1 What is the total displacement of a student who walks 3 blocks east, 2 blocks north, 1 block west, and then 2 blocks south?

(1) 0
(2) 2 blocks east
(3) 2 blocks west
(4) 8 blocks

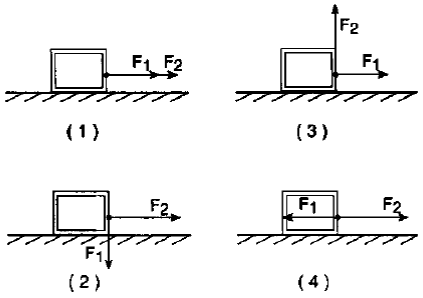
2 A baseball pitcher throws a fastball at 42 meters per second. If the batter is 18 meters from the pitcher, approximately how much time does it take for the ball to reach the batter?

(1) 1.9 s
(2) 2.3 s
(3) 0.86 s
(4) 0.43 s

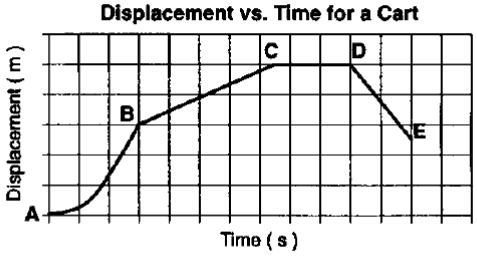
4 A stone is dropped from a bridge 45 mete above the surface of a river. Approximately ho many seconds does the stone take to reach tl water's surface?

(1) 1.0 s
(2) 10. s
(3) 3.0 s
(4) 22 s

5 A 150.-newton force, F_1, and a 200.-newt force, F_2, are applied simultaneously to the san point on a large crate resting on a frictionle horizontal surface. Which diagram shows tl forces positioned to give the crate the greate acceleration?



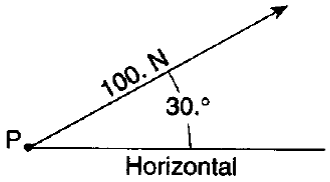
6 The displacement-time graph below represents the motion of a cart along a straight line.



During which interval was the cart accelerating?

(1) *AB*
(2) *BC*
(3) *CD*
(4) *DE*

8 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

(1) 30. N
(2) 50. N
(3) 71 N
(4) 87 N

Base your answers to questions 9 and 10 on the information below.

A 1,000-kilogram car traveling with a velocity of +20. meters per second decelerates uniformly at –5.0 meters per second^2 until it comes to rest.

9 What is the total distance the car travels as it decelerates to rest?

(1) 10. m
(2) 20. m
(3) 40. m
(4) 80. m

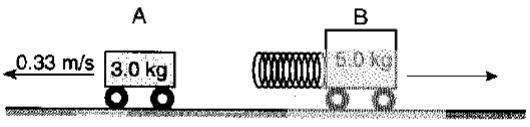
10 What is the magnitude of the impulse applied to the car to bring it to rest?

(1) 1.0×10^4 N•s
(2) 2.0×10^4 N•s
(3) 3.9×10^4 N•s
(4) 4.3×10^4 N•s

12 What is the magnitude of the net force acting on a 2.0×10^3-kilogram car as it accelerates from rest to a speed of 15 meters per second in 5.0 seconds?

(1) 6.0×10^3 N
(2) 2.0×10^4 N
(3) 3.0×10^4 N
(4) 6.0×10^4 N

14 The diagram below shows two carts on a horizontal, frictionless surface being pushed apart when a compressed spring attached to one of the carts is released. Cart *A* has a mass of 3.0 kilograms and cart *B* has a mass of 5.0 kilograms. The speed of cart *A* is 0.33 meter per second after the spring is released.



If the carts are initially at rest, what is the approximate speed of cart *B* after the spring is released?

(1) 0.12 m/s
(2) 0.20 m/s
(3) 0.33 m/s
(4) 0.55 m/s

15 The magnitude of the gravitational force of attraction between Earth and the Moon is approximately

(1) 2.1×10^{20} N
(2) 6.0×10^{24} N
(3) 6.7×10^{-11} N
(4) 7.8×10^{28} N

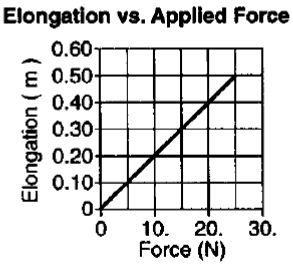
16 How much work is done on a downhill skier by an average braking force of 9.8×10^2 newtons to stop her in a distance of 10. meters?

(1) 1.0×10^1 J
(2) 9.8×10^1 J
(3) 1.0×10^3 J
(4) 9.8×10^3 J

18 A spring has a spring constant of 120 newtons per meter. How much potential energy is stored in the spring as it is stretched 0.20 meter?

(1) 2.4 J
(2) 4.8 J
(3) 12 J
(4) 24 J

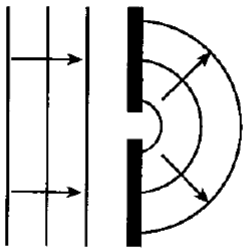
19 The graph below shows the relationship between the elongation of a spring and the force applied to the spring causing it to stretch.



What is the spring constant for this spring?

(1) 0.020 N/m
(2) 2.0 N/m
(3) 25 N/m
(4) 50. N/m

43 The diagram below shows straight wave fronts passing through an opening in a barrier



This wave phenomenon is called

1 reflection
2 refraction
3 polarization
4 diffraction

4 After a model rocket reached its maximum height, it then took 5.0 seconds to return to the launch site. What is the approximate maximum height reached by the rocket? [Neglect air resistance.]

(1) 49 m
(2) 98 m
(3) 120 m
(4) 250 m

36 The diagram below shows a transverse wave moving to the right along a rope.

As the wave passes point *X*, the motion of *X* will be

1 up, then down
2 down, then up
3 left, then right
4 in a circle

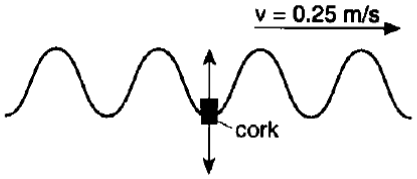
37 The frequency of a light wave is 5.0×10^{14} hertz. What is the period of the wave?

(1) 1.7×10^6 s
(2) 2.0×10^{-15} s
(3) 6.0×10^{-7} s
(4) 5.0×10^{-14} s

38 The amplitude of a sound wave is to its loudness as the amplitude of a light wave is to its

1 brightness
2 frequency
3 color
4 speed

40 In the diagram below, a water wave having a speed of 0.25 meter per second causes a cork to move up and down 4.0 times in 8.0 seconds.



What is the wavelength of the water wave?

(1) 1.0 m
(2) 2.0 m
(3) 8.0 m
(4) 0.50 m

46 Which phenomenon can occur with light, but *not* with sound?

1 interference
2 polarization
3 refraction
4 the Doppler effect

1 Which is a vector quantity?

(1) distance
(2) speed
(3) power
(4) force

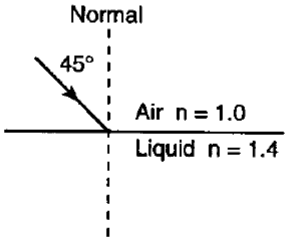
3 An object with an initial speed of 4.0 meters per second accelerates uniformly at 2.0 meters per second^2 in the direction of its motion for a distance of 5.0 meters. What is the final speed of the object?

(1) 6.0 m/s
(2) 10. m/s
(3) 14 m/s
(4) 36 m/s

44 The absolute index of refraction for a substance is 2.0 for light having a wavelength of 5.9×10^{-7} meter. In this substance, what is the critical angle for light incident on a boundary with air?

(1) 30.° (3) 60.°
(2) 45° (4) 90.°

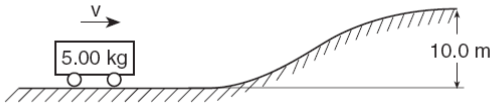
45 A ray of monochromatic light ($\lambda = 5.9 \times 10^{-7}$ meter) traveling in air is incident on an interface with a liquid at an angle of 45°, as shown in the diagram below.



If the absolute index of refraction of the liquid is 1.4, the angle of refraction for the light ray is closest to

(1) 10.° (3) 30.°
(2) 20.° (4) 40.°

15 The diagram below shows a moving, 5.00-kilogram cart at the foot of a hill 10.0 meters high. For the cart to reach the top of the hill, what is the minimum kinetic energy of the cart in the position shown? [Neglect energy loss due to friction.]



(1) 4.91 J (3) 250. J
(2) 50.0 J (4) 491 J

19 In a vacuum, light with a frequency of 5.0×10^{14} hertz has a wavelength of

(1) 6.0×10^{-21} m (3) 1.7×10^{6} m
(2) 6.0×10^{-7} m (4) 1.5×10^{23} m

29 A source of sound waves approaches a stationary observer through a uniform medium. Compared to the frequency and wavelength of the emitted sound, the observer would detect waves with a

(1) higher frequency and shorter wavelength
(2) higher frequency and longer wavelength
(3) lower frequency and shorter wavelength
(4) lower frequency and longer wavelength

7 A 70.-kilogram astronaut has a weight of 560 newtons on the surface of planet Alpha. What is the acceleration due to gravity on planet Alpha?

(1) 0.0 m/s^2 (3) 9.8 m/s^2
(2) 8.0 m/s^2 (4) 80. m/s^2

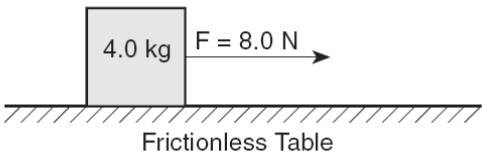
11 A 0.10-kilogram model rocket's engine is designed to deliver an impulse of 6.0 newton-seconds. If the rocket engine burns for 0.75 second, what average force does it produce?

(1) 4.5 N (3) 45 N
(2) 8.0 N (4) 80. N

14 An object moving at a constant speed of 25 meters per second possesses 450 joules of kinetic energy. What is the object's mass?

(1) 0.72 kg (3) 18 kg
(2) 1.4 kg (4) 36 kg

10 The diagram below shows a horizontal 8.0-newton force applied to a 4.0-kilogram block on a frictionless table.



What is the magnitude of the block's acceleration?

(1) 0.50 m/s^2 (3) 9.8 m/s^2
(2) 2.0 m/s^2 (4) 32 m/s^2

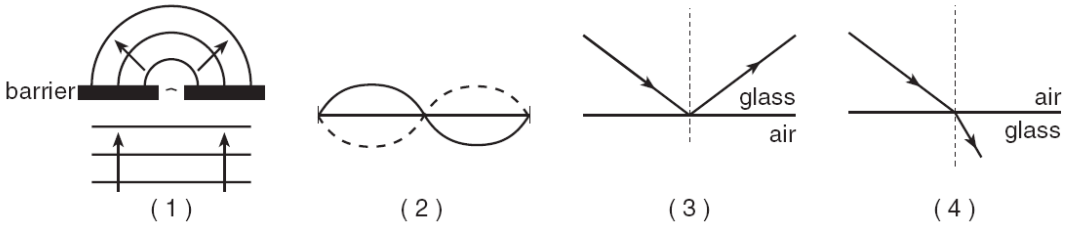
16 A constant force of 1900 newtons is required to keep an automobile having a mass of 1.0×10^3 kilograms moving at a constant speed of 20. meters per second. The work done in moving the automobile a distance of 2.0×10^3 meters is

(1) 2.0×10^4 J (3) 2.0×10^6 J
(2) 3.8×10^4 J (4) 3.8×10^6 J

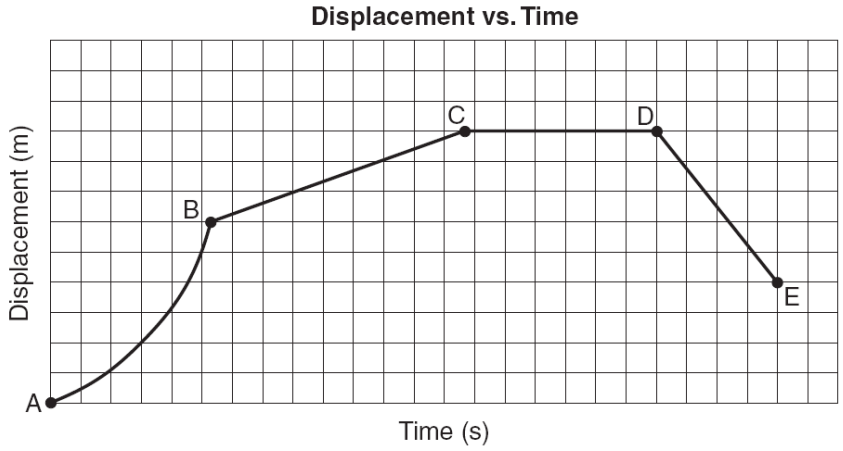
33 A spring of negligible mass has a spring constant of 50. newtons per meter. If the spring is stretched 0.40 meter from its equilibrium position, how much potential energy is stored in the spring?

