A Practice for the AP Physics 1 Exam

These questions are designed to test the material in the AP Physics 1 curriculum but may or may not reflect the exact content or difficulty of the exams produced by the College Board and the Educational Testing Service. (JAS 3/24/2015)

Section I
50 Questions
Time – 90 minutes

Note: To simplify calculations, you may use g = 10 m/s² in all problems unless it is stated otherwise.

Directions: Each of the questions or incomplete statements below is followed by four suggested answers or completions. Select the one that is best in each case and then enter the appropriate letter in the corresponding space on the answer sheet.

1. A car initially at rest experiences a constant acceleration along a horizontal road. The position of the car at several successive equal time intervals is illustrated here.
   Between which adjacent positions is the change in kinetic energy of the car the greatest?

   A) 1 and 2
   B) 2 and 3
   C) 3 and 4
   D) The change is the same for all adjacent pairs.

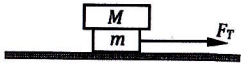
2. A small spherical object initially at rest is accelerating downward as a result of the earth's gravitational force. A constant larger horizontal force, *F*, is applied to it by a wind blowing to the right as shown.

   Which of the following diagrams best illustrates the path of the particle?

   A) 
   B) 
   C) 
   D) 

3. A mass, *m*, is brought from the surface of the earth to the surface of a planet with a radius half as large as the earth and a density that is also one half that of the earth. If the potential energy for the object on earth was U_E what will be its potential energy at the surface of this other planet?

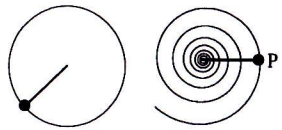
   A) $\frac{1}{16}U_E$
   B) $\frac{1}{8}U_E$
   C) $\frac{1}{4}U_E$
   D) $\frac{1}{2}U_E$



   μ is the coefficient of friction for all of the sliding surfaces

4. Two blocks are stacked up on a horizontal surface as shown above. A sudden force F_T slides the block of mass *m* out from under the second block of mass *M*. Which of the following would be the correct equation describing the motion of the block *m*?

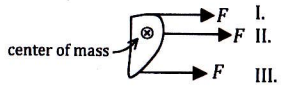
   A) $F_T - \mu Mg - \mu mg = (M+m)a$
   B) $F_T - \mu Mg - \mu mg = ma$
   C) $F_T - \mu(M+m)g - \mu mg = (M+m)a$
   D) $F_T - \mu(M+m)g - \mu Mg = ma$



5. An object attached to a string as shown is initially rotating in a circle on a horizontal frictionless tabletop. The string is then pulled directly toward the center and the object spirals inward as shown at the right.

   Of the following, which arrow correctly shows the direction of resulting acceleration of the mass at point P?

   A) 
   B) 
   C) 
   D) 



6. A rock in space is to have a force *F* of 5.0 N applied to it. Of the three points of application I, II, and III, shown above, which will result in the greatest acceleration of the center of mass?

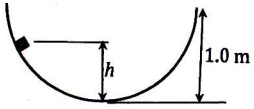
   A) I.
   B) II.
   C) III.
   D) The same acceleration for each.

7. As shown above, a student stands on a cart that is free to roll with no friction. On the cart is a rigidly attached wall. The student throws a heavy ball at the wall. Consider three possible situations.

   I. The ball is made of clay, hits the wall and sticks to it.
   II. The ball is made of rubber, hits the wall, rebounds, and the student catches it.
   III. The ball is made of rubber, hits the wall, rebounds, and the student fails to catch it.

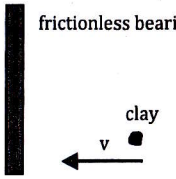
   For which, if any, of these cases will the cart and student gain a net motion to the right?

   A) I.
   B) II.
   C) III.
   D) None of these.



