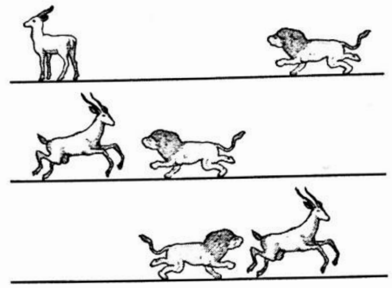
Multiple Choice Cumulative Review

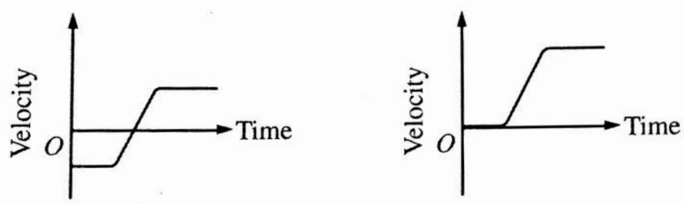
AP Physics 1

Part I: Kinematics

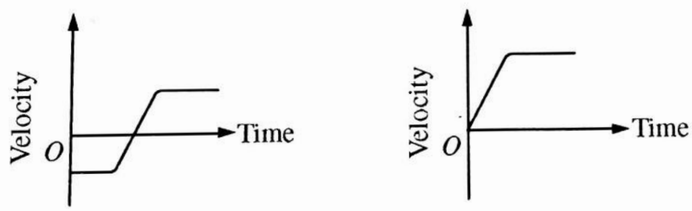


1. A lion is running at constant speed toward a gazelle that is standing still, as shown in the top figure above. After several seconds, the gazelle notices the lion and accelerates directly toward him, hoping to pass the lion and force him to reverse direction. As the gazelle accelerates toward and past the lion, the lion changes direction and accelerates in pursuit of the gazelle. The lion and the gazelle eventually each reach constant but different speeds. Which of the following sets of graphs shows a reasonable representation of the velocities of the lion and the gazelle as functions of time?

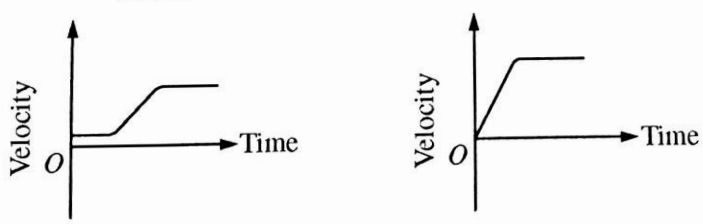
(A) LION GAZELLE



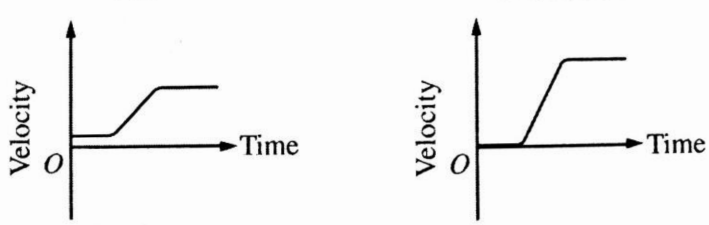
(B) LION GAZELLE



(C) LION GAZELLE

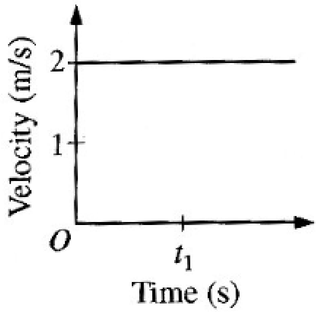


(D) LION GAZELLE

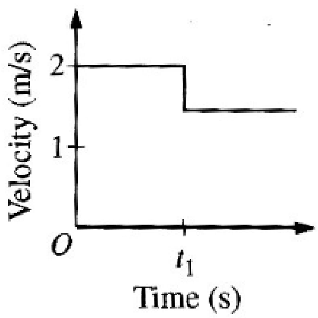


2. Two identical carts are free to move along a straight frictionless track. At time t_1, cart X is moving at 2.0 m/s when it collides with and sticks to cart Y, which is initially at rest. Which of the following graphs best shows the velocity of cart X before and after the collision?

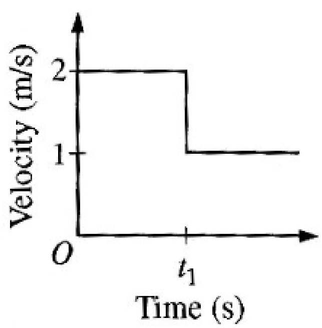
(A)



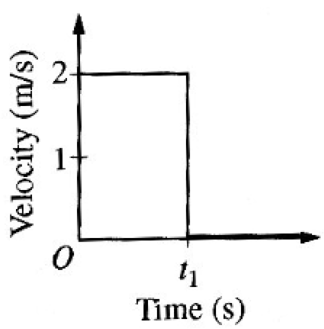
(B)



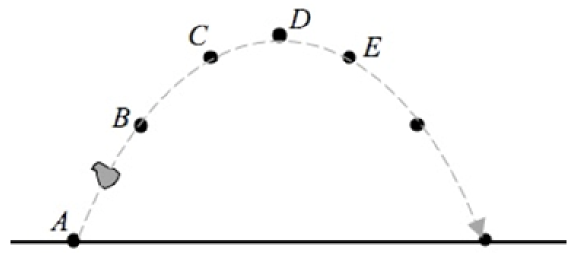
(C)



(D)



3.



A rock is thrown into the air at an angle relative to the vertical, and follows the path shown here. Consider air friction to be negligible. At which position is the vertical velocity of the ball zero?

a. A
b. Both C and E
c. D
d. The vertical velocity is never zero

4. Consider a ball thrown up from the surface of the earth into the air at an angle of 30° above the horizontal. Air friction is negligible. Just *after the* ball is released, its' acceleration is:

a. Upwards at $9.8 m/s^2$
b. Upwards at $4.9 m/s^2$
c. Downwards at $9.8 m/s^2$
d. $0 m/s^2$
e. None of these

5. An object is launched into the air at an angle less than 90° above the surface of the earth. Air resistance is negligible. At the highest point in its path of motion, which of the following statements is true?

a. It has no vertical velocity and no vertical acceleration
b. It has no vertical velocity and no horizontal acceleration
c. It has a vertical velocity and no horizontal acceleration
d. It has a horizontal velocity and no vertical acceleration

6. A car with a mass of 1000-kilograms accelerates from rest, and travels a distance of 48 meters during its first 4.0 seconds of uniform acceleration. What is its velocity at this point?
   a. 6.0 m/s
   b. 12 m/s
   c. 18 m/s
   d. 24 m/s
   e. 48 m/s

7. A 2.00 kg mass is dropped from the top of an 80.0 m high vertical cliff at the same time that a 1.00 kg mass is launched horizontally from the top of the cliff with an initial velocity of 8.00 m/s. If air resistance is negligible:
   a. the 2 kg mass lands first, with the 1 kg mass landing about 32 m from the base of the cliff
   b. the 1 kg mass lands first, about 24 m from the base of the cliff
   c. the two masses land at the same time, the 1 kg mass landing about 80 m from the base of the cliff
   d. the 2 kg mass lands first, with the 1 kg mass landing about 80 m from the base of the cliff
   e. none of the above

8. A student flying a model airplane due north observes a wind 15mph to the east. In order to continue flying due north, the student must:
   a. Increase the velocity of the plane to minimize the effect of the wind
   b. Point the plane so that the westward component of the velocity is 15mph
   c. Point the plane so that the eastward component of the velocity is 15mph
   d. Lower the plane out of the eastward airstream.

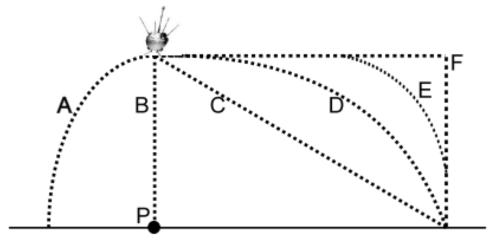
9. A golfer drives her golf ball from the tee down the fairway in a high arcing shot. When the ball is at the highest point of its flight:
   a. The velocity and acceleration are both zero
   b. The x-velocity is zero and the y-velocity is zero
   c. The x-velocity is non-zero and the y-velocity is zero
   d. the velocity is non-zero and the acceleration is zero

10. For a projectile, what is the acceleration in the x-direction?
    a. Depends on initial velocity
    b. Depends on how long it is in the air
    c. Depends on y-acceleration
    d. There is no acceleration in the x direction.

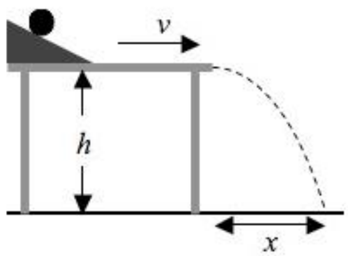
11. A baseball is thrown by the center fielder (from shoulder level) to home plate where it is caught (on the fly at shoulder level) by the catcher. At what point is the magnitude of the acceleration at a minimum? (air resistance is negligible)
    a. Just after leaving the center fielder's hand
    b. Just before arriving at the catcher's mitt
    c. At the top of the trajectory
    d. Acceleration is constant during entire trajectory

12. A NASA probe is moving horizontally to the right across the surface of the moon at a constant velocity. Directly above point P, the probe is released. Which of the following paths in the diagram below represents the projectile path a viewer on the lunar surface would observe?

e. A
f. B
g. C
h. D



13.



