

FINAL TEST REVIEW

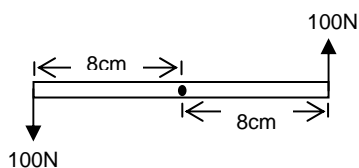
- MULTIPLE CHOICE -

Answer each question with the one best possible answer. Calculators are not allowed on this portion of the test. On all questions requiring numerical calculations, use $g = 10\text{m/s}^2$ to simplify calculations.

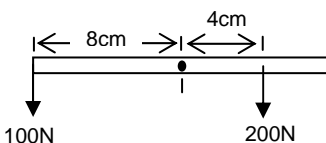
- What is the magnitude of the velocity after 1.5 seconds of a ball thrown upward from a height of 5m at 40m/s?
 - 15m/s
 - 20m/s
 - 25m/s
 - 30m/s
 - 35m/s
- For an object that travels 20km north and then 15km south, what is the ratio of the distance traveled to the displacement?
 - 0
 - 1/7
 - 1
 - 7
 - 35
- Two vectors **A** and **B** are perpendicular to one another. The magnitude of the vector sum of these two vectors...
 - is less than the magnitude of A plus the magnitude of B.
 - is greater than the magnitude of A plus the magnitude of B.
 - is equal to the magnitude of A plus the magnitude of B.
 - is equal to zero.
 - could be any of the above answers, depending on the exact values of **A** and **B**.
- At its maximum height, the vertical component of velocity for an object projected at 9.8m/s at a 60° angle above the horizontal is most nearly...
 - 9.8m/s
 - 4.9m/s
 - 0m/s
 - 4.9m/s
 - 9.8m/s
- What is the orbital speed of a satellite of mass m orbiting the earth at a distance r from the center of the Earth? (Assume that G stands for the gravitational constant and M stands for the Earth's mass.)
 - $\frac{GM}{r}$
 - $\sqrt{\frac{2GM}{r}}$
 - $\frac{2Gm}{r}$
 - $\sqrt{\frac{2Gm}{r}}$
 - $\sqrt{\frac{GM}{r}}$
- A child has a toy tied to the end of a string and whirls the toy above his head at a constant speed in a horizontal circular path of radius R . The toy completes each revolution of its motion in a time period T . What is the magnitude of the acceleration of the toy?
 - Zero
 - $\frac{4\pi^2 R}{T^2}$
 - $\frac{\pi R}{T^2}$
 - g
 - $2\pi g$

7. Three balls are projected from the edge of a cliff. Ball I is fired horizontally, ball II is fired at an angle of 30° above the horizontal with the same speed as ball I, and ball III is released from rest. Which one of the following is true?
- I and II hit at the same time, and III hits later.
 - I and II hit at the same time, and III hits earlier.
 - I and III hit at the same time, and II hits later.
 - I and III hit at the same time, and II hits earlier.
 - All three balls hit at the same time.
8. A hydraulic jack is going to be used to jack a 1000kg car up off of the ground. The radius of the input piston is 2cm, and the radius of the output piston is 10cm. What input force is necessary?
- 40N
 - 400N
 - 2,000N
 - 4,000N
 - 250,000N
9. A man fills a 5000cm^3 bucket with water from a hose with a cross-sectional area of 2cm^2 . If the bucket completely fills in 100s, at what speed must water be exiting the hose?
- 2.5cm/s
 - 5cm/s
 - 10cm/s
 - 25cm/s
 - 50cm/s
10. An object has a mass M , and appears to have a mass M_{app} when submerged in a fluid of density D_f . The density of this object is...
- $\frac{MD_f}{M - M_{\text{app}}}$
 - $\frac{M - M_{\text{app}}}{D_f}$
 - $(M - M_{\text{app}})(D_f)$
 - $\frac{MD_f}{M_{\text{app}}}$
 - $\frac{M_{\text{app}}D_f}{M}$
11. A rock is thrown horizontally off a building. The speed of the rock as it leaves the thrower's hand at the edge of the building is v_0 . It takes an amount of time, t , to travel from the edge of the building to the ground. How far from the side of the building, measured horizontally, does the rock land?
- $v_0t - \frac{g}{2}t^2$
 - $-\frac{g}{2}t^2$
 - v_0t
 - $t\sqrt{gv_0^{14}}$
12. An object is thrown straight upward. Which of the following are the correct signs of the velocity and acceleration vectors at the moment the object is at its highest point?
- | | <u>Velocity</u> | <u>Acceleration</u> |
|----|-----------------|---------------------|
| a. | + | - |
| b. | + | 0 |
| c. | - | 0 |
| d. | 0 | - |
| e. | 0 | 0 |
13. A spacecraft has one engine at its tail, which can propel it forward at 400m/s, as well as stabilizing engines on either side, each of which can propel the craft at 300m/s perpendicular to the direction of the tail engine's propulsion. If one of the side engines and the rear engine are simultaneously operating, at what angle will the craft travel relative to forward?
- 30°
 - 37°
 - 45°
 - 53°
 - 60°

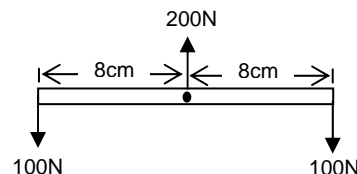
14. In a traditional coordinate system, if an object is slowing down while moving to the left, it is said to have a _____ acceleration and a _____ velocity.
- a. positive, positive b. negative, positive
c. positive, negative d. negative, negative
15. Which of the following objects is in static equilibrium? (Assume the indicated forces are the only forces acting on the objects. The point marked with a dot in the middle of the object denotes the center of gravity for each object.)



