed of +49 meters per second. The ball reaches its maximum height in 5.0 seconds. (Disregard air resistance.)

What is the total displacement of the ball from the time it is thrown until it returns to the point from which it was thrown?

A) 248 m B) 9.8 m
C) 49 m **D) 0 m**

76. A baseball is thrown at an angle of 40.0° above the horizontal. The horizontal component of the baseball's initial velocity is 12.0 meters per second. What is the magnitude of the ball's initial velocity?

A) 7.71 m/s B) 9.20 m/s
C) 15.7 m/s D) 18.7 m/s

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

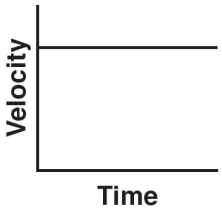
Projectile *A* is launched horizontally at a speed of 20. meters per second from the top of a cliff and strikes a level surface below, 3.0 seconds later. Projectile *B* is launched horizontally from the same location at a speed of 30. meters per second.

Approximately how high is the cliff?

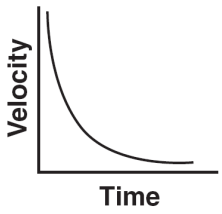
A) 29 m **B) 44 m**
C) 60. m D) 104 m

78. Which graph best represents the relationship between the velocity of an object thrown straight upward from Earth's surface and the time that elapses while it is in the air? [Neglect friction.]

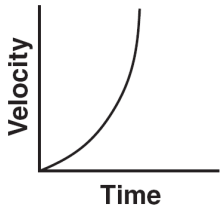
A)



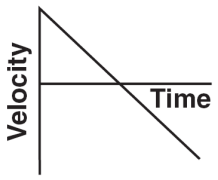
B)



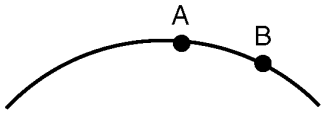
C)



D)



79. The diagram below represents the path of an object after it was thrown.



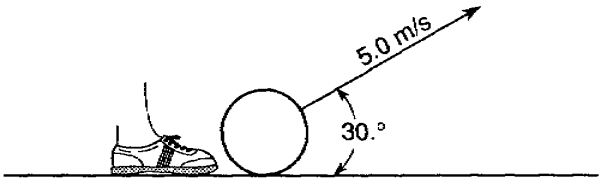
What happens to the object's acceleration as it travels from *A* to *B*? [Neglect friction.]

A) It decreases.
B) It increases.
C) It remains the same.

80. A projectile is fired with an initial velocity of 120 meters per second at an angle, θ, above the horizontal. If the projectile's initial horizontal speed is 55 meters per second, then angle θ measures approximately

A) 13° B) 27° **C) 63°** D) 75°

81. Base your answer to the following question on the diagram below which represents a ball being kicked by a foot and rising at an angle of 30.° from the horizontal. The ball has an initial velocity of 5.0 meters per second. [Neglect friction.]



What is the magnitude of the horizontal component of the ball's initial velocity?

A) 2.5 m/s **B) 4.3 m/s**
C) 5.0 m/s D) 8.7 m/s

82. A ball is fired vertically upward at 5.0 meters per second from a cart moving horizontally to the right at 2.0 meters per second. Which vector best represents the resultant velocity of the ball when fired?

A) 

B) 

C) 

D) 

83. A soccer ball kicked on a level field has an initial vertical velocity component of 15.0 meters per second. Assuming the ball lands at the same height from which it was kicked, what is the total time the ball is in the air? [Neglect friction.]

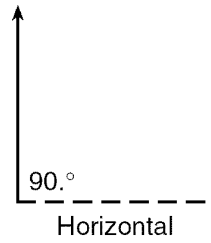
A) 0.654 s B) 1.53 s
C) 3.06 s D) 6.12

84. A projectile launched at an angle of 45° above the horizontal travels through the air. Compared to the projectile's theoretical path with no air friction, the actual trajectory of the projectile with air friction is

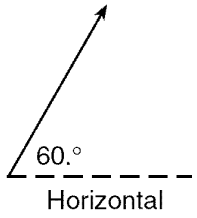
A) lower and shorter
B) lower and longer
C) higher and shorter
D) higher and longer

85. A volleyball hit into the air has an initial speed of 10. meters per second. Which vector best represents the angle above the horizontal that the ball should be hit to remain in the air for the greatest amount of time?