In a lab experiment, a ball is rolled down a ramp so that it leaves the edge of the table with a horizontal velocity *v*. If the table has a height *h* above the ground, how far away from the edge of the table, a distance *x*, does the ball land? You may neglect air friction in this problem.

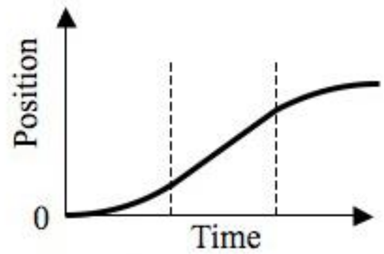
a. $\frac{2v^2}{g}$

b. $v\sqrt{\frac{2h}{g}}$

c. $\frac{2vh}{g}$

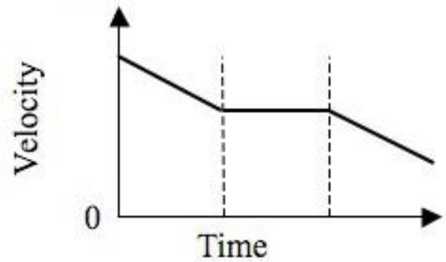
d. $\frac{2h}{g}$

14.



The graph given here shows the *position* vs. *time* for an object traveling along the *x*-axis. Which graph below shows the *velocity* vs. *time* for this same object during the same time period?

a.



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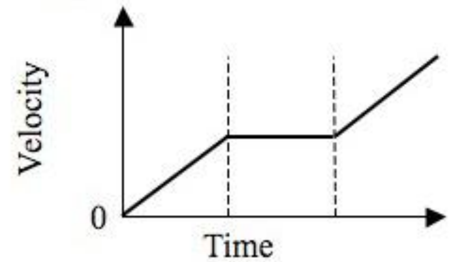
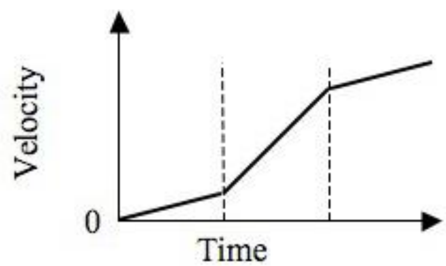
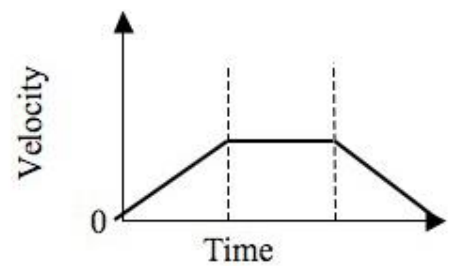


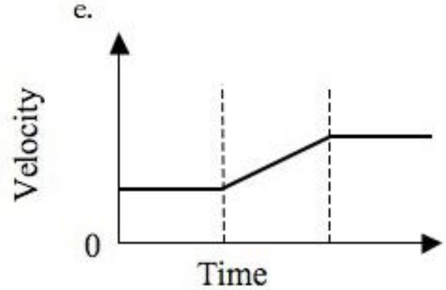
c.



d.

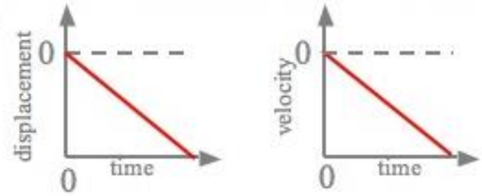


e.

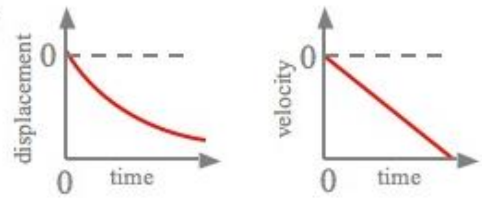


15. A mass is dropped from a height h above the ground, and freely falls under the influence of gravity. Which graphs here correctly describe the displacement and velocity of the object during the time the object is falling? Consider the "up" direction to be positive.

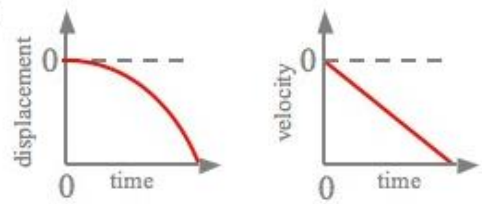
a.



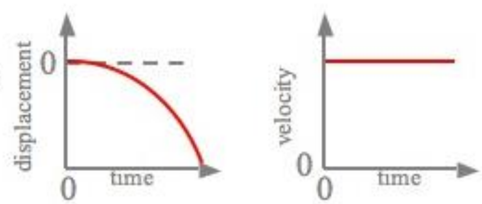
b.



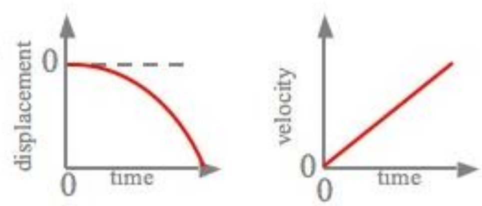
c.



d.

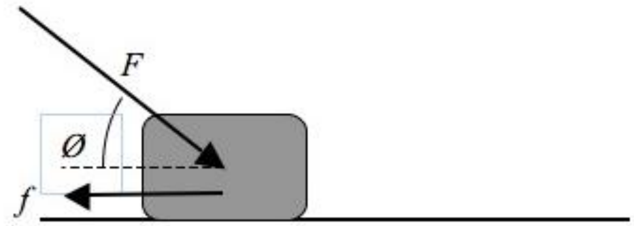


e.



Part II: Forces & Dynamics

1.



A block of mass *m* is pushed across a rough surface by an applied force *F*, directed at an angle Ø relative to the horizontal as shown above. The block experiences a friction force *f* in the opposite direction. What is the coefficient of friction between the block and the surface?

a. $\frac{mg}{F\sin\phi}$

b. $\frac{f}{F\sin\phi + mg}$

c. $\frac{f}{mg}$

d. $\frac{mg}{f}$

e. $\frac{f}{F\sin\phi - mg}$

2. A 20-ton truck collides with a 1500-lb car and causes a lot of damage to the car. Since a lot of damage is done on the car…

a. the force on the truck is greater than the force on the car.
b. the force on the truck is equal to the force on the car.
c. the force on the truck is smaller than the force on the car
d. the truck did not slow down during the collision.

3. A net force F accelerates a mass m with an acceleration a. If the same net force is applied to mass 2m, then the acceleration will be

a. 4a
b. 2a
c. a/2
d. a/4

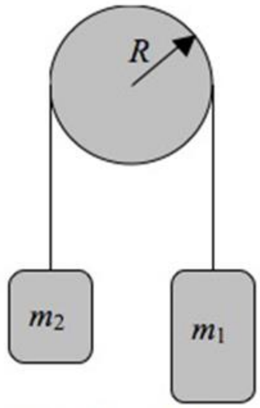
4. Which one of the following is NOT consistent with a car that is accelerating?

a. The car is moving with an increasing speed.
b. The car is moving with a decreasing speed.
c. The car is moving with a high speed.
d. The car is turning

8 . According to Newton's first law of motion, a moving object that is not acted on by an unbalanced force will

a. remain in motion
b. change its momentum.
c. come to a stop.
d. accelerate.

5.



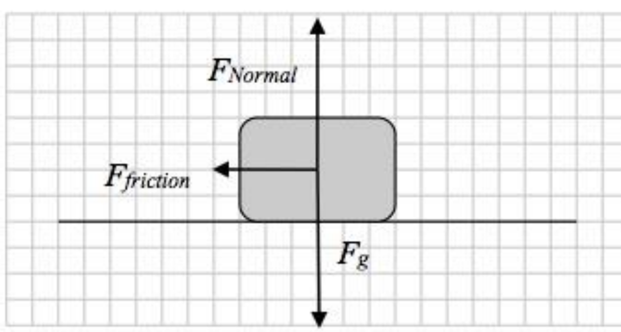
Two masses are hung are connected by a light cord and hung from a frictionless pulley of negligible mass as shown. Mass $m_1 = 3.00$kg, and mass $m_2 = 2.00$kg. When the two masses are released from rest, the resulting acceleration of the two masses is approximately:

a. 1 m/s²
b. 2 m/s²
c. 4 m/s²
d. 6 m/s²
e. 8 m/s²

6. If an action force is a cue ball (white) hitting a billiard ball (various colors) when playing pool, then the reaction force is

a. exerted on the table.
b. exerted on all the other billiard balls.
c. not present.
d. exerted by the billiard ball on the cue ball.

7.



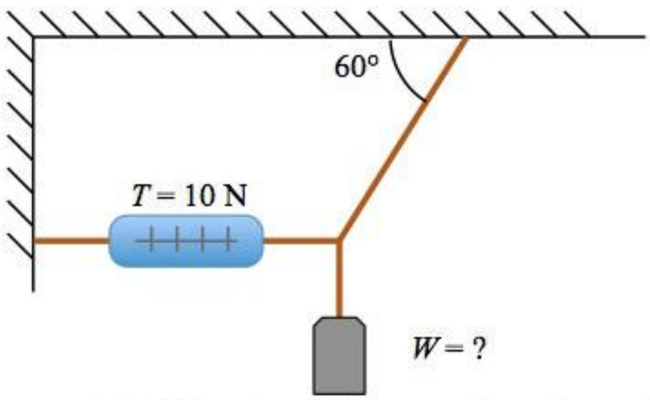
The free-body diagram shows all forces acting on a box supported by a stationary horizontal surface, where the length of each force vector is proportional to its magnitude. Which statement below is correct?

a. The box must be moving to the left, due to the Force of friction acting in that direction.
b. The box must be accelerating to the right, as indicated by the Force of friction in the opposite direction.
c. The box must be moving to the right, as indicated by the Force of friction in the opposite direction.
d. The diagram is drawn incorrectly: there can be no Force of friction unless the box is moving.
e. None of these statements is correct.