Object 1



Object 2

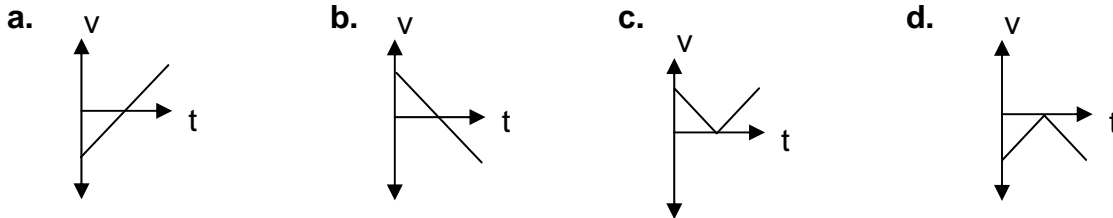


Object 3

- a. Object 1 only b. Object 2 only c. Object 3 only
d. Objects 2 and 3 e. Objects 1, 2, and 3
16. Which of the following objects is in static equilibrium?
- Object 1:** A uniform teeter-totter with its fulcrum in its center, with equally-weighted children at its far ends.
- Object 2:** A merry-go-round slowing down under the action of friction.
- Object 3:** A kickball that was initially kicked directly upward, now stopped momentarily at the highest point of its trajectory.
- a. Object 1 only b. Object 2 only c. Object 3 only
d. Objects 1, 2, and 3 e. None of the objects
17. A ball is launched horizontally off a building. The speed of the ball as it leaves the launcher at the edge of the building is V . It takes an amount of time, T , to travel from the edge of the building to the ground. What is the height of the building?
- a. VT b. $VT - \frac{g}{2}T^2$ c. $-VT - \frac{g}{2}T^2$ d. $\frac{g}{2}T^2$
18. Which scientist's theories formed the basis for nearly all physics until Einstein's theories were developed in the 20th century? (This scientist is also considered by many to be one of the most influential people of all time.)
- a. Newton b. Galileo c. Aristotle d. Copernicus
19. Three forces act on an object. If the object is in translational equilibrium, which of the following must be true?
- I. The vector sum of the three forces must equal zero.
II. The magnitudes of the three forces must all be equal.
III. All three forces must be parallel.
- a. I only b. II only c. I and III only d. II and III only e. I, II, and III



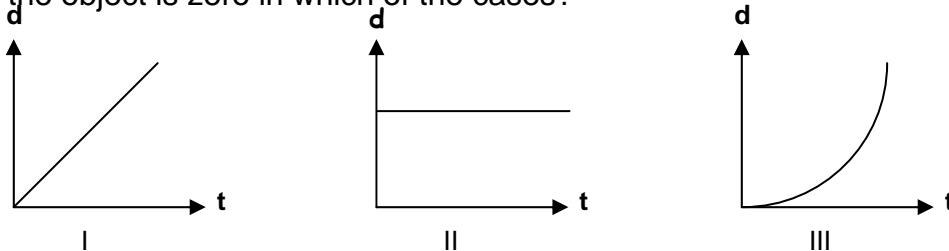
20. A cart is given an initial velocity to the left on an inclined ramp, as shown above. Taking the cart's initial direction to be negative (and disregarding friction), which of the following graphs best represents the cart's motion from the time it is given the initial velocity until it returns to its original location?



21. Ball 1 is thrown straight upward from the edge of the top of a building. At the moment that ball 1 is back to its original height, ball 2 is dropped to fall from the same height as ball 1 is at. Disregarding air resistance, which of the following statements is true about the balls hitting the ground below?

- Ball 1 hits the ground before ball 2.
- Ball 2 hits the ground before ball 1.
- Both balls hit at the same time.
- The answer is dependent on the initial upward velocity of ball 1.

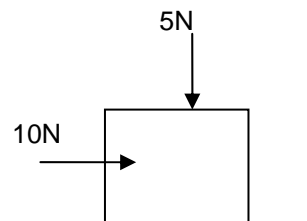
22. Three objects can only move along a straight, level path. The graphs below show the position d of the objects plotted as a function of time t . The sum of the forces on the object is zero in which of the cases?



- II only
- III only
- I and II only
- I and III only
- I, II, and III

23. A 2kg block slides with constant velocity along a horizontal tabletop. A horizontal applied force of 10N and a downward applied force of 5N act on the block, as shown. The coefficient of friction between the block and tabletop is most nearly...

- 0.3
- 0.4
- 0.5
- 0.75
- 1

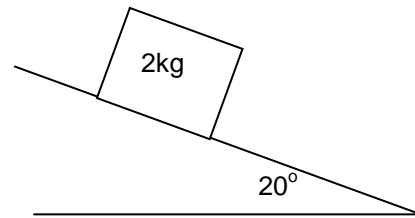


24. Which of the following is Newton's third law?

- $\sum F = ma$
- A falling object will accelerate at 9.8 m/s^2 in the downward direction.
- An object at rest will stay at rest and an object in motion will stay in motion until the object is acted upon by a net external force.
- For every action there is an equal and opposite reaction.

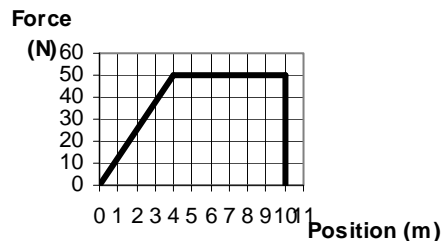
25. A 2kg object is released to slide down a 20° incline. If the coefficient of kinetic friction between the object and incline is 0.4, the object will accelerate down the incline at a rate of...