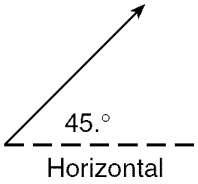
A)



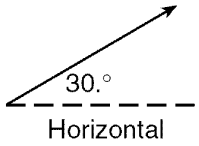
B)



C)



D)



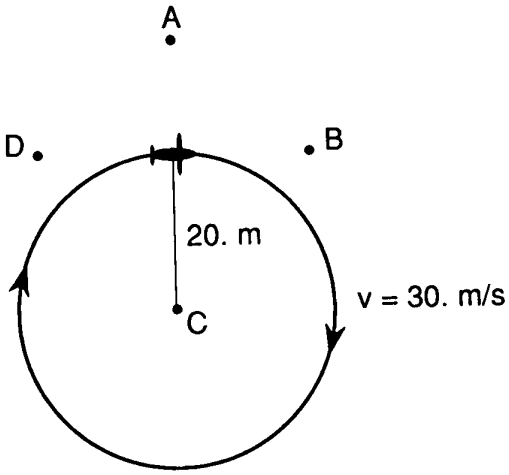
86. A machine launches a tennis ball at an angle of 25° above the horizontal at a speed of 14 meters per second. The ball returns to level ground. Which combination of changes *must* produce an increase in time of flight of a second launch?

A) decrease the launch angle and decrease the ball's initial speed
B) decrease the launch angle and increase the ball's initial speed
C) increase the launch angle and decrease the ball's initial speed
D) increase the launch angle and increase the ball's initial speed

87. A projectile is fired from a gun near the surface of Earth. The initial velocity of the projectile has a vertical component of 98 meters per second and a horizontal component of 49 meters per second. How long will it take the projectile to reach the highest point in its path?

A) 5.0 s
B) 10. s
C) 20. s
D) 100. s

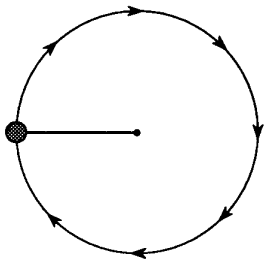
88. Base your answer to the following question on the diagram below which shows a 2.0-kilogram model airplane attached to a wire. The airplane is flying clockwise in a horizontal circle of radius 20. meters at 30. meters per second.



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

A) 0 m/s^2
B) 1.5 m/s^2
C) 45 m/s^2
D) 90. m/s^2

89. The diagram below represents a ball undergoing uniform circular motion as it travels clockwise on a string.



At the moment shown in the diagram, what are the correct directions of both the velocity and centripetal acceleration of the ball?

A) $v\uparrow$ $\overset{a}{\rightarrow}$ B) $\overset{v}{\rightarrow}$ $a\uparrow$

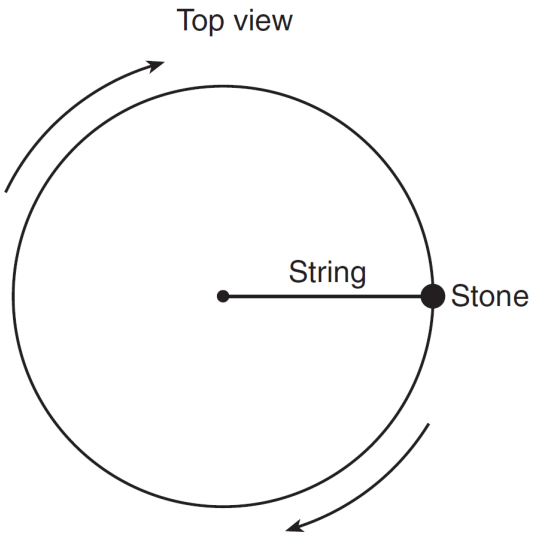
C) $v\downarrow$ $\overset{a}{\leftarrow}$ D) $\overset{v}{\rightarrow}$ $a\downarrow$

90. 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?

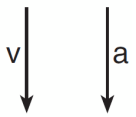
A) 8.0 m/s B) 2.0 m/s

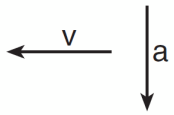
C) 16 m/s **D) 4.0 m/s**

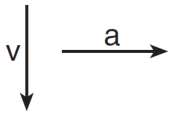
91. A stone on the end of a string is whirled clockwise at constant speed in a horizontal circle as shown in the diagram below.