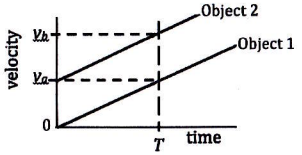
8. A small object slides with negligible friction from rest at the rim of a hemispherical bowl of radius one meter. At which height *h* above the bottom of the bowl will the speed of the object be equal to one-half of its speed at the bottom?

   A) $h = \frac{\sqrt{3}}{2}$ meters
   B) $h = \frac{\sqrt{2}}{2}$ meters
   C) $h = \frac{1}{2}$ meter
   D) $h = \frac{3}{4}$ meter



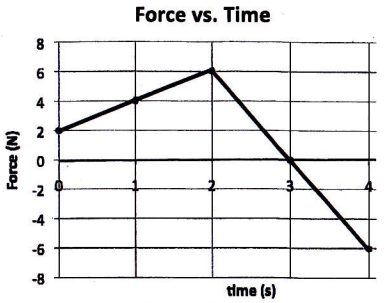
9. A long rod is suspended by a frictionless bearing near its top. A lump of clay is projected from the right, collides with the block and sticks to it. Which one of the following statements is correct about the clay and rod system for this collision?

A) The mechanical energy, linear momentum and angular momentum remain constant.
B) The linear momentum and the angular momentum remain constant but the mechanical energy changes.
C) Only the angular momentum remains constant.
D) None of the quantities of mechanical energy, linear momentum, or angular momentum remain constant.



10. Two objects are to fall straight downward under the influence of gravity with an acceleration g. Object 1 is released from rest and object 2 is thrown downward from a somewhat greater height with an initial velocity v_a. Graphs of their motion are shown above. The second object catches up with the first object at time T. Which of the following expression correctly describes the initial difference in heights?

A) $v_a T$
B) $(v_b - v_a)T$
C) $\frac{1}{2}(v_a + v_b)T$
D) $\frac{1}{2}gT^2 + v_a T$

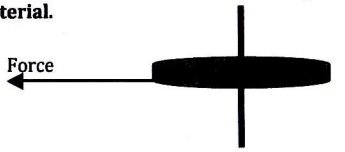


11. A net force F is applied to a 2.0 kg object that is initially moving at 3.0 m/s. The Force varies as shown in the graph above. The speed of the object at the end of the 4.0s time interval is closest to which of the following?
A) 5.0 m/s
B) 7.0 m/s
C) 10. m/s
D) 14 m/s

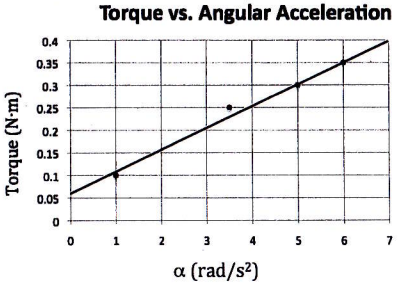
12. Students watching a large mass swing on a long cable decide to determine the length of the cable assuming it acts as a simple pendulum. They make several measurements of the time the mass goes through ten complete cycles. They measure the time for these ten cycles to be 88 ± 1 s. *Because this is an experiment they realize they must take $g = 9.8\ m/s^2$ in this case.*
Given the uncertainty of the data which of the following would be the best indication of the length of the cable?

A) 18 to 19 m
B) 19.1 to 19.3 m
C) 19 to 20. m
D) 20. to 21m

Questions 13-14 refer to the following material.

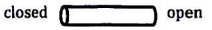


A pair of students measure the torque applied to a wheel supported by a vertical axle. They also measure resulting angular acceleration. A plot of their data results in this graph.