9. A rocket moves through empty space in a straight line with constant speed. It is far from the gravitational effect of any star or planet. Under these conditions, the force that must be applied to the rocket in order to sustain its motion is

a. equal to its weight.
b. equal to its mass.
c. dependent on how fast it is moving.
d. zero.

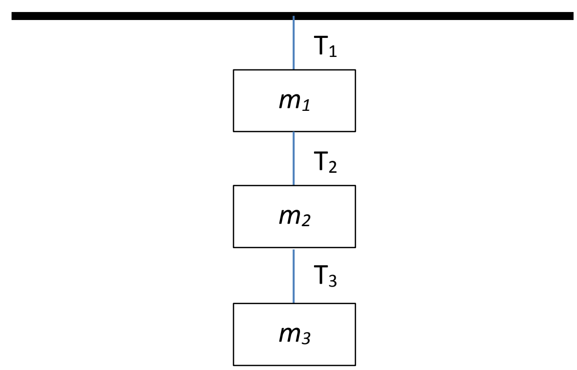
10.



A mass with unknown weight W is suspended from cords as shown above. When the system is in static equilibrium, the tension in the horizontal cord is 10N. The weight W of the mass is:

a. $20\ N$
b. $10\ N$
c. $10\sqrt{3}\ N$
d. $5\sqrt{3}\ N$
e. $20\sqrt{3}\ N$

11. Three masses are hung from a ceiling like shown. The tension in rope two is equal to:

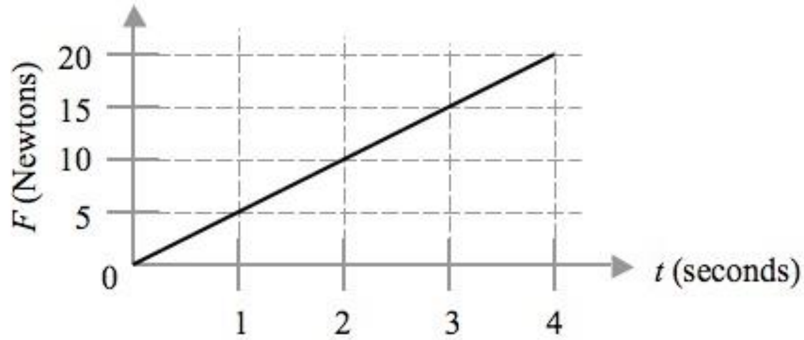


a. $(m_1+m_2)\cdot g$
b. $(m_1\cdot g)/(m_2-m_3)$
c. $(m_1+m_2+m_3)\cdot g$
d. $(m_2+m_3)\cdot g$

13. When an object is experiencing a net force, what kind of motion can it have?

a. Circular
b. Accelerating
c. Decelerating
d. All of the above.

12.

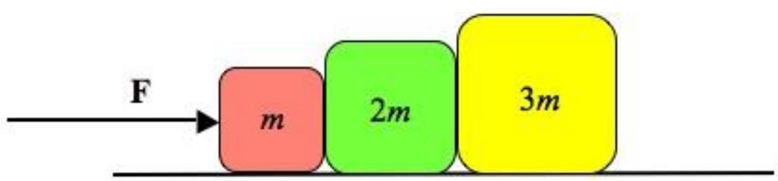


A block is pushed along a horizontal, frictionless surface, with a horizontal Force that varies as a function of time as shown in the graph here. At time $t = 3$ seconds, the acceleration of the block is 5.0 m/s^2. The mass of the block is

a. 1 kg
b. 2 kg
c. 3 kg
d. 5 kg
e. 15 kg

14. You push along a handle down toward a sled to move it across the snow. The handle is at an angle with the horizontal. As you increase the angle the handle makes with the horizontal, what happens to the normal force the ground exerts on the sled?
    a. It decreases.
    b. It increases.
    c. It remains the same.
    d. It depends on the mass of the sled

15.



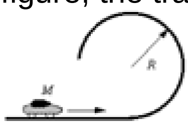
Three blocks of mass m, $2m$ and $3m$, are placed adjacent to each other on a frictionless, horizontal surface as shown above. A constant force of magnitude **F** is applied to the right. Which of the following statements is true?

a. The acceleration of the blocks will vary according to their mass.
b. The acceleration of each block will be the same: $\mathbf{F}/m$.
c. The net force acting on each block is the same.
d. The magnitude of the force on block $3m$ from $2m$ is greater than the magnitude of the force back on $2m$ from $3m$.
e. The net force acting on block $3m$ is three times greater than the net force acting on m.

Part III: Circular Motion & Gravitation

1. A racecar is traveling in uniform circular motion around a racetrack. What happens to the centripetal acceleration of the car if the speed is doubled but the radius of the circle remains constant?
A) It remains the same.
B) It increases by a factor of 2.
C) It increases by a factor of 4.
D) It is decreased by a factor of one-half.
E) It is decreased by a factor of one-fourth.

A small car of mass *M* travels along a straight, horizontal track. As suggested in the figure, the track then bends into a vertical circle of radius *R*.



2. What is the minimum acceleration that the car must have at the top of the track if it is to remain in contact with the track?
A) 4.91 m/s^2, downward
B) 4.91 m/s^2, upward
C) 9.81 m/s^2, upward
D) 9.81 m/s^2, downward
E) 19.6 m/s^2, upward

3. A boy is whirling a stone around his head by means of a string. The string makes one complete revolution every second, and the tension in the string,$F_{T,}$ is directed horizontally. The boy then speeds up the stone, keeping the radius of the circle constant, so that the string makes two complete revolutions every second. What happens to the tension in the sting?
A) The tension is unchanged.
B) The tension reduces to half of its original value.
C) The tension increases to twice its original value.
D) The tension increases to four times its original value.
E) The tension reduces to one-fourth of its original value.

4. A certain string just breaks when it is under 400 N of tension. A boy uses this string to whirl a 10-kg stone in a horizontal circle of radius 10 m. The boy continuously increases the speed of the stone. At approximately what speed will the string break? Assume the tension force is directed horizontally.
A) 10 m/s
B) 20 m/s
C) 80 m/s
D) 100 m/s
E) 400 m/s

5. Which force is responsible for holding a car in an *unbanked* curve?
A) the car's weight
B) the force of friction
C) the reaction force to the car's weight
D) the vertical component of the normal force
E) the horizontal component of the normal force

6. A satellite is placed in equatorial orbit above Mars, which has a radius of 3397 km and a mass $M_M = 6.40 \times 10^{23}$ kg. The mission of the satellite is to observe the Martian climate from an altitude of 488 km. What is the orbital period of the satellite?

A) 9.18×10^2 s
B) 3.62×10^3 s
C) 7.36×10^3 s
D) 1.08×10^5 s
E) 7.27×10^{12} s

7. Determine the minimum angle at which a roadbed should be banked so that a car traveling at 20.0 m/s can safely negotiate the curve without the aid of friction. The radius of the curve is 2.00×10^2 m.

A) 0.200°
B) 0.581°
C) 11.5°
D) 19.6°
E) 78.2°

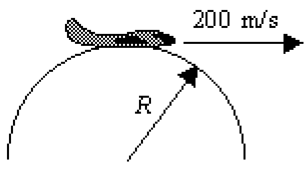
8. A 0.25-kg ball attached to a string is rotating in a horizontal circle of radius 0.5 m. Assume the tension force is directed horizontally. If the ball revolves twice every second, what is the tension in the string?

A) 2 N
B) 5 N
C) 7 N
D) 10 N
E) 20 N

9. Consider a hypothetical planet in our solar system whose average distance from the Sun is about four times that of Earth. Determine the orbital period for this hypothetical planet.

A) 0.25 year
B) 2.5 years
C) 4 years
D) 8 years
E) 16 years

10. A plane is traveling at 200 m/s following the arc of a vertical circle of radius *R*. At the top of its path, the passengers experience "weightlessness." To one significant figure, what is the value of *R*?



