Sample Exam Questions

The sample exam questions that follow illustrate the relationship between the course framework and AP Physics 1 Exam and serve as examples of the types of questions that appear on the exam. After the sample questions, teachers will find a table that shows which science practice(s), learning objective(s), and unit each question relates to. The table also provides the answers to the multiple-choice questions.

Section I: Multiple-Choice Questions

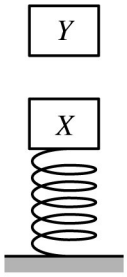

Figure 1

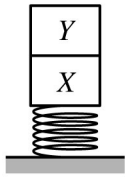

Figure 2

1. Block Y with mass m_Y falls onto and sticks to block X, which is attached to a vertical spring, as shown in Figure 1. A short time later, as shown in Figure 2, the blocks are momentarily at rest. At that moment, block Y exerts a force of magnitude F_{down} on block X, and block X exerts a force of magnitude F_{up} on block Y. Which of the following correctly relates F_{up}, F_{down}, and $m_Y g$ at the instant shown in Figure 2?

   (A) $\left(F_{up} = F_{down}\right) > m_Y g$

   (B) $\left(F_{up} = m_Y g\right) > F_{down}$

   (C) $m_Y g > F_{up} > F_{down}$

   (D) $F_{up} = F_{down} = m_Y g$

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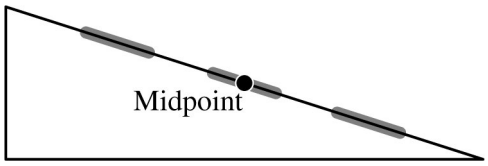


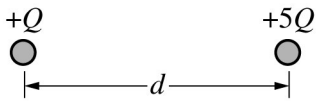
2. A block is released from rest and slides down a ramp. The surface of the ramp has three rough sections where the friction between the surface and the block is not negligible, as shown by the shaded regions above. Measuring which of the following will allow for the best estimate of the block's instantaneous acceleration when the block is at the midpoint of the ramp?

   (A) The total distance traveled by the block and the total elapsed time

   (B) The final speed of the block and the total elapsed time

   (C) The distance between points just before and just after the midpoint and the time it takes the block to travel between them

   (D) The speed of the block at points just before and just after the midpoint and the time it takes the block to travel between them



Note: Figure not drawn to scale.

3. Two small conducting spheres initially have charges $+Q$ and $+5Q$, as shown above. When the centers of the spheres are a distance d apart, the electric force that each sphere exerts on the other has magnitude F_0. The two spheres are brought into contact, after which they have the same charge. If the spheres are then separated to a distance of $3d$ between their centers, the electric force between them will have a magnitude of

   (A) $\frac{1}{9}F_0$

   (B) $\frac{1}{5}F_0$

   (C) $\frac{5}{9}F_0$

   (D) $\frac{9}{5}F_0$

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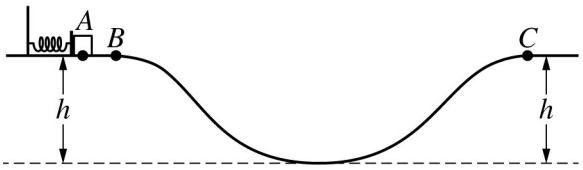

4. A block is held at rest against a compressed spring at point *A* at the top of a frictionless track of height *h*, as shown above. The block is released, loses contact with the spring at point *B*, and slides along the track until it passes point *C*, also at height *h*. How do the potential energy *U* of the block-Earth system and the kinetic energy *K* of the block at point *C* compare with those at point *A*?

	Potential Energy of Block-Earth System	Kinetic Energy of Block
(A)	$U_C = U_A$	$K_C = K_A$
(B)	$U_C = U_A$	$K_C > K_A$
(C)	$U_C > U_A$	$K_C = K_A$
(D)	$U_C > U_A$	$K_C > K_A$

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Questions 5–7 refer to the following material.