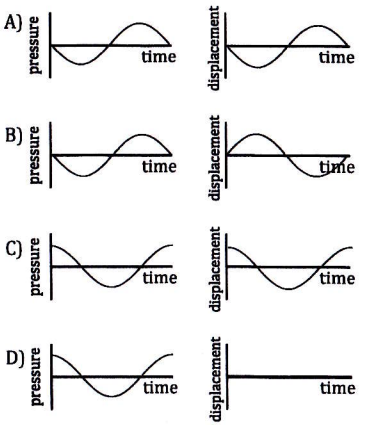


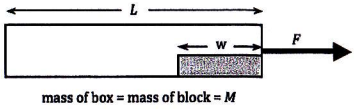
13. Which of the following would be the best value for the rotational inertia of wheel?
A) 0.05 kg·m²
B) 0.06 kg·m²
C) 0.10 kg·m²
D) 0.35 kg·m²

14. Of the following which is the most likely torque supplied by friction?
A) -0.06 N·m
B) -0.10 N·m
C) +0.06 N·m
D) +0.10 N·m



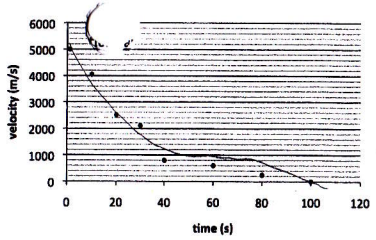
15. Sound is resonant in a tube closed at its left end as shown above. Which of the following pairs of graphs best represents the pressure and displacement of the air at the wall of the *closed* end?





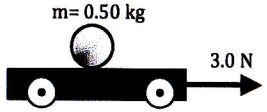
16. A block of width w is located inside of the right side of a box of length L. The block and box are of *equal mass, M,* and are initially at rest. The surface between the block and box is frictionless. An external force F is applied to the box that accelerates while the block slides until it strikes the left end of the box. During that time period what distance will the block+box system's center of mass have moved?

A) $L - w$
B) $L - \frac{w}{2}$
C) $\frac{L}{2} - w$
D) $\frac{L}{2} - \frac{w}{2}$



17. A 200. kg space probe descends to the surface of a planet. The speed of the probe during the time of descent is graphed above. The average force exerted on the probe from the moment the rockets fire at t = 0 s to the moment it is at rest on the planet is about...

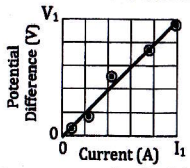
A) 2 800 N
B) 10 000 N
C) 145 000 N
D) 29 000 000 N



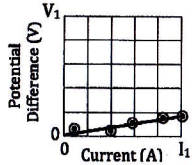
18. A 0.50 kg ball sits on a cart. When the cart is pulled to the right by a net force of 3.0 N, friction exerts a force of 2.0 N on the bottom of the ball. The ball rolls without slipping. How far will the ball travel relative to the ground in 0.10 s?

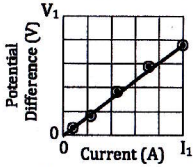
A) 0 m
B) 0.01 m
C) 0.02 m
D) 0.05 m

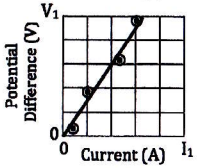
19. A group of students pass a current along the length of a long cylindrical sample of a material. They measure the current through the sample for different potential differences supplied across the ends and obtain a graph of the data that looks like the one shown here.

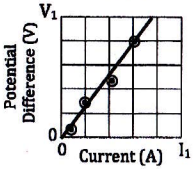


They have a second cylindrical sample of the same material but it has one-half the diameter of the original and is only one-third the length. Making similar measurements on this second sample they might get a graph that resembles which of the following?

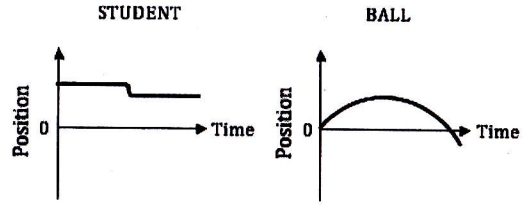
A)


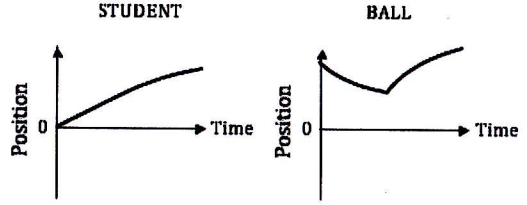
B)


