

## Physics

### Final exam review questions 2016-2017

1) A car maintains a constant velocity of 100 km/hr for 10 seconds. During this interval its acceleration is

- A) zero.
- B) 10 km/hr.
- C) 110 km/hr.
- D) 1000 km/hr.

2) An object is thrown upwards and is rising. During this time, the

- A) velocity decreases.
- B) acceleration decreases.
- C) both of these
- D) neither of these

3) An object at rest near the surface of a distant planet starts to fall freely. If the acceleration there is twice that of the Earth, its speed one second later would be

- A) 10 m/s.
- B) 20 m/s.
- C) 30 m/s.
- D) 40 m/s.

4) If a car increases its velocity from zero to 60 km/h in 6 seconds, its acceleration is

- A) 3 km/h/s.
- B) 6 km/h/s.
- C) 10 km/h/s.
- D) 60 km/h/s.
- E) 600 km/h/s.

5) Twelve seconds after starting from rest, an object falling freely will have a speed of

- A) 10 m/s.
- B) 50 m/s.
- C) 100 m/s.
- D) more than 100 m/s.

6) A block attached to a spring oscillates left and right. When it is at its furthest right position:

- A) velocity is zero and its acceleration is zero.
- B) velocity is zero and its acceleration is negative

C) velocity is positive and acceleration is positive

D) velocity positive and acceleration is zero

E) none of these

7) Drop a rock from a 5-m height and it accelerates at  $-10 \text{ m/s}^2$  and strikes the ground 1 s later. Drop the same rock from a height of 2.5 m and its acceleration of fall is about

- A) half as much.
- B) the same amount.
- C) twice as much.
- D) four times as much.

8) A car transitions from 15m/s to 17.5m/s over a time of ten seconds. What is the car's acceleration in meters per second per second?

- A) 0.25
- B) 2.8
- C) 4.0
- D) 10
- E) 40

9) If a car accelerates from rest at 2 meters per second per second, its speed 3 seconds later will be about

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

10) It takes 3 seconds for a stone to fall to the bottom of a well. How deep is the well?

- A) about 30 m
- B) about 45 m
- C) about 60 m
- D) more than 60 m

11) Disregarding air resistance, objects fall with constant

- A) velocity.
- B) speed.
- C) acceleration.
- D) distances each successive second.

12) A ball tossed vertically upward rises, reaches its highest point, and then falls back to its starting point. During this time the velocity of the ball is

- A) always upward
- B) always downward
- C) zero
- D) always changing

13) An object falls freely from rest on a planet where the acceleration due to gravity is twice as much as it is on Earth. In the first 5 seconds it falls a distance of

- A) 100 m.
- B) 150 m.
- C) 250 m.
- D) 500 m.
- E) none of these

14) An object covers a distance of 8 meters in the first second of travel, 10 meters during the next second, and 12 meters during the third second. Its acceleration in meters per second per second is approximately

- A) 0.
- B) 2.
- C) 4.
- D) 8.

15) Disregarding air drag, how fast must you toss a ball straight up in order for it to take 2 seconds to return to the level from which you tossed it?

- A) 5 m/s
- B) 7.5 m/s
- C) 10 m/s
- D) 15 m/s
- E) 20 m/s

16) If a projectile is fired straight up at a speed of 40 m/s, the time it takes to reach the top of its path is about

- A) 2 second.
- B) 4 seconds.
- C) 8 seconds.
- D) not enough information to estimate

17) A car accelerates from rest for 5 seconds until it reaches a speed of 20 m/s. What is the car's acceleration in meters per second per second?

- A) 1
- B) 2
- C) 3
- D) 4
- E) 5

18) Ten seconds after starting from rest, a car is moving at 40 m/s. What is the car's acceleration in meters per second per second?

- A) 0.25
- B) 2.8
- C) 4.0
- D) 10
- E) 40

19) A bullet is dropped from the top of the Empire State Building while another bullet is fired downward from the same location. Neglecting air resistance, the acceleration of

- A) the fired bullet is greater.
- B) the dropped bullet is greater.
- C) each bullet is -10 meters per second per second.

20) What is the maximum possible resultant of a pair of vectors with magnitudes of 5 and 7 units? What is the minimum possible resultant?

- A) 5 and 7
- B) 12 and 5
- C) 7 and 2
- D) 12 and 7
- E) 12 and 2



21) A block is pulled across a floor as shown in the vector diagram. The force vector  $\mathbf{F}$  has the greater component in the