Figure 1

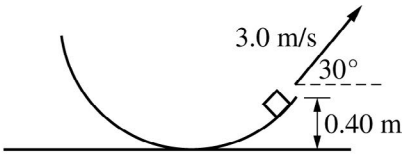

Figure 2

Note: Figures not drawn to scale.

The figures above show a small block of mass 0.20 kg on a track in the shape of a circular arc. The block is released from rest at a height H above the floor, as shown in Figure 1. The block slides along the track with negligible friction and leaves it at a height of 0.40 m above the floor and a speed of 3.0 m/s at a 30° angle, as shown in Figure 2.

5. The height H is most nearly
   (A) 0.45 m
   (B) 0.51 m
   (C) 0.86 m
   (D) 1.7 m

6. The magnitude of the gravitational force exerted on the block is F_g, and the magnitude of the normal force exerted by the track on the block is F_n. Which of the following correctly compares the magnitudes of these two forces when the block is at the lowest point on the track?
   (A) $F_n > F_g$
   (B) $F_n = F_g$
   (C) $F_n < F_g$
   (D) The magnitudes cannot be compared without knowing the radius of the arc of the track.

7. After the block leaves the track, what is the block's speed when it reaches the highest point of its motion?
   (A) 0
   (B) 1.5 m/s
   (C) 2.6 m/s
   (D) 3.0 m/s

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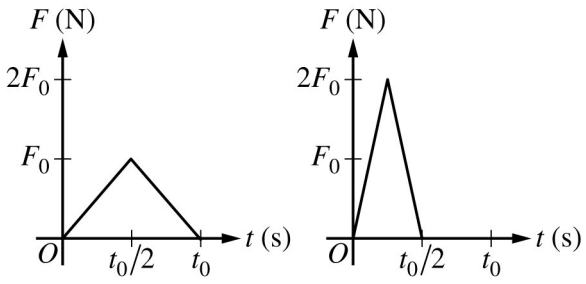


Object X Object Y

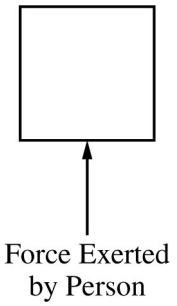
8. Objects X and Y are constrained to move along a straight line. The graphs above show the net force exerted along that line on each of the objects as functions of time. Which of the following correctly ranks the change in momentum Δp of the objects?

(A) $\Delta p_X < \Delta p_Y$

(B) $\Delta p_X = \Delta p_Y$

(C) $\Delta p_X > \Delta p_Y$

(D) The ranking cannot be determined without knowing the masses of the objects.



9. A person exerts an upward force on a box, as shown above. The box may be moving upward, downward, or not at all while the person exerts the upward force. For which of the following motions of the box is the work done by the person on the box correctly indicated?

	Motion of Box	Work Done by Person on Box
(A)	No motion	Positive
(B)	Upward with decreasing speed	Negative
(C)	Downward with constant speed	Zero
(D)	Downward with increasing speed	Negative

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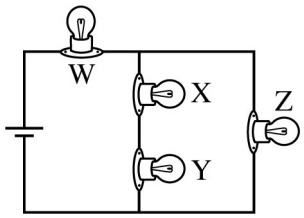
10. Two satellites are in circular orbits around Earth. Satellite 1 has mass m_0 and an orbital radius of $2R_E$, where R_E is the radius of Earth. Satellite 2 has mass $2m_0$ and an orbital radius of $3R_E$. Which of the following correctly compares the magnitude F of the force exerted by Earth on each satellite and the speed v of each satellite?