A) 200 m
B) 1000 m
C) 2000 m
D) 4000 m
E) 40 000 m

11. Two masses are a distance *d* apart and exert some force of gravity *F*. If this distance is doubled, the new force of gravity will be:
    a. 2*F*
    b. 4*F*
    c. ½*F*
    d. ¼*F*
12. Two masses are a distance *d* apart and exert some force of gravity *F*. If *both* masses are doubled, the new force of gravity will be:
    a. 2*F*
    b. 4*F*
    c. ½*F*
    d. ¼*F*
13. Two masses are a distance *d* apart and exert some force of gravity *F*. If this distance is halved, the new force of gravity will be:
    a. 2*F*
    b. 4*F*
    c. ½*F*
    d. ¼*F*
14. Two masses are a distance *d* apart and exert some force of gravity *F*. If the distance is changed and the force of gravity is found to be 3*F*, what is the new distance?
    a. $\sqrt{3}d$
    b. $3d$
    c. $\sqrt{1/3}d$
    d. $1/3d$
15. Based on Kepler's Law of Equal areas, the velocity of an orbiting satellite will be greatest when it is:
    a. Closest to the central mass
    b. Furthest from the central mass
    c. At its average orbital radius
    d. Halfway through its orbital period

16. Increasing the mass of an orbiting satellite will:
    a. Increase the velocity of the satellite
    b. Decrease the velocity of the satellite
    c. Cause the satellite to move closer to the central mass
    d. Have no effect

17. Increasing the velocity of an orbiting satellite will:
    a. Change the acceleration of the satellite
    b. Cause the satellite to maintain a circular orbit
    c. Cause the satellite to return to its previous velocity
    d. All of the above

Part IV: Simple Harmonic Motion

1. All of the following will NOT affect the period of a pendulum EXCEPT:
    a. Mass
    b. Initial displacement
    c. Length of the string
    d. None of the above
2. Increasing the length of the pendulum by 15% will increase the period by:
    a. 5%
    b. 7%
    c. 10%
    d. 12%
3. The negative in Hooke's Law (F_s=-kx) refers to
    a. The direction of the force
    b. The energy loss in a spring
    c. The negative acceleration due to gravity
    d. None of the above
4. Increasing the mass on a spring will ________ the spring's period
    a. Double
    b. Increase
    c. Decrease
    d. Remain the same
5. The displacement equation [x(t)=Acos(2πft)] can be applied to…
    a. Only springs
    b. Only pendulums
    c. Any undampened oscillator
    d. Any motion

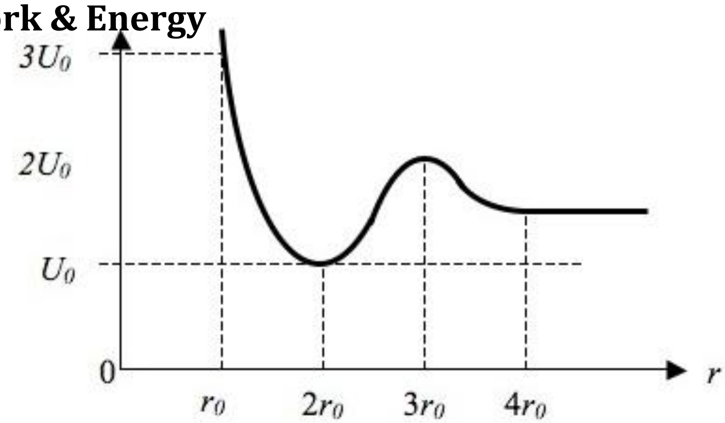
6. A particle oscillates with undamped simple harmonic motion. Which one of the following statements about the acceleration of the oscillating particle is true?
    a. It is least when the speed is greatest.
    b. It is always in the opposite direction to its velocity.
    c. It is proportional to the frequency.
    d. It decreases as the potential energy increases.

7. A simple pendulum and a mass-spring system both have the same time period T at the surface of the Earth. If taken to another planet where the acceleration due to gravity was half that on Earth, which line, A-D, in the table gives correctly the new periods?

	simple pendulum	mass-spring
a.	$T\sqrt{2}$	T
b.	$\frac{T}{\sqrt{2}}$	T
c.	$T\sqrt{2}$	$\frac{T}{\sqrt{2}}$
d.	$\frac{T}{\sqrt{2}}$	$T\sqrt{2}$

Part V: Work & Energy

1.



The graph above represents the potential energy U as a function of position r for a particle of mass m. If the particle is released from rest at position r_0, what will its speed be at position $3r_0$?

a. $\sqrt{\dfrac{8U_0}{m}}$

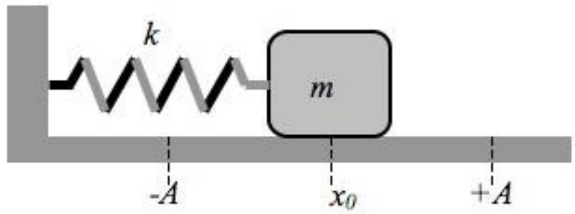
b. $\sqrt{\dfrac{4U_0}{m}}$

c. $\sqrt{\dfrac{2U_0}{m}}$

d. $\sqrt{\dfrac{6U_0}{m}}$

2. A 10-meter long, vertical cannon is used to accelerate a 1.0-kg ball straight up into the air. A constant force of 13.2-Newtons is used to accelerate the bowling ball up the length of the cannon. What is the ball's approximate velocity as it leaves the cannon (assuming no energy loss to friction)?
   a. 29 m/s
   b. 16 m/s
   c. 14 m/s
   d. 9 m/s
   e. 8 m/s

3.



A spring with negligible mass and spring constant k is attached on one end to a block of mass m, and fastened at the other end to a wall. The block is pulled back a distance A from its equilibrium position and released so that it oscillates on the frictionless, horizontal surface. What is the velocity v of the mass as it passes the equilibrium position x_0?

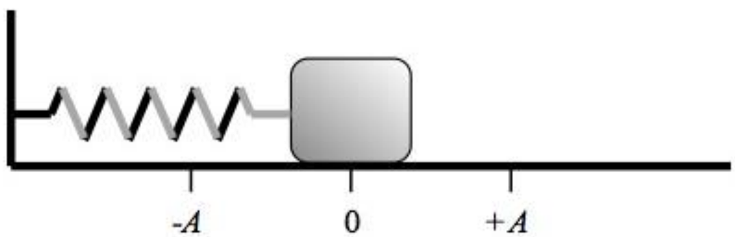
a. $\sqrt{\dfrac{2kA}{m}}$

b. $\dfrac{k}{m}x^2$

c. $\dfrac{k}{m}A^2$

d. $A\sqrt{\dfrac{k}{m}}$

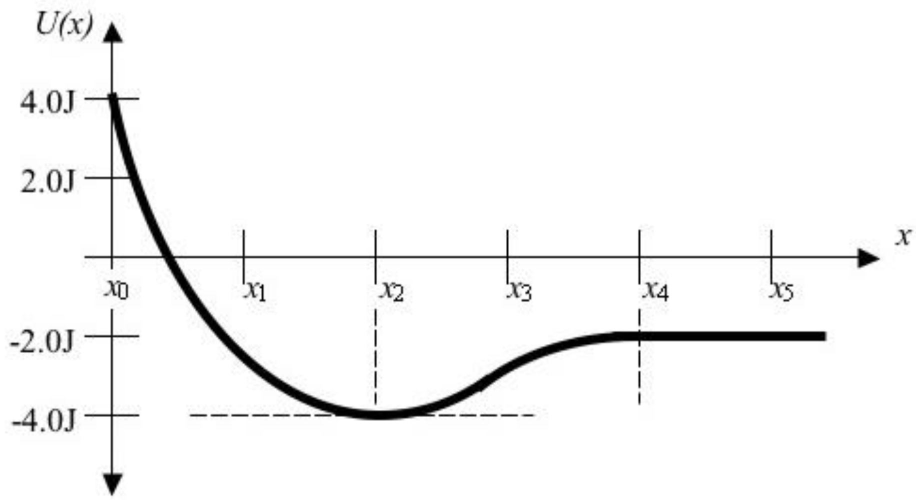
4.



A block of mass m sits on a horizontal frictionless surface, and is attached to a nearby vertical support by a spring as shown here. The spring, of negligible mass, is unstretched when the block is located at equilibrium position 0. The block is moved to position $+A$ and released, after which it oscillates with simple harmonic motion. Which of the following statements is true?

a. The block has maximum acceleration at A.
b. The block has maximum velocity at A.
c. The block has maximum displacement at 0.
d. The block has zero velocity at 0.
e. The block has zero displacement at A.

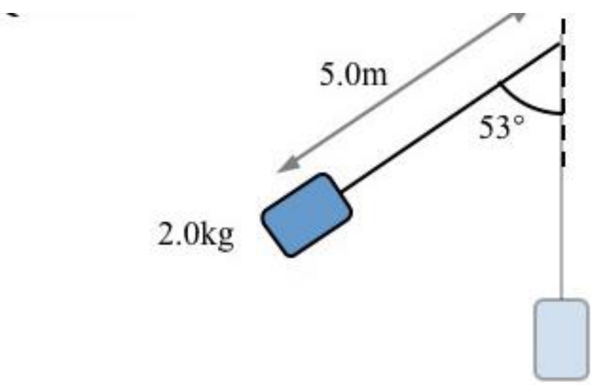
5.



The potential energy function $U(x)$ is associated with a conservative force F and described by the graph given here. If a particle being acted upon by this force has a kinetic energy of 1.0 J at position x_0, what is the particle's kinetic energy at position x_4?

a. 6.0 J
b. 7.0 J
c. 2.0 J
d. -2.0 J
e. -7.0 J

6.