(1) 20. J (3) 8.0 J
(2) 10. J (4) 4.0 J

35 Which diagram below best represents the phenomenon of diffraction?



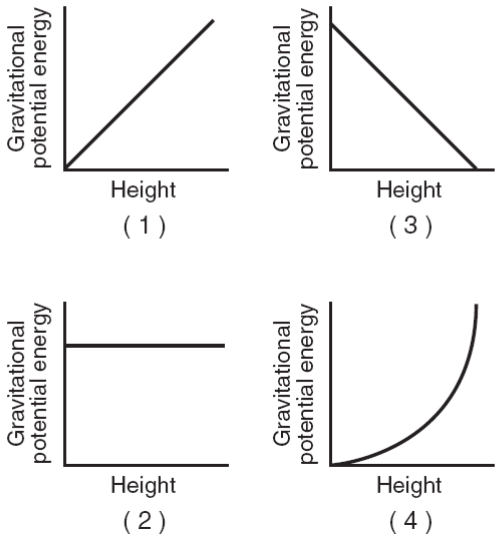
36 The displacement-time graph below represents the motion of a cart initially moving forward along a straight line.



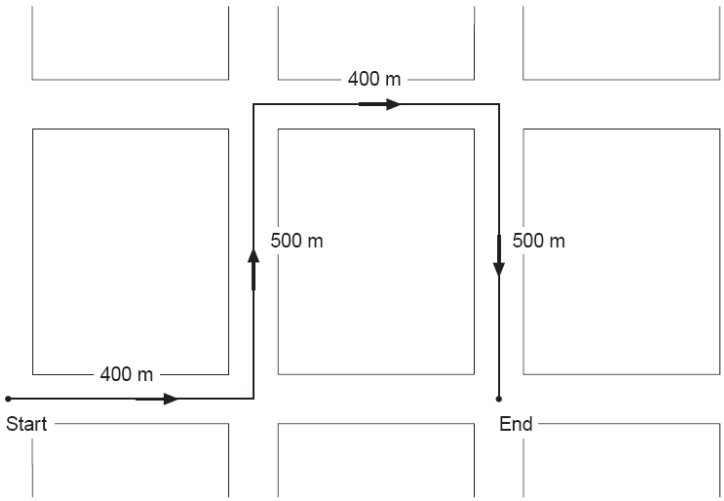
During which interval is the cart moving forward at constant speed?

(1) *AB*
(2) *BC*
(3) *CD*
(4) *DE*

43 Which graph best represents the relationship between the gravitational potential energy of a freely falling object and the object's height above the ground near the surface of Earth?



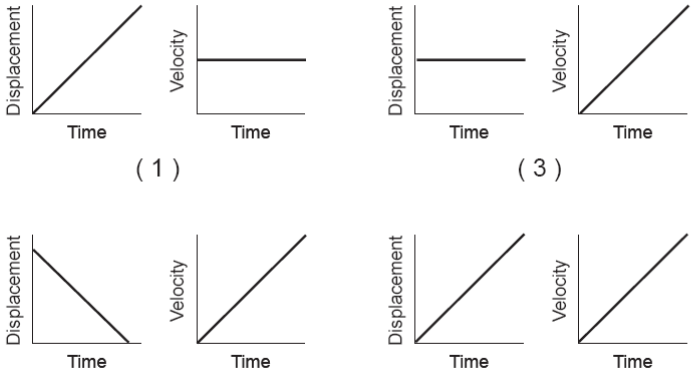
1 The map below shows the route traveled by a school bus.



What is the magnitude of the total displacement of the school bus from the start to the end of its trip?

(1) 400 m
(2) 500 m
(3) 800 m
(4) 1,800 m

2 Which pair of graphs represent the same motion?



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

(1) 80. kg•m/s due east
(2) 80. kg•m/s due west
(3) 1.8×10^4 kg•m/s due east
(4) 1.8×10^4 kg•m/s due west

9 Which terms represent a vector quantity and its respective unit?

1 weight — kilogram
2 mass — kilogram
3 force — newton
4 momentum — newton

18 A student applies a 20.-newton force to move a crate at a constant speed of 4.0 meters per second across a rough floor. How much work is done by the student on the crate in 6.0 seconds?

(1) 80. J
(2) 120 J
(3) 240 J
(4) 480 J

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

1 doubling the mass of both objects, only
2 doubling the distance between the objects, only
3 doubling the mass of both objects and doubling the distance between the objects
4 doubling the mass of one object and doubling the distance between the objects

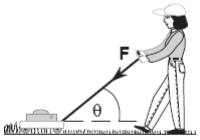
3 A runner starts from rest and accelerates uniformly to a speed of 8.0 meters per second in 4.0 seconds. The magnitude of the acceleration of the runner is

(1) 0.50 m/s^2
(2) 2.0 m/s^2
(3) 9.8 m/s^2
(4) 32 m/s^2

4 A cart moving across a level surface accelerates uniformly at 1.0 meter per second^2 for 2.0 seconds. What additional information is required to determine the distance traveled by the cart during this 2.0-second interval?

1 coefficient of friction between the cart and the surface
2 mass of the cart
3 net force acting on the cart
4 initial velocity of the cart

5 In the diagram below, a force, F, is applied to the handle of a lawnmower inclined at angle θ to the ground.



The magnitude of the horizontal component of force F depends on

1 the magnitude of force F, only
2 the measure of angle θ, only
3 both the magnitude of force F and the measure of angle θ
4 neither the magnitude of force F nor the measure of angle θ

20 A 5.0×10^2-newton girl takes 10. seconds to run up two flights of stairs to a landing, a total of 5.0 meters vertically above her starting point. What power does the girl develop during her run?

(1) 25 W
(2) 50. W
(3) 250 W
(4) 2,500 W

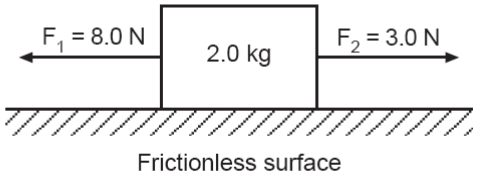
21 The kinetic energy of a 980-kilogram race car traveling at 90. meters per second is approximately

(1) 4.4×10^4 J
(2) 8.8×10^4 J
(3) 4.0×10^6 J
(4) 7.9×10^6 J

11 Compared to 8 kilograms of feathers, 6 kilograms of lead has

1 less mass and less inertia
2 less mass and more inertia
3 more mass and less inertia
4 more mass and more inertia

12 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

(1) 1.5 m/s^2 to the right
(2) 2.5 m/s^2 to the left
(3) 2.5 m/s^2 to the right
(4) 4.0 m/s^2 to the left

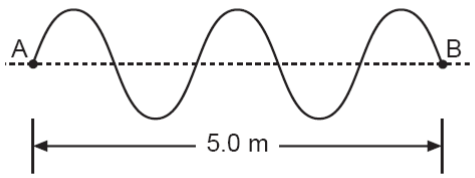
13 A 15-kilogram mass weighs 60. newtons on planet X. The mass is allowed to fall freely from rest near the surface of the planet. After falling for 6.0 seconds, the acceleration of the mass is

(1) 0.25 m/s^2
(2) 10. m/s^2
(3) 24 m/s^2
(4) 4.0 m/s^2

14 Sand is often placed on an icy road because the sand

1 decreases the coefficient of friction between the tires of a car and the road
2 increases the coefficient of friction between the tires of a car and the road
3 decreases the gravitational force on a car
4 increases the normal force of a car on the road

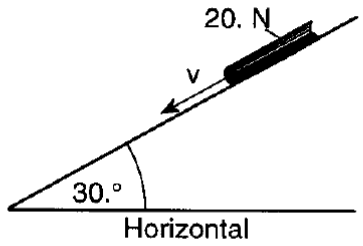
34 In the diagram below, the distance between points A and B on a wave is 5.0 meters.



The wavelength of this wave is

(1) 1.0 m
(2) 2.0 m
(3) 5.0 m
(4) 4.0 m

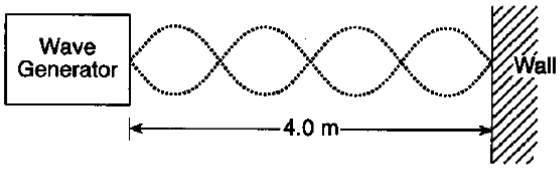
12 A book weighing 20. newtons slides at constant velocity down a ramp inclined 30.° to the horizontal as shown in the diagram below.



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

(1) 10. N up the ramp
(2) 17 N up the ramp
(3) 10. N down the ramp
(4) 17 N down the ramp

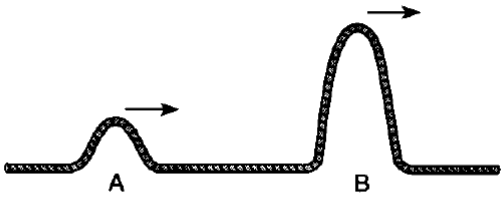
38 A wave generator located 4.0 meters from a reflecting wall produces a standing wave in a string, as shown in the diagram below.



If the speed of the wave is 10. meters per second, what is its frequency?

(1) 0.40 Hz (3) 10. Hz
(2) 5.0 Hz (4) 40. Hz

37 The diagram below shows two pulses, *A* and *B*, moving to the right along a uniform rope.



Compared to pulse *A*, pulse *B* has

1 a slower speed and more energy
2 a faster speed and less energy
3 a faster speed and the same energy
4 the same speed and more energy

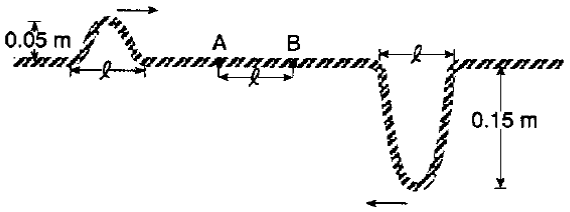
18 Which action would require no work to be done on an object?

1 lifting the object from the floor to the ceiling
2 pushing the object along a horizontal floor against a frictional force
3 decreasing the speed of the object until it comes to rest
4 holding the object stationary above the ground

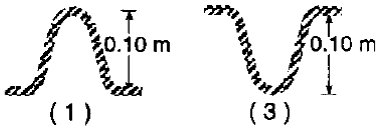
20 A 60.-kilogram student running at 3.0 meters per second has a kinetic energy of

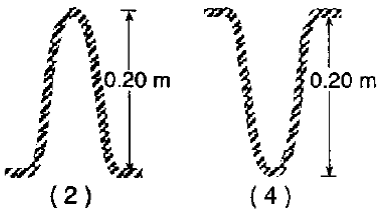
(1) 180 J (3) 540 J
(2) 270 J (4) 8100 J

39 The diagram below shows two pulses, each of length ℓ, traveling toward each other at equal speed in a rope.



Which diagram best represents the shape of the rope when both pulses are in region *AB*?

