AP Physics 1 Practice Exam: Section I (Multiple-Choice)

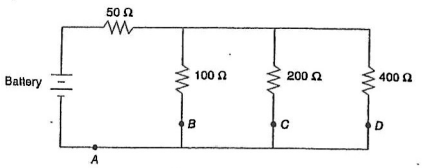
Directions: The multiple-choice section consists of 50 questions to be answered in **90 minutes.** You may write scratch work in the test booklet itself, but only the answers on the answer sheet will be scored. You may use a calculator, the equation sheet, and the table of information.

Questions 1–45: Single-Choice Items

Directions: Choose the single best answer from the four choices provided and grid the answer with a pencil on the answer sheet.

1. A circuit consists of a battery and a light bulb. At first, the circuit is disconnected. Then, the circuit is connected, and the light bulb lights. After the light bulb has been lit for a few moments, how has the net charge residing on the circuit elements changed?

   (A) The net charge has become more positive.
   (B) The net charge has become more negative.
   (C) The net charge has not changed.
   (D) Whether the net charge becomes more positive or more negative depends on the initial net charge residing on the circuit elements before the bulb was lit.



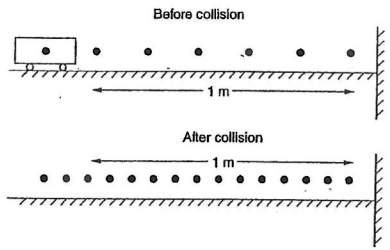
2. At which position in the above circuit will the charge passing that position in one second be largest?

   (A) A
   (B) B
   (C) C
   (D) D

3. Spring scales are used to measure the net force applied to an object; a sonic motion detector is used to measure the object's resulting acceleration. A graph is constructed with the net force on the vertical axis and the acceleration on the horizontal axis. Which of the following quantities is directly measured using the slope of this graph?

   (A) Gravitational mass
   (B) Weight
   (C) Velocity
   (D) Inertial mass

Questions 4 and 5 refer to the information below:



In the laboratory, a 0.5-kg cart collides with a fixed wall, as shown in the preceding diagram. The collision is recorded with a video camera that takes 20 frames per second. A student analyzes the video, placing a dot at the center of mass of the cart in each frame. The analysis is shown above.

4. About how fast was the cart moving before the collision?

   (A) 0.25 m/s
   (B) 4.0 m/s
   (C) 0.20 m/s
   (D) 5.0 m/s

5. Which of the following best estimates the change in the cart's momentum during the collision?

   (A) 27 N·s
   (B) 13 N·s
   (C) 1.3 N·s
   (D) 2.7 N·s

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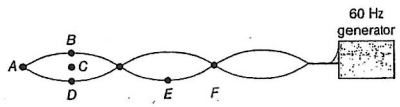
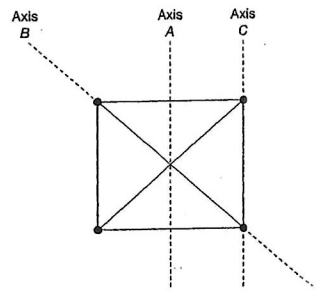


6. In the laboratory, a 60-Hz generator is connected to a string that is fixed at both ends. A standing wave is produced, as shown in the preceding figure. In order to measure the wavelength of this wave, a student should use a meterstick to measure from positions

   (A) B to C
   (B) B to D
   (C) D to E
   (D) A to F



7. Four identical lead balls with large mass are connected by rigid but very light rods in the square configuration shown in the preceding figure. The balls are rotated about the three labeled axes. Which of the following correctly ranks the rotational inertia I of the balls about each axis?