	Force	Speed
(A)	$F_1 > F_2$	$v_1 > v_2$
(B)	$F_1 > F_2$	$v_2 > v_1$
(C)	$F_2 > F_1$	$v_1 > v_2$
(D)	$F_2 > F_1$	$v_2 > v_1$



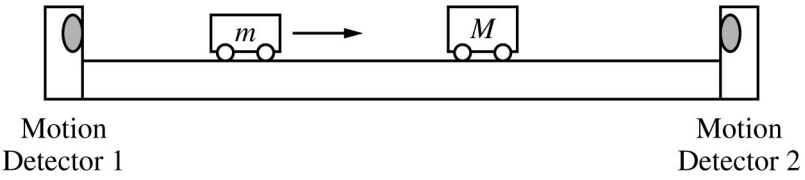
11. A battery and four identical lightbulbs are used to create the circuit shown above. Which of the following correctly ranks the current I in each bulb?

(A) $I_W > I_X > I_Y > I_Z$

(B) $(I_W = I_Z) > (I_X = I_Y)$

(C) $I_W > I_Z > I_X > I_Y$

(D) $I_W > I_Z > (I_X = I_Y)$



12. In the setup shown above, a student uses motion detector 1 to measure the speed v_i of a cart with mass m before it collides with and sticks to a stationary cart with mass M. Motion detector 2 measures the speed v_f of the carts after the collision. The student repeats the experiment several times using different values of v_i and creates a graph of v_f as a function of v_i. The slope of this graph is most nearly equal to

(A) $\frac{m}{M}$

(B) $\frac{m}{M+m}$

(C) $\frac{M-m}{M+m}$

(D) $\sqrt{\frac{m}{M+m}}$

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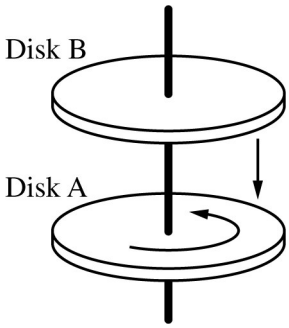
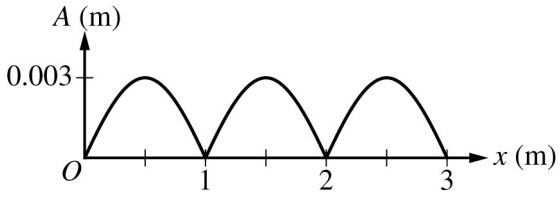


13. Cylindrical disk *A* is rotating freely about an axis when an identical disk *B* that is not rotating is dropped directly on top of disk *A*. If the two disks stick together, how does the total angular momentum and total kinetic energy of the two-disk system after the disks are stuck together compare to that of the system before disk *B* was dropped?

	Total Angular Momentum	Total Kinetic Energy
(A)	Remains the same	Is one-half its original value
(B)	Remains the same	Is one-fourth its original value
(C)	Is one-half its original value	Is one-half its original value
(D)	Is one-half its original value	Is one-fourth its original value



14. A standing wave is produced on a horizontal string of length 3 m that is fixed at both ends. The graph above shows the amplitude *A* of the vertical oscillations of points on the string as a function of the distance *x* from one end of the string. For any point on the string, the amplitude is the absolute value of the maximum displacement of that point from its equilibrium position. The wavelength of the standing wave is

(A) 1.0 m

(B) 1.5 m

(C) 2.0 m

(D) 3.0 m

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15. Which of the following statements about a satellite in an elliptical orbit around Earth are correct? Select two answers.

(A) The satellite's kinetic energy is constant throughout the orbit.

(B) The satellite's angular momentum about the center of mass of the satellite-Earth system is constant throughout the orbit.

(C) The magnitude of the satellite's linear momentum is constant throughout the orbit.

(D) The gravitational potential energy of the Earth-satellite system is greatest at the satellite's farthest point from Earth.

16. Which of the following can be used as evidence for the claim that the energy carried by a mechanical wave increases with the amplitude of the wave? Select two answers.

(A) A person does not move when a small ocean wave passes by but is pushed over by a higher wave.

(B) A high-pitched sound may cause more discomfort to a person's ear than a low-pitched sound does.

(C) The interference of two waves of amplitude A_0 may result in an amplitude that is either larger or smaller than A_0.

(D) A wave pulse on a string is larger or smaller, depending on how far the person creating the pulse moves the end of the string.

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