- a. $(0.4)(2g)$
 b. $\frac{(0.4)(2g)}{2}$
 c. $\frac{(0.4)(2g)(\cos 20^\circ)}{2}$
 d. $\frac{(2g)(\sin 20^\circ) - (0.4)(2g)(\cos 20^\circ)}{2}$
 e. $\frac{(0.4)(2g)(\cos 20^\circ) - (2g)(\sin 20^\circ)}{2}$



26. The only force acting on an 8kg object varies as shown in the given graph. Determine the work done by this force to move the object from $x=0\text{m}$ to $x=10\text{m}$.

- a. zero
 b. 50J
 c. 300J
 d. 400J
 e. 500J



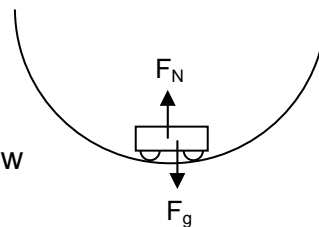
27. Assuming it started from rest at position 0m, the speed of the 8kg object in problem #26 at the end of the 10m displacement is closest to which one of the following?
 a. zero b. 2m/s c. 5m/s d. 7.1m/s e. 10m/s

28. A child has a toy tied to the end of a string, and whirls the toy above his head at a constant speed in a horizontal circular path of radius 4m. If the toy completes each revolution of its motion in a time of 2s, what is the magnitude of the acceleration of the toy?

- a. 2π b. 4π c. $4\pi^2$ d. 16π e. $16\pi^2$

29. A roller-coaster-car is at the very bottom of a semi-circular piece of track. If the coaster-car is moving at a constant speed, which of the following statements must be true about the object's weight (F_g) and the normal force (F_N) of the track pushing on the coaster-car ?

- a. $F_g = F_N$
 b. $F_g > F_N$
 c. $F_g < F_N$
 d. There is not enough information given to know the relationship between the two forces.



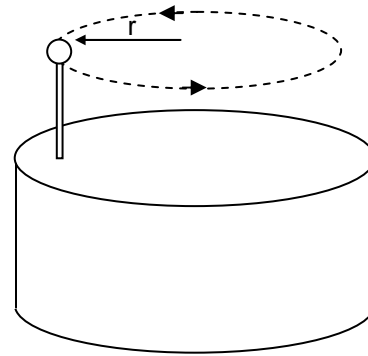
Note: Forces are not drawn to scale.

30. What is the weight of a 50kg object on a planet that has the same mass as the Earth, but one half the radius of the Earth?

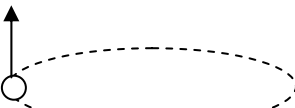
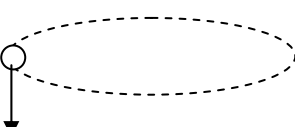

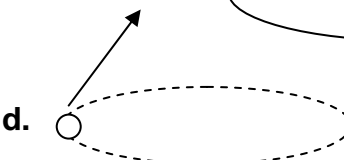
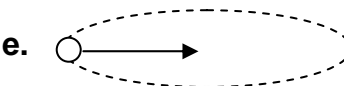
- a. 125N b. 250N c. 500N d. 1000N e. 2000N

Questions 31 and 32:

A steel ball supported by a stick is attached to a rotating cylinder, and itself rotates in a circle of radius r , as shown.



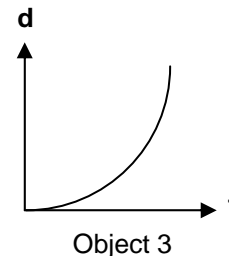
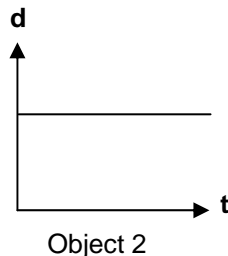
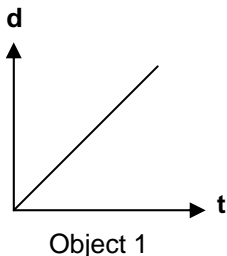
31. The direction of the net force acting on the ball when it is in the position shown is indicated by which of the following?

- a. 
- b. 
- c. 
- d. 
- e. 

32. If the ball becomes disconnected from its supporting stick at the position shown in the diagram above, it will become a projectile with an initial velocity in which direction?

- a. straight upward
 b. straight downward
 c. out of the plane of the page
 d. to the right
 e. to the left

33. Three objects can only move along a straight horizontal path. The graphs below show the position d of the objects plotted as a function of time t . For which object(s) is the magnitude of its momentum increasing?



- a. Object 1 only
 b. Object 2 only
 c. Object 3 only
 d. Objects 1 and 2
 e. Objects 1 and 3

34. For the same graphs as in problem #33, for which object(s) is the net work on the object equal to zero during the given time interval?