- A) horizontal direction,
- B) vertical direction,

22. This component is  
 A) larger than the vector **F**.  
 B) smaller than the vector **F**.  
 C) equal to the vector **F**.
- 23) If a vector that is 1cm long represents a velocity of 10km/h, what velocity does a vector 25cm long drawn to the same scale represent?  
 A) 25 km/h  
 B) 2.5km/h  
 C) 250km/h  
 D) 10km/h  
 E) 4km/h
- 24) From his camp, a hiker walks directly north for 8km and then directly east for 4km. How far is he from the camp?  
 A) Greater than 4km, but less than 8km  
 B) Greater than 8km, but less than 12km  
 C) Less than 4km  
 D) Greater than 12km
- 25) Which of the following is not a vector quantity?  
 A) velocity  
 B) speed  
 C) acceleration  
 D) None are vector quantities.  
 E) All are vector quantities.
26. Which of the following is a not a vector quantity?  
 A) temperature  
 B) velocity  
 C) force  
 D) acceleration  
 E) momentum
- 27) A stone is thrown horizontally from the top of a cliff. Two seconds after it has left your hand, its vertical distance below the top of the cliff is  
 A) 20 m.  
 B) 40 m.  
 C) 80 m.
- 28) A projectile is launched vertically upward at 50 m/s. If air resistance is negligible, its speed upon returning to its starting point is  
 A) less than 50 m/s.  
 B) 50 m/s.  
 C) more than 50 m/s.
- 29) A bullet fired horizontally over level ground hits the ground in 0.5 second. If it had been fired with four times the speed in the same direction, it would have hit the ground in  
 A) 2.0s  
 B) 4.0s  
 C) 0.5 s.
- 30) A projectile is fired horizontally in a region of no air resistance. The projectile maintains its horizontal component of velocity because  
 A) it is not acted on by any forces.  
 B) it is not acted on by any horizontal forces.  
 C) it has no vertical component of velocity to begin with.  
 D) the net force acting on it is zero.  
 E) none of these
- 31) A gun with a muzzle velocity of 50 m/s is fired horizontally from a tower. Neglecting air resistance, how far downrange will the bullet be 1 second later?  
 A) 50 m  
 B) 98 m  
 C) 100 m  
 D) 490 m  
 E) none of these
- 32) A hunter on level ground fires a bullet at an angle of 10 degrees above the horizontal while simultaneously dropping another bullet from the level of the rifle. Which bullet will hit the ground first?  
 A) the dropped one  
 B) the fired one  
 C) Both hit at the same time.

33) A bullet fired horizontally over level ground hits the ground in 0.5 second. If it had been fired with twice the speed in the same direction, it would have hit the ground in

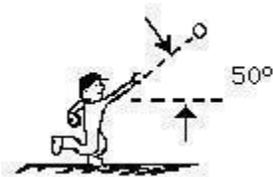
- A) less than 0.5 s.
- B) more than 0.5 s.
- C) 0.5 s.

34) A ball player wishes to determine pitching speed by throwing a ball horizontally from an elevation of 5 m above the ground. The player sees the ball land 25 m down range. What is the player's pitching speed?

- A) about 5 m/s
- B) about 10 m/s
- C) about 20 m/s
- D) about 25 m/s
- E) none of these

35) An airplane flies at 60 m/s at an altitude of 50 meters. The pilot drops a heavy package which falls to the ground. Where, approximately, does the package land relative to the plane's new position?

- A) beneath the plane
- B) 400 m behind the plane
- C) 600 m behind the plane
- D) more than 600 m behind the plane
- E) none of these



36) A rock is thrown upward at 50 degrees with respect to the horizontal. As it rises, neglecting air drag, its horizontal component of velocity

- A) increases.
- B) remains unchanged.
- C) decreases.

37) A catapult fires a projectile in an arcing path. As it rises, its vertical component of velocity

- A) decreases.
- B) remains constant.
- C) increases.

38) A kilogram is a measure of an object's

- A) weight.
- B) force.
- C) mass.
- D) size.

39) Compared to the mass of a certain object on Earth, the mass of the same object on the moon is

- A) one sixth as much.
- B) the same.
- C) six times as much.
- D) zero.

40) A 10-kg brick and a 1-kg book are dropped in a vacuum. The force of gravity on the 10-kg brick is

- A) the same as the force on the 1-kg book.
- B) 10 times as much.
- C) one-tenth as much.
- D) zero.

41) A rock weighs 20 N on the moon. A second rock weighs 20 N on the Earth. Which of the two rocks has the lesser mass?

- A) the one on Earth
- B) the one on the moon
- C) They have the same mass.
- D) not enough information to say

42) If an object's mass is decreasing while a constant force is applied to the object, the acceleration

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

43) An object is pulled northward by a force of 10 N and at the same time another force of 15 N pulls it southward. The magnitude of the resultant force on the object is

- A) 0 N.
- B) 5 N.
- C) 25 N.
- D) 150 N.

44) An apple weighs 1 N. When held at rest above your head, the net force on the apple is  
A) 0 N.  
B) 0.1 N.  
C) 1 N.  
D) 9.8 N.  
E) none of these

45) An object is propelled along a straight-line path by a force. If the net force quadrupled, the object's acceleration would be  
A) half as much.  
B) the same.  
C) twice as much.  
D) four times as much.  
E) none of these

46) An apple at rest weighs 1 N. The net force on the apple when it is in free fall is  
A) 0 N.  
B) -0.1 N.  
C) -1 N.  
D) -10 N.  
E) none of these

47) Whenever the net force on an object is zero, its acceleration  
A) may be less than zero.  
B) is zero.  
C) may be more than zero

48) The force of friction on a sliding object is -12 Newtons. The applied force needed to maintain a constant velocity is  
A) more than 12 N.  
B) less than 12 N.  
C) 12 N.

49) A heavy block at rest is suspended by a vertical rope. When the block is accelerated upward by the rope, the rope tension  
A) increases.  
B) decreases.  
C) remains the same.