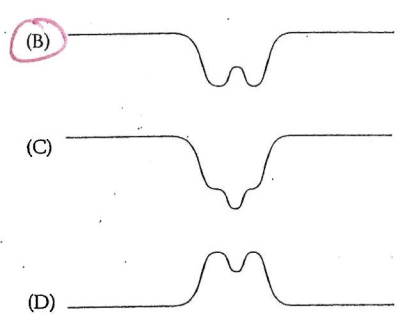
   (A) $I_A > I_B = I_C$
   (B) $I_A > I_C = I_B$
   (C) $I_C > I_A > I_B$
   (D) $I_C > I_A = I_B$

8. In the laboratory, a cart experiences a single horizontal force as it moves horizontally in a straight line. Of the following data collected about this experiment, which is sufficient to determine the work done on the cart by the horizontal force?

   (A) The magnitude of the force, the cart's initial speed, and the cart's final speed
   (B) The mass of the cart and the distance the cart moved
   (C) The mass of the cart, the cart's initial speed, and the cart's final speed
   (D) The mass of the cart and the magnitude of the force

9. A wave pulse on a string is shown above. Which pulse, when superimposed with the one above, will produce complete destructive interference?

   (A)
   (B)
   (C)
   (D)



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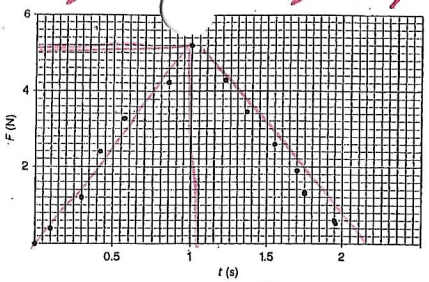
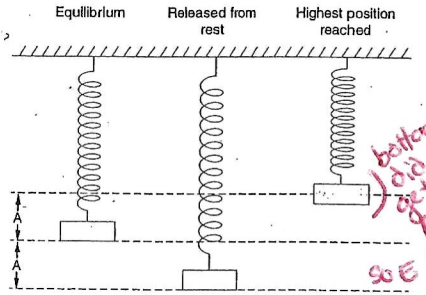


10. In the laboratory, a 3-kg cart experiences a varying net force. This net force is measured as a function of time, and the data collected are displayed in the graph above. What is the change in the cart's momentum during the interval $t = 0$ to $t = 2$ s?

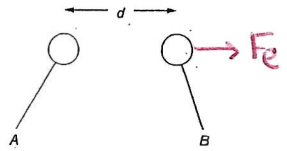
(A) 5 N·s
(B) 10 N·s
(C) 15 N·s
(D) 30 N·s



11. A block is attached to a vertical spring. The block is pulled down a distance A from equilibrium, as shown above, and released from rest. The block moves upward; the highest position above equilibrium reached by the mass is less than A, as shown. When the mass returns downward, how far below the equilibrium position will it reach?

(A) Greater than the distance A below equilibrium
(B) Less than the distance A below equilibrium
(C) Equal to the distance A below equilibrium
(D) No distance—the block will fall only to the equilibrium position.

Questions 12 and 13 refer to the following information:



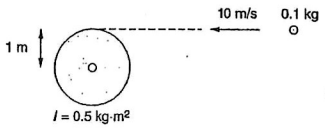
Two charged Styrofoam balls are brought a distance d from each other, as shown. The force on Ball B is 2 μN to the right. When the distance between the balls is changed, the force on Ball B is 8 μN to the right.

12. Which of the following can indicate the sign of the charges of balls A and B?

	Ball A	Ball B
(A)	positive	negative
(B)	neutral	positive
(C)	negative	negative
(D)	positive	neutral

13. When the force on Ball B is 8 μN, what is the distance between the centers of the two balls?

(A) $d/4$
(B) $d/2$
(C) $d/16$
(D) $d/\sqrt{2}$



14. A disk of radius 1 m and rotational inertia $I = 0.5$ kg·m² is free to rotate, but initially at rest. A blob of putty with mass 0.1 kg is traveling toward the disk with a speed of 10 m/s, as shown in the preceding figure. The putty collides with the outermost portion of the disk and sticks to the disk. What is the angular momentum of the combined disk-putty system after the collision?