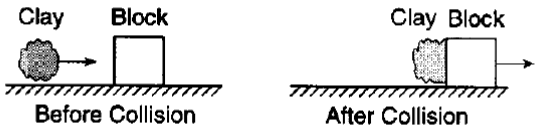




40 A nearby object may vibrate strongly when a specific frequency of sound is emitted from a loudspeaker. This phenomenon is called

1 resonance 3 reflection
2 the Doppler effect 4 interference

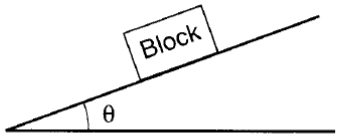
54 As shown in the diagrams below, a lump of clay travels horizontally to the right toward a block at rest on a frictionless surface. Upon collision, the clay and the block stick together and move to the right.



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

1 less
2 greater
3 the same

10 In the diagram below, a block rests on a ramp, making angle θ with the horizontal.



If angle θ is increased, what will occur?

1 The block's mass will decrease.
2 The block's weight will increase.
3 The block's component of weight parallel to the ramp will decrease.
4 The block's component of weight parallel to the ramp will increase.

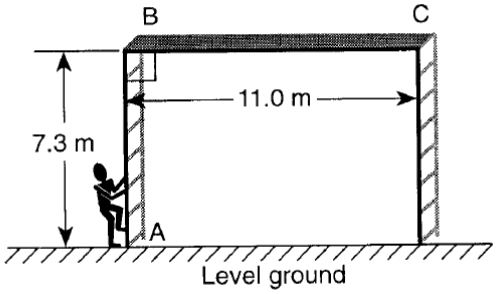
11 Which combination of fundamental units can be used to express the weight of an object?

1 kilogram/second
2 kilogram•meter
3 kilogram•meter/second
4 kilogram•meter/second^2

12 What is the momentum of a 1.5×10^3-kilogram car as it travels at 30. meters per second due east for 60. seconds?

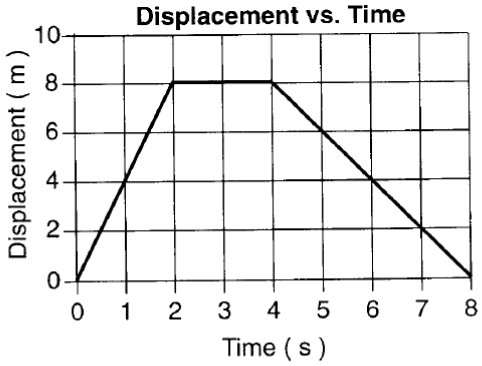
(1) 4.5×10^4 kg•m/s, east
(2) 4.5×10^4 kg•m/s, west
(3) 2.7×10^6 kg•m, east
(4) 2.7×10^6 kg•m, west

1 As shown in the diagram below, a painter climbs 7.3 meters up a vertical scaffold from A to B and then walks 11.0 meters from B to C along a level platform.



The magnitude of the painter's total displacement while moving from A to C is

(1) 3.7 m
(2) 13.2 m
(3) 18.3 m
(4) 25.6 m



5 What is the magnitude of the object's total displacement after 8.0 seconds?

(1) 0 m
(2) 2 m
(3) 8 m
(4) 16 m

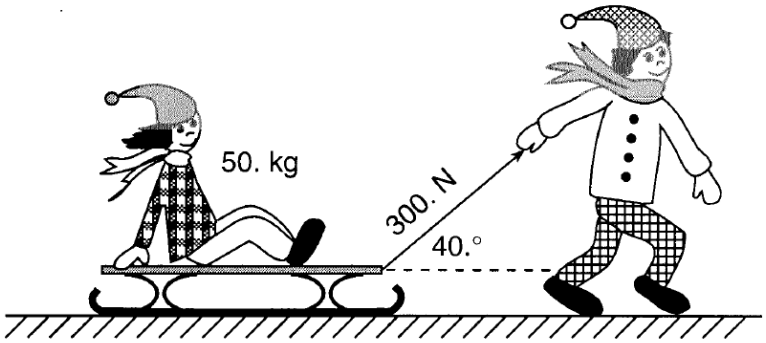
6 What is the average speed of the object during the first 4.0 seconds?

(1) 0 m/s
(2) 2 m/s
(3) 8 m/s
(4) 4 m/s

19 A girl rides an escalator that moves her upward at constant speed. As the girl rises, how do her gravitational potential energy and kinetic energy change?

1 Gravitational potential energy decreases and kinetic energy decreases.
2 Gravitational potential energy decreases and kinetic energy remains the same.
3 Gravitational potential energy increases and kinetic energy decreases.
4 Gravitational potential energy increases and kinetic energy remains the same.

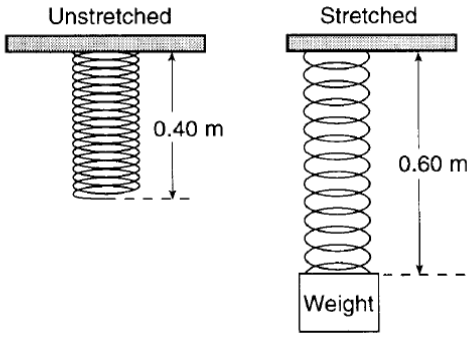
15 The diagram below shows a child pulling a 50.-kilogram friend on a sled by applying a 300.-newton force on the sled rope at an angle of 40.° with the horizontal.



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

(1) 510 N
(2) 230 N
(3) 190 N
(4) 32 N

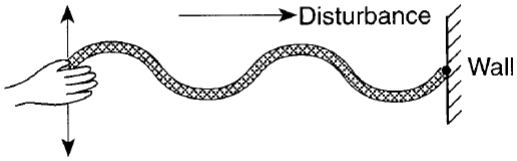
21 The unstretched spring in the diagram below has a length of 0.40 meter and spring constant k. A weight is hung from the spring, causing it to stretch to a length of 0.60 meter.



How many joules of elastic potential energy are stored in this stretched spring?

(1) $0.020 \times k$
(2) $0.080 \times k$
(3) $0.18 \times k$
(4) $2.0 \times k$

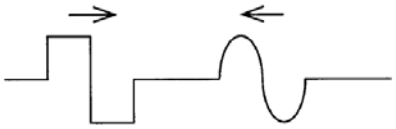
40 The diagram below shows a person shaking the end of a rope up and down, producing a disturbance that moves along the length of the rope.



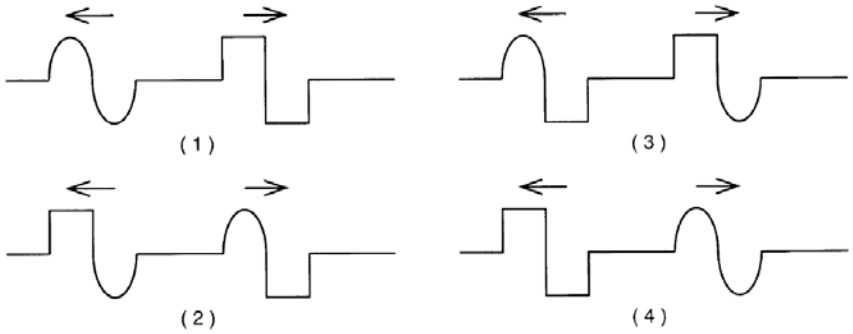
Which type of wave is traveling in the rope?

1 torsional
2 longitudinal
3 transverse
4 elliptical

43 The diagram below shows two waves approaching each other in the same uniform medium.



Which diagram best represents the appearance of the medium after the waves have passed through each other?



46 Two identical guitar strings are tuned to the same pitch. If one string is plucked, the other nearby string vibrates with the same frequency. This phenomenon is called

1 resonance
2 reflection
3 refraction
4 destructive interference

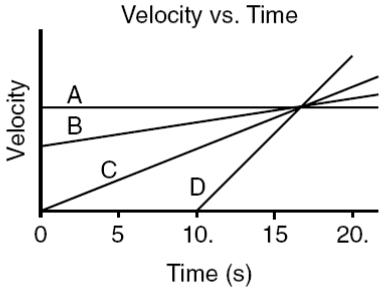
48 Light from the star Betelgeuse displays a Doppler red shift. This shift is best explained by assuming that Betelgeuse is

1 decreasing in temperature
2 increasing in temperature
3 moving toward Earth
4 moving away from Earth

49 Light with a wavelength of 6.0×10^{-7} meter passes through a pair of narrow slits and falls on a screen 2.0 meters away. If the distance between two adjacent bright bands on the screen is 3.0×10^{-2} meter, what is the distance between the slits?

(1) 9.0×10^{-9} m
(2) 1.0×10^{-5} m
(3) 4.0×10^{-5} m
(4) 2.5×10^{4} m

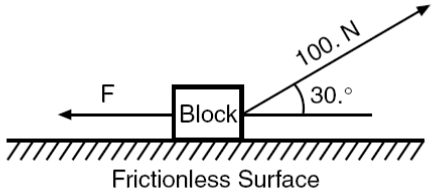
2 The diagram below represents the relationship between velocity and time of travel for four cars, *A*, *B*, *C*, and *D*, in straight-line motion.



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

(1) *A*
(2) *B*
(3) *C*
(4) *D*

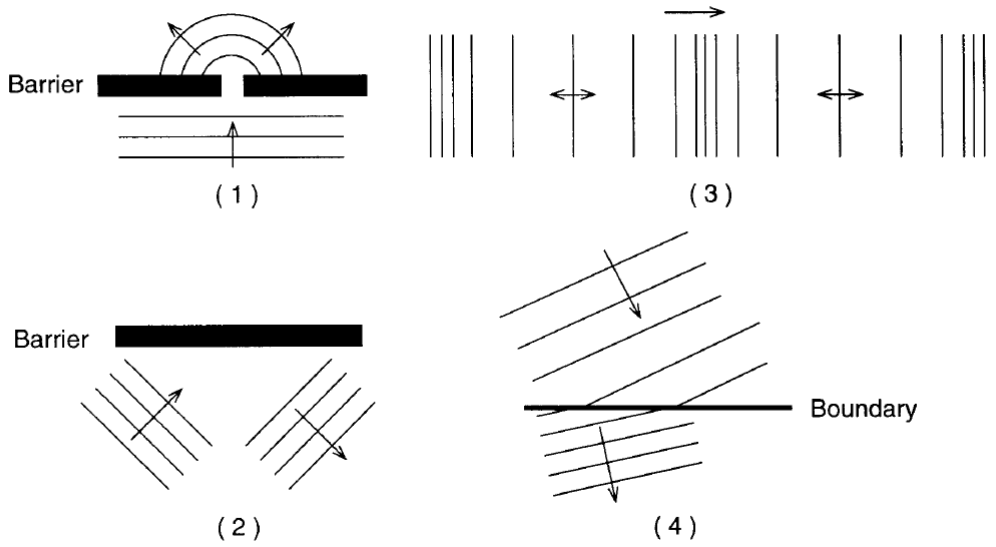
3 The diagram below shows a block on a horizontal frictionless surface. A 100.-newton force acts on the block at an angle of 30.° above the horizontal.



What is the magnitude of force *F* if it establishes equilibrium?

(1) 50.0 N
(2) 86.6 N
(3) 100. N
(4) 187 N

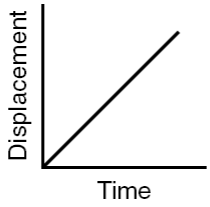
50 Which diagram best illustrates wave diffraction?



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

(1) 5.0×10^{0} N
(2) 3.3×10^{-10} N
(3) 6.7×10^{-11} N
(4) 1.3×10^{-11} N

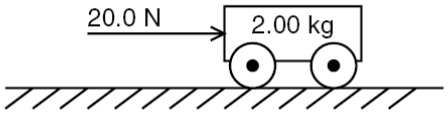
14 The graph below represents the motion of an object.



