

# PHYSICS TEST

The top portion of the page of the answer sheet that you will use in taking the Physics Test must be filled in exactly as illustrated below. When your supervisor tells you to fill in the circle next to the name of the test you are about to take, mark your answer sheet as shown.

<input type="radio"/> Literature	<input type="radio"/> Mathematics Level 1	<input type="radio"/> German	<input type="radio"/> Chinese Listening	<input type="radio"/> Japanese Listening
<input type="radio"/> Biology E	<input type="radio"/> Mathematics Level 2	<input type="radio"/> Italian	<input type="radio"/> French Listening	<input type="radio"/> Korean Listening
<input type="radio"/> Biology M	<input type="radio"/> U.S. History	<input type="radio"/> Latin	<input type="radio"/> German Listening	<input type="radio"/> Spanish Listening
<input type="radio"/> Chemistry	<input type="radio"/> World History	<input type="radio"/> Modern Hebrew		
<input checked="" type="radio"/> Physics	<input type="radio"/> French	<input type="radio"/> Spanish		

**Background Questions:**  1  2  3  4  5  6  7  8  9

After filling in the circle next to the name of the test you are taking, locate the Background Questions section, which also appears at the top of your answer sheet (as shown above). This is where you will answer the following Background Questions on your answer sheet.

## BACKGROUND QUESTIONS

Please answer the three questions below by filling in the appropriate circle in the Background Questions box on your answer sheet. The information you provide is for statistical purposes only and will not affect your test score.

### Question 1

How many semesters of physics have you taken in high school, including any semester in which you are currently enrolled? (Count as two semesters any case in which a full year's course is taught in a one-semester [half-year] compressed schedule.) Fill in only one circle of circles 1-3.

- One semester or less —Fill in circle 1.
- Two semesters —Fill in circle 2.
- Three semesters or more —Fill in circle 3.

### Question 2

About how often did you do lab work in your first physics course? (Include any times when you may have watched a film or a demonstration by your teacher and then discussed or analyzed data.) Fill in only one circle of circles 4-7.

- Less than once a week —Fill in circle 4.
- About once a week —Fill in circle 5.
- A few times a week —Fill in circle 6.
- Almost every day —Fill in circle 7.

### Question 3

If you have taken or are currently taking an Advanced Placement (AP) Physics course, which of the following describes the course? Fill in both circles if applicable. (If you have never had AP Physics, leave circles 8 and 9 blank.)

- A course that uses algebra and trigonometry but NOT calculus (Physics 1 and/or Physics 2) —Fill in circle 8.
- A course that uses calculus (Physics C) —Fill in circle 9.

When the supervisor gives the signal, turn the page and begin the Physics Test. There are 100 numbered circles on the answer sheet and 75 questions in the Physics Test. Therefore, use only circles 1 to 75 for recording your answers.

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# PHYSICS TEST

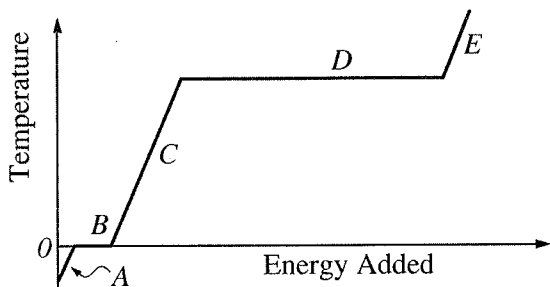
**Note:** To simplify calculations, you may use  $g = 10 \text{ m/s}^2$  for the acceleration due to gravity at Earth's surface.

## Part A

**Directions:** Each set of lettered choices below refers to the numbered questions immediately following it. Select the one lettered choice that best answers each question, and then fill in the corresponding circle on the answer sheet. A choice may be used once, more than once, or not at all in each set.

### Questions 1-3

The graph below shows the temperature of a sample of pure water as a function of the energy added to the sample. The water is initially ice and is then taken through the liquid and gaseous phases.



1. Portion of the graph corresponding to the water boiling
2. Portion of the graph corresponding to the liquid water getting warmer
3. Portion of the graph corresponding to the ice melting

### Questions 4-5

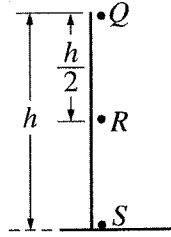
An ideal gas undergoes a process from an initial state to a final state. The process may be one of the following.

- (A) A constant-temperature process
  - (B) A constant-volume process
  - (C) A constant-pressure process
  - (D) A process by which pressure, volume, and temperature all increase
  - (E) A process by which pressure, volume, and temperature all decrease
4. For which process will the average kinetic energy of the molecules be constant throughout the entire process?
  5. For which process will no work be done on or by the gas throughout the entire process?



PHYSICS TEST—Continued

Questions 6-7



A stone is dropped from the top of the cliff of height  $h$  shown above. The stone is at point  $Q$  just after release. Point  $S$  is just above the ground. Let the gravitational potential energy be defined to be zero at the ground, and assume air resistance is negligible.

- (A) It is 4 times that at  $R$ .
  - (B) It is 2 times that at  $R$ .
  - (C) It is  $\sqrt{2}$  times that at  $R$ .
  - (D) It is the same as at  $R$ .
  - (E) It is half that at  $R$ .
6. How does the acceleration of the stone at  $Q$  compare to that at  $R$  ?
7. How does the gravitational potential energy when the stone is at  $Q$  compare to that at  $R$  ?

Questions 8-10

The table below includes three properties of the net force on an object: the magnitude, direction, and angle with respect to the object's path. For each situation in the questions that follow, select the choice that indicates whether these quantities are constant or changing during the course of the motion.

	<u>Magnitude of Net Force</u>	<u>Direction of Net Force</u>	<u>Angle of Net Force with Respect to Path</u>
(A)	Constant	Constant	Constant
(B)	Constant	Constant	Changing
(C)	Constant	Changing	Constant
(D)	Changing	Constant	Constant
(E)	Changing	Changing	Constant

8. A block sliding down a frictionless inclined plane
9. A satellite moving in a circular orbit at constant speed
10. A projectile following a parabolic trajectory near Earth's surface



PHYSICS TEST—Continued



Questions 11-12 refer to the following types of energy.