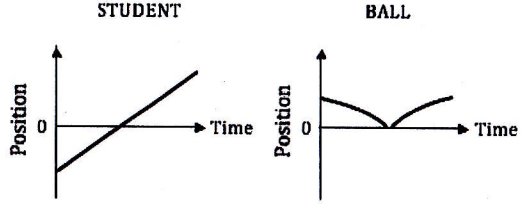
C)


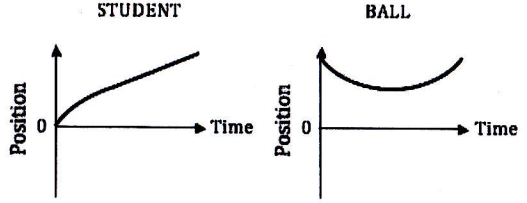
D)


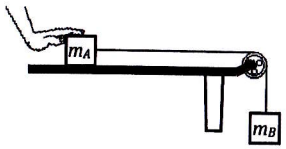
20. A student is running at a constant speed toward a ball that is rolling directly toward him but slowing down. The student arrives at the ball and kicks it in the same direction that the student was moving. Which of the following sets of graphs shows a reasonable representation of the positions of the student and the ball?

A)


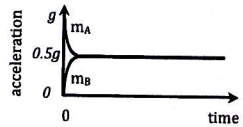
B)


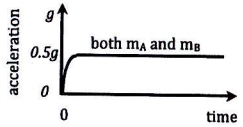
C)


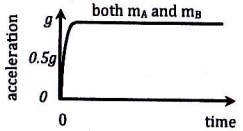
D)


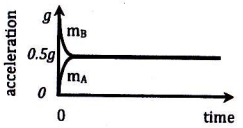


21. As shown above, a mass, m_A, initially held at rest on a horizontal frictionless surface, is connected by a string passing over a frictionless pulley to a second equal mass, m_B, hanging over the edge of the table. Carefully consider only the forces acting on each mass from the instant mass A is released. Which of the following graphs correctly shows the acceleration of the two masses over time?

A)


B)


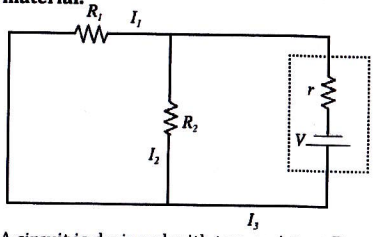
C)


D)


22. A student suspends an object at the end of a string attached to the ceiling of the classroom. It is set into motion in a horizontal circle. In order to calculate the speed of the mass, which of the following data sets would be sufficient? (Assume g is known for this location.)

A) mass of the object and period of the motion
B) mass of the object and the radius of the rotation.
C) angle the string makes with the vertical, and length of the string
D) angle the string makes with the vertical, and the mass of the object

Questions 23 and 24 refer to the following material.



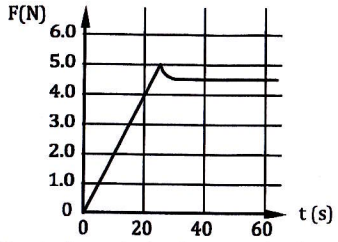
A circuit is designed with two resistors R_1, R_2 and a battery that provides a potential difference V but has an internal resistance r.