According to the graph, as time increases, the velocity of the object

1 decreases
2 increases
3 remains the same

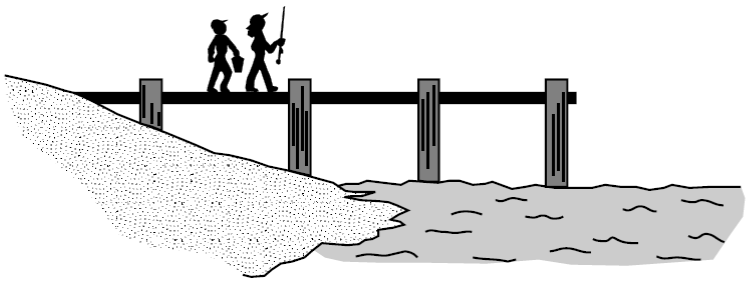
16 In the diagram below, a 20.0-newton force is used to push a 2.00-kilogram cart a distance of 5.00 meters.



The work done on the cart is

(1) 100. J
(2) 200. J
(3) 150. J
(4) 40.0 J

18 Two vacationers walk out on a horizontal pier as shown in the diagram below.



As they approach the end of the pier, their gravitational potential energy will

1 decrease
2 increase
3 remain the same

39 As a wave travels through a medium, the particles of the medium vibrate in the direction of the wave's travel. What type of wave is traveling through the medium?

1 longitudinal
2 torsional
3 transverse
4 hyperbolic

40 A wave completes one vibration as it moves a distance of 2 meters at a speed of 20 meters per second. What is the frequency of the wave?

(1) 10 Hz
(2) 2 Hz
(3) 20 Hz
(4) 40 Hz

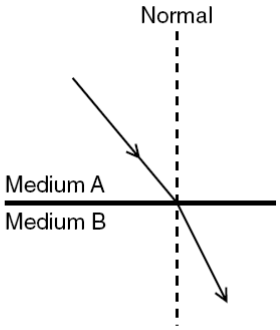
2 A 1.0-kilogram ball is dropped from the roof of a building 40. meters tall. What is the approximate time of fall? [Neglect air resistance.]

(1) 2.9 s
(2) 2.0 s
(3) 4.1 s
(4) 8.2 s

3 Which is a scalar quantity?

(1) acceleration
(2) momentum
(3) speed
(4) displacement

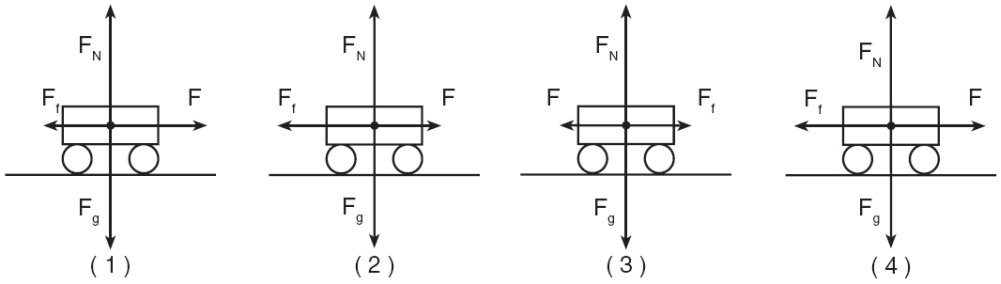
52 The diagram below shows a ray of light passing through two media.



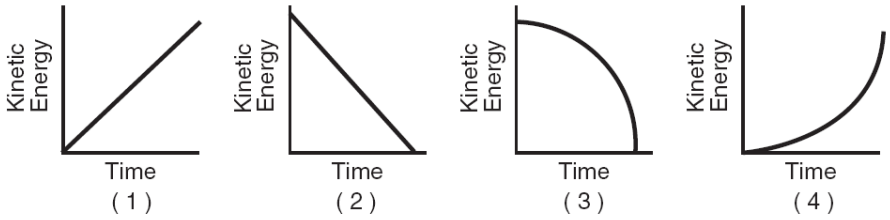
When the wave travels from medium *A* into medium *B*, its speed

1 decreases
2 increases
3 remains the same

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



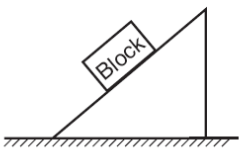
44 An object falls freely near Earth's surface. Which graph best represents the relationship between the object's kinetic energy and its time of fall?



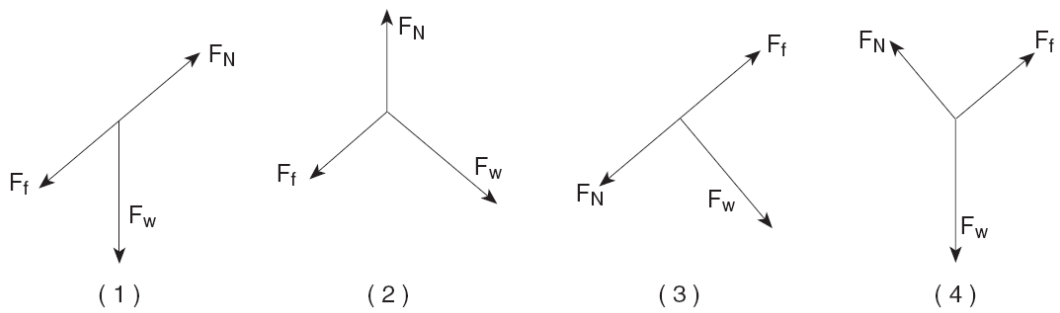
30 Radio waves diffract around buildings more than light waves do because, compared to light waves, radio waves

(1) move faster
(2) move slower
(3) have a higher frequency
(4) have a longer wavelength

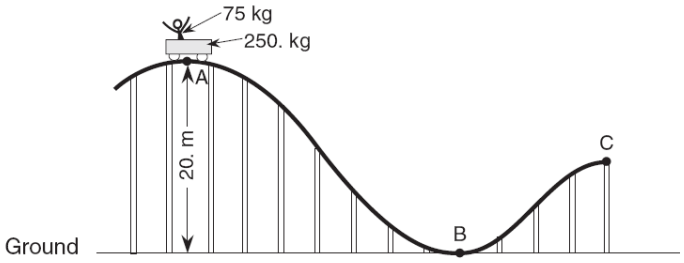
45 The diagram below represents a block at rest on an incline.



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



A 250.-kilogram car is initially at rest at point *A* on a roller coaster track. The car carries a 75-kilogram passenger and is 20. meters above the ground at point *A*. [Neglect friction.]



62 Calculate the total gravitational potential energy, relative to the ground, of the car and the passenger at point *A*. [Show all work, including the equation and substitution with units.] [2]

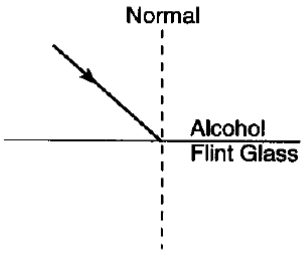
63 Calculate the speed of the car and passenger at point *B*. [Show all work, including the equation and substitution with units.] [2]

64 Compare the total mechanical energy of the car and passenger at points *A*, *B*, and *C*. [1]

41 The driver of a car sounds the horn while traveling toward a stationary person. Compared to the sound of the horn heard by the driver, the sound heard by the stationary person has

1 lower pitch and shorter wavelength
2 lower pitch and longer wavelength
3 higher pitch and shorter wavelength
4 higher pitch and longer wavelength

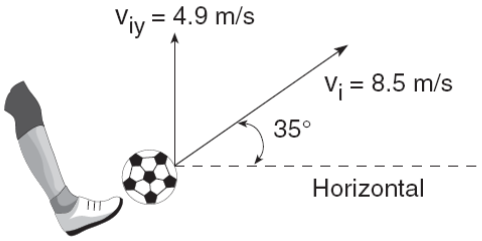
42 The diagram below shows a ray of monochromatic light incident on an alcohol-flint glass interface.



What occurs as the light travels from alcohol into flint glass?

1 The speed of the light decreases and the ray bends toward the normal.
2 The speed of the light decreases and the ray bends away from the normal.
3 The speed of the light increases and the ray bends toward the normal.
4 The speed of the light increases and the ray bends away from the normal.

A child kicks a ball with an initial velocity of 8.5 meters per second at an angle of 35° with the horizontal, as shown. The ball has an initial vertical velocity of 4.9 meters per second and a total time of flight of 1.0 second. [Neglect air resistance.]



6 The horizontal component of the ball's initial velocity is approximately

(1) 3.6 m/s (3) 7.0 m/s
(2) 4.9 m/s (4) 13 m/s

5 Which object has the most inertia?

(1) a 0.001-kilogram bumblebee traveling at 2 meters per second
(2) a 0.1-kilogram baseball traveling at 20 meters per second
(3) a 5-kilogram bowling ball traveling at 3 meters per second
(4) a 10.-kilogram sled at rest

2 A vector makes an angle, θ, with the horizontal. The horizontal and vertical components of the vector will be equal in magnitude if angle θ is

(1) 30° (3) 60°
(2) 45° (4) 90°

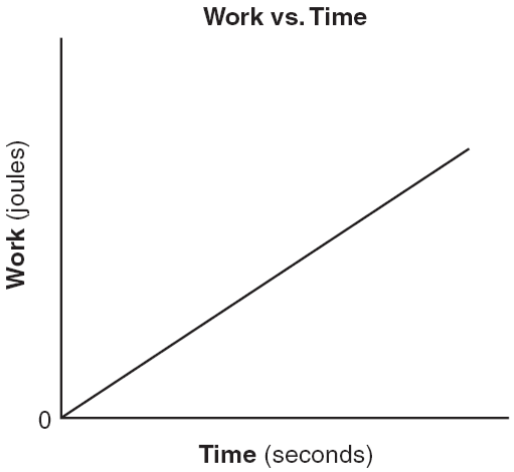
3 A skater increases her speed uniformly from 2.0 meters per second to 7.0 meters per second over a distance of 12 meters. The magnitude of her acceleration as she travels this 12 meters is

(1) 1.9 m/s^2 (3) 2.4 m/s^2
(2) 2.2 m/s^2 (4) 3.8 m/s^2

4 A ball thrown vertically upward reaches a maximum height of 30. meters above the surface of Earth. At its maximum height, the speed of the ball is

(1) 0.0 m/s (3) 9.8 m/s
(2) 3.1 m/s (4) 24 m/s

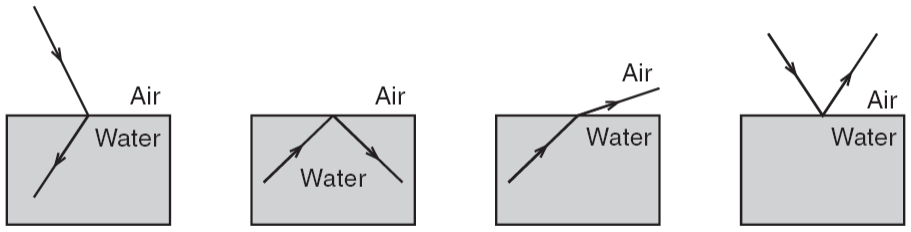
40 The graph below represents the relationship between the work done by a student running up a flight of stairs and the time of ascent.



What does the slope of this graph represent?

(1) impulse (3) speed
(2) momentum (4) power

28 Which ray diagram best represents the phenomenon of refraction?



(1) (2) (3) (4)

9 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?