- (A) Gravitational potential energy
  - (B) Electrical potential energy
  - (C) Elastic potential energy
  - (D) Nuclear potential energy
  - (E) Kinetic energy
11. The energy that increases as a simple pendulum swings upward toward the highest point of its swing
12. The major source of the energy released by a uranium atom undergoing fission

Questions 13-14 refer to the following types of spectra.

- I. Continuous spectrum
  - II. Bright-line spectrum
  - III. Dark-line spectrum
- (A) I only
  - (B) II only
  - (C) III only
  - (D) II and III only
  - (E) I, II, and III
13. Which of these spectra does a glowing lightbulb filament produce?
14. Which of these spectra does the gas discharge tube of a neon sign produce?

Questions 15-16

The following are positions at which electric or magnetic fields may exist. Assume that in each position there are no electric or magnetic fields other than those due to the charges or currents mentioned.

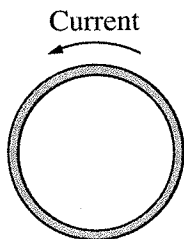
- (A) Inside a charged hollow metal sphere
  - (B) In the vicinity of a bar magnet
  - (C) In the vicinity of an electric point charge
  - (D) Midway between two infinitely long and wide parallel plates carrying charges of equal magnitude and the same sign
  - (E) Midway between two infinitely long parallel wires carrying equal currents in the same direction
15. Where must there exist an electric field that is not equal to zero?
16. Where must there exist a magnetic field that is not equal to zero?



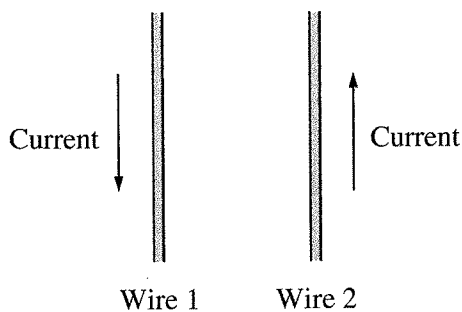
PHYSICS TEST—Continued

Questions 17-18 refer to the following possible directions for magnetic fields or forces.

- (A) Toward the left
- (B) Toward the right
- (C) Toward the bottom of the page
- (D) Toward the top of the page
- (E) Out of the page



17. A wire loop in the plane of the page carries a counterclockwise current, as shown above. What is the direction of the magnetic field at the center of the loop?



18. Wires 1 and 2 lie in the plane of the page and carry currents in opposite directions, as shown above. What is the direction of the magnetic force on wire 2 due to wire 1?

Questions 19-20

Each of the following pairs of electric charges is the same distance apart. Point  $P$  is equidistant from the charges in each case. Assume that each pair is isolated from all other charges.

- (A)  $+Q$   $P$   $+Q$
- (B)  $+Q$   $P$   $-Q$
- (C)  $+2Q$   $P$   $-2Q$
- (D)  $-Q$   $P$   $+2Q$
- (E)  $+2Q$   $P$   $-Q$

19. For which pair is the electric field at  $P$  equal to zero?

20. For which pair is the magnitude of the electric field at  $P$  the greatest?

Questions 21-22

- (A) Loudness
  - (B) Pitch
  - (C) Quality (timbre)
  - (D) Beats
  - (E) Resonance
21. Primarily determined by the amplitude of a sound wave
22. For a vibrating string of fixed length, always increases with an increase in tension

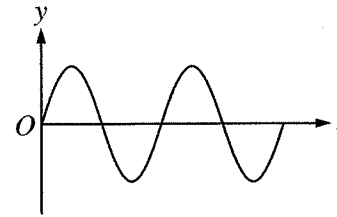
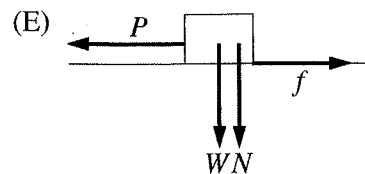
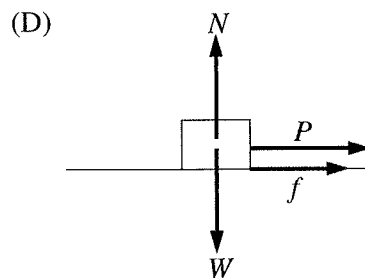
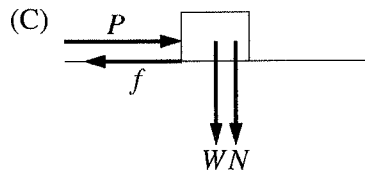
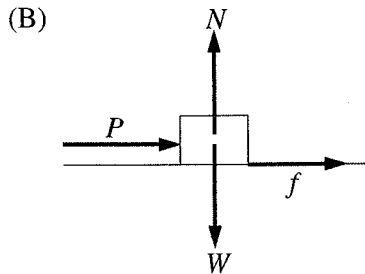
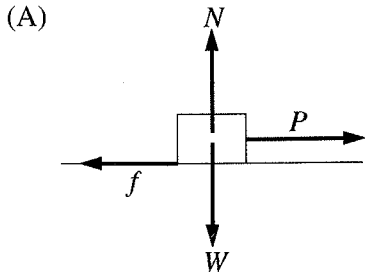


PHYSICS TEST—Continued

Part B

**Directions:** Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case and then fill in the corresponding circle on the answer sheet.

23. A block of weight  $W$  is moving to the right, pushed across a floor by horizontal force  $P$ . The force due to friction is  $f$ , and the normal force is  $N$ . Which of the following diagrams best shows the forces acting on the block?



24. The vertical displacement  $y$  of a ball is given as a function of time  $t$  in the graph above. The motion of which of the following balls could have created the graph?

- I. Ball I is in free fall under the influence of a constant gravitational force.
- II. Ball II is floating in a ripple tank.
- III. Ball III is attached to the end of a vertical spring.