50) A car has a mass of 750 kg and accelerates at 2 meters per second per second. What is the magnitude of the net force exerted on the car?  
A) 500 N  
B) 1000 N  
C) 1500 N  
D) 2000 N  
E) none of these

51) A girl pulls on a 10-kg wagon with a constant horizontal force of 30 N. If there are no other horizontal forces, what is the wagon's acceleration in meters per second per second?  
A) 0.3  
B) 3.0  
C) 10  
D) 30  
E) 300

52) For a space shuttle in free space to move at a constant velocity, the thrusters must apply a force which is:  
A) zero.  
B) equal to the mass of the object.  
C) equal to the weight of the object.  
D) equal to the force required to stop it.  
E) none of these

53) If the mass of an object does not change, a constant net force on the object produces constant  
A) velocity.  
B) acceleration.  
C) both of these  
D) neither of these

54) A 5-N block and a 1-N block lie on a horizontal frictionless table. To provide them with equal horizontal acceleration, we would have to push with  
A) equal forces on each block.  
B) 5 times as much force on the heavier block.  
C) 25 times as much force on the heavier block.  
D) 1/5 as much force on the heavier block.

55) Suppose a particle is being accelerated through space by a 10-N force. Suddenly the particle encounters a second force of 9 N in the opposite direction from the first force. The particle with both forces acting on it

- A) is brought to a rapid halt.
- B) decelerates gradually to a halt.
- C) continues at the speed it had when it encountered the second force.
- D) continues accelerating in the initial direction
- E) none of these

56) A player catches a ball. Consider the action force to be the impact of the ball against the player's glove. The reaction to this force is the

- A) player's grip on the glove.
- B) force the glove exerts on the ball.
- C) friction of the ground on the player's shoes.
- D) muscular effort in the player's arms.
- E) none of these

57) A 5-kg ball is thrown at 10 m/s straight upward. Neglecting air resistance, the net force that acts on the ball when it is halfway to the top of its path is about

- A) -5 N.
- B) -1 N.
- C) -50 N.
- D) -7.5 N.
- E) -10 N.

58) The attraction of a person's body toward Earth is called weight. The reaction to this force is

- A) the person's body pushing against Earth's surface.
- B) the Earth's surface pushing against the person's body.
- C) the person's body pulling on the Earth.
- D) none of these

59) A skydiver of mass 50 kg experiences air resistance of 200 N, and an acceleration of

- A) about 0.4 g.
- B) about 0.6 g.
- C) about 0.8 g.
- D) about 0.5 g.
- E) more than 0.8 g.

60) The force exerted on the tires of a car to directly accelerate it along a road is exerted by the

- A) engine.
- B) tires.
- C) air.
- D) road.
- E) none of these

61) A pitcher throws a baseball. Consider the action force to be the pitcher against the baseball. The reaction to this force is the

- A) baseball against the pitcher
- B) air resistance against the baseball
- C) friction of the ground against the pitcher's feet.
- D) Earth pulling down on the baseball
- E) baseball pulling up on the Earth

62) A vehicle that weighs 4000 N on the surface of the Earth is travelling in outer space at a velocity of -200 m/s. The smallest constant force that must be applied to stop it in 20 seconds is

- A) 20 N.
- B) 40 N.
- C) 400 N.
- D) 4000 N.
- E) more than 4000 N.

63) A baseball is thrown upwards and rises. The action force is the pull of Earth on the ball. The reaction force is the

- A) air resistance acting against the ball.
- B) acceleration of the ball.
- C) pull of the ball's mass on the Earth.
- D) none of these

64) A freight train rolls along a track with considerable momentum. If it rolls at the same speed but has twice as much mass, its momentum is

- A) zero.
- B) doubled.
- C) quadrupled.
- D) unchanged.

65) A rifle recoils while firing a bullet. The speed of the rifle's recoil is small because the  
A) force against the rifle is smaller than against the bullet.  
B) momentum is mainly concentrated in the bullet.  
C) rifle has much more mass than the bullet.  
D) momentum of the rifle is smaller.

66) Two objects have the same size and shape, but one is much heavier than the other. When they are dropped simultaneously from a tower, they reach the ground at the same time, but the heavier one has a greater  
A) speed.  
B) acceleration.  
C) momentum.  
D) all of these  
E) none of these

67) A heavy bowling ball strikes a light bowling pin. The force of impact is  
A) greater on the bowling ball.  
B) greater on the bowling pin.  
C) the same for both.

68) A 4 kg ball has a momentum of 12 kg m/s. What is the ball's speed?  
A) 3 m/s  
B) 4 m/s  
C) 12 m/s  
D) 48 m/s  
E) none of these

69) A tow truck exerts a force of 3000 N on a car, accelerating it at 3 meters per second per second. What is the mass of the car?  
A) 500 kg  
B) 1000 kg  
C) 1500 kg  
D) 3000 kg  
E) none of these

70) A ball is moving at 3 m/s and has a momentum of 48 kg m/s. What is the ball's mass?  
A) 4 kg  
B) 12 kg  
C) 16 kg  
D) 144 kg  
E) none of these

71) Two billiard balls having the same mass and speed roll toward each other. What is their combined momentum after they meet?  
A) 0  
B) half the sum of their original momentums  
C) twice the sum of their original momentums  
D) impossible to determine without additional information

72) The impulse-momentum relationship is a direct result of  
A)  $F = ma$   
B) Action and reaction forces  
C) the definition of inertial mass  
D) conservation of energy

73) A 1000-kg car moving at -10 m/s brakes to a stop in 5 s. The average braking force is  
A) 1000 N.  
B) 2000 N.  
C) 3000 N.  
D) 4000 N.  
E) 5000 N.

