PHYSICS TEST

The top portion of the section of the answer sheet that you will use in taking the Physics test must be filled in exactly as shown in the illustration below. Note carefully that you have to do all of the following on your answer sheet.

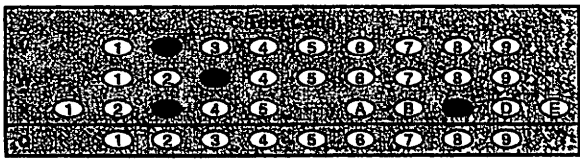
1. Print PHYSICS on the line under the words "Subject Test (print)."
2. In the shaded box labeled "Test Code" fill in four ovals:

—Fill in oval 2 in the row labeled V.

—Fill in oval 3 in the row labeled W.

—Fill in oval 3 in the row labeled X.

—Fill in oval C in the row labeled Y.



3. Please answer the three questions below by filling in the appropriate ovals in the row labeled Q on the answer sheet. The information you provide is for statistical purposes only and will not affect your score on the test.

Question I

How many semesters of physics have you taken in high school? (If you are taking physics this semester, count it as a full semester.) Fill in only one oval of ovals 1-3.

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

Question II

Which of the following describe courses you have taken or are taking now? (Fill in all ovals that apply.)

- Algebra I or Elementary Algebra —Fill in oval 4.
- Geometry —Fill in oval 5.
- Algebra II or Intermediate Algebra —Fill in oval 6.
- Algebra III or Trigonometry or Precalculus —Fill in oval 7.

Question III

Are you currently taking Advanced Placement Physics? If you are, fill in oval 8.

Leave oval 9 blank.

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

PHYSICS TEST

Part A

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

Questions 1-3 relate to the following.

(A) Electron
(B) Proton
(C) Neutron
(D) Positron
(E) Alpha particle

1. Which particle could NOT be deflected by a uniform magnetic field?

2. If all of the particles were in the same electric field, which would be accelerated in a direction opposite to the field?

3. If all of the particles were in the same uniform electric field, which would have the greatest force acting on it?

Questions 4-7 relate to the following equations or physical principles that might be used to solve certain problems.

(A) Kinematic equations for constant acceleration
(B) Newton's second law ($F = ma$)
(C) Newton's third law (For every action there is an equal and opposite reaction.)
(D) Conservation of mechanical energy
(E) Conservation of linear momentum

Select the choice that should be used to provide the best and most direct solution to each of the following problems.

4. A marble is dropped from rest at a given height above the ground. Air resistance is negligible. How long is the marble in free fall?

5. A weight is dropped onto the bed of a toy flatcar that is initially coasting on a straight, horizontal, frictionless track. What is the speed of the flatcar after the weight has settled on it?

6. A frictionless pendulum of given length and mass is released from a horizontal position. What is the speed of the pendulum bob at the lowest position in its swing?

7. A brick of known weight is in free fall. While it is falling, what force does the brick exert on the Earth?

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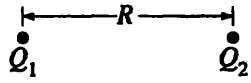
Questions 8-9



Two point charges, Q_1 and Q_2, are separated by a distance R, as shown above. The following choices refer to the electric force on Q_1 due to Q_2.

(A) It is quadrupled.
(B) It is doubled.
(C) It remains the same.
(D) It is halved.
(E) It is quartered.

8. What happens to the magnitude of the force on Q_1 if the sign of Q_1 is changed and Q_2 remains the same?

9. What happens to the magnitude of the force on Q_1 if Q_1 is doubled and Q_2 remains the same?

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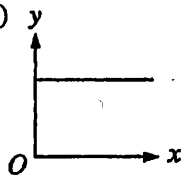
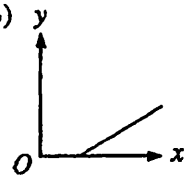
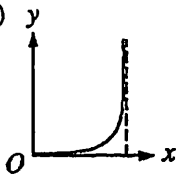
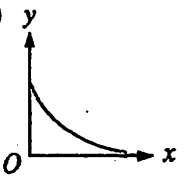
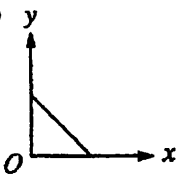
Questions 10-12 relate to the following graphs