- (A) I only
- (B) III only
- (C) I and II only
- (D) II and III only
- (E) I, II, and III

25. On a trip to Washington, D.C., a group of students ran up the steps of the Capitol building. If they all started together and stopped at the top at the same time, which of the students expended the greatest average power in overcoming gravity to make the climb?

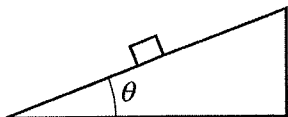
- (A) The heaviest
- (B) The lightest
- (C) They all expended the same average nonzero power.
- (D) None of them expended power, since energy is always conserved.
- (E) It cannot be determined without knowing the total mass of all the students.



PHYSICS TEST—Continued



Questions 26-27



A box of mass  $m$  is at rest on an inclined plane, as shown above.

26. What is the magnitude of the normal force on the box?

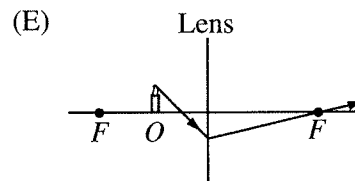
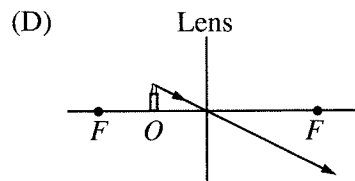
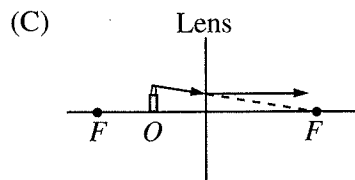
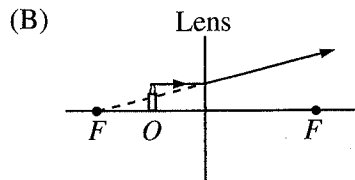
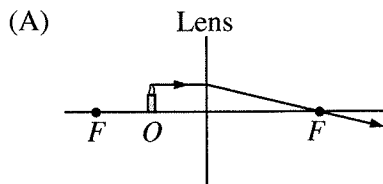
- (A) Zero
- (B)  $mg$
- (C)  $mg \tan \theta$
- (D)  $mg \sin \theta$
- (E)  $mg \cos \theta$

27. What is the direction of the net force on the box?

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

(E) The net force has no direction because it is zero.

28. The following diagrams show the path of a light ray from an object  $O$  passing through a thin lens having focal points  $F$ . Which ray diagram CANNOT be correct for either a converging or a diverging lens?





PHYSICS TEST—Continued

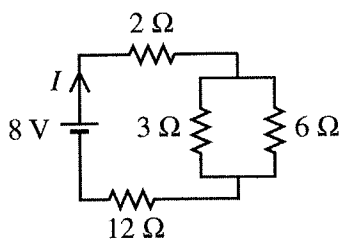


29. Which of the following is a phenomenon that is observed for light waves in air but not for sound waves in air?
- (A) Polarization
  - (B) Interference
  - (C) Diffraction
  - (D) Attenuation
  - (E) Resonance
30. When monochromatic light is passed through two narrow parallel slits, processes that occur include which of the following?
- I. The light is diffracted at each slit.
  - II. The waves from the two slits exhibit interference.
  - III. The wavelength of the light decreases.
- (A) I only
  - (B) III only
  - (C) I and II only
  - (D) II and III only
  - (E) I, II, and III
31. If a satellite in a circular orbit moves with constant speed, then its
- (A) momentum changes in direction
  - (B) potential energy changes in magnitude
  - (C) potential energy changes in direction
  - (D) kinetic energy changes in direction
  - (E) centripetal and tangential accelerations are both zero
32. Ball 1 is thrown straight down from the top of a building with a given initial speed. At the same time ball 2 is thrown straight up from the top of the same building with the same initial speed. Air resistance is negligible. If ball 1 has a speed  $v$  just before hitting the ground, what is the speed of ball 2 just before hitting the ground?
- (A)  $4v$
  - (B)  $2v$
  - (C)  $v$
  - (D)  $v/2$
  - (E)  $v/4$
33. An object with zero acceleration will
- (A) move along the trajectory of a projectile
  - (B) change speed without changing direction
  - (C) change direction without changing speed
  - (D) maintain constant circular motion
  - (E) maintain constant speed and direction
34. A student decides to investigate the electrical shock she receives as she gets out of her car. Which of the following factors is LEAST likely to have a significant effect on the size of the shock?
- (A) The materials her clothing contains
  - (B) The distance she slides across the seat when getting out
  - (C) The part of the car she touches as she gets out
  - (D) The humidity of the air
  - (E) Whether the engine is running





PHYSICS TEST—Continued



35. Four resistors are connected in a circuit with a power supply, as shown in the figure above. A current  $I$  leaves the battery. Which resistor in the circuit dissipates the most power?
- (A) The  $2\ \Omega$  resistor
  - (B) The  $3\ \Omega$  resistor
  - (C) The  $6\ \Omega$  resistor
  - (D) The  $12\ \Omega$  resistor
  - (E) All four resistors dissipate the same power.

36. You are given only a coil of wire, a battery of unknown emf, and connecting wires and are asked to determine the resistance of the coil. Which of the following additional instruments should you request?

- I. A voltmeter
- II. An ammeter
- III. An electroscopes

- (A) I only
- (B) II only
- (C) III only
- (D) I and II only
- (E) II and III only

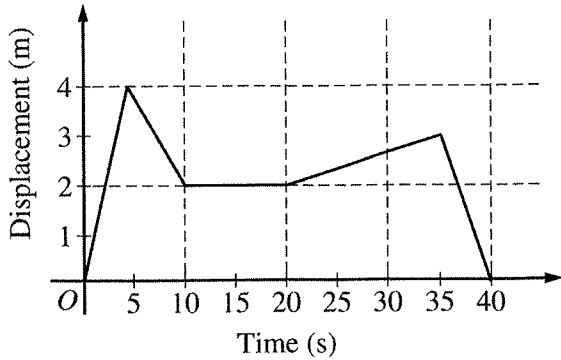


PHYSICS TEST—Continued



Questions 37-39

The graph below shows the displacement of a mouse running in a straight, narrow, 8-meter-long tunnel. The entrance of the tunnel is taken as the origin.