(A) 5 kg·m²/s
(B) 1 kg·m²/s
(C) 0.5 kg·m²/s
(D) 0 kg·m²/s

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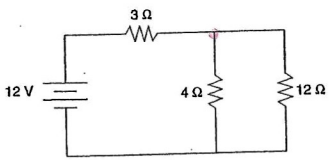
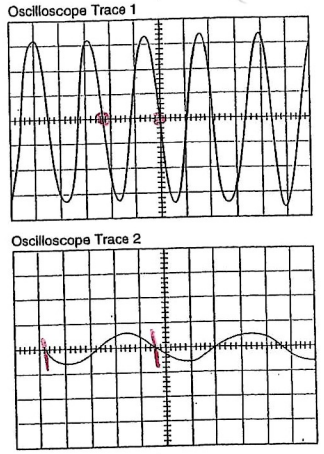
15. A 1-kg object is released from rest at the top of a rough-surfaced incline. The object slides without rotating to the bottom of the incline. The object's kinetic energy at the bottom must be

(A) Equal to the block's gravitational potential energy when it was released, because total mechanical energy must be conserved.
(B) Equal to the block's gravitational potential energy when it was released, because the gain in kinetic energy compensates for the mechanical energy lost to thermal energy on the rough incline.
(C) Less than the block's gravitational potential energy when it was released, because the gravitational potential energy was converted both to thermal energy and to kinetic energy.
(D) Less than the block's gravitational potential energy when it was released, because the work done by the friction force must be greater than the block's gain in kinetic energy.



16. What is the current in the 4 Ω resistor in the circuit in the preceding illustration?

(A) 1.5 A
(B) 2.0 A
(C) 3.0 A
(D) 6.0 A



17. Two sounds are played in the laboratory. A microphone is connected to an oscilloscope, which displays the traces shown above for each sound. On these traces, the horizontal axis is time; the vertical axis is related to the distance the microphone's diaphragm is displaced from its resting position. The scales are identical for each diagram. Which of the following is correct about the sounds that produce the traces above?

(A) Sound 1 is louder, and sound 2 is higher pitched.
(B) Sound 2 is louder, and sound 2 is higher pitched.
(C) Sound 1 is louder, and sound 1 is higher pitched.
(D) Sound 2 is louder, and sound 1 is higher pitched.

18. The radius of Mars is about half that of Earth; the mass of Mars is about one-tenth that of Earth. Which of the following is closest to the gravitational field at the surface of Mars?

(A) 10 N/kg
(B) 4 N/kg
(C) 2 N/kg
(D) 0.5 N/kg

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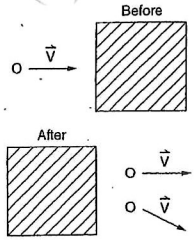


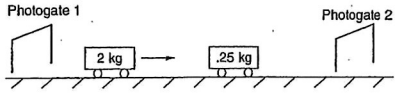
19. In an experiment, a marble rolls to the right at speed v, as shown in the top diagram. The marble rolls under a canopy, where it is heard to collide with marbles that were not initially moving. Such a collision is known to be elastic. After the collision, two equal-mass marbles are observed leaving the canopy with velocity vectors directed as shown. Which of the following statements justifies why the experimenter believes that a third marble was involved in the collision under the canopy?

(A) Before collision, the only marble momentum was directed to the right. After the collision, the combined momentum of the two visible marbles is still to the right. Another marble must have a leftward momentum component to conserve momentum.

(B) Before collision, the only marble momentum was directed to the right. After the collision, the combined momentum of the two visible marbles has a downward component; another marble must have an upward momentum component to conserve momentum.

(C) Before collision, the only marble kinetic energy was directed to the right. After the collision, the combined kinetic energy of the two visible marbles is still to the right. Another marble must have a leftward kinetic energy component to conserve kinetic energy.

(D) Before collision, the only marble kinetic energy was directed to the right. After the collision, the combined kinetic energy of the two visible marbles has a downward component; another marble must have an upward kinetic energy component to conserve kinetic energy.