(1) 0.00 N
(2) 2.00×10^2 N
(3) 1.60×10^3 N
(4) 3.20×10^3 N

11 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

(1) 0 N
(2) between 0 N and 12 N
(3) 12 N
(4) greater than 12 N

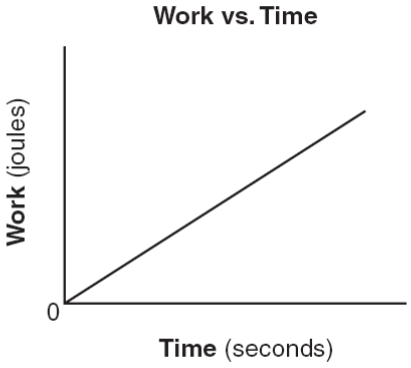
18 As a ball falls freely (without friction) toward the ground, its total mechanical energy

(1) decreases
(2) increases
(3) remains the same

23 A change in the speed of a wave as it enters a new medium produces a change in

(1) frequency
(2) period
(3) wavelength
(4) phase

40 The graph below shows the relationship between the work done by a student and the time of ascent as the student runs up a flight of stairs.



The slope of the graph would have units of

(1) joules
(2) seconds
(3) watts
(4) newtons

12 Ball *A* of mass 5.0 kilograms moving at 20. meters per second collides with ball *B* of unknown mass moving at 10. meters per second in the same direction. After the collision, ball *A* moves at 10. meters per second and ball *B* at 15 meters per second, both still in the same direction. What is the mass of ball *B*?

(1) 6.0 kg
(2) 2.0 kg
(3) 10. kg
(4) 12 kg

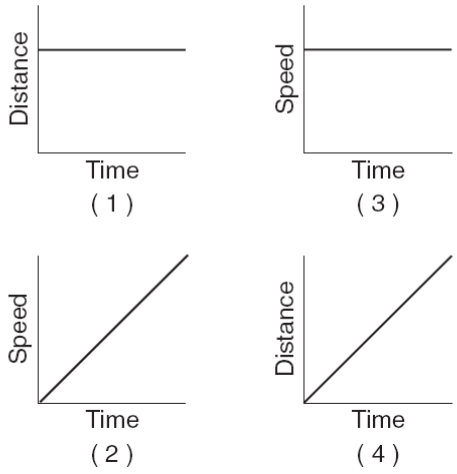
13 A 1.5-kilogram lab cart is accelerated uniformly from rest to a speed of 2.0 meters per second in 0.50 second. What is the magnitude of the force producing this acceleration?

(1) 0.70 N
(2) 1.5 N
(3) 3.0 N
(4) 6.0 N

20 What is the average power developed by a motor as it lifts a 400.-kilogram mass at constant speed through a vertical distance of 10.0 meters in 8.0 seconds?

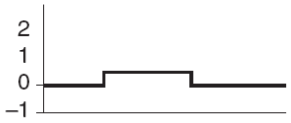
(1) 320 W
(2) 500 W
(3) 4,900 W
(4) 32,000 W

46 Which graph best represents the motion of an object that is *not* in equilibrium as it travels along a straight line?



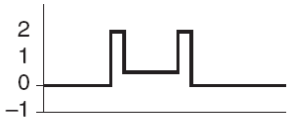
45 The diagram below shows two pulses, *A* and *B*, approaching each other in a uniform medium.

Which diagram best represents the superposition of the two pulses?



(1)

(3)



(2)

(4)

49 The driver of a car blows the horn as the car approaches a crosswalk. Compared to the actual pitch of the horn, the pitch observed by a pedestrian in the crosswalk is

1 lower
2 higher
3 the same

50 Compared to wavelengths of visible light, the wavelengths of ultraviolet light are

1 shorter
2 longer
3 the same

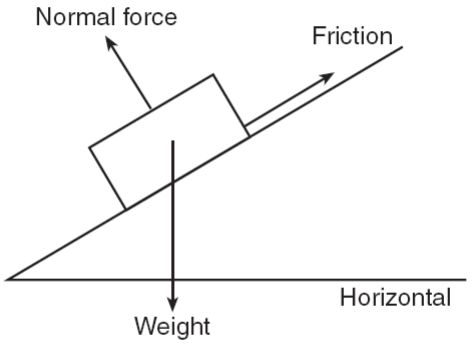
1 Velocity is to speed as displacement is to

(1) acceleration (3) momentum
(2) time (4) distance

31 A wave is diffracted as it passes through an opening in a barrier. The amount of diffraction that the wave undergoes depends on both the

(1) amplitude and frequency of the incident wave
(2) wavelength and speed of the incident wave
(3) wavelength of the incident wave and the size of the opening
(4) amplitude of the incident wave and the size of the opening

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



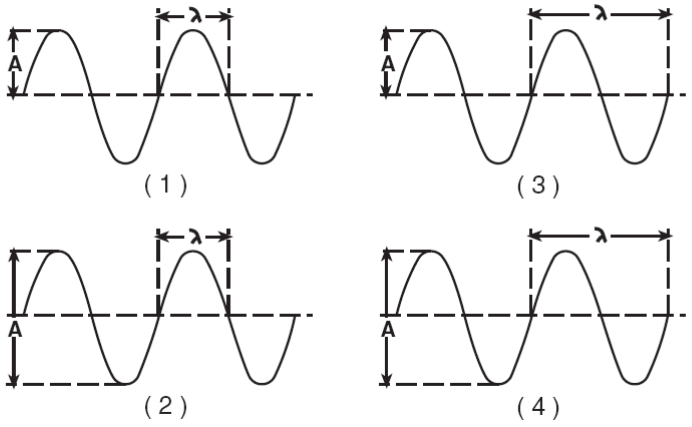
If the box is at rest, the net force acting on it is equal to

(1) the weight (3) friction
(2) the normal force (4) zero

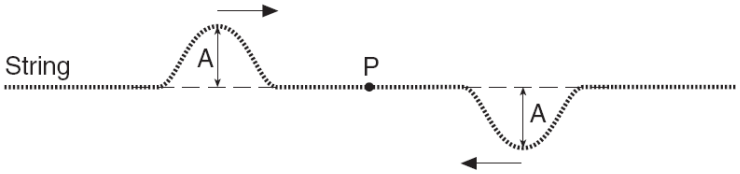
26 A single vibratory disturbance moving through a medium is called

(1) a node (3) a standing wave
(2) an antinode (4) a pulse

33 Which wave diagram has *both* wavelength (λ) and amplitude (*A*) labeled correctly?



10 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

(1) *A*
(2) 2*A*
(3) 0
(4) $\frac{A}{2}$

17 The spreading of a wave into the region behind an obstruction is called

(1) diffraction
(2) absorption
(3) reflection
(4) refraction

13 A tuning fork vibrating in air produces sound waves. These waves are best classified as

(1) transverse, because the air molecules are vibrating parallel to the direction of wave motion
(2) transverse, because the air molecules are vibrating perpendicular to the direction of wave motion
(3) longitudinal, because the air molecules are vibrating parallel to the direction of wave motion
(4) longitudinal, because the air molecules are vibrating perpendicular to the direction of wave motion

19 A train sounds a whistle of constant frequency as it leaves the train station. Compared to the sound emitted by the whistle, the sound that the passengers standing on the platform hear has a frequency that is

(1) lower, because the sound-wave fronts reach the platform at a frequency lower than the frequency at which they are produced
(2) lower, because the sound waves travel more slowly in the still air above the platform than in the rushing air near the train
(3) higher, because the sound-wave fronts reach the platform at a frequency higher than the frequency at which they are produced
(4) higher, because the sound waves travel faster in the still air above the platform than in the rushing air near the train

20 What is the gravitational potential energy with respect to the surface of the water of a 75.0-kilogram diver located 3.00 meters above the water?

(1) 2.17×10^4 J
(2) 2.21×10^3 J
(3) 2.25×10^2 J
(4) 2.29×10^1 J

21 A 60.0-kilogram runner has 1920 joules of kinetic energy. At what speed is she running?

(1) 5.66 m/s
(2) 8.00 m/s
(3) 32.0 m/s
(4) 64.0 m/s

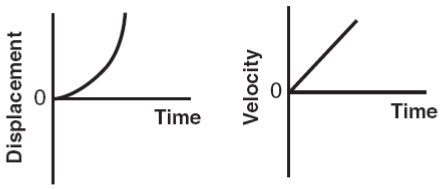
24 A motor used 120. watts of power to raise a 15-newton object in 5.0 seconds. Through what vertical distance was the object raised?

(1) 1.6 m
(2) 8.0 m
(3) 40. m
(4) 360 m

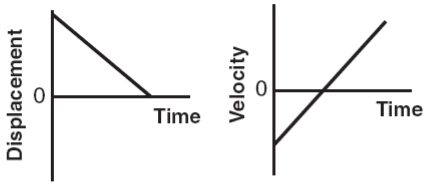
39 Which unit is equivalent to a newton per kilogram?

(1) $\frac{m}{s^2}$
(2) $\frac{W}{m}$
(3) J•s
(4) $\frac{kg \bullet m}{s}$

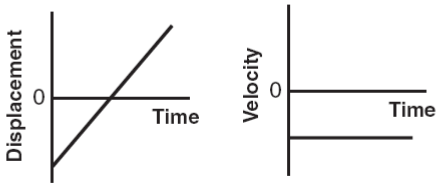
36 Which pair of graphs represents the same motion of an object?



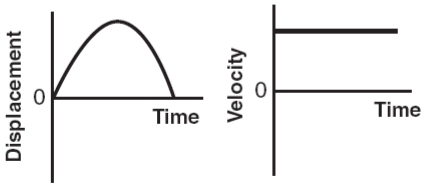
(1)



(3)

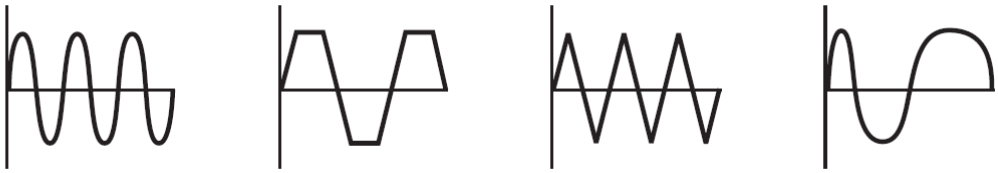


(2)



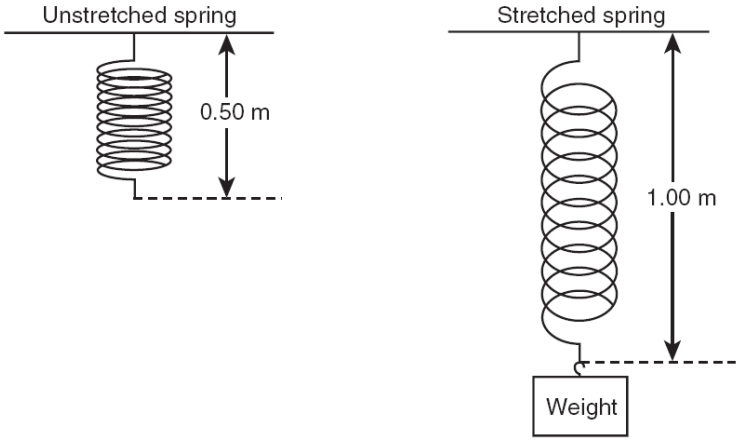
(4)

48 Which diagram below does *not* represent a periodic wave?



(1) (2) (3) (4)

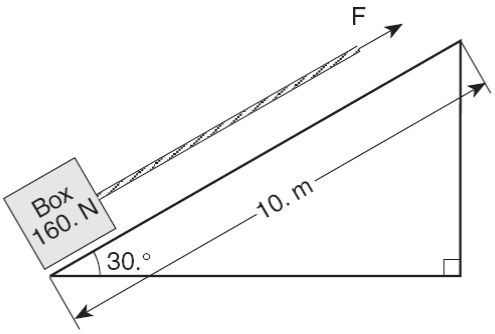
46 As shown in the diagram below, a 0.50-meter-long spring is stretched from its equilibrium position to a length of 1.00 meter by a weight.