37. What is the farthest position the mouse reaches inside the tunnel?

- (A) 3 meters into the tunnel
- (B) 4 meters into the tunnel
- (C) 7 meters into the tunnel
- (D) The end of the tunnel
- (E) It cannot be determined from the information given.

38. What is the average speed of the mouse for the interval from 10 to 35 seconds?

- (A) 0 m/s
- (B)  $\frac{1}{25}$  m/s
- (C)  $\frac{1}{15}$  m/s
- (D)  $\frac{3}{25}$  m/s
- (E)  $\frac{1}{5}$  m/s

39. What is the magnitude of the average velocity of the mouse for the 40-second interval?

- (A) 0 m/s
- (B)  $\frac{1}{10}$  m/s
- (C)  $\frac{1}{5}$  m/s
- (D)  $\frac{1}{4}$  m/s
- (E)  $\frac{2}{5}$  m/s



PHYSICS TEST—Continued



40. A diver is lying at the bottom of a calm pool of water. A bird is in a tree above the water, directly over the diver's feet. Correct statements about this situation include which of the following?
- I. To the diver, the bird will appear to be higher above the ground than it actually is.
  - II. To the diver, the bird and the tree will be inverted because the surface of the pool behaves like a lens.
  - III. The bird cannot see the diver because the light is totally reflected by the surface of the water.
- (A) I only  
(B) III only  
(C) I and II only  
(D) II and III only  
(E) I, II, and III
41. A beam of light has a wavelength,  $\lambda$  in air. If the beam passes from air into water, which has an index of refraction of  $4/3$ , its wavelength in the water is
- (A)  $\frac{\lambda}{4}$   
(B)  $\frac{3\lambda}{4}$   
(C)  $\lambda$   
(D)  $3\lambda$   
(E)  $4\lambda$
42. According to the conservation of charge principle, which of the following is certain to be true when charged objects interact?
- (A) The charge on each object remains the same.
  - (B) The number of charged objects is the same before and after the interaction.
  - (C) The total net charge of the objects is the same before and after the interaction.
  - (D) The total net charge of all the objects can change during the interaction only by an amount equal to an integer times the charge of an electron.
  - (E) The total net charge of the objects can increase only if, in a later interaction, the total net charge decreases by an equal amount.
43. The present theory of matter postulates that electrons in an atom do not have fixed orbital radii. For each possible electron energy state, there are regions around the nucleus where there is a high probability of finding the electron, sometimes referred to as the electron cloud. The existence of the electron cloud is directly related to which of the following?
- (A) Electrons in the atom move very quickly.
  - (B) Electrons are negatively charged.
  - (C) Electrons have wave properties.
  - (D) Electrons are point particles.
  - (E) Electrons are repelled by other electrons.
44. At room temperature, the resistance of a piece of a certain superconducting material is 10 ohms. When the temperature of the material drops below its critical temperature ( $T_c = 20$  K), its resistance becomes
- (A) zero
  - (B)  $0.5 \Omega$
  - (C)  $2 \Omega$
  - (D)  $10 \Omega$
  - (E) infinite
45. Of the following, which is the best estimate of the angular velocity of Earth's rotation?
- (A)  $10^{-1}$  rev/s
  - (B)  $10^{-3}$  rev/s
  - (C)  $10^{-5}$  rev/s
  - (D)  $10^{-7}$  rev/s
  - (E)  $10^{-9}$  rev/s
46. The resistances of two resistors are measured to be  $5.2 \pm 0.3$  ohms and  $7.7 \pm 0.2$  ohms. These measurements are used to determine the net resistance when the resistors are placed in series. The error in the calculated value is most nearly
- (A)  $\pm 0.06 \Omega$
  - (B)  $\pm 0.1 \Omega$
  - (C)  $\pm 0.5 \Omega$
  - (D)  $\pm 1.0 \Omega$
  - (E)  $\pm 2.5 \Omega$



PHYSICS TEST—Continued

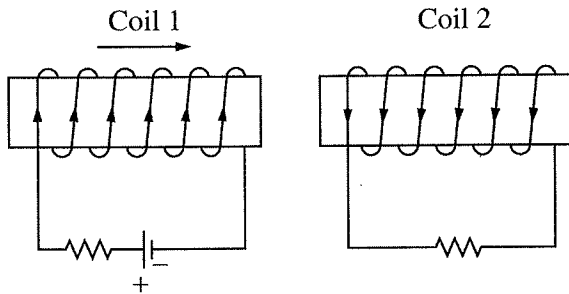


47. Which of the following is a correct evaluation of the expression  $\frac{(2 \text{ kg})(2 \text{ m/s}^2)(2 \text{ m})}{2 \text{ s}}$  ?

- (A) 4 kg·m/s
- (B) 4 N
- (C) 4 N·s
- (D) 4 J
- (E) 4 W

48. Experimental evidence of the existence of the top quark is considered to be essential in support of which of the following?

- (A) The standard model of particles and fields
- (B) The model of high-temperature superconductivity
- (C) The general theory of relativity
- (D) The special theory of relativity
- (E) The Bohr model of the atom

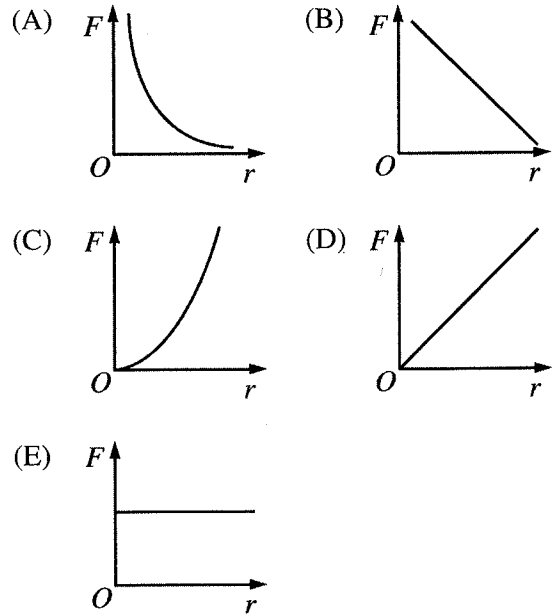


49. In the figure above, coil 1 is moving toward coil 2. Which of the following changes will increase the induced current in coil 2 ?