23. What is the relationship between the three labeled currents?

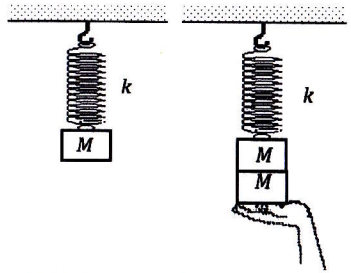
A) $I_3 > I_1 + I_2$
B) $I_3 = I_1 + I_2$
C) $I_3 < I_1 + I_2$
D) $I_3 = I_1 = I_2$

24. What of the following is a correct relationship for the above circuit?

A) $V = I_3 r = I_2 R_2 = I_1 R_1$
B) $V = I_1 R_1 + I_2 R_2 + I_3 r$
C) $V = I_3 r + I_1 R_1$
D) $V = I_1 R_1 + I_2 R_2$



25. As shown in the above graph, a force is applied to a 5.0 kg block that is initially at rest. At about 25 s the block begins to slide. The coefficient of kinetic friction for the sliding block is nearest to which of the following numbers?
A) 0.02
B) 0.09
C) 0.20
D) 0.90

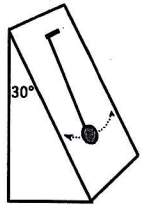


26. An ideal spring with a spring constant k has a mass M attached and is hanging at rest with spring stretched by an amount d. A student now supports the mass and attaches an additional mass M. The student releases the masses. During its oscillation what will be the maximum kinetic energy of the system?

A) $\frac{1}{2}kd^2$
B) kd^2
C) $2kd^2$
D) $\frac{5}{2}kd^2$

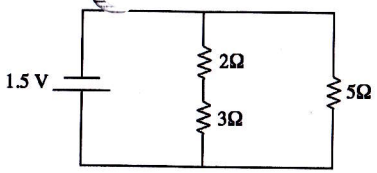
27. Of the following, which does **not** involve an assumption about the equivalence of inertial and gravitational mass?

A) The centripetal acceleration of a satellite is given by $a = G\frac{m_{planet}}{r^2}$
B) At a point on the earth's surface the freefall acceleration of all objects is the same.
C) The period of oscillation for an object suspended from a spring is given by $T_s = 2\pi\sqrt{\frac{m}{k}}$
D) The acceleration of a given object pulled across a surface is given by a force, F, is given by $a = \frac{F - \mu_k mg}{m}$



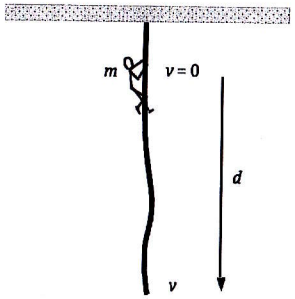
28. A simple pendulum consisting of a mass M hangs from a string. When set in motion its period is T. The same pendulum is now placed so it swings back and forth on the surface of a frictionless incline as shown at the right in the diagram. If the angle between the incline and the vertical is 30°, the period of the motion will now be closest to which of the following?

A) $0.5T$
B) T
C) $1.1T$
D) $2T$



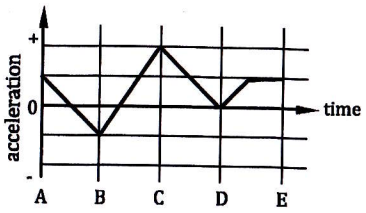
29. What is the potential drop across the 3Ω resistor in the circuit shown above?

A) 0.5 V
B) 0.9 V
C) 1.0 V
D) 1.5 V



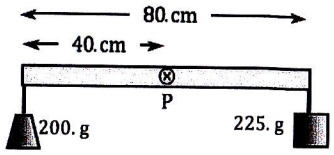
30. Starting from rest a person of mass m hanging on at the top of a rope climbs down a distance d to the ground where they arrive traveling at a speed v. Which of the following would give the net work done during the decent.

A) $\frac{1}{2}mv^2$
B) mgd
C) $mgd - \frac{1}{2}mv^2$
D) $mgd + \frac{1}{2}mv^2$



31. The above graph shows the acceleration of an object as a function of time. Which of the following correctly ranks the change in velocity, Δv, for each time interval?