A mass of 2.0 kg is attached to the end of a light cord to make a pendulum 5.0 meters in length. The mass is raised to an angle of 53° relative to the vertical, as shown, and released. The speed of the mass at the bottom of its swing is:

a. 60 m/s
b. 7.7 m/s
c. 40 m/s
d. 6.3 m/s
e. 10 m/s

7. A 300-Watt electric wheelchair has a mass of 50kg, and carries its 50kg occupant at constant velocity up a long ramp. About how much time does it take the wheelchair to reach the top of the 10-meter high ramp?

   a. 3 s
   b. 17 s
   c. 10 s
   d. 333 s
   e. 33 s

8. An object of mass *m* moves horizontally, increasing in speed from 0 to *v* in a time *t*. The Power necessary to accelerate the object during this time period is:

   a. $\frac{mv^2t}{2}$
   b. $\frac{mv^2}{2}$
   c. $2mv^2$
   d. $v\sqrt{\frac{m}{2t}}$
   e. $\frac{mv^2}{2t}$

9. Mass *m* is placed at the top of a frictionless ramp of initial height *h* and released. A different mass *M* is placed at the top of a different frictionless ramp of initial height *H* and released. If both masses have the same kinetic energy at the bottom of their respective ramps, the velocity *V* of mass *M* is

   a. $\sqrt{\frac{m}{M}}\,v$
   b. $\sqrt{\frac{M}{m}}\,v$
   c. $\frac{m}{M}\,v$
   d. $\frac{M}{m}\,v$
   e. $\frac{m}{M}\sqrt{v}$

10. A bucket of water with a total weight of 50 Newtons is lifted at constant velocity up a 10 meter deep well. If it takes 20 seconds to raise the bucket this distance, the Power required to lift the bucket is:

a. 25 W
b. 25 J
c. 2.5 J
d. 500 J
e. 500 W

11. From the top of a tall cliff of height *y*, a soccer ball is kicked horizontally so that it leaves the cliff with a velocity *v*. Assuming air friction is negligible, the speed of the ball just before it hits the ground is:

a. $2gy$
b. $\sqrt{2gy}$
c. $v^2 + 2gy$
d. $\sqrt{v^2 + 2gy}$
e. $\sqrt{v^2 - 2gy}$

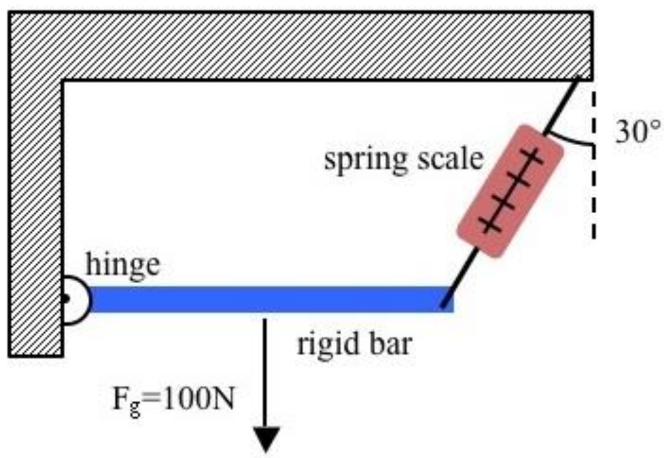
12. A block of wood, initially moving along a rough surface, is pushed with an applied horizontal force F_{applied} that is less than the friction force F_{friction}. Which of the following statements is *false*?

a. The Work being done by the applied force is negative.
b. The net Work being done on the block is negative.
c. The block is slowing down.
d. The net Work being done on the box decreases its kinetic energy *K*.
e. There is an increase in internal energy due to friction.

Part VI: Rotational Motion

1. A certain star, of mass *m* and radius *r*, is rotating with a rotational velocity ω. After the star collapses, it has the same mass but with a much smaller radius. Which statement below is true?

   a. The star's moment of inertia *I* has decreased, and its angular momentum *L* has increased.
   b. The star's moment of inertia *I* has decreased, and its angular velocity ω has decreased.
   c. The star's moment of inertia *I* remains constant, and its angular momentum *L* has increased.
   d. The star's angular momentum *L* remains constant, and its rotational kinetic energy has decreased.
   e. The star's angular momentum *L* remains constant, and its rotational kinetic energy has increased.

2. 

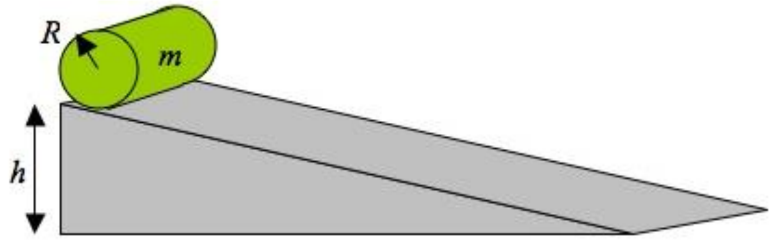
A rigid bar with a weight of 100 Newtons is free to rotate about a frictionless hinge at a wall, and supported in a horizontal position by a spring scale attached to the ceiling at an angle of 30° to the vertical, as shown. What force of tension is indicated by the spring scale?

   a. $100\ N$
   b. $100\sqrt{3}\ N$
   c. $100/\sqrt{3}\ N$
   d. $50/\sqrt{3}\ N$
   e. $50\ N$

3. A long, thin, rod of with moment of inertia I=2 kg•m² is free to rotate about an axis passing through the midpoint of the rod. The rod begins rotating from rest at time t=0 seconds, accelerating constantly so that it has a rotational velocity of 4π rad/s after rotating through two complete revolutions. What is the rod's angular momentum at this point?

   a. $2\pi\ kg \bullet m^2/s$
   b. $8\pi\ kg \bullet m^2/s$
   c. $8\ kg \bullet m^2/s$
   d. $4\pi\ kg \bullet m^2$
   e. $4\ kg \bullet m^2$

4.



A cylinder of mass m and radius R has a moment of inertia of $\frac{1}{2}mR^2$. The cylinder is released from rest at a height h on an inclined plane, and rolls down the plane without slipping. What is the velocity v of the cylinder when it reaches the bottom of the incline?

a. $\sqrt{\frac{4}{3}gh}$

b. $\sqrt{\frac{1}{2}gh}$

c. $\sqrt{\frac{3}{4}gh}$

d. $\sqrt{\frac{3}{4}mgh}$

e. $\sqrt{gh}$

5. A solid disk with radius R, mass M, and moment of inertia $I = \frac{1}{2}MR^2$, rolls along a surface (without slipping) at constant velocity v. What is the angular momentum of the disk about its own axis as it rolls?

a. MRv

b. $\frac{MRv}{2}$

c. $2MRv$

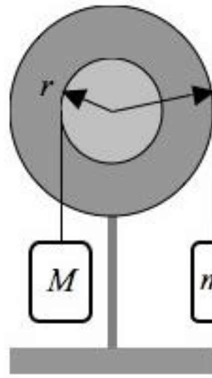
d. $M\omega$

e. $\frac{M\omega}{2}$

6. A turntable begins to rotate from rest with a constant angular acceleration. If a point on the edge of the turntable travels 9 radians during a 3.0 second time period, the angular acceleration of the turntable is

a. $2.0s^{-2}$
b. $3.0s^{-2}$
c. $4.0s^{-2}$
d. $6.0s^{-2}$
e. $9.0s^{-2}$

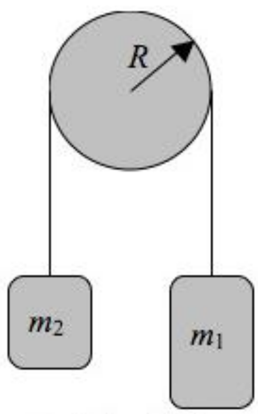
7.



The pulley system consists of two solid disks of different radii fastened together coaxially, with two different masses connected to the pulleys as shown above. Under what condition will this pulley system be in static equilibrium?

a. $m = M$
b. $rm = RM$
c. $r^2 m = R^2 M$
d. $rM = Rm$
e. $r^2 M = R^2 m$

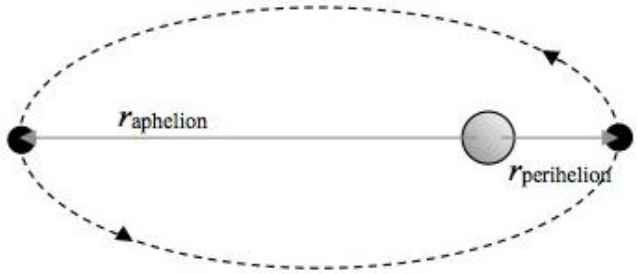
8.



Two masses are hung are connected by a light cord and hung from a frictionless pulley of negligible mass as shown. Mass $m_1 = 3.00$kg, and mass $m_2 = 2.00$kg. When the two masses are released from rest, the resulting acceleration of the two masses is approximately:

a. 1 m/s^2
b. 2 m/s^2
c. 4 m/s^2
d. 6 m/s^2
e. 8 m/s^2

9.

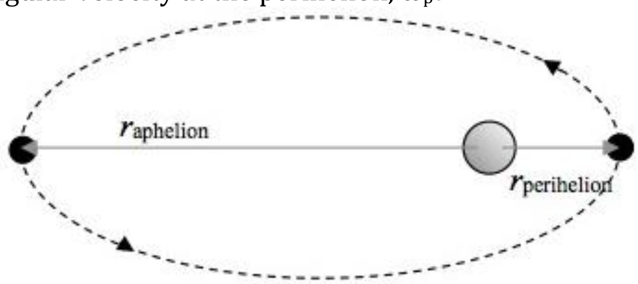


A planet has an elliptical orbit around a large star, as shown. If the planet has a speed of $v_{aphelion}$ at its farthest distance from the star, which of the following statements about the planets velocity at perihelion is true?