(A) 

(B) 

(C) 

(D) 

(E) 

Select the graph above that best expresses each of the following relationships (y as a function of x).

	y		x
10.	Decay rate of nuclei in a radioactive sample	*vs.*	Time
11.	Kinetic energy of a relativistic particle	*vs.*	Speed of the particle
12.	Maximum kinetic energy of a photoelectron ejected from a metal plate	*vs.*	Frequency of the light incident on the plate

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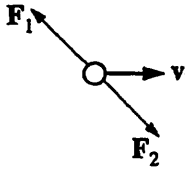
Part B

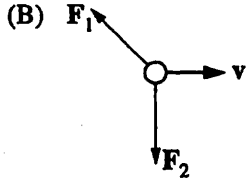
Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case and then fill in the corresponding oval on the answer sheet.

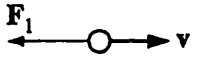
13. You are in a glider that is traveling due east at 60 kilometers per hour relative to an air mass that is traveling due north at 60 kilometers per hour relative to the ground. Your motion relative to the ground is

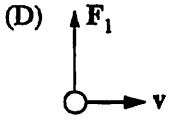
(A) due east
(B) northeast
(C) due north
(D) southwest
(E) due south

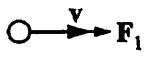
14. Each of the figures below shows the velocity v of a particle and the force or forces acting on the particle. Forces $\mathbf{F}_1$ and $\mathbf{F}_2$ have the same magnitude. In which figure is the particle's speed or direction NOT being changed?

(A) 

(B) 

(C) 

(D) 

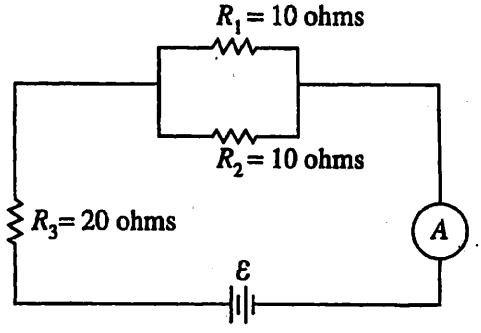
(E) 

15. The magnitude of the electric force exerted by charged particle *X* on charged particle *Y* depends on which of the following?

I. The magnitude of the charge on particle *X*
II. The magnitude of the charge on particle *Y*
III. The distance between particle *X* and particle *Y*

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

Questions 16-17 refer to the electrical circuit shown below. Ammeter *A* reads 2.0 amperes.



16. What is the voltage across R_3 ?

(A) 10 V
(B) 20 V
(C) 30 V
(D) 40 V
(E) 80 V

17. What is the current in R_1 ?

(A) 1.0 A
(B) 2.0 A
(C) 4.0 A
(D) 10 A
(E) 20 A

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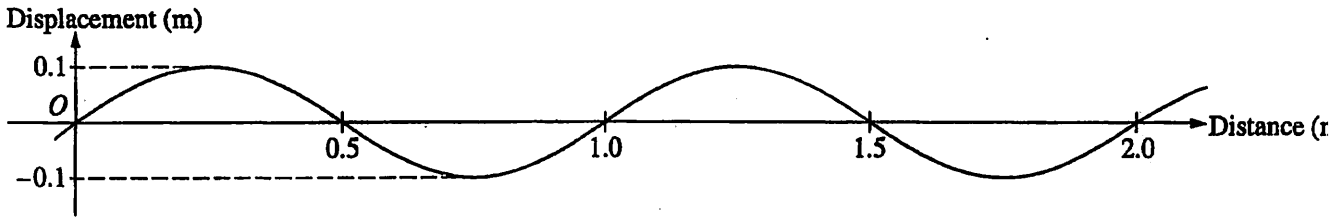
Questions 18-19 refer to the following drawing of a wave.