- a. Object 1 only
 b. Object 2 only
 c. Object 3 only
 d. Objects 1 and 2
 e. Objects 1 and 3

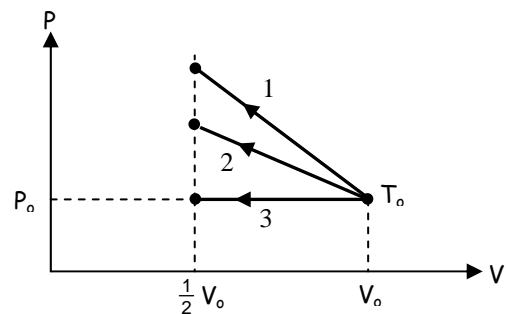
35. A simple pendulum and a mass hanging on a spring both have a period of 1s when set into small oscillatory motion on Earth. They are taken to Planet X, which has the same diameter as Earth but twice the mass. Which of the following statements is true about the periods of the two objects on Planet X compared to their periods on Earth?
- Both are shorter.
 - Both are the same.
 - Both are longer.
 - The period of the mass on the spring is shorter; that of the pendulum is the same.
 - The period of the pendulum is shorter; that of the mass on the spring is the same.

36. A certain pipe that is closed at one end has a length of 4m and plays its fundamental frequency at 100Hz. What is the wavelength of the wave in the pipe?
- 4m
 - 16m
 - 25m
 - 160m
 - 250m

37. For a vibrating object (or a wave), which of the following is defined as the number of cycles or vibrations per unit of time?
- Amplitude
 - Period
 - Frequency
 - Wavelength
 - Harmonic

38. A certain quantity of an ideal gas initially at temperature T_0 , pressure P_0 , and volume V_0 is compressed to one-half its initial volume. As shown in the graph, the process may happen in several different manners, as represented by the three different lines on the graph. Which of the following is true of the final temperature of this gas?

- It is greatest for process 1.
- It is greatest for process 2.
- It is greatest for process 3.
- It is the same for processes 1 and 2.
- It is the same for processes 1 and 3.



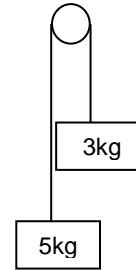
39. For the same graph as in problem #38, which of the following is true of the magnitude of the mechanical work done on the gas?
- It is greatest for process 1.
 - It is greatest for process 3.
 - It is the same for processes 1 and 2.
 - It is the same for processes 1 and 3.
 - It is the same for all three processes.

40. A man is walking to the north and hears a sound from the siren on a passing ambulance that speeds by him. At some particular moment, he observes a higher frequency than the one the ambulance is actually producing. This could be because the ambulance is moving to the _____ and is presently (at the particular moment) to the _____ of the man.
- north, north
 - north, south
 - south, north
- I only
 - II only
 - III only
 - I and II
 - II and III

41. A 10kg mass is attached to a string of length 40m, and hung down from a rooftop to make a long pendulum. If the pendulum is set into simple harmonic motion, what is its period of vibration?
- a. $\pi/2$ seconds b. π seconds c. 2π seconds
d. 4π seconds e. 8π seconds
42. A mass attached to a spring is vibrating with simple harmonic motion according to the following equation: $x = (0.4)\cos(8\pi t)$
Assuming all quantities are measured in S.I. units, what is the period of vibration of the mass?
- a. 0.25s b. 0.4s c. 2s d. 4s e. 8s
43. During a certain thermodynamic process, a gas with a fixed number of molecules does 4000J of work on its surroundings, and its internal energy decreases from 7000J to 5000J. The process described is...
- a. an isothermal process. b. an adiabatic process.
c. an isovolumetric process. d. no special type of process.
e. a physically impossible process.
44. Which of the following is the method of heat transfer that happens when the warm air directly above a candle rises to higher parts of the room, taking heat energy with it?
- a. Conduction b. Radiation c. Constriction
d. Convection e. Compression
45. According to the first law of thermodynamics, what are the two possible ways to cause an increase in the internal energy of a system?
- a. Transfer heat to the system, and let the system do work on its surroundings.
b. Transfer heat to the system, and do work on the system.
c. Transfer heat from the system, and do work on the system.
d. Transfer heat from the system, and let the system do work on its surroundings.
46. Which law of thermodynamics has to do with the concept of entropy?
- a. 0th b. 1st c. 2nd d. 3rd
47. The pressure on an ideal gas is cut in half, resulting in a decrease in temperature to three-fourths of the original value. Calculate the ratio of the final volume to the initial volume of the gas, $\frac{V_{\text{final}}}{V_{\text{initial}}}$.
- a. 3/8 b. 6/1 c. 1/6 d. 3/2 e. 2/3
48. In what direction do centripetal forces always point?
- a. Toward the center of a circular path.
b. Outward from the center of a circular path.
c. Tangent to a circular path.
d. In a direction between center and tangent to a circular path.
e. Always towards Mr. Smith, because he's the center of the physics universe.

49. The pulley-system shown in the diagram is released from rest. Which one of the following equations about the acceleration of the pulley-system is true? Assume the pulley is frictionless, and that the masses of the pulley and rope are negligible. T stands for the tension in the rope.

- a. $5g - 3g = 3a$
 b. $5g - T = 5a$
 c. $5g - 3g - T = 8a$
 d. $5g - 3g - T = 5a$
 e. $T - 3g = 8a$

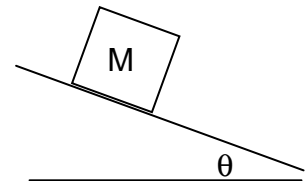


50. A 5kg block is supported by a rope of negligible mass. What tension force in the rope would be necessary to give the block an upward acceleration of 2m/s^2 ?
- a. 2N b. 10N c. 15N d. 50N e. 60N

51. Which of the following is equal to 1 Newton of force?

- a. $1 \frac{\text{m}^2}{\text{s}^2}$ b. $1 \frac{\text{kg} \cdot \text{m}^2}{\text{s}^2}$ c. $1 \frac{\text{kg} \cdot \text{m}}{\text{s}^2}$ d. $1 \frac{\text{kg} \cdot \text{m}}{\text{s}}$

52. An object of mass M is sliding down a ramp of inclined at an angle θ from the horizontal. What must be the coefficient of kinetic friction between the block and incline, if the block is sliding down the incline at a constant speed?