20. In the laboratory, two carts on a track collide in the arrangement shown in the preceding figure. Before the collision, the 2-kg cart travels through photogate 1, which measures its speed; the 0.25-kg cart is initially at rest. After the collision, the carts bounce off one another. Photogate 2 measures the speed of each cart as it passes.

A student is concerned about his experimental results. When he adds the momentum of both carts after collision, he gets a value greater than the momentum of the 2-kg cart before collision. Which of the following is a reasonable explanation for the discrepancy?

(A) The track might have been slanted such that the carts were moving downhill.

(B) Human error might have been involved in reading the photogates.

(C) Friction might not have been negligible.

(D) The collision might not have been elastic.

	Wheel Structure	Wheel Mass	Wheel Radius
Wagon A	solid disk, $I = \frac{1}{2}MR^2$	0.5 kg	0.1 m
Wagon B	solid disk, $I = \frac{1}{2}MR^2$	0.2 kg	0.2 m
Wagon C	hollow hoop, $I = MR^2$	0.2 kg	0.1 m

21. Three wagons each have the same total mass (including that of the wheels) and four wheels, but the wheels are differently styled. The structure, mass, and radius of each wagon's wheels are shown in the preceding chart. In order to accelerate each wagon from rest to a speed of 10 m/s, which wagon requires the greatest energy input?

(A) Wagon A
(B) Wagon B
(C) Wagon C
(D) All require the same energy input

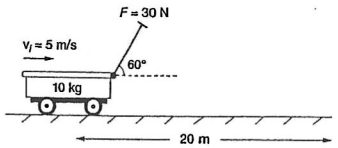
22. A swimmer is able to propel himself forward through the water by moving his arms. Which of the following correctly states the applicant and recipient of the force responsible for the swimmer's forward acceleration?

(A) The force of the surrounding water on the swimmer's arms

(B) The force of the swimmer's arms on the swimmer's torso

(C) The force of the swimmer's arms on the surrounding water

(D) The force of the swimmer's torso on the swimmer's arms



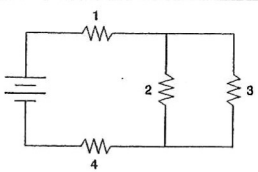
23. A 10-kg wagon moves horizontally at an initial speed of 5 m/s. A 30-N force is applied to the wagon by pulling the rigid handle, which is angled 60° above the horizontal. The wagon continues to move horizontally for another 20 m. By how much has the wagon's kinetic energy increased over the 20 m?

(A) 300 J
(B) 600 J
(C) 125 J
(D) 63 J

24. A moving 1.5-kg cart collides with and sticks to a 0.5-kg cart which was initially at rest. Immediately after the collision, the carts each have the same _____ as each other.

(A) Velocity
(B) Kinetic energy
(C) Mass
(D) Linear momentum

Questions 25 and 26 refer to the information below:

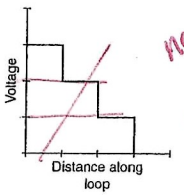


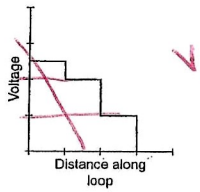
Four identical resistors are connected to a battery in the configuration shown in the preceding figure.

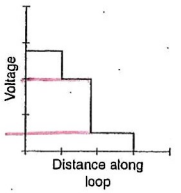
25. Which of the following ranks the current I through each resistor?

(A) $I_1 = I_4 > I_2 > I_3$
(B) $I_1 = I_4 > I_2 = I_3$
(C) $I_1 = I_2 = I_3 = I_4$
(D) $I_1 > I_2 = I_3 > I_4$

26. Which graph represents the electric potential with respect to the negative end of the battery as a function of the location on a loop of wire starting from the positive end of the battery, going through resistors 1, 2, and 4, and ending back on the negative end of the battery?

(A)


(B)


(C)


(D)