74) Uniform pads are used to cushion the strikes received by the players because, with the pads, the:  
A) force of impact is increased.  
B) relative velocity is less.  
C) time of impact is increased.  
D) time of impact is decreased.  
E) none of these

75) A 1-kg chunk of putty moving at 1 m/s collides with and sticks to a 5-kg bowling ball that is initially at rest on a frictionless surface. The speed of the putty thereafter is

- A) 1/4 m/s.
- B) 1/5 m/s.
- C) 1/6 m/s.
- D) impossible to solve with the information given.

76) If you stand on a skateboard at rest and then throw a bowling ball to the right, you will end up:

- A) moving right
- B) moving left
- C) remaining stationary

77) An astronaut, floating alone in outer space, throws a baseball. If the ball floats away at a speed of 20 meters per second, the astronaut will

- A) move in the opposite direction at a speed of 20 m/s.
- B) move in the opposite direction, but at a lower speed.
- C) move in the opposite direction but at a higher speed.
- D) not move as stated in any of the above choices.

78) The force that accelerates a water rocket comes from:

- A) the plastic casing of the rocket.
- B) rocket's wings.
- C) atmospheric pressure.
- D) the expelled water.
- E) none of these

79) Consider massive gliders that slide friction-free along a horizontal air track. Glider A has a mass of 1 kg, a speed of 1 m/s, and collides with Glider B that has a mass of 5 kg and is at rest. If they stick upon collision, their speed after collision will be

- A) 1/4 m/s.
- B) 1/5 m/s.
- C) 1/6 m/s.
- D) 1 m/s.
- E) none of these

80) A rifle of mass 2 kg is suspended by strings. The rifle fires a bullet of mass 0.02 kg at a velocity of 200 m/s. The recoil velocity of the rifle is about

- A) -0.002 m/s.
- B) -0.02 m/s.
- C) -0.2 m/s.
- D) -2 m/s.
- E) none of these

81) Two identical gliders slide toward each other on an air track. One moves at 1 m/s and the other at 2 m/s. They collide and stick. The combined mass moves at

- A) 1/2 m/s.
- B) 1/3 m/s.
- C) 1/6 m/s.
- D) 3/4 m/s.
- E) 1.5 m/s.

82) A heavy bowling ball strikes a light bowling pin. Which undergoes the greater change in momentum during the time of contact?

- A) the bowling ball
- B) the bowling pin
- C) both the same

83) A 5000-kg freight car moving at 2 m/s runs into a 10,000-kg freight car at rest. They couple upon collision and move away as one body at

- A) 2 m/s.
- B) 1 m/s.
- C) 2/3 m/s.
- D) 1/3 m/s.

84) A small cart moving forward with  $10\text{kg}\cdot\text{m/s}$  of momentum strikes and bounces backward off a large cart initially at rest and free to move. The large cart is set in motion with a momentum of

- A) less than  $10\text{kg}\cdot\text{m/s}$
- B) more than  $10\text{kg}\cdot\text{m/s}$
- C)  $10\text{kg}\cdot\text{m/s}$
- D) not enough information

85) A 1-kg glider and a 2-kg glider both slide toward each other at 3 m/s on an air track. They collide and stick. The combined mass moves at

- A) 0 m/s.
- B)  $1/2$  m/s
- C)  $1/3$  m/s.
- D) 1 m/s.
- E)  $3/2$  m/s.

86) A 5000-kg freight car runs into a 10,000-kg freight car at rest. They couple upon collision and move with a speed of 3 m/s. What was the initial speed of the 5000-kg car?

- A) 3 m/s
- B) 6 m/s
- C) 9 m/s
- D) 12 m/s
- E) none of these

87) The change in momentum, in  $\text{kg}\cdot\text{m/s}$ , that occurs when a 2.0 kg ball travelling at 4.0 m/s strikes a wall and bounces back at -2.0 m/s is

- A) -12.
- B) -4.
- C) -6.
- D) -8.

88) Do 100 J of work in 50 s and your power output is

- A)  $1/2$  W
- B) 2 W.
- C) 4 W.
- D) 50 W.
- E) 5,000 W.

89) If an object is raised twice as high, its potential energy will be

- A) half as much
- B) twice as much.
- C) four times as much.
- D) impossible to determine unless the time is given.

90) An object lifted 10 meters gains 200 J of potential energy. If the same object is lifted 20 meters, its potential energy gain is

- A) half as much.
- B) the same.
- C) twice as much.
- D) four times as much.
- E) more than four times as much.

91) An object that has kinetic energy must be

- A) moving.
- B) falling.
- C) at an elevated position.
- D) at rest.
- E) none of these

92) If you find that four times as much work is needed to perform a task but it takes twice as much time, the amount of power required is

- A) twice as much.
- B) four times as much.
- C) sixteen times as much.
- D) unchanged.

93) The ball rolling down an incline has its maximum potential energy at

- A) the top.
- B) a quarter of the way down.
- C) halfway down.
- D) the bottom.

94) A ball rolling down an incline has its maximum kinetic energy at

- A) the top.
- B) halfway down.
- C) three-quarters of the way down.
- D) the bottom.

95) A clerk can lift containers a vertical distance of 1 meter or can roll them up a 4 meter-long ramp to the same elevation. With the ramp, the applied force required is about

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

96) A 2-kg mass is held 4 m above the ground. What is the approximate potential energy of the mass with respect to the ground?

- A) 6 J
- B) 8 J
- C) 32 J
- D) 80 J
- E) none of these

97) A marble begins at rest at a height of 2.0m. When it has fallen to 1.0m, its kinetic energy is:

- A) less than its potential energy.
- B) greater than its potential energy.
- C) the same as its potential energy.
- D) impossible to determine.