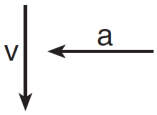


Which pair of arrows best represents the directions of the stone's velocity, *v*, and acceleration, *a*, at the position shown?

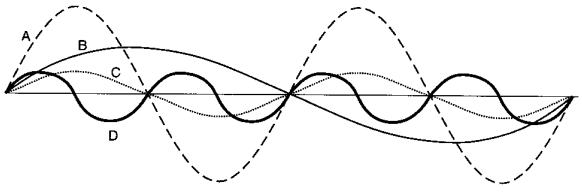
A) 

B) 

C) 

D) 

92. Base your answer to the following question on the diagram below, which represents waves *A*, *B*, *C*, and *D* traveling in the same medium.



Which wave has the longest period?

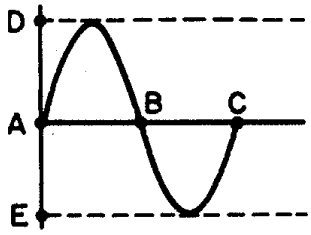
A) *A* **B) *B*** C) *C* D) *D*

93. Which is a unit of wavelength?

A) cycles/second B) meters/second

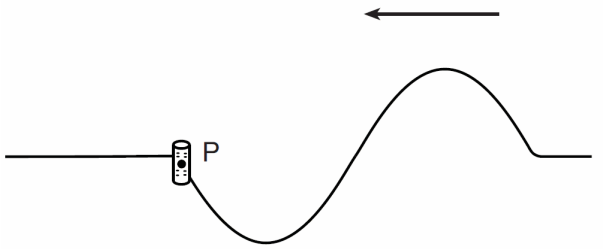
C) seconds **D) meters/cycle**

94. The amplitude of the wave shown below represented by the distance between points



A) *A* and *B* B) *A* and *C*
C) *A* and *D* D) *E* and *D*

95. The diagram below represents a transverse water wave propagating toward the left. A cork is floating on the waters surface at point *P*.

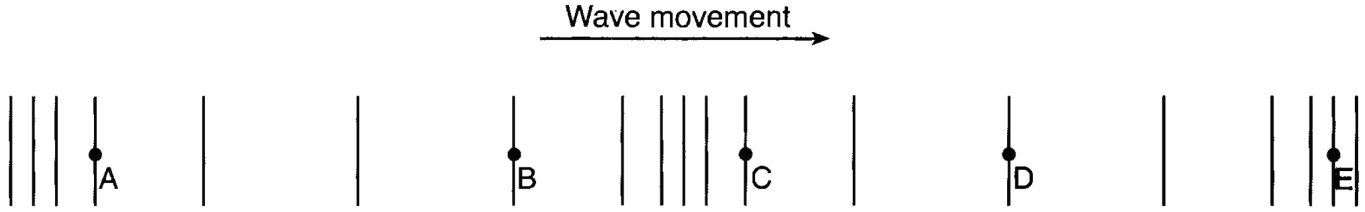


In which direction will the cork move as the wave passes point *P*?

A) up, then down, then up
B) down, then up, then down
C) left, then right, then left
D) right, then left, then right

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

A longitudinal wave moves to the right through a uniform medium, as shown below. Point *A*, *B*, *C*, *D*, and *E* represent the positions of particles of the medium



The energy of this wave is related to its

A) amplitude B) period C) speed D) wavelength

97. The frequency of a light wave is 5.0×10^{14} hertz. What is the period of the wave?

A) 1.7×10^{6} s **B) 2.0×10^{-15} s**
C) 6.0×10^{-7} s D) 5.0×10^{-14} s

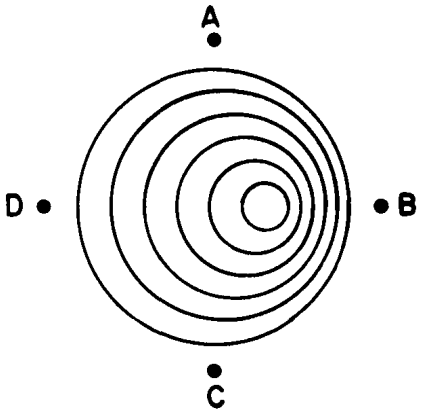
98. The time for one wave to pass by a point is called the

A) frequency of the wave
B) wavelength of the wave
C) amplitude of the wave
D) period of the wave

99. A wave has a frequency of 200 vibrations per second and a speed of 100 meters per second. The wavelength is

A) 1 m B) 2 m
C) 3 m **D) 0.5 m**

Base your answers to questions **100** and **101** on the diagram below which represents the wave pattern produced by a vibrating source moving linearly in a shallow tank of water. The pattern is viewed from above and the lines represent wave crests.