- a. $Mg \sin \theta$ b. $Mg \frac{\cos \theta}{\sin \theta}$ c. $Mg \frac{\sin \theta}{\cos \theta}$ d. $\frac{\sin \theta}{\cos \theta}$ e. $\frac{\cos \theta}{\sin \theta}$

53. Two objects, A and B, initially at rest, are “exploded” apart by the release of a coiled spring that was compressed between them. As they move apart, the velocity of object A is 5m/s and the velocity of object B is -2m/s . The ratio of the mass of A to the mass of B, m_A/m_B , is...

- a. $4/25$ b. $2/5$ c. $1/1$ d. $5/2$ e. $25/4$

54. A railroad car of mass m , moving at a speed v , collides with a second railroad car of mass M which is at rest. The two cars lock together and move along the track. What is the speed of the cars immediately after the collision?

- a. $\frac{v}{2}$ b. $\frac{(m+M)}{v}$ c. $\frac{mv}{M}$ d. $\frac{mv}{(m+M)}$ e. $\frac{Mv}{m}$

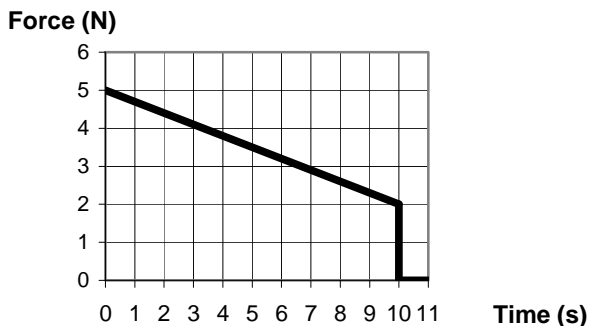
55. A solid metal ball and a hollow plastic ball of the same external radius are released from rest in a large vacuum chamber. When each has fallen 1m , they both have the same...

- a. inertia b. speed c. momentum d. KE e. change in PE

56. A rope of negligible mass supports a block that weighs 30N . The breaking strength of the rope is 50N . The largest acceleration that can be given to the block by pulling up on it with the rope without breaking the rope is most nearly...

- a. 6m/s^2 b. 6.7m/s^2 c. 10m/s^2 d. 15m/s^2 e. 16.7m/s^2

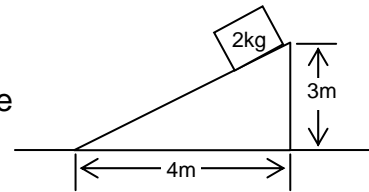
57. A wandering dog walks 30m at 40° S of E, and then another 20m at 30° N of E. The horizontal (eastern) component of the dog's resultant displacement can best be found in which one of the following ways?
- $20\sin 30^\circ + 30\sin 40^\circ$
 - $20\cos 30^\circ + 30\cos 40^\circ$
 - $20\sin 30^\circ - 30\sin 40^\circ$
 - $20\cos 30^\circ - 30\cos 40^\circ$
58. A new planet is discovered that has twice the Earth's mass and twice the Earth's radius. On the surface of this new planet, a person who weighs 500N on Earth would experience a gravitational force of...
- 125N
 - 250N
 - 500N
 - 1000N
 - 2000N
59. According to the work-kinetic energy theorem, what must be true about an object if the net work done on it during some time interval is equal to zero?
- The object is sitting still.
 - The object is not accelerating.
 - The object is slowing down.
 - The object is speeding up.
60. A child pushes horizontally on a box of mass m which moves with constant speed v across a horizontal floor. The coefficient of kinetic friction between the box and floor is μ . At what rate does the child do work on the box?
- μmgv
 - $\frac{\mu mg}{v}$
 - mgv
 - μmv^2
 - $\frac{v}{\mu mg}$
61. The only force acting on a 5kg object varies over time as shown in the given graph. Determine the speed of the object at the end of 10s, assuming the object started from rest at $t=0$ s.



- 3m/s
 - 7m/s
 - 10m/s
 - 15m/s
 - 35m/s
62. Two people of unequal masses are initially standing still on ice with negligible friction. They then simultaneously push each other horizontally. After they push off of each other, which of the following is true?
- The kinetic energies of the two people are equal.
 - Each person's speed is equal to the other person's.
 - Each person's momentum is equal in magnitude to the other person's.
 - The less massive person has a smaller initial acceleration than the other person.

63. A rock of mass M is thrown upward at an angle θ from ground level with an initial speed of v_0 . When the rock is at its highest point, it is at a height H above ground level. What is the kinetic energy of the rock at its highest point?
- a. zero b. $\frac{1}{2}Mv_0^2$ c. MgH d. $\frac{1}{2}Mv_0^2 + MgH$ e. $\frac{1}{2}Mv_0^2 - MgH$

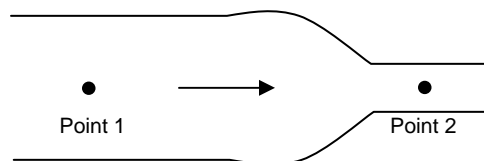
64. A 2kg object is released from rest at the top of the frictionless incline shown in the diagram. The speed of the object as it reaches the base of the incline is closest to which of the following?