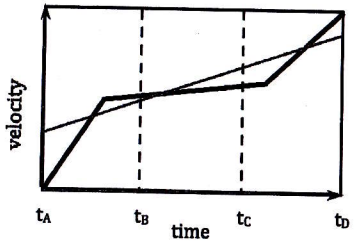
A) $\Delta v_{AB} < \Delta v_{BC} < \Delta v_{CD} < \Delta v_{DE}$
B) $\Delta v_{AB} < \Delta v_{CD} < \Delta v_{BC} < \Delta v_{DE}$
C) $\Delta v_{DE} < \Delta v_{AB} < \Delta v_{BC} < \Delta v_{CD}$
D) $\Delta v_{AB} < \Delta v_{BC} < \Delta v_{DE} < \Delta v_{CD}$



mass of stick is 200.g

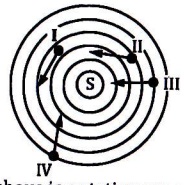
32. An 80. cm long non-uniform stick has two masses, 200. g and 225 g hanging on its ends. The stick itself has a mass of 200. g. The system is balanced at the point P exactly half way between the ends of the stick. Which of the following is the distance of the center of mass of the stick from its left end?

A) 25. cm
B) 30. cm
C) 35. cm
D) 45. cm



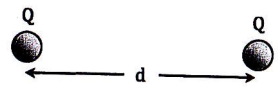
33. Starting at the same position two toy cars are moving to the right along straight lines. The graph above shows their velocities as a function of time. During what time interval, after t = 0s does one car pass the other?

A) t_A to t_B
B) t_B to t_C
C) t_C to t_D
D) They do not pass in this time period.



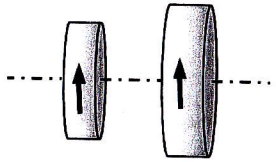
34. Shown above is a stationary source, S, of sound waves. The evenly spaced concentric circles represent wave fronts, and each of the round dots I, II, III, and IV indicate the location of listeners. They are all moving at the same speed but in the directions indicated by their associated arrows. Which of the following would correctly rank from *lowest to highest* the sound frequencies received by each?

A) I, II, III, IV
B) I, II, IV, III
C) III, II, IV, I
D) III, IV, I, II



35. Two small identical objects are given the same amount of charge, Q. They are placed a distance d apart and experience a force F. A student proposes to remove a small amount of charge q one and add it to the other in order to reduce the force to one half of its original value but wants to maintain the original separation. Which of the following is true?

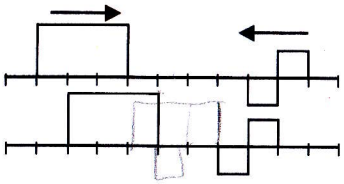
A) This can be done if $q = \frac{\sqrt{2}}{2}Q$
B) This can be done if $q = \frac{1}{2}Q$
C) This can be done if $q = \frac{1}{4}Q$
D) This cannot be done without changing either the distance or the total charge.



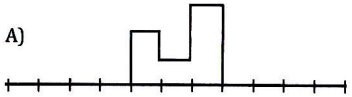
$I,\ \omega_1$ $\qquad$ $I,\ \omega_2 = 3\omega_1$

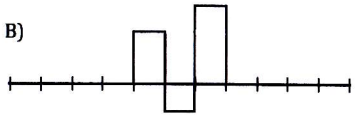
36. Two disks rotating in the same direction about the same axis are shown above. The rotational inertia for each disk is the same, that is $I_1 = I_2 = I$. The initial angular speeds are ω_1 and ω_2 where $\omega_2 = 3\omega_1$. If the two disks slide along the axis, collide and stick together, which of the following statement will be the correct expression for the rotational kinetic energy of the combined disk?

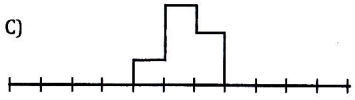
A) $K = 2I\omega_1^2$
B) $K = 3I\omega_1^2$
C) $K = 4I\omega_1^2$
D) $K = 5I\omega_1^2$

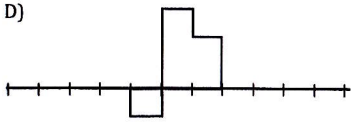


37. Referring to the diagram above, the top picture shows the position of two wave pulses that are approaching each other. The waves move forward one of the tick marks on the line each second, so one second later they are only two marks apart as shown in the second picture. Of the following which picture best illustrates the situation after *two* further seconds have passed?