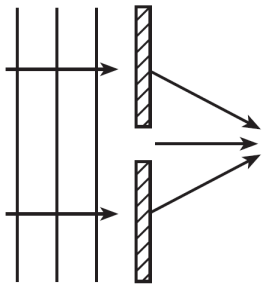
100. Compared to the frequency of the waves observed at point *D*, the frequency of the waves observed at point *B* is

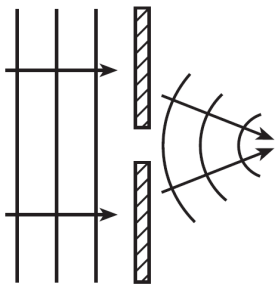
A) lower **B) higher**
C) the same

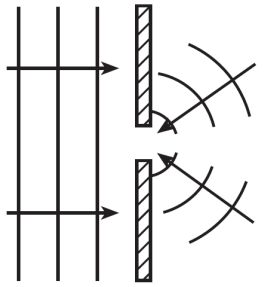
101. The wave pattern is an illustration of

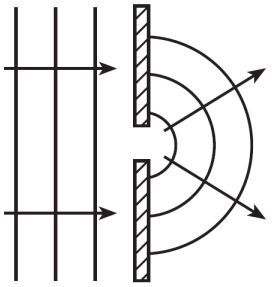
A) diffraction
B) interference
C) dispersion
D) the Doppler effect

102. Which diagram best represents the shape and direction of a series of wave fronts after they have passed through a small opening in a barrier?

A) 

B) 

C) 

D) 

103. When x-ray radiation and infrared radiation are traveling in a vacuum, they have the same

A) speed B) frequency
C) wavelength D) energy per photon

104. Orange light has a frequency of 5.0×10^{14} hertz in a vacuum. What is the wavelength of this light?

A) 1.5×10^{23}m B) 1.7×10^{6}m
C) 6.0×10^{-7} m D) 2.0×10^{-15} m

105. Which phenomenon provides evidence that light has a wave nature?

A) emission of light from an energy-level transition in a hydrogen atom
B) diffraction of light passing through a narrow opening
C) absorption of light by a black sheet of paper
D) reflection of light from a mirror

106. An electromagnetic AM-band radio wave could have a wavelength of

A) 0.005 m B) 5 m
C) 500 m D) 5 000 000 m

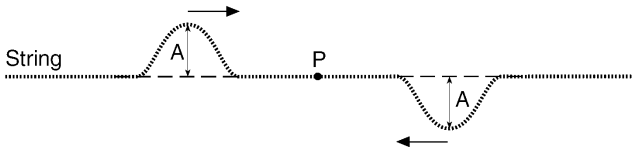
107. Compared to wavelengths of visible light, the wavelengths of ultraviolet light are

A) shorter B) longer
C) the same

108. Standing waves are most commonly produced when periodic waves arriving at a fixed boundary of a medium are

A) reflected B) refracted
C) diffracted D) dispersed

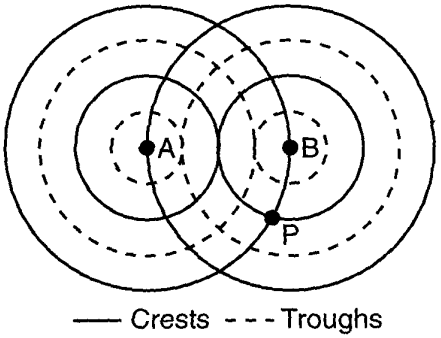
109. The diagram below shows two pulses of equal amplitude, A,approaching point P along a uniform string.



When the two pulses meet at P, the vertical displacement of the string at P will be

A) A B) 2A **C) 0** D) $\frac{A}{2}$

110. The diagram below shows two sources, *A* and *B*, vibrating in phase in the same uniform medium and producing circular wave fronts.