18. What is the wavelength of the wave?

(A) 0.1 m
(B) 0.2 m
(C) 0.5 m
(D) 1.0 m
(E) 2.0 m

19. What is the amplitude of the wave?

(A) 0.1 m
(B) 0.2 m
(C) 0.5 m
(D) 1.0 m
(E) It varies between −0.1 m and +0.1 m.

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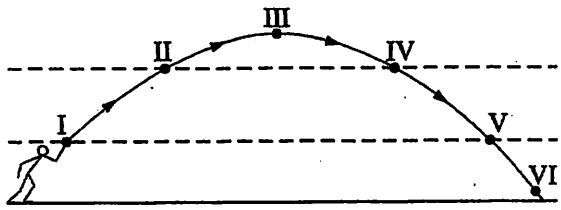
Questions 20-22



The sketch above shows the path of a heavy iron ball thrown by an athlete. The ground is level and the dashed lines are parallel to the ground. Assume that the frictional forces acting on the ball are negligible.

20. The speed of the ball at point I, when it leaves the hand of the athlete, is the same as its speed at point

(A) II
(B) III
(C) IV
(D) V
(E) VI

21. The potential energy of the ball is greatest at point

(A) I
(B) II
(C) III
(D) IV
(E) VI

22. Which of the following is a true statement about the acceleration of the ball during its flight?

(A) It is greatest at point I.
(B) It is greatest at point III.
(C) It is least at point III.
(D) It is least at point V.
(E) It is the same at all points.

23. Which of the following is true of the half-life of a particular radioactive isotope?

(A) It increases as the isotope decays.
(B) It increases as pressure increases.
(C) It increases as temperature increases.
(D) It decreases as the amount of the original substance increases.
(E) It remains constant.

24. All of the following statements concerning the structure of atoms are true EXCEPT:

(A) Two atoms can have the same atomic number and different mass numbers.
(B) Two atoms can have different atomic numbers and the same mass number.
(C) An atom can have an atomic number greater than its mass number.
(D) A hydrogen atom with one proton and no neutrons is an isotope of hydrogen.
(E) The number of neutrons in an atom can be less than the number of protons.

25. The fact that heat flows naturally from a hotter body to a cooler body is a consequence of which of the following principles of physics?

(A) Ideal gas law
(B) Conservation of charge
(C) Conservation of momentum
(D) First law of thermodynamics (conservation of energy)
(E) Second law of thermodynamics (entropy increase)

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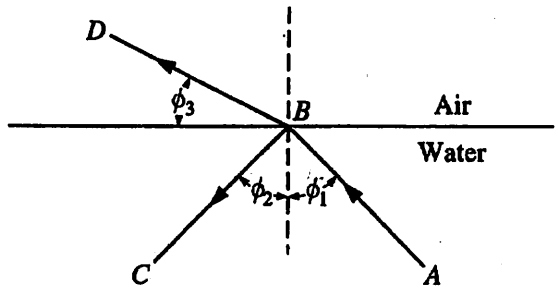
26. A black metal ball and a black rubber ball of equal radius are both heated to the same temperature. A person who picks up the balls, one in each hand, finds that the metal ball feels hotter to the touch. Which of the following is a correct explanation of this phenomenon?

(A) The density of the metal is higher; therefore the metal ball has a higher heat capacity.
(B) The mass of the metal ball is higher; therefore the thermal energy of the metal ball is higher.
(C) The specific heat of the metal is lower; therefore the thermal energy of the metal ball is higher.
(D) The thermal conductivity of the metal is higher; therefore the metal ball conducts heat to the hand more quickly.
(E) The melting point of the metal is higher; therefore the metal ball can absorb more heat from its surroundings.



27. In the diagram above, the angle of reflection and the refracted ray are correctly labeled by which of the following?

	Angle of Reflection	Refracted Ray
(A)	ϕ_1	*BC*
(B)	ϕ_2	*BC*
(C)	ϕ_2	*BD*
(D)	ϕ_3	*BC*
(E)	ϕ_3	*BD*

28. Diffraction is a property of which of the following?

I. Visible light
II. Sound waves
III. Radio waves

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

29. Which of the following properties of light can be used to explain why the legs of a child standing waist deep in water, when viewed from above the water, appear to be shorter than they actually are?