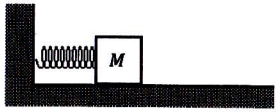
A)


B)


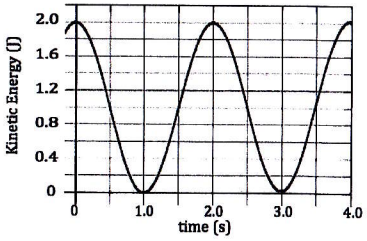
C)


D)


Questions 38 and 39 refer to the following material.

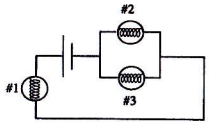


A spring connects a mass, *M*, to a wall. The mass is set in horizontal oscillation on a frictionless surface. The following graph indicates the kinetic energy of the mass as a function of time.



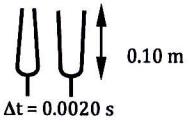
38. What is the total mechanical energy?
A) 1.0 J
B) 2.0 J
C) 3.0 J
D) 4.0 J

39. What is the period of the motion?
A) 0.5 s
B) 1.0 s
C) 2.0 s
D) 4.0s



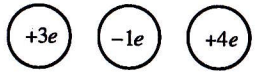
40. Three identical bulbs are connected in a circuit as shown above. The internal resistance of the battery is negligible. Consider that bulb #3 burns out. Which of the following statements is correct?
A) The potential difference for bulb #1 will decrease and the current through bulb #2 will remain unchanged.
B) The potential difference for bulb #1 will increase and the current through bulb #2 will decrease.
C) The potential difference for bulb #1 will decrease and the current through bulb #2 will increase.
D) The potential difference for bulb #1 and the current through bulb #2 will both remain unchanged.

Questions 41-42 refer to the following. Shown here are two extreme positions of the tines of a tuning fork as it vibrates with the metal of the fork in a standing wave. The time between the two positions of the fork as shown is 0.002s. The length of each tine is 0.10 m.



41. Assume the speed of sound in air to be 340 m/s. What would be the wavelength of the sound in air produced by this tuning fork?
A) .68 m
B) 1.4 m
C) 2.0 m
D) 2.7 m

42. What would be the wavelength of the transverse standing wave in the metal of this fork?
A) 0.10 m
B) 0.20 m
C) 0.30 m
D) 0.40 m



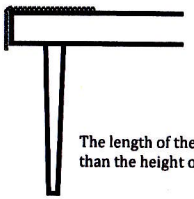
43. Three identical conducting spheres initially have the charges shown above. If they are moved together in a line and brought into contact, which of the following would be the resulting charge distribution in the new arrangement?

A) +2e +2e +2e

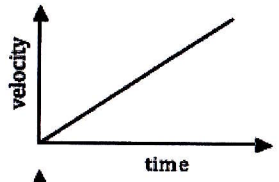
B) $+3\frac{1}{2}e$ −1e $+3\frac{1}{2}e$

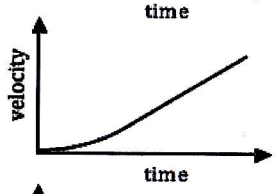
C) +3e 0 +3e

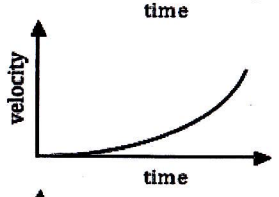
D) +4e −2e +4e

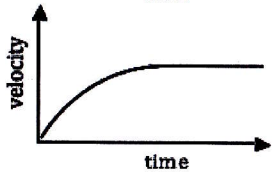


44. A chain is hanging over the edge of a frictionless table. It is released and falls to the ground. Which of the following graphs would best represent its velocity from the moment it is released to the moment it strikes the ground?