98) A 2 kg mass has 40 J of potential energy with respect to the ground. Approximately how high is it above the ground?

- A) 1 m
- B) 2 m
- C) 3 m
- D) 4 m
- E) none of these

99) Two identical arrows, one with twice the kinetic energy of the other, are fired into a hay bale. The faster arrow will penetrate

- A) the same distance as the slower arrow.
- B) twice as far as the slower arrow.
- C) four times as far as the slower arrow.
- D) more than four times as far as the slower arrow.
- E) none of these

100) No work is done by gravity on the Earth as it orbits the sun because:

- A) no force acts on the Earth.
- B) no distance is covered by the Earth.
- C) the force on the Earth is at right angles to its motion.
- D) the mass of the sun remains constant
- E) the mass of the Earth remains constant

101) A car moves 4 times as fast as another identical car. Compared to the slower car, the faster car has

- A) 4 times the KE.
- B) 8 times the KE.
- C) 12 times the KE.
- D) 16 times the KE.

102) It takes 40 J to push a large box 8m across a floor. Assuming the push is in the same direction as the motion, what is the magnitude of the force on the box?

- A) 4 N
- B) 5N
- C) 40 N
- D) 10 N
- E) none of these

103) A ball is projected into the air with 100 J of kinetic energy which is transformed to gravitational potential energy at the top of its trajectory. When it returns to its original level after encountering air resistance, its kinetic energy is

- A) less than 100 J.
- B) more than 100 J.
- C) 100 J.
- D) not enough information given

104) Using 1000 J of work, a toy elevator is raised from the ground floor to the second floor in 50 seconds. The power needed to do this job was

- A) 20 W.
- B) 50 W.
- C) 100 W.
- D) 1000 W.
- E) 20,000 W.

105) If an object has kinetic energy, then it also must have

- A) impulse.
- B) momentum.
- C) acceleration.
- D) force.
- E) none of these

106) Which has greater kinetic energy, a car traveling at 20 km/hr or a car of half the mass traveling at 40 km/hr?

- A) the 20 km/hr car
- B) the 40 km/hr car
- C) Both have the same kinetic energy.
- D) More information is needed about the distance traveled.

107) If the speed of a moving object doubles, which of the following also doubles?

- A) momentum
- B) kinetic energy
- C) acceleration
- D) all of the above

108) A 3000-N pile-driver ram falls 10 m and drives a post 0.1 m into the ground. The average impact force on the ram is

- A) 3,000 N.
- B) 30,000 N.
- C) 300,000 N.
- D) 3,000,000 N.

109) Two identical arrows, one with three times the speed of the other, are fired into a hay bale.

The faster arrow will penetrate

- A) the same distance as the slower arrow.
- B) three times further than the slower arrow.
- C) six times further than the slower arrow.
- D) nine times further than the slower arrow.
- E) none of these

110) Neglecting air resistance, a man on a high ladder releases a ball which strikes the ground with 150 J of kinetic energy. If he were to throw it straight upward instead, it will eventually reach the ground with a kinetic energy of

- A) 150 J.
- B) more than 150 J.
- C) less than 150 J.

111) A catapult on wheels fires a projectile to the right. Compared to the catapult, the projectile has:

- A) a greater momentum.
- B) a greater kinetic energy.
- C) a smaller speed.
- D) all of the above

112) A very small cart rolls to the right, strikes a very large cart, and then bounces backwards to the left. After the collision, the small cart has:

- A) more momentum, but less kinetic energy.
- B) more kinetic energy, but less momentum.
- C) more momentum and more kinetic energy.
- D) less momentum and less kinetic energy.
- E) Not enough information is given to say.

113) A 1-kg ball dropped from a height of 2 m rebounds only 1.0 m after hitting the ground. The amount of energy converted to heat is about

- A) 5 J.
- B) 10 J.
- C) 15 J.
- D) 20 J.
- E) more than 20 J.

114) Newton's cradle consists of an aligned row of identical metal spheres that are suspended by strings. When three spheres are lifted from one end and released, they strike the row and three spheres pop out from the other end. If instead one sphere popped out with twice the speed of the two, this would be a violation of conservation of

- A) momentum.
- B) energy.
- C) both of these
- D) none of these

115) A moving object has

- A) speed.
- B) velocity.
- C) momentum.
- D) energy.
- E) all of these

116) When an object is in motion, which of the following could not have a value of zero?

- A) momentum
- B) kinetic energy
- C) mass
- D) inertia
- E) None of the above could be zero.

117) A heavy and a light object released from the same height in a vacuum have equal

- A) weights.
- B) momenta.
- C) kinetic energies.
- D) accelerations.
- E) none of the above

118) If a ping pong ball and a golf ball are both moving in the same direction with the same amount of kinetic energy, the speed of the ping pong ball must be

- A) less than the golf ball.
- B) more than the golf ball.
- C) the same as the golf ball.
- D) impossible to predict without additional information

119) Two identical freight cars roll without friction (one at 1 m/s, the other at 2 m/s) toward each other on a level track. They collide, couple together, and roll away in the direction that

- A) the slower car was initially going.
- B) the faster car was initially going.
- C) Neither of these. They stop.

120) Two 5000-kg passenger cars roll without friction (one at 1 m/s, the other at 2 m/s) toward each other on a level track. They collide, couple, and roll away together with a combined momentum of

- A) zero.
- B) 5000 kg m/s.
- C) 10,000 kg m/s.
- D) 15,000 kg m/s.