(A) Reflection
(B) Absorption
(C) Interference
(D) Polarization
(E) Refraction

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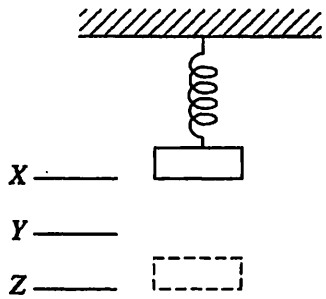
Questions 30-31 refer to the diagram below, which represents a mass suspended on a spring. The mass oscillates between levels X and Z. Level Y is halfway between X and Z. Assume that gravitational potential energy is zero at Z and that there is no loss of energy from the system due to friction.



30. The net force acting on the mass is upward and at its greatest magnitude at what level?

(A) X
(B) Between X and Y
(C) Y
(D) Between Y and Z
(E) Z

31. When the mass is at level X, it has

(A) zero energy
(B) zero acceleration
(C) potential energy but not kinetic energy
(D) kinetic energy but not potential energy
(E) both potential energy and kinetic energy

32. A satellite is moving around the Earth in a circle. All forces on the satellite except the force of gravity are negligible. Which of the following is true of the acceleration resulting from the gravitational force?

(A) It is constant in magnitude and direction.
(B) It is constant in magnitude but not in direction.
(C) It is zero.
(D) It causes the speed of the satellite to increase.
(E) It causes the speed of the satellite to decrease.

33. A spaceship orbits the Earth at constant speed in a circular path. An astronaut inside the spaceship releases a ball, but the ball shows no tendency to move away from the astronaut's hand. Which of the following best explains the behavior of the ball?

(A) Any object moving in a circle around the Earth experiences no gravitational pull.
(B) The gravitational pull of the spaceship on the ball exactly balances the gravitational pull of the Earth on the ball.
(C) The mass of the ball is so small that the pull of gravity exerted on the ball by the Earth is negligible.
(D) The force of gravity exerted on the ball by the Earth is extremely weak due to the great distance of the spaceship from the Earth.
(E) The force of gravity exerted on the ball by the Earth causes the ball to move in the same circular path as the spaceship.

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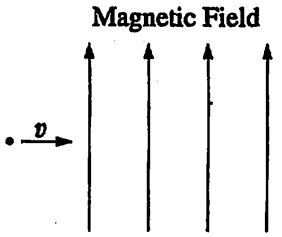
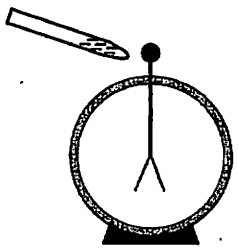


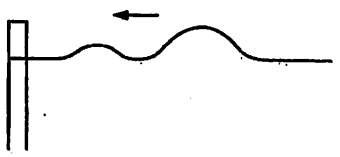
34. A proton of charge 1.6×10^{-19} coulomb moves through a vacuum with a speed v of 1×10^{6} meters per second. It passes through a uniform magnetic field as shown above. If the force exerted on the proton is 8×10^{-15} newton, the magnitude of the magnetic field is most nearly

(A) 1.3×10^{-27} T
(B) 2×10^{-11} T
(C) 5×10^{-10} T
(D) 5×10^{-2} T
(E) 20 T

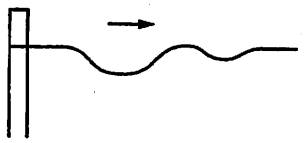


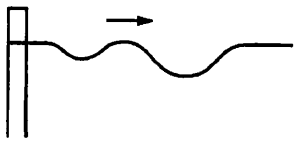
35. A negatively charged rod is brought close to the knob of an uncharged electroscope and the leaves of the electroscope diverge, as shown above. The correct explanation for this phenomenon is that

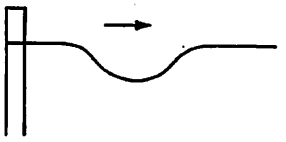
(A) both leaves become positively charged
(B) both leaves become negatively charged
(C) both leaves remain neutral
(D) one leaf becomes positively charged and the other becomes negatively charged
(E) one leaf becomes positively charged and the other remains neutral

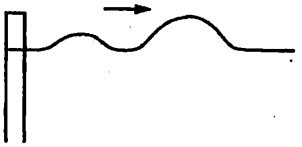


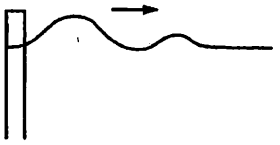
36. Two wave pulses travel toward the left on a taut string, as shown above. If the string is tightly attached to the rigid post at the left, which of the following correctly shows the reflection of these pulses?