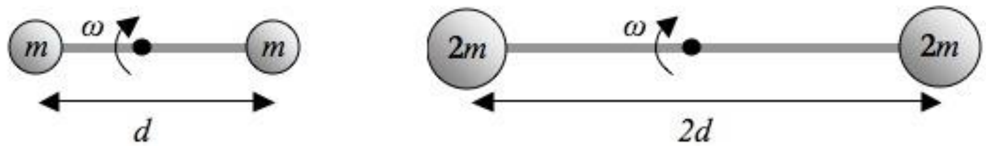
a. $v_{perihelion} < v_{aphelion}$, because the angular momentum of the system has decreased
b. $v_{perihelion} < v_{aphelion}$, because the angular momentum of the system is the same
c. $v_{perihelion} > v_{aphelion}$, because the angular momentum of the system has increased
d. $v_{perihelion} > v_{aphelion}$, because the angular momentum of the system is the same
e. $v_{perihelion} = v_{aphelion}$, because the angular momentum of the system is the same

11. A sphere with mass *m* rotates around a central mass in an elliptical orbit. The radius of the orbit is three times larger at the aphelion than at the perihelion. What is the angular velocity, ω_a, at the aphelion in terms of angular velocity at the perihelion, ω_p?

a. $\omega_a = \omega_p$
b. $\omega_a = 1/3\omega_p$
c. $\omega_a = 1/6\omega_p$
d. $\omega_a = 1/9\omega_p$
e. $\omega_a = 1/27\omega_p$



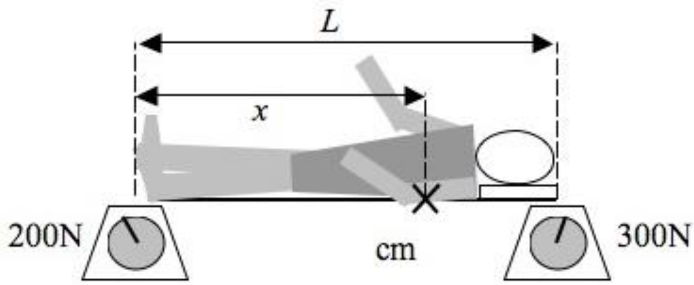
12.



A dumbbell consists of two masses *m* connected by a rigid rod of negligible mass and length *d*. A physics student takes the dumbbell and rotates it about its center of mass with an angular velocity ω, giving it an angular momentum L_1. The student then takes a second dumbbell, with masses $2m$ and length $2d$, and rotates them with the same angular velocity ω. What is the angular momentum L_2 of this second dumbbell?

a. $2\,L_1$
b. $4\,L_1$
c. $6\,L_1$
d. $8\,L_1$
e. $16\,L_1$

13.

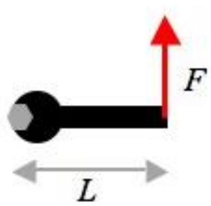


A student lies on a rigid platform of negligible mass, which is in turn placed upon two spring scales as shown. The scale on the left, at $x = 0$, reads 200 Newtons, and the scale on the right, at $x = L$, reads 300 Newtons. At what position x is the center of mass located?

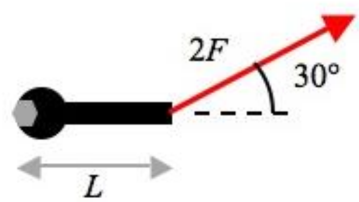
a. $\frac{1}{2}L$
b. $\frac{2}{5}L$
c. $\frac{3}{5}L$
d. $\frac{3}{4}L$
e. $\frac{4}{5}L$

14. A series of wrenches of different lengths is used on a hexagonal bolt, as shown below. Which combination of wrench length and Force applies the greatest torque to the bolt?

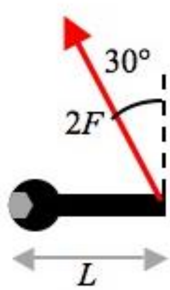
a.



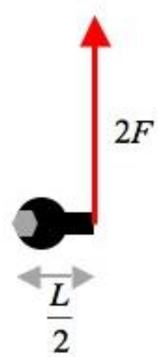
b.



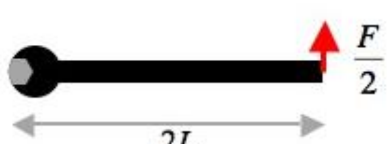
c.



d.



e.



15. If a wheel turns with constant angular speed then:
a. Each point on its rim moves with constant velocity
b. Each point on its rim moves with constant acceleration
c. The wheel turns through equal angles in equal times
d. The angle through which the wheel turns in each second increases as time goes on
e. The angle through which the wheel turns in each second decreases as time goes on

16. The angular speed in rad/s of the second hand of a watch is:
    a. π/1800
    b. π /60
    c. π /30
    d. 2 π

17. A wheel starts from rest and has an angular acceleration of 4.0 rad/s2. The time it takes to make 10 revolutions is:
    a. 0.50 s
    b. 0.71 s
    c. 2.2 s
    d. 2.8 s
    e. 5.6 s

Part VII : Electrostatics

1. Two spheres, one with a charge of $-Q$ and the other with a charge of $+2Q$ are separated by a distance R, and exert a force F on each other. The spheres are now altered so that the force between them is $2F$. Which of the following would have produced this result?
    a. The charge on both spheres was doubled.
    b. The charge on only one sphere was increased by a factor of 4.
    c. The charge on both spheres was doubled, and the distance between them halved.
    d. The charge on only one sphere was halved, and the distance between them halved.
    e. The charge on both spheres was increased by a factor of 4, and distance between them doubled.

2. A neutral conducting rod is touched by a positively charged metal sphere. What happens to the rod?
    a. It becomes positive
    b. It becomes negative
    c. It remains neutral
    d. It is impossible to determine

3. In the scenario above, this is caused by:
    a. Movement of electrons from the rod to the sphere
    b. Movement of protons from the rod to the sphere
    c. Movement of electrons from the sphere to the rod
    d. Movement of protons from the rod to the sphere

4. A rubber balloon is rubbed against a sample of animal fur before being stuck to the wall. This is because:
    a. The positive balloon attracts the neutral wall
    b. The negative balloon attracts the neutral wall
    c. The neutral balloon attracts the negative wall
    d. The negative balloon attracts the positive wall.

5. In the scenario above, the balloon is removed from the wall and sticks to the animal fur (also from the previous scenario). This is because:
    a. The positive balloon attracts the negative animal wall
    b. The neutral balloon attracts the positive animal fur
    c. The negative balloon attracts the positive animal fur
    d. The positive balloon attracts the neutral animal fur

6. A man in uniform rings your door bell and inquires about how recently you have re-charged your lightning rod. You slam the door and chuckle:
    a. "Lightning rods are re-charged in every lightning storm"
    b. "Lightning rods are not necessary; alarmist media encourages consumers to buy useless products"
    c. "Lightning rods are just made of a regular old metal pole and wire; re-charging makes no sense"
    d. "Lightning rods are plugged into the side of the house so they're always charged"

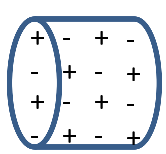
7. In the winter, water molecules can make up nearly 4% of the mass of the air. In the summer, this number doubles. Based on this information, you are more likely to experience static shocks during:
    a. The summer
    b. The winter
    c. The probability is equal
    d. It is impossible to tell

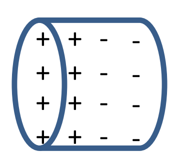
8. A metal conducting sphere has a massive positive charge. A person touches the sphere and their hair stands straight up from their head. This is because:
    a. The protons flow from the sphere to the person and cause their hair strands to become positively charged. They stand up because like-charged objects repel.
    b. The electrons flow from the person to the sphere and cause the person's hair to then become positively charged. They stand up because like-charged objects repel.
    c. The electrons flow from the sphere to the person, causing the person to become negatively charged. The electrons in the hair cause the hair to be negative and thus, they stand up because like-charged objects repel.
    d. The speed of the electrons flowing into the person produces a force that pushed the hair away.

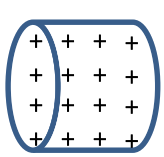
9. An object that is grounded will always be:
    a. Negative
    b. Positive
    c. Neutral
    d. Impossible to determine

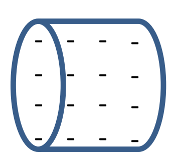
10. An insulating rod with a highly concentrated positive charge is brought next to a neutral soda can. The can and rod will:
    a. Repel
    b. Attract
    c. Do nothing
    d. Impossible to determine

11. An illustration of the can in the previous question might look like:

b.


a.


d.


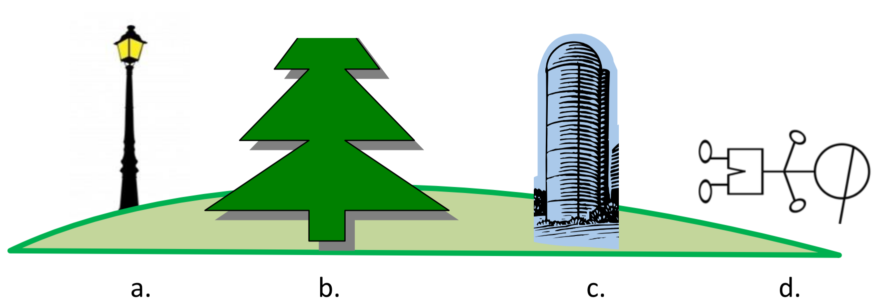
c.