- I. The speed of coil 1 is increased.
- II. The number of turns in coil 1 is increased.
- III. The battery attached to coil 1 is replaced by one of higher emf.

- (A) I only
- (B) III only
- (C) I and II only
- (D) II and III only
- (E) I, II, and III

50. Two point charges are a distance  $r$  apart. Which of the following best shows the magnitude  $F$  of the electric force on either charge as a function of  $r$  ?



51. Two spheres,  $X$  and  $Y$ , are 8 meters apart. The charge on sphere  $X$  is 2 microcoulombs and the charge on sphere  $Y$  is 1 microcoulomb. If  $F$  is the magnitude of the force of  $X$  on  $Y$ , then what is the magnitude of the force of  $Y$  on  $X$  ?

- (A)  $\frac{1}{8}F$
- (B)  $\frac{1}{2}F$
- (C)  $F$
- (D)  $2F$
- (E)  $8F$



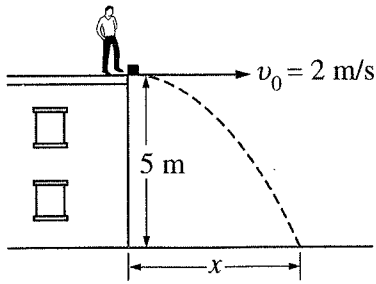
PHYSICS TEST—Continued



52. If the energy of a photon is  $E$ , which of the following is the correct expression for the wavelength  $\lambda$  of the photon in terms of its energy  $E$ , Planck's constant  $h$ , and the speed of light  $c$ ?
- (A)  $\lambda = Ehc$
- (B)  $\lambda = \frac{E}{hc}$
- (C)  $\lambda = \frac{hc}{E}$
- (D)  $\lambda = \frac{Eh}{c}$
- (E)  $\lambda = \frac{Ec}{h}$
53. The mass of an electron at rest is approximately  $9 \times 10^{-31}$  kilogram. If this mass were completely converted to energy, the amount of energy produced would be most nearly
- (A)  $10^{-21}$  J
- (B)  $10^{-13}$  J
- (C)  $10^{-8}$  J
- (D)  $10^{-3}$  J
- (E)  $10^2$  J
54. Assume that Earth is uniform in density. If Earth's radius could be doubled with its mass remaining the same, the magnitude of the gravitational acceleration on Earth's surface would be
- (A)  $g/4$
- (B)  $g/2$
- (C)  $g$
- (D)  $2g$
- (E)  $4g$
55. A ball undergoes uniform circular motion with centripetal acceleration  $a$ . If both the radius of the circle and the speed of the ball are tripled, which of the following is the new acceleration of the ball?
- (A)  $\frac{a}{9}$
- (B)  $\frac{a}{3}$
- (C)  $\frac{a}{\sqrt{3}}$
- (D)  $3a$
- (E)  $9a$
56. A 10-kilogram steel ball is dropped from the top of a tower 100 meters high. The kinetic energy of the ball just before it strikes the ground is most nearly
- (A) 10 J
- (B) 100 J
- (C) 1,000 J
- (D) 10,000 J
- (E) 100,000 J



PHYSICS TEST—Continued



Note: Figure not drawn to scale.

57. A worker accidentally kicks a scrap of lumber off the flat roof of a building, giving it an initial horizontal speed  $v_0$  of 2 meters per second. The building is 5 meters high, as shown above. If air resistance is negligible, the distance  $x$  from the edge of the building to where the wood scrap lands is most nearly

- (A) 0.5 m
- (B) 1.0 m
- (C) 2.0 m
- (D) 5.0 m
- (E) 10 m

58. A projectile is fired from ground level at an angle of  $60^\circ$ . Air resistance is negligible. Which of the following is true of the projectile's velocity and acceleration vectors at the highest point of its path?

<u>Velocity Vector</u>	<u>Acceleration Vector</u>
------------------------	----------------------------

- |                         |             |
|-------------------------|-------------|
| (A) Equals zero         | Equals zero |
| (B) Equals zero         | Points down |
| (C) Points horizontally | Equals zero |
| (D) Points horizontally | Points down |
| (E) Points vertically   | Points down |

59. Which of the following is a completely inelastic collision?
- (A) A ball rebounds against a wall, reversing its velocity.
  - (B) Two balls collide head on, each reversing its velocity.
  - (C) Two balls collide, stick to each other, and move together after the collision.
  - (D) Two balls collide and move at a right angle to each other after the collision.
  - (E) A ball with velocity  $\mathbf{v}$  collides with a ball at rest; after the collision the first ball is at rest and the second ball has velocity  $\mathbf{v}$ .