(A)


(B)


(C)


(D)


(E)


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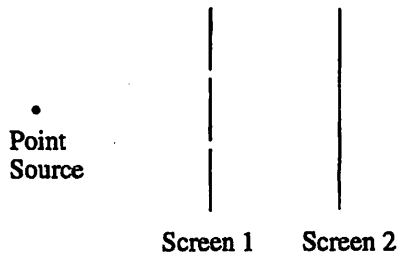
37. A guitar string vibrates with a frequency of 400 hertz. If the tension in the string is increased but the length of the string is fixed, which of the following will change?

I. The wavelength of the fundamental standing wave on the string
II. The frequency of the fundamental standing wave on the string
III. The pitch of the sound produced

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



38. In a darkened room, monochromatic light from the point source shown above passes through two very narrow slits in screen 1. Which of the following best describes the interference pattern that is formed on screen 2 ?

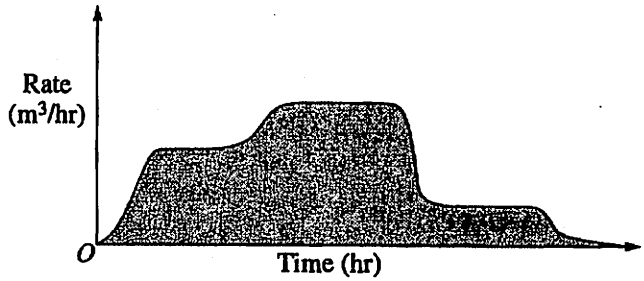
(A) A set of bright concentric circles
(B) An array of bright dots
(C) A continuous bright band dimming toward the middle
(D) A set of bright parallel bars at right angles to the slits
(E) A set of bright parallel bars parallel to the slits

39. If the mass of a body and the net force acting on the body are both doubled, the acceleration of the body is

(A) quartered
(B) halved
(C) unchanged
(D) doubled
(E) quadrupled

40. An object starts from rest and accelerates at 4.0 meters per second squared. How far will it travel during the first 3.0 seconds?

(A) 6.0 m
(B) 18 m
(C) 24 m
(D) 36 m
(E) 48 m



41. The graph above shows the rate at which water is pumped into a tank (measured in cubic meters per hour) as a function of time (measured in hours). The shaded area under the curve is equal to the

(A) average volume pumped in one hour
(B) average rate of pumping in m^3/hr
(C) average time required to pump 1 m^3
(D) total volume of water pumped into the tank
(E) total time required to fill the tank

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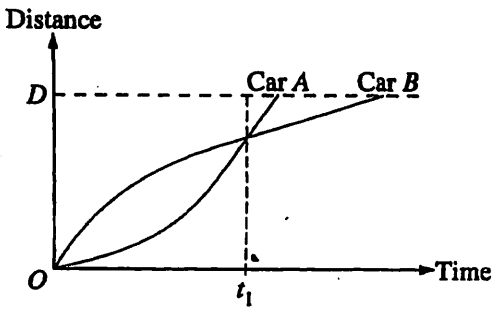


42. Two cars, A and B, begin moving from a starting line at time $t = 0$ and race over a total distance D. The graph above shows their respective distances from the starting line as functions of time. Correct statements about the cars include which of the following?

I. At time t_1, car A has a greater speed than car B.
II. At time t_1, car A is closer to the finish line than car B.
III. Car A crosses the finish line first.