121) If several spheres are thrown straight up with varying initial velocities, the quantity that will have the same value for each trial is the sphere's

- A) initial momentum.
- B) maximum height.
- C) time of travel.
- D) acceleration.
- E) None of the above choices are correct.

122) A wave oscillates 60 times as it travels 30 meters in 2 seconds. Its frequency is

- A) 30 hertz and it travels at 15 m/s.
- B) 60 hertz and it travels at 30 m/s.
- C) 1800 hertz and it travels at 2 m/s.

123) A common source of wave motion is a

- A) wave pattern.
- B) harmonic object.
- C) vibrating object.
- D) region of variable high and low pressure.
- E) none of these

124) The vibrations of a transverse wave move in a direction

- A) along the direction of wave travel.
- B) at right angles to the direction of wave travel.
- C) that changes with speed.

- 125) The vibrations of a longitudinal wave move in a direction
- A) along the direction of wave travel.
  - B) at right angles to the direction of wave travel.
  - C) that changes with speed.

- 126) A standing wave can occur when
- A) two individuals send waves down from opposite ends of a long slinky
  - B) a tuning fork is held above an air column
  - C) one individual sends waves down a long slinky and they reflect from a fixed boundary
  - D) all of the above

- 127) The frequency of a simple pendulum depends on
- A) its mass.
  - B) its length.
  - C) the acceleration due to gravity.
  - D) all of these
  - E) two of these

- 128) If the frequency of a certain wave is 10 hertz, its period is
- A) 0.1 seconds.
  - B) 10 seconds.
  - C) 100 seconds.
  - D) None of the above choices are correct.

- 129) A floating leaf oscillates up and down four complete cycles in one second as a water wave passes by. The wave's wavelength is 10 meters. What is the wave's speed?
- A) 2 m/s
  - B) 10 m/s
  - C) 20 m/s
  - D) 40 m/s
  - E) more than 40 m/s

- 130) An object that completes 10 vibrations in 20 seconds has a frequency of
- A) 0.5 hertz.
  - B) 2 hertz.
  - C) 200 hertz.



- 131) A weight suspended from a spring bobs up and down over a distance of 1 meter in two seconds. Its frequency is
- A) 0.5 hertz.
  - B) 1 hertz.
  - C) 2 hertz.
  - D) None of the above choices are correct.

- 132) As a train of water waves goes by, a piece of cork floating on the water bobs up and down two complete cycles each second. The waves are 2 meters long. What is the speed of the wave?
- A) 0.25 m/s
  - B) 0.50 m/s
  - C) 1.0 m/s
  - D) 2 m/s
  - E) 4 m/s

- 133) The pendulum with the lowest frequency is the pendulum with the
- A) shortest period.
  - B) shortest length.
  - C) shortest amplitude.
  - D) greatest length

- 134) A tuning fork of frequency 200 hertz will resonate if a sound wave incident on it has a frequency of
- A) 50 hertz.
  - B) 600 hertz.
  - C) either of 50 hertz or 600 hertz.
  - D) neither 50 hertz nor 600 hertz.

135) At a concert the oboe is playing a long steady note as you walk towards the stage at an increasing velocity. The pitch of the sound that you hear is

- A) steady but higher than normal.
- B) steady but lower than normal.
- C) continually decreasing.
- D) continually increasing.
- E) None of the above choices are correct.

136) Volumes of high and low particle density are characteristic of:

- A) longitudinal waves.
- B) transverse waves.
- C) both longitudinal and transverse waves.
- D) none of the above.

137) The frequency of the second hand on a clock is

- A) 1 hertz.
- B) 1/60 hertz.
- C) 60 hertz.

138) The period of the second hand on a clock is

- A) 1 second.
- B) 1/60 second.
- C) 60 seconds.
- D) 3600 seconds.
- E) 12 hours.

139) To change the frequency at which an object resonates, one can change its:

- A) size, shape, or elasticity.
- B) size or shape.
- C) size or elasticity.
- D) shape or elasticity.

140) When 440Hz and 442Hz tuning forks are played simultaneously, the beat frequency arises because of:

- A) refraction.
- B) reflection.
- C) interference.

- D) all of these
- E) none of these

141) A 1056-hertz tuning fork is sounded at the same time a piano note is struck. You hear four beats per second. What is the frequency of the piano string?

- A) not enough information to be certain
- B) 1060 hertz
- C) 1052 hertz
- D) 1056 hertz
- E) two of the above are possible

142) On a balanced seesaw, a boy three times lighter than his partner sits

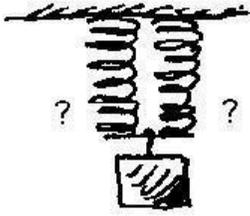
- A) 3 times the distance from the fulcrum.
- B) 1/3 the distance from the fulcrum.
- C) more than 3 times the distance from the fulcrum.

143) A stone in a slingshot is whirled in a circle with constant speed. The net force on the stone is

- A) directed forward, in the direction of travel.
- B) directed toward the center of the circle.
- C) zero because the car is not accelerating.
- D) directed outward from the center of the circle

144) A strong spring is stretched 10 cm by a suspended weight. If the weight is tripled, the spring will stretch

- A) no more.
- B) another 10 cm, making the total stretch 20 cm.
- C) another 20 cm, making the total stretch 30 cm.
- D) another 30 cm, making the total stretch 40 cm.
- E) more than another 30 cm.