60. A toy truck of mass 0.6 kilogram initially coasts horizontally at a constant speed of 2 meters per second. A child drops a beanbag of mass 0.2 kilogram straight down into the truck. Immediately afterward, the speed of the truck is most nearly

- (A) 0.3 m/s
- (B) 1.2 m/s
- (C) 1.5 m/s
- (D) 2.0 m/s
- (E) 2.4 m/s

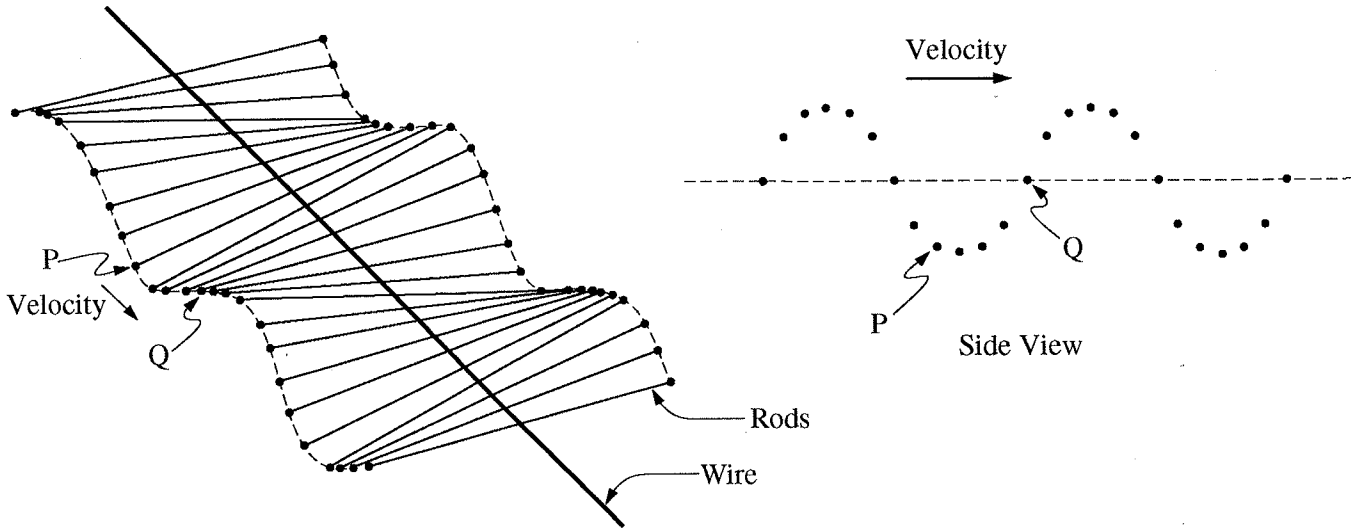
61. A car moves along a straight road at constant speed until its brakes are applied. The car then slows down until it comes to a stop. Three quantities are measured: the car's mass, the speed of the car just before the brakes are applied, and the time it takes for the car to come to a stop. Which of the following can be calculated from this information?

- I. The average acceleration of the car
- II. The average net force exerted on the car
- III. The average power expended while the brakes are applied

- (A) I only
- (B) II only
- (C) III only
- (D) I and II only
- (E) I, II, and III



Questions 62-63



A wave machine consists of many long rods rigidly connected perpendicularly at their centers to a taut wire. A wave generator moves one end of the last rod up and down, which causes a transverse wave with velocity  $v$  to travel on the machine, as shown above on the left. When the wave is traveling, the rod ends outline a sine wave. The side view, above on the right, shows the positions of the rod ends at a particular instant.

62. The wave generator suddenly increases the amplitude of the waves it is producing, but the frequency of the waves remains the same. Which of the following properties of the waves will also increase as a result?

- I. The average speed at which the rod ends move up and down
- II. The speed at which the wave moves along the rods
- III. The wavelength of the waves

- (A) I only
- (B) III only
- (C) I and II only
- (D) II and III only
- (E) I, II, and III

63. Which of the following correctly describes the direction of motion of rod ends P and Q at the instant shown?

<u>Rod End P</u>	<u>Rod End Q</u>
(A) Up	Down
(B) Right	Left
(C) Right	Right
(D) Down	Down
(E) Up	At rest



PHYSICS TEST—Continued

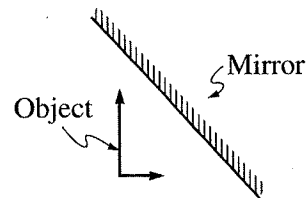


64. A siren on a fire truck creates a sound of frequency  $f$  when the truck is at rest. Which of the following correctly explains why the frequency of the siren heard by a stationary observer is higher than  $f$  when the truck is moving toward the observer?

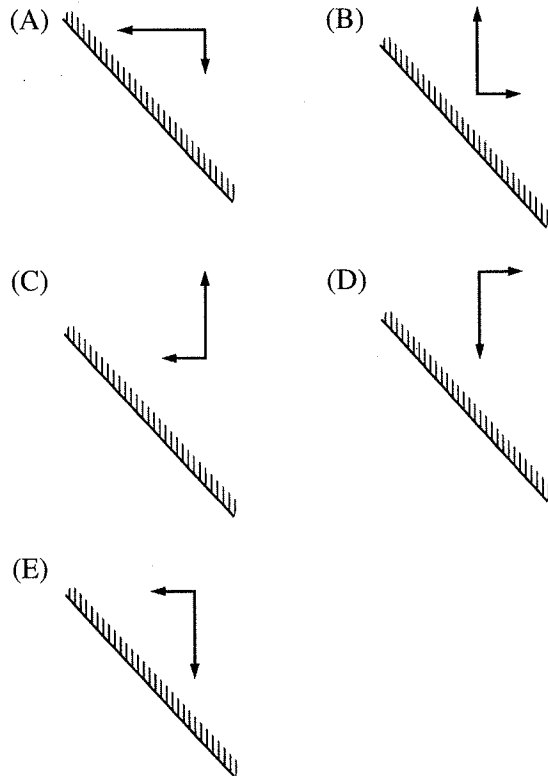
- (A) The velocity of the waves is equal to the velocity of sound in air plus the truck's velocity.
- (B) The motion of the truck causes a decrease in the wavelength of waves reaching the observer.
- (C) The motion of the truck causes an increase in the amplitude of waves reaching the observer.
- (D) Different parts of the sound wave interfere because one part moves faster than the other.
- (E) The siren creates a higher frequency sound when the truck is moving.