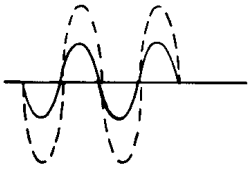


Which phenomenon occurs at point *P*?

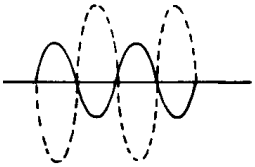
A) destructive interference
B) constructive interference
C) reflection
D) refraction

111. Which pair of waves will produce a resultant wave with the smallest amplitude?

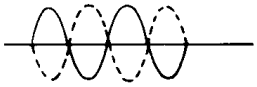
A)



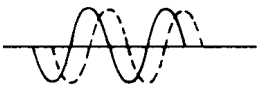
B)



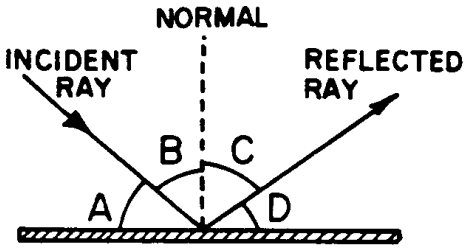
C)



D)



112. A ray is reflected from a surface as shown in the diagram below. Which letter represents the angle of incidence?

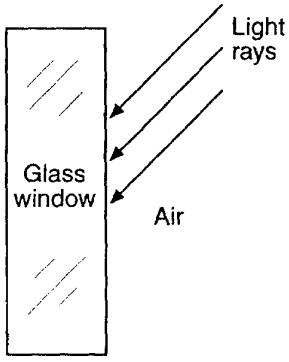


A) *A* **B) *B*** C) *C* D) *D*

113. When a pulse traveling in a medium strikes the boundary of a different medium, the energy of the pulse will be

A) completely absorbed by the boundary
B) entirely transmitted into the new medium
C) entirely reflected back into the original medium
D) partly reflected back into the original medium and partly transmitted or absorbed into the new medium

114. The diagram below shows light rays in air about to strike a glass window.



When the rays reach the boundary between the air and the glass, the light is

A) totally refracted
B) totally reflected
C) partially reflected and partially diffracted
D) partially reflected and partially refracted

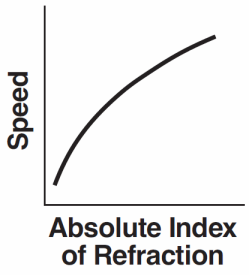
115. Which will generally occur when a pulse reaches a boundary between two different media?

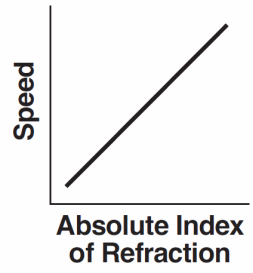
A) The entire pulse will be reflected.
B) The entire pulse will be absorbed.
C) The entire pulse will be transmitted.
D) Part of the pulse will be transmitted and part will be reflected.

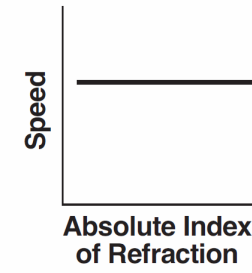
116. A light spring is attached to a heavier spring at one end. A pulse traveling along the light spring is incident on the boundary with the heavier spring. At this boundary, the pulse will be

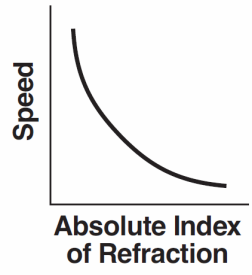
A) totally reflected
B) totally absorbed
C) totally transmitted into the heavier spring
D) partially reflected and partially transmitted into the heavier spring

117. A ray of light ($f = 5.09 \times 10^{14}$ Hz) travels through various substances. Which graph best represents the relationship between the absolute index of refraction of these substances and the corresponding speed of light in these substances?