- a. 5.5m/s b. 7.7m/s c. 12.6m/s d. 15m/s e. 60m/s
65. Two solid objects with the same mass, with one made of low-density aluminum and the other made of higher-density lead, are fully submerged in a tank of water. Which one of the following statements is true?
- a. Both objects receive the same magnitude buoyant force.
 b. A larger buoyant force acts on the aluminum object.
 c. A larger buoyant force acts on the lead object.
 d. Neither object receives any buoyant force.
 e. This question cannot be answered with only the given information.

66. A 0.5m-tall rectangular horse trough full of water sits on the ground. The dimensions of the base of the trough are $2\text{m} \times 2.5\text{m}$, and the density of water is 1000kg/m^3 . Calculate the force acting on the bottom of the trough, caused by the gauge pressure of the water.
- a. 1000N b. 5000N c. 25,000N d. 50,000N e. 100,000N

67. For fluid flowing horizontally to the right through the pipe shown in the diagram, the **velocity** at point 1 is _____ at point 2, and the **pressure** at point 1 is _____ at point 2.
- a. less than, less than
 b. less than, greater than
 c. greater than, less than
 d. greater than, greater than
 e. equal to, equal to



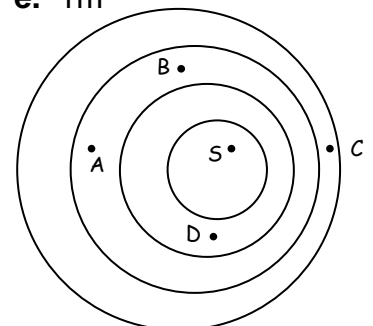
68. A motor pulls a 10kg object horizontally along a frictionless surface, increasing its speed from rest to 4m/s in 8s. What is the rate at which work is done by this motor? (Note: All answer-choices are given in S.I. units.)
- a. 10 units b. 12 units c. 20 units d. 25 units e. 80 units
69. A 5kg box is sitting on a table. The tabletop is 1m above the floor, and the ceiling in the room is 4m above the floor. What is the box's gravitational potential energy relative to the ceiling?
- a. -15J b. 20J c. -50J d. -150J e. 200J

70. A physics teacher explains to his class why an egg dropped on a pillow doesn't break, though an egg dropped from the same height onto a hard floor does break. In his explanation, which of the following ideas is the most helpful?
- conservation of momentum
 - impulse and momentum
 - conservation of energy
 - power
 - work done by non-conservative forces



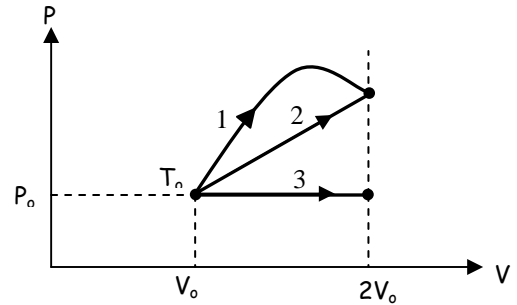
71. The two blocks of masses M and $2M$ shown above initially travel at the same speed v but in opposite directions. They collide and stick together. What is their velocity after the collision?
- zero
 - $\frac{1}{3}v_0$ right
 - $\frac{1}{3}v_0$ left
 - v_0 right
 - v_0 left
72. Which of the following objects are definitely in static equilibrium?
- Object 1: A meterstick has one string tied to it, pulling upward at a force equal to the weight of the meterstick.
- Object 2: A ball has been thrown into the air and is now at its highest point.
- Object 3: A crate slides to the right on a horizontal surface at a constant speed.
- None of the objects
 - Object 1 only
 - Object 3 only
 - Objects 1 and 2
 - Objects 1 and 3
73. A horizontal, uniform board of weight 125N and length 4m is supported by vertical chains at each end. A person weighing 500N is sitting on the board. The tension in the right chain is 250N . What is the tension in the left chain?
- 250N
 - 375N
 - 500N
 - 625N
 - 875N
74. For the same situation as explained in question #2, how far from the left end of the board is the person sitting?
- 0.4m
 - 1.5m
 - 2m
 - 2.5m
 - 3m
75. A certain vibrating string has two successive harmonics of frequencies of 250Hz and 300Hz . If the speed of the wave on the string is 100m/s , the length of the string is closest to which of the following?
- 0.25m
 - 0.33m
 - 0.40m
 - 0.5m
 - 1m

76. A small vibrating object on the surface of a ripple tank is the source of waves of frequency 20Hz and speed 60cm/s . If the source S is moving to the right, as shown in the diagram, with a speed of 20cm/s , at which of the labeled points will the frequency measured by a stationary observer be the greatest?
- A
 - B
 - C
 - D
 - It will be the same at all four points.