145) A spring is stretched 5 cm by a suspended 2-kg block. If two such springs side-by-side are used to suspend the block, so each spring supports half the weight of the block, then each spring will stretch

- A) 5 cm.
- B) 10 cm.
- C) 20 cm.
- D) 30 cm.
- E) none of these

146) The buoyant force on a stone sinking underwater is:

- A) equal to the weight of the stone
- B) equal to the weight of liquid displaced.
- C) equal to the pressure on the stone
- E) none of these

147) Water pressure is greatest against the

- A) top of a submerged object.
- B) bottom of a submerged object.
- C) sides of a submerged object.
- D) is the same against all surfaces
- E) none of these

148) When holes are drilled through the wall of a water tower, water will spurt out the least horizontal distance from the hole closest to

- A) the bottom of the tower.
- B) the middle of the tower.
- C) the top of the tower.
- D) The horizontal distance will be the same for all holes.

149) The pressure in a liquid depends on liquid

- A) density.
- B) depth.
- C) both of these
- D) neither of these

150) A rock suspended by a string weighs 5 N out of water and 2 N when submerged. What is the buoyant force on the rock?

- A) 8 N
- B) 5 N
- C) 3 N
- D) 2 N
- E) none of these

151) Pumice is a volcanic rock that floats. Its density is

- A) less than the density of water.
- B) equal to the density of water.
- C) more than the density of water.

152) Compared to an empty ship, the same ship loaded with Styrofoam will float

- A) higher in the water.
- B) lower in the water.
- C) at the same level in the water.

153) When gas in a container is squeezed to one-fourth its volume, its density

- A) halves.
- B) doubles.
- C) quadruples.
- D) remains the same.

154) Consider a closed, sealed can of air placed on a hot stove. The contained air undergoes an increase in

- A) mass.
- B) pressure.
- C) temperature.
- D) all of these
- E) two of these

155) When gas in a container is squeezed to half its volume and the temperature doubles, the gas pressure

- A) halves.
- B) doubles.
- C) quadruples.
- D) remains the same.

156) Aluminum has a specific heat capacity more than twice that of copper. Place equal masses of aluminum and copper wire in a flame and the one to undergo the fastest increase in temperature will be

- A) copper.
- B) aluminum.
- C) both the same

157) One hundred joules of heat is added to a system that performs 40 joules of work. The internal energy change of the system is

- A) 0 J.
- B) 40 J.
- C) 60 J.
- D) 100 J.
- E) None of the above choices are correct.

158) In an electrically neutral atom the number of protons in the nucleus is equal to the number of

- A) electrons that surround the nucleus.
- B) neutrons in the nucleus.
- C) Choices A and B are both correct.
- D) Choices A and B are both incorrect.

159) A positive ion has more

- A) electrons than neutrons.
- B) electrons than protons.
- C) protons than electrons.
- D) protons than neutrons.
- E) neutrons than protons.

160) The electrical force between charges is weakest when the charges are

- A) close together.
- B) far apart.
- C) The electric force is constant everywhere.

161) Strip electrons from an atom and the atom becomes a

- A) positive ion.
- B) negative ion.
- C) different element.
- D) molecule.

162) Two charged particles held close to each other are released. As they move, the force on each particle decreases. Therefore, the particles must have

- A) the same sign.
- B) opposite signs.
- C) the same mass.
- D) the same size.
- E) impossible to answer without additional information

163) An Ohm is a unit of electrical

- A) pressure.
- B) current.
- C) resistance.
- D) all of these
- E) none of these

164) A coulomb of charge that passes through a 9-volt battery is given

- A) 9 joules.
- B) 9 amperes.
- C) 9 ohms.
- D) 9 watts.
- E) 9 Newtons.

165) The electric power of a lamp that carries 2 A at 120 V is

- A) 1/6 watts.
- B) 2 watts.
- C) 60 watts.
- D) 20 watts.
- E) 240 watts.

166) The current through a 10-ohm resistor connected to a 100-V power supply is

- A) 1 A.
- B) 10 A.
- C) 12 A.
- D) 120 A.
- E) none of these

167) When two lamps are connected in parallel to a battery, the electrical resistance that the battery senses is

- A) more than the resistance of either lamp.
- B) less than the resistance of either lamp.
- C) none of these

168) When two lamps are connected in series to a battery, the electrical resistance that the battery senses is

- A) more than the resistance of either lamp.
- B) less than the resistance of either lamp.
- C) none of these

169) A 10-ohm resistor has a 2-A current in it. What is the voltage across the resistor?

- A) -5 V
- B) -10 V
- C) -15 V
- D) -20 V
- E) more than -20 V

170) On some early automobiles both headlights went out when one bulb burned out. The headlights must have been connected in

- A) parallel.
- B) perpendicular.
- C) series.

171) When a 20-V battery is connected to a resistor, the current in the resistor is 2 A. What is the resistor's value?

- A) 2 ohms
- B) 5 ohms
- C) 10 ohms
- D) 20 ohms
- E) more than 20 ohms

172) In a 110-volt circuit containing a lamp in series with the voltage source

- A) 110 coulombs of charge flow through the lamp every second.
- B) 110 joules of energy are converted to heat and light in the circuit every second.
- C) 110 joules of energy are given up by each coulomb of charge making up the current in the circuit.
- D) 110 joules of energy are shared among all the coulombs in the circuit at any instant.
- E) none of the above

173) When a 60-watt light bulb is connected to a 240-volt source the current in the light bulb is

- A) 0.25 A.
- B) 0.5 A.
- C) 2 A.
- D) 4 A.
- E) more than 4 A.