12. The can from the previous scenario is now grounded with a piece of wire on the side opposite the rod. Electrons will:
    a. Flow up the wire into the can
    b. Flow down the wire out of the can
    c. Stay still
    d. Impossible to determine

13. Two electrons are 0.01m apart. What is the force between them?
    a. 2.56×10^{-34}N
    b. 1.45×10^{-5}N
    c. 2.3×10^{-24}N
    d. -2.3×10^{-24}N

14. A large negative thunderhead cloud rolls in over Fairfield. This causes
    a. Electrons in the ground and in objects near the ground to move deeper into the ground because they are repelled by the thunderhead.
    b. Protons in the ground and in objects near the ground to rise to the surfaces of the ground/objects because they are attracted to the thunderhead
    c. Neither A nor B
    d. Both A and B

15. In the picture below, where would lightning most likely strike?



16. Two charged objects are held some distance *d* apart and exert some force F_E on each other. If that distance is cut in half, the new force they exert in terms of the original force (F_E) will become:
    a. $1F_E$
    b. $2F_E$
    c. $4F_E$
    d. $8F_E$

17. A soda can is charged via induction. The soda can:
    a. Gained electrons
    b. Lost electrons
    c. Neither gained nor lost electrons
    d. Impossible to tell

18. When charging two objects via friction, the object that has the higher electron affinity will be:
    a. Positive
    b. Negative
    c. Neutral
    d. Depends on the direction of the rubbing

19. Electrons flow through a material. The material is a:
    a. Conductor
    b. Semi-conductor
    c. Insulator
    d. Mystery

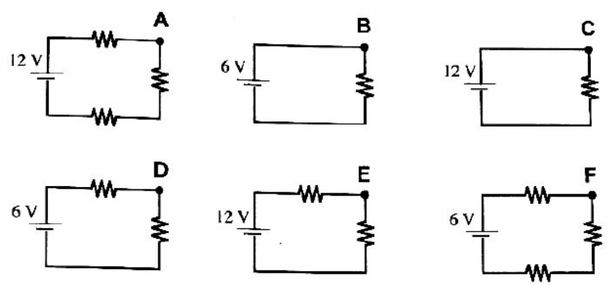
20. Two spheres, Sphere 1 and Sphere 2, have charges +3Q and -1Q, respectively. The force of Sphere 1 on Sphere 2 is:
    a. 2 times larger than the force of sphere 2 on sphere 1
    b. Equal to the force of sphere 2 on sphere 1
    c. 2 times less than the force of sphere 2 on sphere 1
    d. Impossible to determine

Part VIII : Simple Circuits

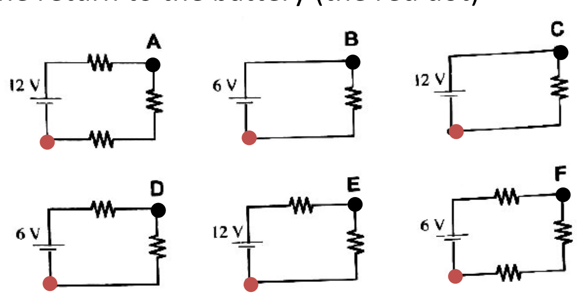
1. Increasing the voltage in a simple circuit while keeping the resistance constant will cause the current to:
    a. Increase
    b. Decrease
    c. Remain constant
    d. Impossible to say

2. A circuit contains two un-equal resistances in parallel
    a. Current is same in both
    b. A large current flows in larger resistor
    c. potential difference across each is same
    d. The smaller resistance has a smaller potential difference.

3. In the circuits below, every resister has an equal resistance. Circle the circuit with the highest current in the upper right-hand corner (by the letter)

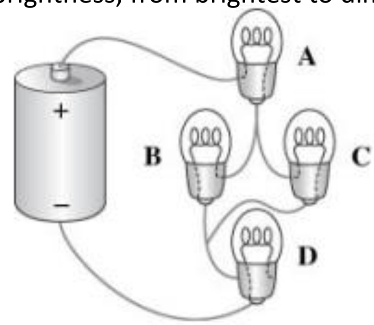


4. In the circuits below, every resister has an equal resistance. Circle the circuit with the greatest potential difference between the upper right hand corner (the black dot) and the return to the battery (the red dot)

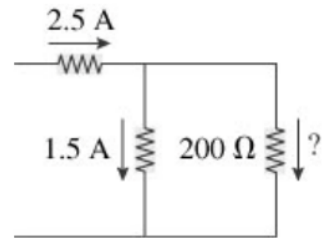


5. A battery is connected to a resistor. Increasing the resistance of the resistor will:
    a. Increase the current in the circuit.
    b. Decrease the current in the circuit.
    c. Not affect the current in the circuit.
    d. Impossible to tell

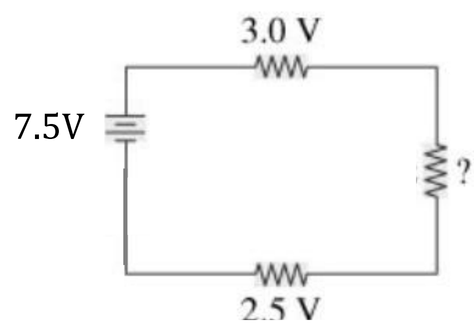
6. Rank the bulbs in the following circuit according to their brightness, from brightest to dimmest. You can assume they all have equal resistance.
    a. A > B = C > D
    b. A = B = C = D
    c. A = D > B = C
    d. B = C > A = D



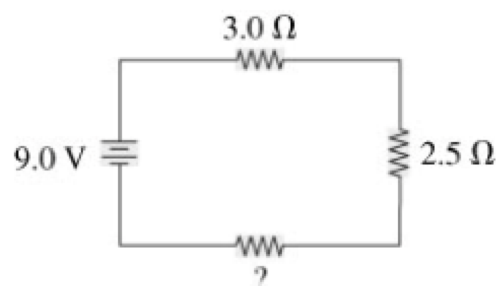
7. The diagram to the right shows a segment of a circuit. What is the current in the 200Ω resistor?
    a. 0.5 A
    b. 1.0 A
    c. 1.5 A
    d. 2.0 A



8. The diagram to the right shows a circuit with a battery and three resistors. What is the potential difference across the remaining resistor?
    a. 2.0 V
    b. 3.0 V
    c. 4.5 V
    d. 7.5 V



9. There is a current of 1.0 A in the circuit to the right. What is the resistance of the unknown circuit element?
    a. 9Ω
    b. 4.5Ω
    c. 3.5Ω
    d. 1Ω



10. In a parallel circuit containing set of bulbs, if one of the bulb blew up the equivalent resistance of the circuit will
    a. Increase
    b. Fluctuate
    c. Remains same
    d. Decrease

11. A circuit contains a battery and six lightbulbs in parallel. Adding a 7th light bulb in parallel will cause the **equivalent resistance** to:
    a. Increase
    b. Decrease
    c. Remain the same
    d. Impossible to tell.

12. A circuit contains a battery and six lightbulbs in parallel. Adding a 7th light bulb in parallel will cause the **voltage drop** across each resistor to:
    a. Increase
    b. Decrease
    c. Remain the same
    d. Impossible to tell
13. A circuit contains a battery and six lightbulbs in parallel. Adding a 7th light bulb in parallel will cause the **current** out of the battery to:
    a. Increase
    b. Decrease
    c. Remain the same
    d. Impossible to tell
14. A circuit contains a battery and six lightbulbs in parallel. Adding a 7th light bulb in parallel will cause the **power of each resistor** to:
    a. Increase
    b. Decrease
    c. Remain the same
    d. Impossible to tell
15. A circuit contains a battery and six lightbulbs in series. Adding a 7th lightbulb in series will cause the **equivalent resistance** to:
    a. Increase
    b. Decrease
    c. Remain the same
    d. Impossible to tell
16. A circuit contains a battery and six lightbulbs in series. Adding a 7th lightbulb in series will cause the **voltage drop** across each resistor to:
    a. Increase
    b. Decrease
    c. Remain the same
    d. Impossible to tell
17. A circuit contains a battery and six lightbulbs in series. Adding a 7th lightbulb in series will cause the **current** out of the battery to:
    a. Increase
    b. Decrease
    c. Remain the same
    d. Impossible to tell
18. A circuit contains a battery and six lightbulbs in series. Adding a 7th lightbulb in series will cause the **power of each resistor** to:
    a. Increase
    b. Decrease
    c. Remain the same
    d. Impossible to tell

19. An open circuit always has a **current** of:
    a. $\frac{V}{R}$
    b. 0
    c. Infinite
    d. Impossible to tell

20. Current is measured by a(n) ___________.
    a. Voltmeter
    b. Electrometer
    c. Ohmmeter
    d. Ammeter

21. Voltage is measured by a(n) ____________.
    a. Voltmeter
    b. Electrometer
    c. Ohmmeter
    d. Ammeter

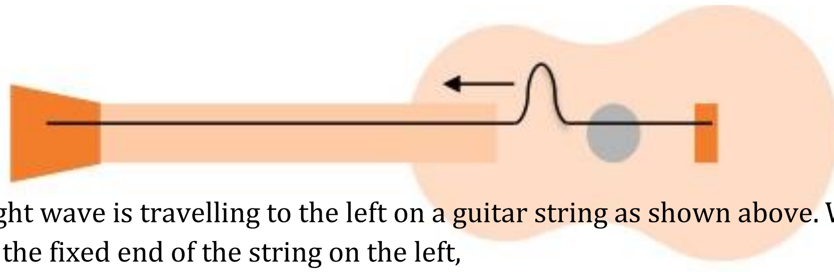
22. In a series circuit consisting of 3 resistors of 45 Ω each and a 50-V source, what is the approximate amount of power produced by each resistor?
    a. 6 W
    b. 8 W
    c. 18 W
    d. 135 W

23. In order to increase the resistance of a circuit, you should:
    a. Add resistors in series
    b. Remove resistors in parallel
    c. Re-arrange parallel resistors so they are in series
    d. All of the above

24. If you needed to increase the current through a circuit element you could:
    a. Increase the voltage at the source (like the battery)
    b. Decrease the resistance of that circuit element
    c. Remove a resistor in series with it
    d. All of the above