77. A mass is attached to a spring and set into simple harmonic motion. Which one of the following statements is true about the mass?
- The mass has minimum kinetic energy when it is at equilibrium.
 - The mass has maximum velocity when it is at its amplitude.
 - The total mechanical energy of the mass is greater when it is at equilibrium than at its amplitude.
 - The mass experiences the maximum restoring force at equilibrium.
 - The mass has maximum acceleration when it is at its amplitude.
78. Two strings sound two different frequencies, and a third frequency (created due to interference of the two original waves) of 100Hz is detected. If the lower string vibrates with a frequency of 300Hz, what must be the frequency of the second string?
- 50Hz
 - 100Hz
 - 200Hz
 - 300Hz
 - 400Hz
79. A block attached to the lower end of a vertical spring oscillates up and down. If the spring obeys Hooke's law, the period of oscillation depends on which of the following?
- Mass of the block
 - Amplitude of the vibration
 - Force constant of the spring
- I only
 - II only
 - III only
 - I and II
 - I and III
80. A pipe closed at one end has a length of 2m. If the conditions of the air in the pipe are such that the speed of sound in the air is 400m/s, what are the frequencies of the first two harmonics for the pipe?
- 50Hz and 100Hz
 - 100Hz and 200Hz
 - 100Hz and 300Hz
 - 50 Hz and 150Hz
 - 200Hz and 400Hz
81. A sample of an ideal gas is in a tank of constant volume. The sample absorbs heat energy so that its temperature changes from 300K to 600K. If v_1 is the average speed of the gas molecules before the absorption of heat and v_2 is their average speed after the absorption of heat, what is the ratio v_2/v_1 ?
- 1/2
 - 1
 - $\sqrt{2}$
 - 2
 - 4
82. The temperature of a 5m-long object is increased by 20°C. The temperature of a second object, made of the same material as the first object but of length 50cm, is increased by 10°C. Which one of the following statements is true about the change in length experienced by the 5m-long object, compared to the change in length experienced by the 50cm-long object?
- The 5m-long object changes by 2 times as much as the other object.
 - The 5m-long object changes by 10 times as much as the other object.
 - The 5m-long object changes by 20 times as much as the other object.
 - The 5m-long object changes by 100 times as much as the other object.
 - Both object change length by the same amount.

83. If the pressure of an ideal gas held in a vessel is halved while its volume is quadrupled, the resulting temperature will be...
- half of its original value.
 - the same as its original value.
 - twice its original value.
 - one quarter of its original value.
 - four times its original value.
84. A certain quantity of an ideal gas initially at temperature T_0 , pressure P_0 , and volume V_0 expands to twice its initial volume. As shown in the graph, the process may happen in several different manners, as represented by the three different lines on the graph. Which of the following is true of the final temperature of the gas?
- It is greatest for process 1.
 - It is greatest for process 2.
 - It is greatest for process 3.
 - It is the same for processes 1 and 2.
 - It is the same for processes 1 and 3.

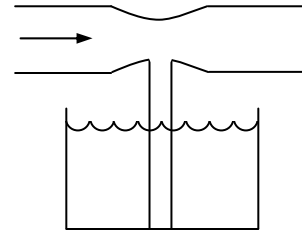


85. Use the same graph as on problem #84 to answer the following question: Which of the following is true of the magnitude of work done by the gas?
- It is greatest for process 1.
 - It is greatest for process 2.
 - It is greatest for process 3.
 - It is the same for processes 1 and 2.
 - It is the same for all three processes.
86. Use the same graph as on #84 to answer the following question: What type of process is process 3?
- Isothermal
 - Isovolumetric
 - Isobaric
 - Adiabatic
87. Which one of the following would most closely double the rms-speed of the particles in a gas at 200K?
- Raise the temperature of the gas to 283K.
 - Raise the temperature of the gas to 400K.
 - Raise the temperature of the gas to 800K.
 - Lower the temperature of the gas to 100K.
 - Lower the temperature of the gas to 50K.
88. 40J of work is done by a gas with a fixed number of molecules, and 15J of heat are transferred to the gas from the surroundings. What happens to the internal energy of the gas?
- It decreases by 55J.
 - It decreases by 25J.
 - It remains the same.
 - It increases by 25J.
 - It increases by 55J.

89. One mole of nitrogen gas (N_2) is contained in a rigid container, and one mole of oxygen gas (O_2) is contained in an identical container. Assuming both containers are maintained at the same temperature, which one of the following statements is true?
- The average speed of the nitrogen particles is less than that of the oxygen particles.
 - The pressure in the nitrogen container is greater than in the oxygen container.
 - The pressure in the nitrogen container is equal to the pressure in the oxygen container.
 - The pressure in the nitrogen container is less than in the oxygen container.
 - The average kinetic energy of nitrogen particles is less than that of the oxygen particles.
90. Which one of the following ideas expresses the fact that a fluid's flow rate through a pipe is constant?
- Pascal's Principle
 - Continuity Equation
 - Archimedes' Principle
 - Bernoulli's Equation
 - Newton's 3rd Law
91. An object of mass 0.4kg is suspended from a scale, and submerged in a liquid. If the reading on the scale is 3N, then the buoyant force that the fluid exerts on the object is most nearly which of the following?
- 1.3N
 - 1.0N
 - 0.75N
 - 0.33N
 - 0.25N
92. Two vectors **A** and **B** both have magnitudes of 5 units. The magnitude of the vector sum of these two vectors...
- is 5 units.
 - is 10 units.
 - is 0 units.
 - could be answer a or b, but not answer c.
 - could be answer a, b, or c.
93. An object is thrown with a horizontal velocity of 20m/s from a cliff that is 125m above ground level. If air resistance is negligible, the time that it takes the object to fall to the ground from the cliff is most nearly...
- 3s
 - 5s
 - 6s
 - 12s
 - 25s
94. The rate of change of velocity is the definition of...
- displacement
 - average velocity
 - instantaneous velocity
 - acceleration
95. At the highest point of its trajectory, a projectile fired at 30° above the horizontal from a starting height of 20m...
- is instantaneously at rest.
 - has traveled half the distance to its impact point.
 - has 0 acceleration.
 - has a horizontal velocity component equal to its initial value.
 - has more than one of the above properties.
96. A certain object accelerates at a rate of $4m/s^2$ for 3s. What is the object's final speed, if it was initially moving at 10m/s?
- 4m/s
 - 12m/s
 - 14m/s
 - 22m/s
 - 24m/s

97. A T-shaped tube with a constriction is inserted in a vessel containing a liquid, as shown. What happens if air is blown through the tube from the left, as shown by the arrow in the diagram?