65. Which of the following is true of sound waves?

- I. They carry energy.
  - II. They carry momentum.
  - III. They exert pressure.
- (A) None
  - (B) I only
  - (C) II only
  - (D) III only
  - (E) I, II, and III



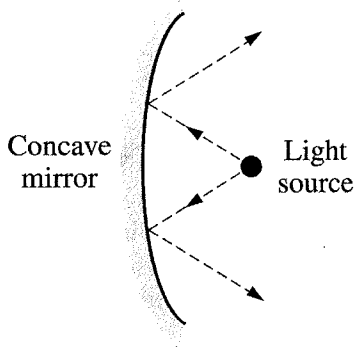
66. The diagram above is a top view of an object and a plane mirror. The image would appear to be in which of the following positions?







PHYSICS TEST—Continued



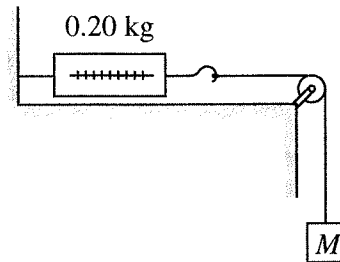
67. A searchlight consisting of a light source and a concave mirror creates a diverging beam of light. Which of the following actions could result in the searchlight creating a parallel beam of light?

- I. Increasing the intensity of the light source
- II. Increasing the distance from the light source to the mirror
- III. Bending the mirror to decrease the radius of the curvature of the mirror

- (A) I only
- (B) II only
- (C) III only
- (D) I and III only
- (E) II and III only

68. A 2-kilogram toy car is traveling forward at 1 meter per second when it is hit in the rear by a 3-kilogram toy truck that was traveling at 3 meters per second just before impact. If the two toys stick together, their speed immediately after the collision is

- (A) 0.8 m/s
- (B) 1.4 m/s
- (C) 1.8 m/s
- (D) 2.0 m/s
- (E) 2.2 m/s

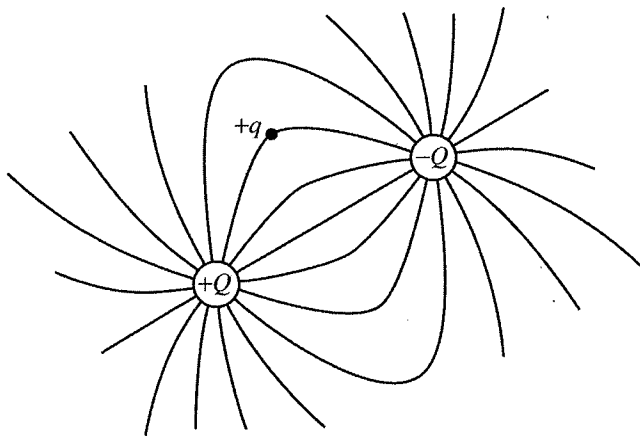


69. A spring scale with a mass of 0.20 kilogram is attached at one end to a wall, as shown above. The other end of the scale is attached to a block of mass  $M$  by a string that passes over a frictionless pulley, so that the block hangs freely. The spring scale registers 10 newtons. The mass  $M$  of the block is most nearly

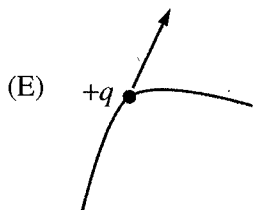
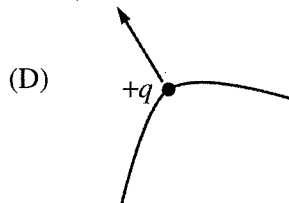
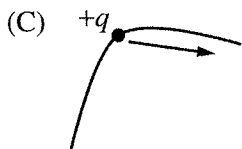
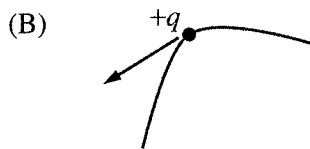
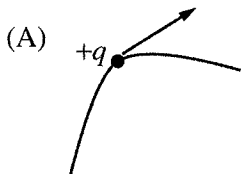
- (A) 0.8 kg
- (B) 1.0 kg
- (C) 1.2 kg
- (D) 1.5 kg
- (E) 2.0 kg



PHYSICS TEST—Continued

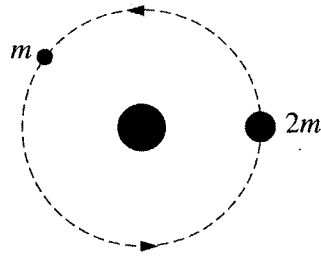
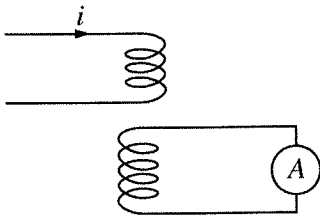


70. A small electric test charge  $+q$  is placed as shown above in the electric field of a positive charge  $+Q$  and a negative charge  $-Q$ . Which of the following best shows the direction of the net electric force on the charge  $+q$ ?





PHYSICS TEST—Continued



71. A coil of wire carrying current  $i$  is next to another coil of wire that is fixed in position and connected to an ammeter, as shown above. The following are four possible states for the current  $i$  in the first coil.

- I. Constant and in the direction of the arrow
- II. Constant and opposite to the direction of the arrow
- III. Increasing and in the direction of the arrow
- IV. Increasing and opposite to the direction of the arrow

Which of the states will create an induced current in the ammeter?

- (A) I and II only
- (B) I and III only
- (C) II and IV only
- (D) III and IV only
- (E) I, II, III, and IV

72. Block  $A$  has mass  $M$  and specific heat  $c$ . Block  $B$  has mass  $M/2$ , specific heat  $c/2$ , and a higher temperature than block  $A$ . The blocks are thermally isolated and put into contact with each other. If block  $A$ 's temperature increases by 20 K, then block  $B$ 's temperature decreases by

- (A) 5 K
- (B) 10 K
- (C) 20 K
- (D) 40 K
- (E) 80 K

73. A planet has two small satellites of mass  $m$  and  $2m$ , respectively, with the same orbital radius and speed, as shown above. The planet exerts a gravitational force  $F$  on the satellite of mass  $m$ , giving the satellite an acceleration of magnitude  $a$ . What gravitational force does the planet exert on the satellite of mass  $2m$  and what is the magnitude of this satellite's resulting acceleration?