174) As more lamps are put into a series circuit, the overall current in the power source

- A) increases.
- B) decreases.
- C) stays the same.

175) As more lamps are put into a parallel circuit, the overall current in the power source

- A) increases.
- B) decreases.
- C) stays the same.

176) An iron nail is more strongly attracted to the

- A) north pole of a magnet.
- B) south pole of a magnet.
- C) north or south pole – no difference really.

177) When a positive charge moves to the right in a magnetic field pointed into the page, the force on the charge is:

- A) upward
- B) downward
- C) leftward
- D) out of the page

178) Compared to the force that attracts an iron tack to a strong magnet, the force that the tack exerts on the magnet is

- A) smaller
- B) the same
- C) larger

179) Which force field can increase a moving electron's speed?

- A) only an electric field
- B) only a magnetic field
- C) either an electric or magnetic field
- D) none of these

180) When the north poles of two magnets are placed together, they:

- A) will attract
- B) will repel
- C) may attract or repel

181) Which pole of a compass needle points to a north pole of a magnet?

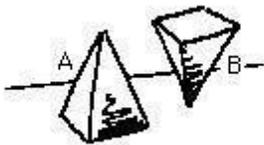
- A) north pole
- B) south pole
- C) both of these

182) Magnet A has twice the magnetic field strength of Magnet B and at a certain distance pulls on magnet B with a force of 50 N. The amount of force that magnet A exerts on magnet B is

- A) at or about 25 N.
- B) exactly 50 N.
- C) More information is needed.

183) Magnetic field lines point:

- A) away from a magnet's north pole
- B) away from a magnet's south pole
- C) either way



184) Which of the two identical pyramids is exerting the least pressure on the floor?

- A
- B
- C) both the same

185) The reason for this is that

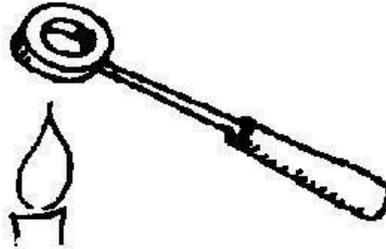
- A) they both have the same weight.
- B) the heaviest part of the pyramid is closer to the floor.
- C) the weight is distributed over a smaller area.
- D) the weight is distributed over a larger area.

186) A scuba diver rises towards the surface of the sea. As he rises, the buoyant force

- A) increases.
- B) decreases.
- C) stays the same

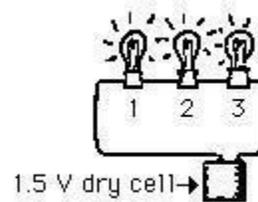
187) Which experiences a greater buoyant force?

- A) a 10 cm<sup>3</sup> steel sphere underwater
- B) a 100 cm<sup>3</sup> balloon underwater
- C) both



188) An iron ring is heated and expands. As it cools, the hole inside becomes:

- A) smaller,
- B) larger,
- C) neither smaller nor larger,

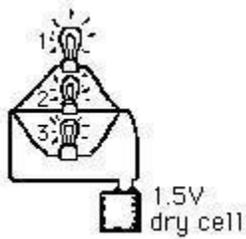


189) Refer to the figure above. If the current in lamp 2 is one ampere, then the current in lamp 3 is

- A) 1/2 ampere,
- B) 1/3 ampere,
- C) 1 ampere,
- D) 2 amperes,

190) The total circuit current (in the same dry cell) is

- A) 2 ampere
- B) 1 ampere.
- C) 3 ampere.
- D) 4 ampere.
- E) 6 amperes.



191) Refer to the figure above, where all bulbs are the same. If the current in lamp 1 is one ampere, then the current in lamp 2 is

- A)  $1/2$  A
- B)  $1/3$  A
- C) 1 A
- D) 2 A
- E) 3 A

192) The voltage across lamp 2 is

- A)  $-1/2$  V.
- B)  $-1/3$  V.
- C) -1 V.
- D) -1.5 V.
- E) -3 V.



193) Two vases of different shapes each contain a goldfish. In the position shown, the fish that will feel the lower pressure is

- A
- B
- C) both experience the same pressure

194) A car increases its speed from 60 to 65 miles per hour in the same time that a bicycle increases its speed from rest to 5 miles per hour. In this case the acceleration is

- A) greater for the car,
- B) greater for the bicycle,
- C) the same for each,

195) The tendency of objects to resist a change in motion is called

- A) friction,
- B) velocity,
- C) inertia,

- D) acceleration,
- E) gravity,

196) This is measured by its

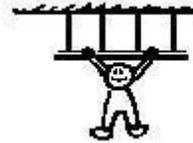
- A) speed.
- B) velocity.
- C) mass.
- D) all of these.

197) In the absence of air resistance, a boulder and a pebble dropped from rest will fall with equal

- A) momenta.
- B) accelerations.
- C) kinetic energies.
- D) all these.

198) Which of the following has the greater weight?

- A) 1 kilogram of gold
- B) 1 kilogram of feathers
- C) both weigh the same in the same locality



199) If an 800-N man hangs motionless from four vertical strands of rope, then the tension in each strand of rope is

- A) 0 N
- B) 200 N
- C) 400 N
- D) 800 N

200) This results in a net force on the man of

- A) 0 N.
- B) 200 N.
- C) 400 N.
- D) 800 N.