- a. The liquid level in the tube rises to a level above the surface of the liquid surrounding the tube.
- b. The liquid level in the tube falls below the level of the surrounding liquid.
- c. The liquid level in the tube remains where it is.
- d. The air bubbles out at the bottom of the tube.
- e. Any of the above, depending on how hard the air flows.



98. An object of mass 10kg and density 200kg/m^3 is completely submerged under water, which has a density of 1000kg/m^3 . Which of the following is closest to the value of the buoyant force that acts on the object?

- a. 2N b. 20N c. 50N d. 500N e. 100,000N

99. A rock of mass m is thrown horizontally off a building from a height h . The speed of the rock as it leaves the thrower's hand at the edge of the building is v_0 . Disregarding air resistance, what is the kinetic energy of the rock just before it hits the ground?

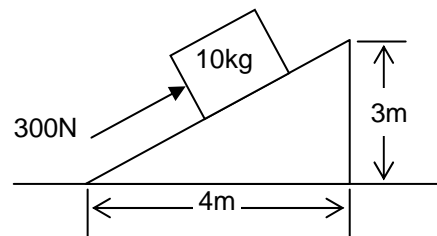
- a. mgh
- b. $\frac{1}{2}mv_0^2$
- c. $mgh - \frac{1}{2}mv_0^2$
- d. $\frac{1}{2}mv_0^2 - mgh$
- e. $\frac{1}{2}mv_0^2 + mgh$

100. A 5kg ball approaches a wall at a speed of 4m/s. It then bounces off of the wall in the opposite direction at the same speed. What is the magnitude of the average force exerted on the ball if it is in contact with the wall for 0.1s?

- a. 0N b. 100N c. 200N d. 400N e. 500N

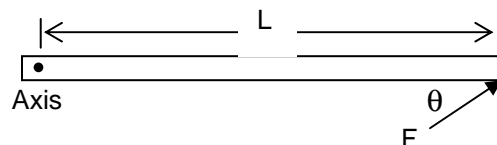
101. A constant force of 300N pushes a 10kg mass up the inclined plane shown in the diagram at a constant speed of 4m/s. The work done by the 300N force in pushing the mass from the bottom of the incline all the way to the top of the incline is most nearly...

- a. 0J
- b. 900J
- c. 1000J
- d. 1500J
- e. 3000J



102. A rod on a horizontal tabletop is pivoted at one end and is free to rotate without friction about a vertical axis through point P, as shown in the diagram (top view). A force F is applied at the end opposite the axis, at an angle of θ to the rod. If F were to be applied perpendicular to the rod, at what distance from the axis should it be applied in order to produce the same torque?

- a. $L\sin\theta$
- b. $L\cos\theta$
- c. $L\tan\theta$
- d. L
- e. $(\sqrt{2})L$



103. Which of the following will occur if the average speed of the gas molecules in a closed rigid container is increased?
- a. The density of the gas will decrease. b. The density of the gas will increase.
 c. The pressure of the gas will increase. d. The pressure of the gas will decrease.
 e. The temperature of the gas will decrease.

104. Which of the following observers would hear the highest frequency from a pitch produced from a source moving to the north at 20m/s?
- a. Observer to the south of the source, moving to the south at 20m/s.
 b. Observer to the south of the source, sitting at rest.
 c. Observer to the south of the source, moving to the north at 20m/s.
 d. Observer to the north of the source, moving to the north at 30m/s.
 e. Cannot answer with the given information, because the answer is dependent on the frequency emitted by the source.

105. A mass attached to a spring is vibrating with simple harmonic motion according to the following equation: $x = (10)\cos(4\pi t)$
 Assuming all quantities are measured in S.I. units, the amplitude of vibration for the system is _____, and the frequency for the system is _____.
- a. 10 meters, 4π Hertz b. 4π meters, 10 Hertz
 c. 2π meters, 10 Hertz d. 10 meters, 4 Hertz
 e. 10 meters, 2 Hertz

106. A spring of constant K is connected to a mass M, making a horizontal mass-spring system. It is then stretched back a distance D from equilibrium, and set into motion. How much kinetic energy is present in the system when the mass is passing through equilibrium?
- a. $\sqrt{\frac{K}{M}(D^2 - M^2)}$ b. $D\sqrt{\frac{K}{M}}$ c. $\frac{1}{2}MD\sqrt{\frac{K}{M}}$
 d. $\frac{1}{2}KD^2$ e. $\frac{1}{2}KD^2 - KD$

107. A gas with a fixed number of molecules does 32J of work on its surroundings, and 16J of heat are transferred from the gas to the surroundings. What happens to the internal energy of the gas?
- a. It decreases by 48J. b. It decreases by 16J.
 c. It remains the same. d. It increases by 16J.
 e. It increases by 48J.

108. The absolute temperature of a sample of monatomic ideal gas is doubled at constant volume. What effect, if any, does this have on the pressure and density of the sample of gas?

<u>Pressure</u>	<u>Density</u>
a. Remains the same	Remains the same
b. Remains the same	Doubles
c. Doubles	Remains the same
d. Doubles	Is halved
e. Is halved	Doubles