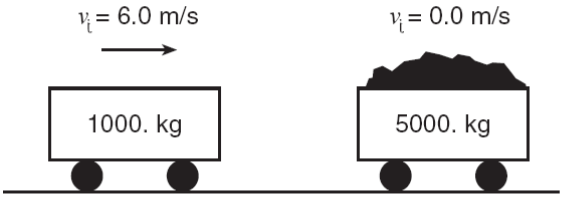
If 15 joules of energy are stored in the stretched spring, what is the value of the spring constant?

(1) 30. N/m
(2) 60. N/m
(3) 120 N/m
(4) 240 N/m

A 160.-newton box sits on a 10.-meter-long frictionless plane inclined at an angle of 30.° to the horizontal as shown. Force (*F*) applied to a rope attached to the box causes the box to move with a constant speed up the incline.



A 1000.-kilogram empty cart moving with a speed of 6.0 meters per second is about to collide with a stationary loaded cart having a total mass of 5000. kilograms, as shown. After the collision, the carts lock and move together. [Assume friction is negligible.]



66 Calculate the speed of the combined carts after the collision. [Show all work, including the equation and substitution with units.] [2]

67 Calculate the kinetic energy of the combined carts after the collision. [Show all work, including the equation and substitution with units.] [2]

68 How does the kinetic energy of the combined carts after the collision compare to the kinetic energy of the carts before the collision? [1]

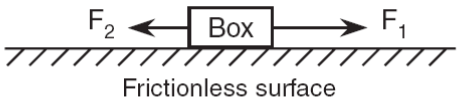
1 What is the total displacement of a student who walks 3 blocks east, 2 blocks north, 1 block west, and then 2 blocks south?

(1) 0
(2) 2 blocks east
(3) 2 blocks west
(4) 8 blocks

7 A 4.0-kilogram rock and a 1.0-kilogram stone fall freely from rest from a height of 100 meters. After they fall for 2.0 seconds, the ratio of the rock's speed to the stone's speed is

(1) 1:1
(2) 1:2
(3) 2:1
(4) 4:1

9 In the diagram below, a box is on a frictionless horizontal surface with forces F_1 and F_2 acting as shown.



If the magnitude of F_1 is greater than the magnitude of F_2, then the box is

(1) moving at constant speed in the direction of F_1
(2) moving at constant speed in the direction of F_2
(3) accelerating in the direction of F_1
(4) accelerating in the direction of F_2

13 The magnitude of the force that a baseball bat exerts on a ball is 50. newtons. The magnitude of the force that the ball exerts on the bat is

(1) 5.0 N
(2) 10. N
(3) 50. N
(4) 250 N

5 An object falls freely from rest near the surface of Earth. What is the speed of the object after having fallen a distance at 4.90 meters?

(1) 4.90 m/s
(2) 9.80 m/s
(3) 24.0 m/s
(4) 96.1 m/s

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

(1) acceleration and velocity
(2) weight and force
(3) speed and time
(4) displacement and distance

5 An opera singer's voice is able to break a thin crystal glass when the singer's voice and the vibrating glass have the same

(1) frequency
(2) speed
(3) amplitude
(4) wavelength

1. A 5.30 kg wagon is moving at 2.00 m/s to the right. A 0.180 kg blob of putty moving at 32.0 m/s also to the right strikes the wagon and sticks to it.
With what speed will the wagon and the putty move after the collision?

2. In a vehicle safety test, a 1 580 kg truck travelling at 60.0 km/h collides with a concrete barrier and comes to a complete stop in 0.120 s. Determine the magnitude of the change in the momentum of the truck, expressed in scientific notation.

3. A sound wave travels through a medium with a speed of 355 m/s. If the frequency of the sound is 440 Hz, what is the period of the sound wave?

4. What is the angle of refraction in a block of glass if the index of refraction is 1.65 and the angle of incidence is 32^0?

5. How much louder is a sound with a sound intensity level of 80 dB than a sound with a sound intensity level of 40 dB?

6. What is the speed of sound in air if the temperature is -16^0C?

7. Sound intensity changes from 10^{-8} W/m^2 to 10^{-2} W/m^2 as a motorcycle passes you on the road. What is the change in sound intensity level?

8. As the wind blows over the rope that is tied between a boat and the wharf it causes the rope to vibrate. The rope is 4.0 m long and a standing wave pattern is set up such that there are 5 antinodes in the rope. If in that condition the frequency is calculated to be 60 Hz,

   a) What is the speed of the wave in the rope?
   b) What is the lowest frequency at which the standing wave will be set up in the rope?
   c) What will be the wavelength of the third overtone (4^{th} harmonic)?

9. A ray of light strikes a rectangular piece of plastic at an angle of 30^0. If the index of refraction for the plastic is 1.50, what is the angle of refraction of the light ray?

10. The index of refraction for diamond is 2.42.
   a) What is the speed of light in diamond?
   b) What is the critical angle for diamond if it is in air?

11. The third resonant length of a closed air column is 75 cm.
   a) What are the first and second resonant lengths?
   b) What is the lowest resonant frequency if the speed of sound is 344 m/s?

12. A student stands 200 m in front of a cliff and fires a starter pistol. She hears the echo 1.23 s later. Compute the air temperature.

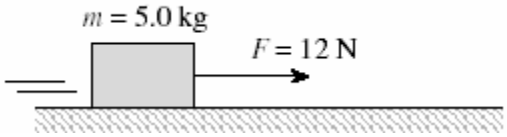
13. An observer, located 2.0 m from a sound source, measures the sound intensity level to be 70 dB. If she then moves off to a distance of 20.0 m from the source, what will be the new value for the sound intensity level?

14. A pipe, 1.4 m long, is open at both ends. By blowing across one end of the tube, a student is able to make it resonate. Compute the lowest resonant frequency given that the speed of sound is 340 m/s.

From here on is your midterm review I gave you in Jan 2008

1. When an object is subjected to a constant positive net force it will experience a constant
   A. velocity. B. momentum. C. acceleration. D. displacement.

2. A 5.0 kg object is pulled at a constant speed by a horizontal 12 N force as shown in the diagram below.



What is the coefficient of friction between the object and the surface?
   A. 0.24 B. 0.42 C. 1.0 D. 2.4

3. A falling 0.60 kg object experiences a frictional force due to air resistance of 1.5 N. What is the object's acceleration?
   A. $2.5 m/s^2$ B. $4.4 m/s^2$ C. $7.3 m/s^2$ D. $12 m/s^2$

4. A 1200 kg vehicle is accelerated from rest to 15 m s over a distance of 85 m. What is the net force on the car during this acceleration?
   A. 1 600 N B. 3 200 N C. 6 800 N D. 10 000 N

5. Which of the following is a correct statement about gravity?
   A. An object falling freely has no gravitational force on it.
   B. The acceleration due to gravity, *g*, is a universal constant.
   C. The gravitational field of a body follows an inverse square law.
   D. The gravitational potential energy varies with the square of distance of separation.

6. An 2100 kg car initially travelling at $25 m/s$ brakes to avoid hitting another car. The car accelerates at $-2.3 m/s^2$ while braking to a stop. How far does the car travel during its acceleration?

7. If the distance between two masses is doubled, the gravitational force (F_g) between the masses is

A. doubled B. quadrupled
C. reduced to one-half D. reduced to one-quarter

8. A car moving at a speed of 6.0 meters per second enters a highway and accelerates at 2.0 meters per second^2. How fast will the car be moving after it has accelerated for 45 meters?

9. Which of the following statements is always correct about an object in motion?
A. It has a tendency to accelerate. B. A net force must be acting on it.
C. It has a tendency to keep moving. D. The net force acting on it must be zero.

10. A boy walks 150 m due East and turns and walks 30 m due West. His displacement is

A. 30 m (W) B. 120 m (W) C. 120 m (E) D. 180 m (E)

11. The process of determining values of the dependent variable beyond the plotted points is called

A. extrapolation B. parallax C. interpolation D. variance

12. A 10.0 kg experiment package is brought from the Earth to the Moon. The gravitational field strength on the Moon is one-sixth that on the earth. Which statement about the package is true

A. It will have a mass less than on the earth
B. It will have a mass greater than on the earth
C. It will have a mass equal to that on the earth.
D. It will have a mass that may be either greater than or less than that on the earth

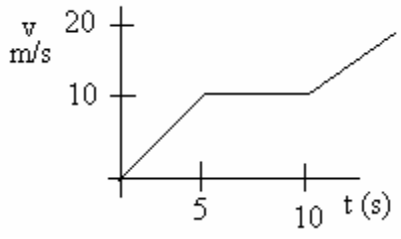
13. Martha accelerates from rest at 3.0 m/s^2 for 6.0s. What distance does Martha travel in this time?

(a) 2.0 m (b) 18 m (c) 54 m (d) 108 m

14. A 2.0 kg object falls from a height of 25 m. What is the speed just before it hits the ground?

(a) 11 m/s (b) 22 m/s (c) 123 m/s (d) 490 m/s

15. The velocity of an object is shown below. What is the displacement of the object during the first 5.0 s?

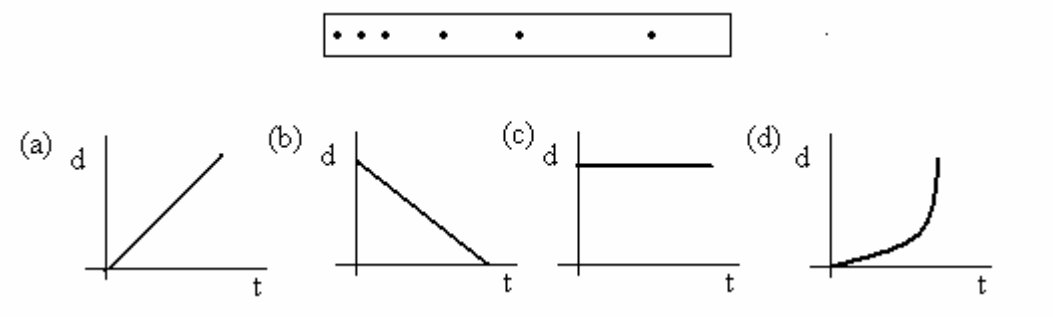


(a) 0 m (b) 2 m (c) 25 m (d) 50 m

16. What quantity is represented by the slope a velocity-time graph?
(a) displacement (b) distance (c) acceleration (d) force

17. A car leaves St. John's for Mount Pearl at 50 km/h. A second car leaves Mount Pearl for St. John's at 80 km/h. If St. John's is 5 km from Mount Pearl, how long will before the cars meet?
(a) 0.04 h (b) 0.17 h (c) 50 h (d) 650 h

18. Which of the following graphs best represents the ticker tape shown?



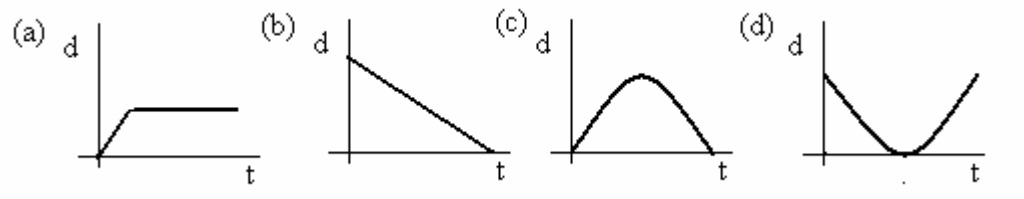
19. A square track has each side 100 m long. A jogger at the southeast corner starts running northward and runs once around the track in 50 s. What is the jogger's average velocity?
(a) 0 m/s (b) 1.0 m/s (W) (c) 2.0 m/s (W) (d) 4.0 m/s (W)

20. What is the magnitude of the acceleration of a car, if it accelerates uniformly from 2.5 m/s to 10.5 m/s in 5.0 s?
(a) 0.5 m/s^2 (b) 1.6 m/s^2 (c) 2.1 m/s^2 (d) 40 m/s^2

21. How long would it take for an object to free fall from the top of an 80 m high building?
(a) 1.0 s (b) 2.0 s (c) 4.0 s (d) 8.0 s

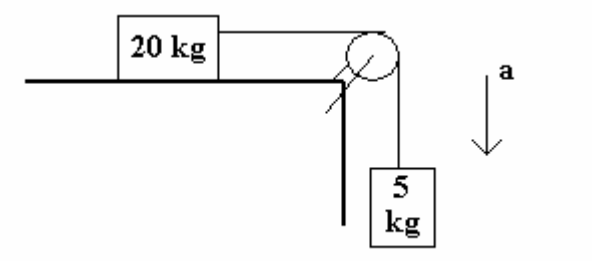
22. If you stand on a bus facing the front as it slows down, in what direction does your body's inertia cause you to fall?
(a) forwards (b) backwards (c) to the left (d) to the right

23. Which of the following graphs best represents the motion of a ball being thrown into the air and then caught at the same level from which it was thrown?