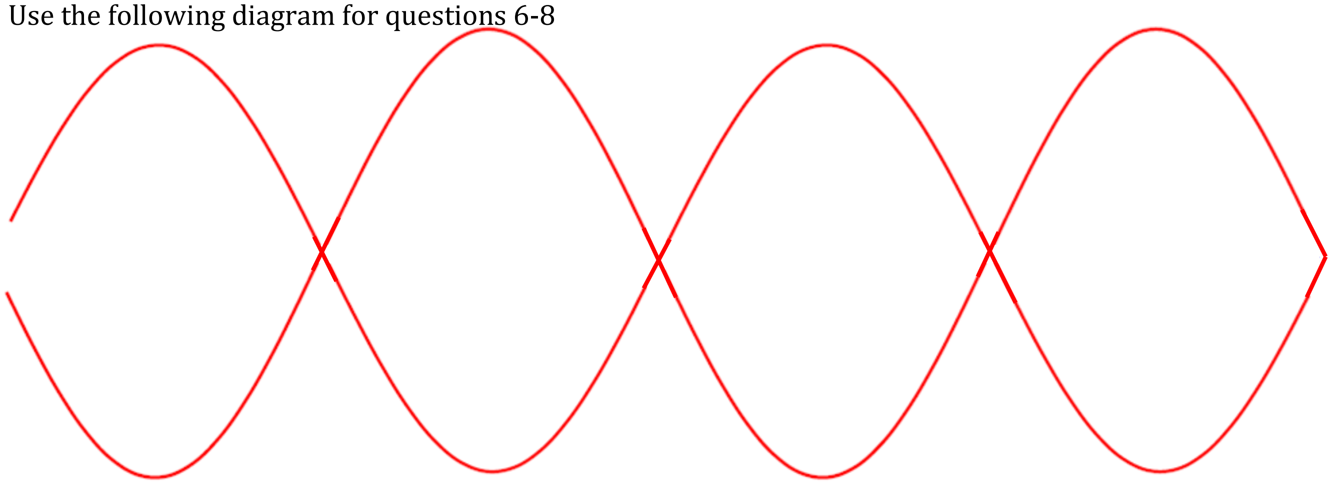
25. If you needed to increase the power of resistor you could:
    a. Re-arrange the circuit so it is in parallel with other resistors, instead of in series
    b. Add resistors in parallel in the circuit
    c. Remove resistors in series with it
    d. All of the above

Part IX: Wave Behavior & Sound



1. An upright wave is travelling to the left on a guitar string as shown above. When the wave reaches the fixed end of the string on the left,
   a. The wave on the string will be absorbed, and not reflected
   b. The reflected wave will be upright & travel at the same speed as the original
   c. The reflected wave will be inverted & travel slower than the original
   d. The reflected wave will be inverted & travel at the same speed as the original
2. A periodic wave travels at 16m/s and has a wavelength of 0.25m. The frequency of the wave is:
   a. 4Hz
   b. 16Hz
   c. 32Hz
   d. 64Hz
3. A standing wave at the 6^{th} harmonic is formed in a string of length 1.8m. The wavelength of this wave is:
   a. 10.8m
   b. 5.4m
   c. 0.6m
   d. 0.3m
4. A flutist creates a fundamental frequency of 150Hz in an open-end resonator (his flute). The speed of sound in the room is 350m/s. Find the wavelength of the wave.
   a. 52500m
   b. 3.5m
   c. 2.3m
   d. 0.43m
5. A musician creates a standing wave in a closed-end resonator with a frequency of 600Hz. The speed of sound in the room is 350m/s. The period of the wave is most nearly:
   a. 1.71s
   b. 0.58s
   c. 0.0029s
   d. 0.0017s

Use the following diagram for questions 6-8



6. A teacher creates a standing wave as shown above. This wave is at the __________ harmonic.
   a. 2nd
   b. 4th
   c. 8th
   d. 10th

7. The wavelength of the standing wave in is __________________ times the length of the string (L)
   a. ½
   b. 1
   c. $^3/_2$
   d. 2

8. If the length of the string is six meters and the teacher moves her hand at a rate of 5 oscillations per second, what is the velocity of the wave in the rope?
   a. $60^m/_2$
   b. $30^m/_s$
   c. $15^m/_s$
   d. $7.5^m/_s$

9. A student sends a wave pulse down a thin piece of string. The pulse passes from the thin string to a thicker string. The *transmitted* pulse will:
   a. Have a shorter wavelength
   b. Move with a greater velocity
   c. Be inverted
   d. Exhibit no change

10. Mr Henry shouts to his class. Students in the back whisper about prom. The MAIN difference between these sound waves **that cause the difference in loudness** is:
    a. The difference in frequencies
    b. The difference in amplitudes
    c. The difference in wavelengths
    d. The difference in wave speed.

11. A kidnapper phones in to demand a ransom. The receiver of the phone call remarks that the person on the phone sounds like a female. This *might* be because:
    a. The wavelength of the sound wave was long, which we interpret as a higher tone.
    b. The amplitude of the sound wave was high, which we interpret as a higher tone.
    c. The frequency of the sound wave was high, which we interpret as a higher tone.
    d. The velocity of the sound wave was high, which we interpret as a higher tone.

12. A sound wave passes through air with velocity v_a, water with velocity v_w, and steel with velocity v_s. Which of the following is true:
    a. $V_s > V_w > V_a$
    b. $V_a > V_w > V_s$
    c. $V_w < V_a < V_s$
    d. $V_s < V_a < V_s$

Use the following diagram for questions 13 & 14

13. Bob and Tina are currently equidistant from a police car speeding to the right. The sound of the siren appears ______________ to Bob than to Tina
    a. Louder
    b. Softer
    c. Higher
    d. Lower

14. Bob and Tina are experiencing:
    a. The Doppler Effect
    b. The Boltzmann Effect
    c. Constructive Wave Interference
    d. Destructive Wave Interference

15. A rope is tied to a wall (creating a fixed end). A student sends a pulse down the rope. The reflected pulse will be:
    a. Upright
    b. Inverted
    c. Elongated
    d. There will be no reflected pulse

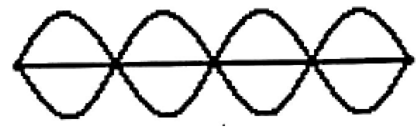
16. By increasing the tension in a rope, it will cause:
    a. The velocity and wavelength of waves to increase
    b. The wavelength and frequency of the waves to increase
    c. The velocity and damping of the waves to increase
    d. The velocity and frequency of the waves to increase

17. A wave pulse travels through a thick medium and encounters a thinner medium. The *transmitted* pulse will:
    a. Have a lower velocity
    b. Have a lower amplitude
    c. Have a higher wavelength
    d. Be inverted

18. How many anti-nodes will a standing wave at the third harmonic have?
    a. 1
    b. 2
    c. 3
    d. 4

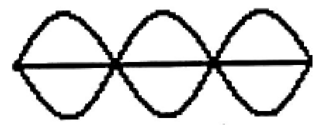
19. Nodes refer to:
    a. Areas of maximum oscillation
    b. Areas of minimal oscillation
    c. Areas of high amplitude
    d. Areas the wave does not pass through

20. A 100Hz wave creates a standing wave in the string at the right. Waves propagate through the string at 10m/s. Find the length of the strings.



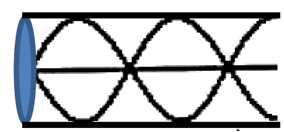
    a. 0.1m
    b. 0.2m
    c. 0.4m
    d. 1.0m

21. A wave of unknown frequency creates a standing wave in the 1m long string to the right. Waves propagate through the string at 10m/s. Find the frequency of the wave.



    a. 15Hz
    b. 10Hz
    c. 5Hz
    d. 1.5Hz

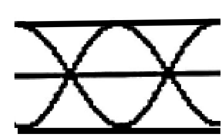
22. How many wave lengths are present in the closed-end resonator to the right?



    a. 2.50
    b. 2.25
    c. 1.50
    d. 1.25

23. If the frequency of the wave in problem 22 is 175Hz, and air in this room travels at 350m/s, find the length of the tube.
    a. 1.25m
    b. 1.75m
    c. 2m
    d. 2.5m

24. In the open-end resonator at the right, the tube has a length of 30cm. If the sound played has a frequency of 1250Hz, find the speed of sound in this room.



    a. 37500m/s
    b. 375m/s
    c. 350m/s
    d. 35m/s

25. The speed of a sound wave depends on the:
    a. Frequency of the wave
    b. Amplitude of the wave
    c. Properties of the medium
    d. Wavelength of the wave

26. A period of 5s corresponds to a frequency of ______ Hz
    a. 0.2
    b. 0.5
    c. 0.02
    d. 0.05
27. A mechanical wave:
    a. Is formed by the motion of various machinery
    b. Requires a medium to travel
    c. Consists of troughs only
    d. Does not include sound waves

28. A sound wave consists of:
    a. Areas of alternating high and low pressure in a medium
    b. Peaks and troughs that correspond to the different frequencies of a sound
    c. Condensations and rarefactions that can travel regardless of the presence of a medium
    d. All of the above

29. When the frequency of a sound wave increases, which of the following are *true?*:
        i. The tone increases
        ii. The velocity decreases
        iii. The wavelength decreases
    a. i and ii
    b. ii and iii
    c. i and iii
    d. i, ii, and iii

30. All of the following statements are <u>true</u> **except:**
    a. Waves are created by a vibration
    b. As a wave moves through a medium, the individual particles of the medium move from the sources of the wave to the end of the wave some distance away
    c. Sound waves are longitudinal waves
    d. Sound waves are mechanical waves