A)


B)


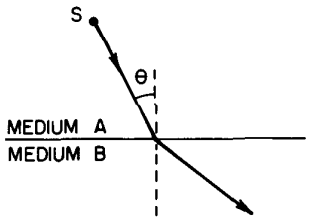
C)


D)


118. What is the speed of light ($f = 5.09 \times 10^{14}$ Hz) in ethyl alcohol?

A) 4.53×10^{-9} m/s
B) 2.43×10^{2} m/s
C) 1.24×10^{8} m/s
D) 2.21×10^{8} m/s

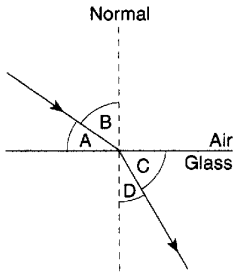
119. In the diagram below, a monochromatic light ray is passing from medium *A* into medium *B*. The angle of incidence *q* is varied by moving the light source *S*.



When angle θ becomes the critical angle, the angle of refraction will be

A) 0°
B) *q*
C) greater than *q*, but less than 90°
D) 90°

120. A light ray passes from air into glass as shown in the diagram below.



Which relationship represents the index of refraction of the glass?

A) $\frac{sinA}{sinC}$ B) $\frac{sinA}{sinD}$ C) $\frac{sinB}{sinC}$ **D)** $\frac{sinB}{sinD}$

121. A light ray traveling in air enters a second medium and its speed slows to 1.71×10^8 meters per second. What is the absolute index of refraction of the second medium?

A) 1.00 B) 0.570
C) 1.75 D) 1.94

122. The index of refraction of a transparent material is 2.0. Compared to the speed of light in air, the speed of light in this material is

A) less B) greater
C) the same

123. What is the speed of a ray of light ($f = 5.09 \times 10^{14}$ hertz) traveling through a block of sodium chloride?

A) 1.54×10^8 m/s **B) 1.95×10^8 m/s**
C) 3.00×10^8 m/s D) 4.62×10^8 m/s

124. If the speed of light in a vacuum is *C* then the speed of light in a medium with an index of refraction of 2 will be

A) $\frac{C}{2}$ B) $2C$ C) $\frac{C}{p}$ D) $4C$

125. Compared to the speed of a sound wave in air, the speed of a radio wave in air is

A) less **B) greater**
C) the same

126. A sound wave passes from air into water and then into steel. With each change in medium, the velocity of this wave will

A) decrease
B) increase
C) decrease, then increase
D) increase, then decrease

Answer Key
Tri-Quarterly Practice

1.	**C**	36.	**D**	71.	**B**	106.	**C**
2.	**A**	37.	**C**	72.	**C**	107.	**A**
3.	**D**	38.	**A**	73.	**D**	108.	**A**
4.	**A**	39.	**C**	74.	**C**	109.	**C**
5.	**C**	40.	**A**	75.	**D**	110.	**B**
6.	**B**	41.	**A**	76.	**C**	111.	**C**
7.	**C**	42.	**D**	77.	**B**	112.	**B**
8.	**A**	43.	**D**	78.	**D**	113.	**D**
9.	**D**	44.	**B**	79.	**C**	114.	**D**
10.	**A**	45.	**B**	80.	**C**	115.	**D**
11.	**D**	46.	**C**	81.	**B**	116.	**D**
12.	**B**	47.	**D**	82.	**D**	117.	**D**
13.	**C**	48.	**A**	83.	**C**	118.	**D**
14.	**A**	49.	**A**	84.	**A**	119.	**D**
15.	**B**	50.	**A**	85.	**A**	120.	**D**
16.	**C**	51.	**C**	86.	**D**	121.	**C**
17.	**A**	52.	**A**	87.	**B**	122.	**A**
18.	**A**	53.	**C**	88.	**C**	123.	**B**
19.	**C**	54.	**D**	89.	**A**	124.	**A**
20.	**A**	55.	**D**	90.	**D**	125.	**B**
21.	**A**	56.	**C**	91.	**D**	126.	**B**
22.	**D**	57.	**C**	92.	**B**		
23.	**A**	58.	**B**	93.	**D**		
24.	**D**	59.	**A**	94.	**C**		
25.	**B**	60.	**D**	95.	**B**		
26.	**C**	61.	**B**	96.	**A**		
27.	**A**	62.	**D**	97.	**B**		
28.	**D**	63.	**B**	98.	**D**		
29.	**B**	64.	**B**	99.	**D**		
30.	**D**	65.	**A**	100.	**B**		
31.	**B**	66.	**B**	101.	**D**		
32.	**D**	67.	**D**	102.	**D**		
33.	**C**	68.	**D**	103.	**A**		
34.	**C**	69.	**A**	104.	**C**		
35.	**D**	70.	**C**	105.	**B**		