24. What force is required to accelerate a 10 kg object from 20 m/s to 40 m/s in 5.0 s?
(a) 10 N (b) 20 N (c) 30 N (d) 40 N

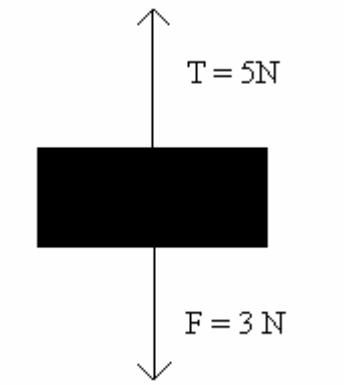
25. What is the acceleration of the two blocks shown, assuming no friction?



26. A student jogs 40 m (N) in 8.0 s. What is the velocity of that student?
(a) 5 m/s (N) (b) 5 m/s^2 (N) (c) 320 m/s (N) (d) 320 m/s^2 (N)

27. What is the *x* component of a 22 N force acting at an angle of 31° to the horizontal?
(a) 0.51 N (b) 0.86 N (c) 11 N (d) 19 N

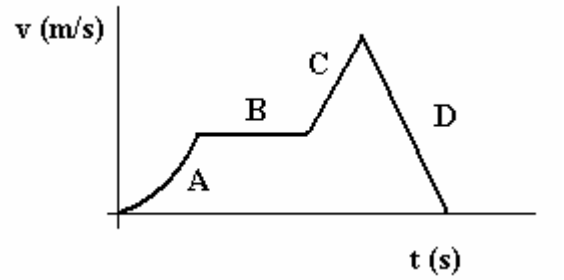
28. The tension (T) in the rope attached to the object shown is 5 N, and the force of gravity (F) acting on the object is 3 N. What is the unbalanced force acting on the object?



(a) 2 N (down) (b) 2 N (up) (c) 8 N (down) (d) 8 N (up)

29. What is the vector sum of all the forces acting on a body called?
(a) equilibrant force (b) gravitational force (c) inertial force (d) net force

30. During which section of the graph shown, would the displacement time graph for the object be a straight line?



(a) A (b) B (c) C (d) D

31. Lori walks 10-km (E) and then turns 90 degrees to walk 50-km (S). What is her displacement?

(a) 51 km (79 ° S of E)
(b) 49 km (79° S of E)
(c) 51 km (27° E of S)
(d) 49 km (27° E of S)

32. A horizontal force of 325 N acts on a 0.9 kg block causing it to slide across a horizontal surface. If the force of friction is 5.0 N, What is the acceleration of the block?

33. What is the vertical component of a 125 N force acting at an angle of 35° to the horizontal?

34. What is the mass of an object that experiences an acceleration of 120 m/s^2 when a net force of 16.0 N acts on the object?

35. A 15 kg object is dropped from a hot air balloon at rest. The force of air resistance acting on the object is 25 N. What is the magnitude of the net force acting on the object?

36. An object is moving to the right and has a mass of 45 kg. If the coefficient of kinetic friction is $\mu_k = 0.32$, what is the frictional force?

37. A football player kicks a football straight up into the air at a velocity of 22m/s. What is the ball's velocity after 2.5 s?

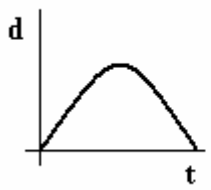
38. What force is required to accelerate a 5.2 kg object at 231 m/s^2 (N)?

39. What is the weight of a 70 kg person?

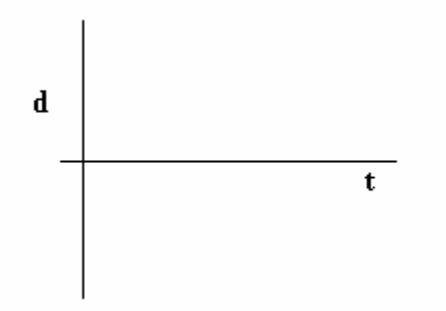
40. What is the net force acting on a 5 kg object moving at a constant speed of 5 m/s?

41. Jenn swims 2 km/h for 1 hour, then runs at 3 km/h for 2 hours. What was her average speed for the trip?

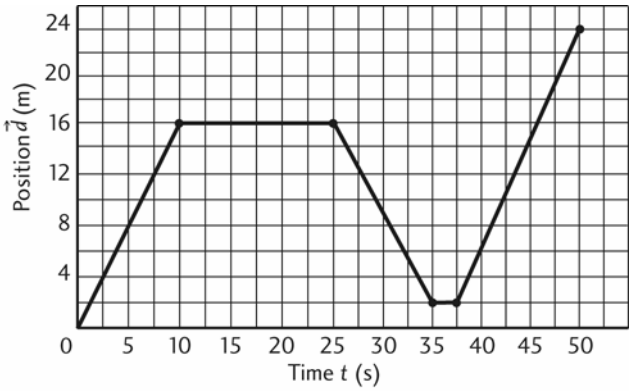
42. Sketch the v-t graph corresponding to the d-t graph shown.



43. Sketch a d-t graph for an object starting at the reference point, travelling to the right and speeding up.



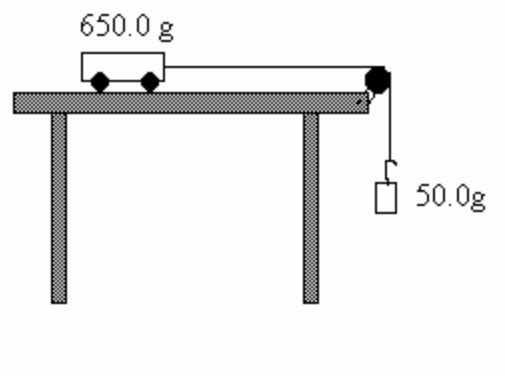
44. Sketch the following position time graph into a velocity time graph. Be sure to include the accurate values for the velocity.



45. When skiing or snowboarding, where your feet are attached to the equipment used. For this reason it is very easy to sprain an ankle. Use Newton's first law to explain why this is so.

46. A 4.5 kg object is thrown vertically upwards with an initial velocity of 5.32 m/s.
(a) How long does it take the object to reach its maximum height?
(b) What is the maximum height reached by the object?
(c) What is the object's final velocity just before it reaches the ground, which is located 1.8 m below where the object was first thrown?

47. Erin decides to enter her go-cart in a race. She begins the race at a speed of 23 m/s and races for 65.0 minutes to end the race at a speed of 67 m/s.
(a) What is Erin's acceleration during the race?
(b) How far does she race?
(c) Erin slows to a stop in 6 seconds. How far does Erin travel pass the finish line before stopping?



48. The diagram to the right shows a cart with mass of 650.0 g, which is on a horizontal table. A mass of 50.0 g, which provides an accelerating force, is attached to the cart by a cord and a pulley.
(a) Calculate the acceleration of the cart. Assume there is no friction.
(b) Still assuming no friction, calculate the tension in the cord.

50. A cat on an alley trek went 500.m [N], then 200.m [E], and then 300.m [S45^{0}E].
(a) Draw a scaled vector addition diagram of this motion
(b) Determine the cat's final displacement.

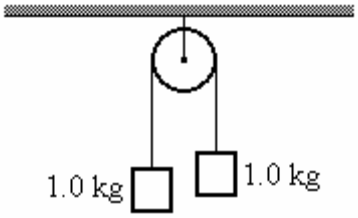
51. A river is 1950m wide. The velocity of the boat relative to the water is 4.5m/s [N].
(a) The velocity of the current is 1.5 m/s [E].
(b) What is the velocity of the boat relative to the shore?
(c) How long will it take the boat to cross the river?

52. Bill jumped upward from a high bridge with a speed of 6.30m/s and fortunately missed the bridge on the way down.
(a) If his bungee cord was 9.50m long, what was Bill's velocity just before he reached the end of the cord?
(b) Calculate the time this took.

53. Bobber is speeding at a speed of v = 45.0 m/s, passes a stopped police car the police car gives chase immediately accelerating at 4.50 m/s^2.
(a) At what time will the police car catch the speeder?
(b) How far did they travel?

54. A car has a mass of 2.40 x 10^3 kg, and is accelerating down a road at a rate of 3.80 m/s^2. What is the coefficient of friction between the car and the road if the engine produces a force of 4.4 x 10^3 N [forward]?

55. Two blocks are connected by a string and pulley as shown. Assuming that the string and pulley are massless and frictionless, and using g = 9.8 m/s^2, the tension in the string is:

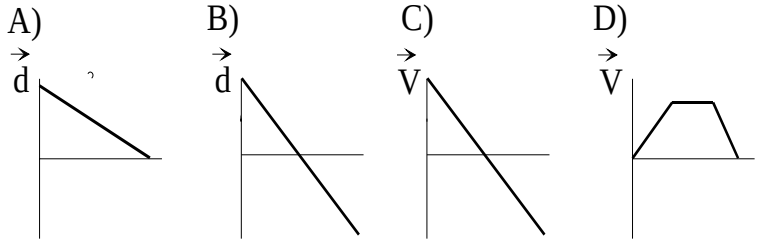


56. Which of the following is a vector quantity?
(a) 55 m/s (b) 55 m/s^2 (c) 55 m, [S] (d) none of these

57. An object travels 180 km with a velocity of 90 km/h. The time was
(a) 2 seconds (b) 2 h (c) 0.5 seconds (d) 0.5 h

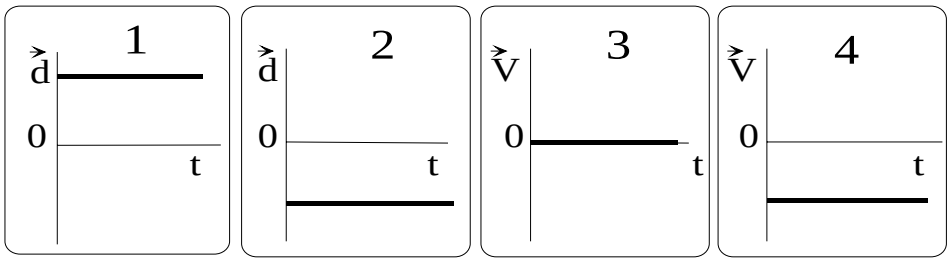
58. For any moving object which of the following four statements is the only true one?
(a) The speed can never be smaller than its velocity.
(b) It's possible for the speed to be zero and the velocity greater than zero.
(c) Its velocity can never be equal to its speed.
(d) If velocity is zero, speed must also be zero.

59. In which graph below does the moving object stop in the same position that it started?



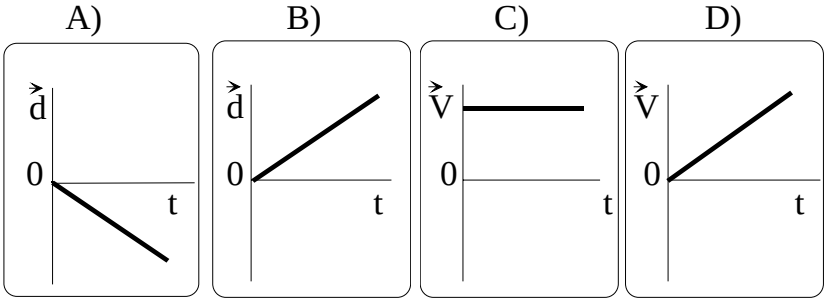
60. How is average speed calculated?
(a) Total displacement divided by the change in time.
(b) Total displacement multiplied by the change in time.
(c) Total distance divided by the total time.
(d) Total displacement multiplied by the total time.