A)


B)


C)


D)


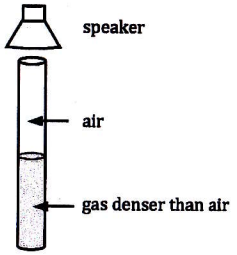
45. A student wants to make a laboratory determination of the resistivity of a material. The student makes the following initial list of ideas about what will be required.

I. A source of known Potential Difference.
II. An ammeter.
III. A balance to determine the mass of the sample
IV. A sample with a simple geometric shape.
V. A device to measure the dimensions of the sample.

Of the items on the list which one(s) will not actually be important?

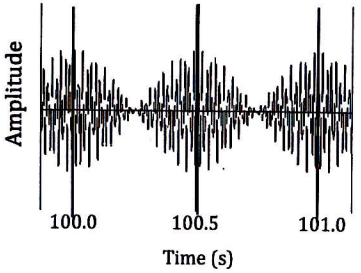
A) I, II
B) III
C) IV, V
D) All of these items are important.

Directions: For each of the questions or incomplete statements below two of the suggested answers will be correct. For each of these questions, you must select both correct choices to ear credit. No partial credit will be earned if only one correct choice is selected. Select the two that are best in each case then enter both of the appropriate letters in the corresponding space on the answer sheet.



46. A sound is transmitted down a vertical tube. The top half of the tube is filled with air and the bottom have is filled with a more dense gas in which the speed of sound is different from that in air. Which two of the following statements are true?

A) The frequency in the second gas will be the same as in the air.
B) The amplitude of the waves in the second gas will be greater than that in the air
C) The wavelength in the second gas will not be the same as in the air
D) There will be a shift in phase as the sound travels from air into the gas.



47. Two sound waves are viewed together on a monitor. The resulting pattern appears in the image above.
Which of the following pairs of frequencies would produce this pattern? Select two answers.

A) 256 Hz and 254 Hz
B) 128 Hz and 64 Hz
C) 64 Hz and 66.0 Hz
D) 32 Hz and 64 Hz

48. A constant net force acts on an object. Which of the following statements is true? Select two answers.

A) The kinetic energy of the object will increase at a constant rate.
B) The work done on the object will be done at a constant rate.
C) The momentum of the object will increase at a constant rate.
D) The power will be delivered to the object at an increasing rate.

object	mass	v_x (m/s)	v_y(m/s)
Number one	m	4.0	0.0
Number two	$2m$	0.0	0.0

49. The above table gives information about two small solid particles that will be involved in a collision. Upon collision the two particles bounce off each other and go their separate ways. Which two of the following tables provide information that could be the possible result of the collision?

A)

object	mass	v_x (m/s)	v_y(m/s)
Number one	m	0.4	0.5
Number two	$2m$	0.8	-0.5

B)

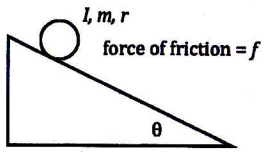
object	mass	v_x (m/s)	v_y(m/s)
Number one	m	0.0	1.0
Number two	$2m$	2.0	-0.5

C)

object	mass	v_x (m/s)	v_y(m/s)
Number one	m	0.2	1.0
Number two	$2m$	0.9	-0.5

D)

object	mass	v_x (m/s)	v_y(m/s)
Number one	m	-2.0	2.0
Number two	$2m$	3.0	-1.0



50. An object rolls without slipping down an inclined plane. The mass of the object is m, its rotational inertia about its center of mass is I, its radius is r, the frictional force is f and the angle of the incline is θ. The resulting acceleration of the center of mass of the object is a.
Which of the following statements must be true? Select two answers.

A) $mgr\sin\theta - fr = 0$

B) $mg\sin\theta - f = ma$

C) $fr = I\frac{a}{r}$

D) $mgr\sin\theta = I\frac{a}{r}$

STOP

END OF SECTION I