	<u>Force</u>	<u>Acceleration</u>
(A)	$F/2$	$a/2$
(B)	$F$	$a$
(C)	$F$	$2a$
(D)	$2F$	$a$
(E)	$2F$	$2a$



PHYSICS TEST—*Continued*

74. A ball is thrown at an angle of  $30^\circ$  above the horizontal, and air resistance is negligible. Under these conditions, each of the following statements concerning the ball at the highest point of its trajectory is true EXCEPT:

- (A) Its kinetic energy is zero.
- (B) Its acceleration is downward.
- (C) Its velocity is horizontal.
- (D) Its momentum is changing.
- (E) Its gravitational potential energy is greater than at any other point in the trajectory.

75. In lifting off against Earth's gravity, the seat of a space shuttle exerts a vertical force of  $4Mg$  on an astronaut of mass  $M$ . What is the astronaut's acceleration?

- (A)  $5g$
- (B)  $4g$
- (C)  $3g$
- (D)  $2g$
- (E)  $g$

**STOP**

**IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS TEST ONLY.  
DO NOT TURN TO ANY OTHER TEST IN THIS BOOK.**

## How to Score the SAT Subject Test in Physics

When you take an actual SAT Subject Test in Physics, your answer sheet will be “read” by a scanning machine that will record your response to each question. Then a computer will compare your answers with the correct answers and produce your raw score. You get one point for each correct answer. For each wrong answer, you lose one-fourth of a point. Questions you omit (and any for which you mark more than one answer) are not counted. This raw score is converted to a scaled score that is reported to you and to the colleges you specify.

### Worksheet 1. Finding Your Raw Test Score

**STEP 1:** Table A on the following page lists the correct answers for all the questions on the Subject Test in Physics that is reproduced in this book. It also serves as a worksheet for you to calculate your raw score.

- Compare your answers with those given in the table.
- Put a check in the column marked “Right” if your answer is correct.
- Put a check in the column marked “Wrong” if your answer is incorrect.
- Leave both columns blank if you omitted the question.

**STEP 2:** Count the number of right answers.

Enter the total here: \_\_\_\_\_

**STEP 3:** Count the number of wrong answers.

Enter the total here: \_\_\_\_\_

**STEP 4:** Multiply the number of wrong answers by .250.

Enter the product here: \_\_\_\_\_

**STEP 5:** Subtract the result obtained in Step 4 from the total you obtained in Step 2.

Enter the result here: \_\_\_\_\_

**STEP 6:** Round the number obtained in Step 5 to the nearest whole number.

Enter the result here: \_\_\_\_\_

**The number you obtained in Step 6 is your raw score.**

# Answers to Practice Test 2

Table A

Answers to the Subject Test in Physics - Practice Test 2 and Percentage of Students Answering Each Question Correctly

Question Number	Correct Answer	Right	Wrong	Percent Answering Correctly*	Question Number	Correct Answer	Right	Wrong	Percent Answering Correctly*
1	D			80	26	E			62
2	C			86	27	E			64
3	B			73	28	E			39
4	A			67	29	A			62
5	B			33	30	C			60
6	D			78	31	A			50
7	B			68	32	C			60
8	A			74	33	E			86
9	C			64	34	E			50
10	B			42	35	D			61
11	A			83	36	D			74
12	D			90	37	B			85
13	A			36	38	B			62
14	B			21	39	A			61
15	C			51	40	A			58
16	B			57	41	B			62
17	E			66	42	C			67
18	B			32	43	C			25
19	A			71	44	A			45
20	C			70	45	C			31
21	A			72	46	C			64
22	B			54	47	E			52
23	A			87	48	A			22
24	D			67	49	E			39
25	A			79	50	A			64

Table A continued on next page

Table A continued from previous page

Question Number	Correct Answer	Right	Wrong	Percent Answering Correctly*	Question Number	Correct Answer	Right	Wrong	Percent Answering Correctly*
51	C			50	66	A			48
52	C			42	67	E			37
53	B			38	68	E			58
54	A			57	69	B			51
55	D			60	70	A			40
56	D			70	71	D			25
57	C			51	72	E			36
58	D			53	73	D			51
59	C			64	74	A			44
60	C			51	75	C			30
61	E			57					
62	A			34					
63	A			26					
64	B			33					
65	E			34					

\* These percentages are based on an analysis of the answer sheets for a random sample of 8,068 students who took the original administration of this test and whose mean score was 647. They may be used as an indication of the relative difficulty of a particular question. Each percentage may also be used to predict the likelihood that a typical Subject Test in Physics candidate will answer correctly that question on this edition of this test.

Note: Answer explanations can be found on page 112.

**Table B**  
**Scaled Score Conversion Table**  
**Subject Test in Physics - Practice Test 2**

<u>Raw Score</u>	<u>Scaled Score</u>	<u>Raw Score</u>	<u>Scaled Score</u>	<u>Raw Score</u>	<u>Scaled Score</u>
75	800	35	650	-5	370
74	800	34	650	-6	360
73	800	33	640	-7	360
72	800	32	630	-8	350
71	800	31	630	-9	340
70	800	30	620	-10	340
69	800	29	610	-11	330
68	800	28	610	-12	320
67	800	27	600	-13	310
66	800	26	590	-14	310
65	800	25	580	-15	300
64	800	24	580	-16	290
63	800	23	570	-17	280
62	800	22	560	-18	280
61	800	21	560	-19	270
60	800	20	550		
59	800	19	540		
58	790	18	530		
57	790	17	530		
56	780	16	520		
55	770	15	510		
54	770	14	510		
53	760	13	500		
52	760	12	490		
51	750	11	480		
50	740	10	480		
49	740	9	470		
48	730	8	460		
47	730	7	450		
46	720	6	450		
45	710	5	440		
44	710	4	430		
43	700	3	430		
42	700	2	420		
41	690	1	410		
40	680	0	400		
39	680	-1	400		
38	670	-2	390		
37	670	-3	380		
36	660	-4	380		