61. Which of the following graphs indicates that the object is moving?



(a) 1, 2, 3 (b) 1, 4 (c) 4 only (d) 1, 2, 4

62. Which one of the following graphs shows uniformly accelerated motion?

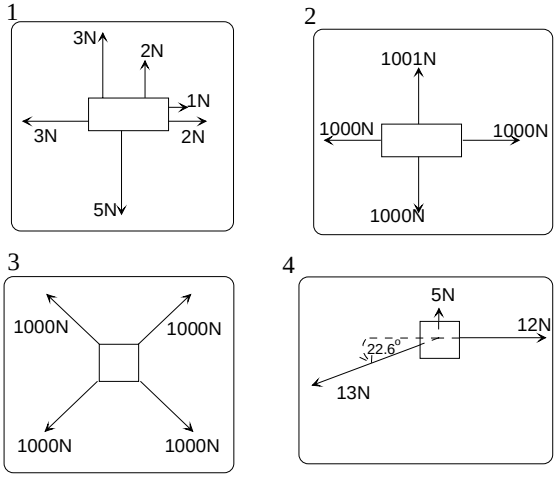


63. If the force exerted on an object were tripled, then we would expect the acceleration to
(a) increase by a factor of 3
(b) decrease by a factor of 3
(c) increase by a factor of 1/9
(d) decrease by a factor of 1/9

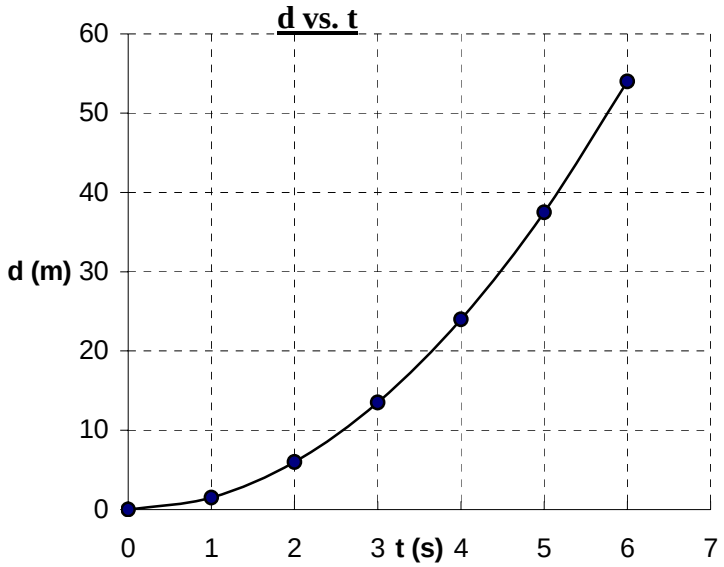
64. Which of the following statements **best** describes Newton's Second Law of Motion?
(a) Acceleration is inversely proportional to the applied force when mass is constant.
(b) Acceleration is directly proportional to the applied force when mass is constant.
(c) Acceleration is directly proportional to the mass of an object when the force is constant.
(d) Both B and C are correct.

65. Calculate the gravitational force of attraction between the moon and the earth.
$mass_{moon} = 7.35 \times 10^{22}$ kg,
$mass_{earth} = 5.97 \times 10^{24}$ kg,
$distance_{earth\ to\ moon} = 384500$ km

66. Determine the net force for each of the following?



67. The graph at the right depicts the motion of an object. Use the graph to find the instantaneous velocities at t = 3 s and t = 5 s.

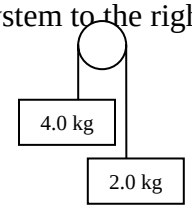


68. Describe the motion of the graph above.

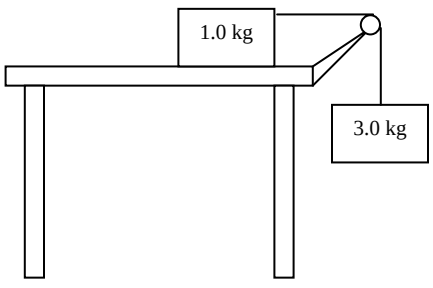
69. Two children are sitting on a sled. The sled and children have a mass of 220 kg. If they are being pulled with a force of 54. N [30^{o}EofN] and pushed from behind with a force of 75 N [55^{o}EofS].
(a)Draw a free body diagram for the sled. Include a legend.
(b) Calculate the acceleration of the children on the sled in the horizontal direction.

70. A box of mass 10.5 kg slides acreoss a floor and comes to a complete stop. If its initial speed was 12.0 km/h and μ_k = 0.25, calculate the following.
(a) the force of friction acting on the box.
(b) the acceleration of the box.
(c) the distance travelled by the box before stopping.
(d) he time it took to stop.

71. Consider the system to the right. Find the acceleration and tension in the rope.



72. Two boxes are attached by a rope, which is then placed over a frictionless pulley and set up on a frictionless table as shown below. What is the tension in the rope?



73. An old owl is much tuckered out after a night of hunting and sleeps so soundly on its tree perch that its claws relax causing it to plummet downwards until it is rudely awakened by encountering the ground after a 2.1 s fall.

a) How high must it fly to get back to its perch?

b) On the way down, how long did it take to fall half way?

c) On the way down, how fast was it falling at the half way point?

74. Just as Sylvester Cat is about to pounce on Tweety Bird, Granny lets out a blood curdling scream and Sylvester leaps vertically into the air but manages to land on all fours after just missing the chandelier which is 2.7 m above the floor.

a) With what speed did the frightened cat propel itself upward?

b) How long was it in the air?

75. What is the gravitational force of attraction between two 2500 kg cars whose centres are 2.0 m apart?

76. What happens to a gravitational force of 900 N when the objects concerned get farther apart by a factor of 3?

77. Which of the following examples is not explained by Newton's First Law
I. knocking snow off you boots by stamping them
II. a car leaving the road on a sharp turn
III. astronauts accelerate in space using thrusters
IV. seatbelts seem to press against you when the brakes are applied

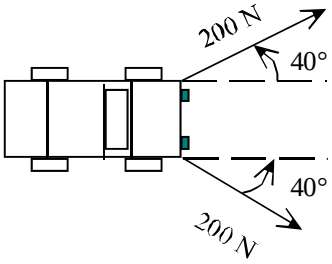
78. What is the net force in the diagram if $F_1 = 10.0$ N and $F_2 = 12.0$ N?
a) 2.0 N [NW]
b) 15.6 N [W40N]
c) 15.6 N [E40N]
d) 15.6 N [E50N]

79. A 6.0 g mass is accelerated with a force of 15.4 N for 0.02 s. What is the acceleration?
a) 2.6 m/s/s b) 0.051 m/s/s c) 51.3 m/s/s d) 2566 m/s/s

80. Which choice makes up an action-reaction pair?
a) Team A and Team B are in a tug of war and neither can make any headway
b) Two tow trucks, each pointing in the same direction are pulling a car from a ditch
c) Bill pushes forwards on the back of a car while Sam pushes backwards on the hood
d) The earth is pulling down on a parachute, and the air is pushing up on the parachute

81. Draw a FBD for each of the following.
a) a parachutist with weight of 600N has air resistance of 600N acting on him
b) a toboggan is pulled with a force of 100 N 30 degrees above the horizontal, and friction amounts to 55 N.

82. What is the net force acting on a car being pulled as shown in the diagram?



83. What is the gravitational attraction between two bodies of mass 2.50 kg held a distance of 4.00 m apart?

84. What happens to a gravitational force of 400 N when the objects concerned get closer to each other by a factor of 2?

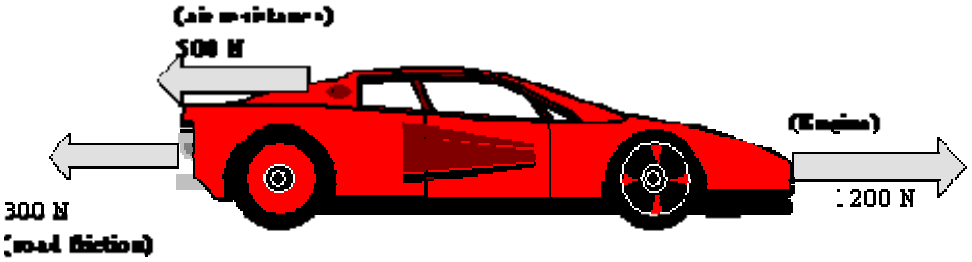
85. When two masses, m_1 and m_2, are a distance, d, apart, the gravitational force between them is 0.01 N or 1.0×10^{-2} N. What will be the new gravitational force if one of the masses is doubled, the other mass is tripled and the distance between them is reduced by ½ ?

86. A satellite with a mass of 450.0 kg is 50.0 m from a space station with a mass of 8.5×10^6 kg. Calculate the gravitational force.

87. A dog sled is being pulled upon in various directions by three sled dogs and also by the driver. Dog 1 pulls 60.0 N [West], Dog 2 pulls 100 N [South], Dog 3 pulls 140 N [40° S of E] and the driver pulls 120 N [North].
(a)Draw a neat diagram to represent forces acting on the sled.
(b) Use trigonometry or graphical analysis to find the resultant of the vectors. Remember to determine both the magnitude and direction.

88. The universal gravitational constant is $G = 6.67 \times 10^{-11}$ Nm^2/kg^2. Two identical boulders each having a mass of 4000 kg are placed 20.00 m apart. Determine the force of gravitational attraction between the masses.

89. What is the net unbalanced force on the car in the picture.



90. Which object has the greatest inertia?
a) 1200 kg sports car moving at 20 km/hr
b) 200 kg cannon ball moving at 150 m/s
c) 50 kg human in freefall
d) 10 kg missile traveling at 750 km/hr

91. Solve the following kinematics problems:
(a) A snowmobile on a frozen pond is moving at 15.0 m/s when the driver decides to pass a slow-moving komatik. If the driver accelerates to a speed of 19.5 m/s in a time of 4.00 s then what was the acceleration?
(b) A bicycle is rolling down a long hill, initially moving at 3.10 m/s. It accelerates at 0.720 m/s^2 until it reaches a speed of 13.1 m/s. Calculate the distance traveled.
(c) A bullet is launched upwards from ground level at a speed of 342.0 m/s. Compute the height of the bullet above the ground after 6.0 s. What is the maximum height reached by the bullet?
(d) A cart moving towards the left at 6.80 m/s is accelerated towards the right at 1.40 m/s^2. What will its velocity be after 3.00 s?
(e) A baseball strikes a catchers glove at an initial velocity of 35.0 m/s and moves the glove back 14.0 cm while coming to rest. What is the average acceleration of the baseball while it is in contact with the glove?
(f) An object is thrown straight upwards with a velocity of 30.0 m/s. How long does it take to reach its maximum height?
(g) A ballast bag is dropped from a balloon that is 70.0 m above the ground and rising at 13.0 m/s. What is the maximum height reached by the ballast bag? What is the ballast bag's position after 5.00 s?
(h) You are standing at the top of a cliff, 40.0 m above the water level. If you throw a ball upward and it hits the water 6.28 s later, at what velocity did you throw the ball?

92. Consider a box-and-pulley system whereby a 2.80 kg mass rests on a table and a 3.20 kg mass hangs freely over the edge from a pulley. Find the acceleration of the system and the tension in the rope if the surface between the 2.80 kg block and the table is frictionless. Then assume that the surface has a coefficient of friction of 0.410 and find acceleration and tension of the system with friction.