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

43. The second hand of a clock completes one revolution each minute. What is its frequency of rotation?

(A) 3,600 Hz
(B) 60 Hz
(C) 1 Hz
(D) 1/12 Hz
(E) 1/60 Hz

44. Halley's comet is in an elliptical orbit about the Sun and is visible from the Earth once every 76 years. Which of the following statements about the comet is true?

(A) The direction of the velocity of the comet and the direction of the force on the comet are the same.
(B) The speed of the comet is always minimum when the comet is closest to the Sun.
(C) The speed of the comet is always maximum when the comet is farthest from the Earth.
(D) The direction and the magnitude of the force on the comet are always changing.
(E) The direction of motion of the comet is always changing, but its speed is constant.

45. Which of the following forms of energy is most likely to be produced in some amount in nearly all energy transformations?

(A) Chemical
(B) Thermal
(C) Electrical
(D) Mechanical
(E) Sound

46. A source emits sound with a frequency of 7.0×10^3 hertz. If the speed of the sound is 3.5×10^2 meters per second, what is the wavelength of the sound?

(A) 4.1×10^{-7} m
(B) 5.0×10^{-2} m
(C) 2.0×10^{-1} m
(D) 2.0×10^{5} m
(E) 2.5×10^{6} m

GO ON TO THE NEXT PAGE

47. A plane mirror can be used alone to form a

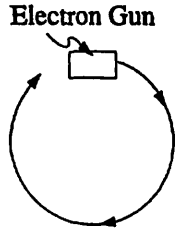
(A) magnified real image
(B) diminished real image
(C) magnified virtual image
(D) diminished virtual image
(E) virtual image neither magnified nor diminished

48. The figure above shows two pulses on a string approaching each other. Which of the following statements about the pulses is true?

(A) They will reflect off each other, reversing their directions.
(B) They will pass through each other without changing their directions.
(C) They will completely cancel each other and afterward there will be no pulse on the string.
(D) They will combine to form a single pulse with amplitude twice that of each original pulse.
(E) They will combine to form a standing wave on the string.

49. If electricity costs \$0.10 per kilowatt-hour, how much does it cost for electricity to operate a 100-watt lightbulb for 10 hours?

(A) \$0.001
(B) \$0.01
(C) \$0.10
(D) \$1.00
(E) \$10.00



50. An experiment involves the deflection of an electron beam by a uniform magnetic field as shown above. In what direction does the magnetic field point?

(A) To the left in the plane of the page
(B) To the right in the plane of the page
(C) Upward in the plane of the page
(D) Into the page
(E) Out of the page

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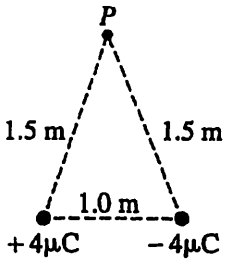
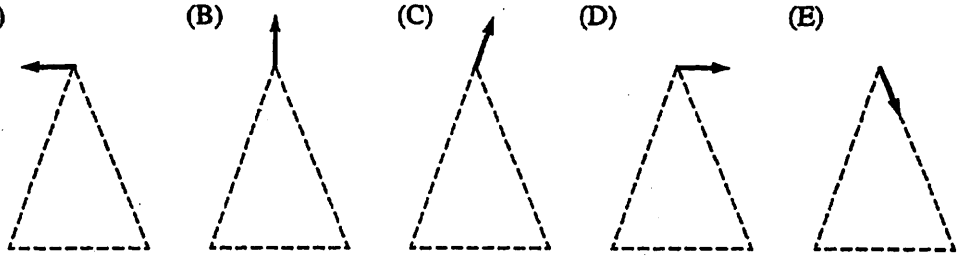


51. Charges of +4 microcoulombs and −4 microcoulombs are located 1.0 meter apart and fixed in place, as shown above. A third charge, of +1 microcoulomb, is released from rest at point P, which is located 1.5 meters from each of the other two charges. If the only forces acting are the electric forces between the charges, in which of the directions indicated below will the +1-microcoulomb charge start to move after release?

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



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52. The rate of heat loss through a wall by conduction is directly proportional to the area A of the wall, to the thermal conductivity k of the wall, and to the temperature difference across the wall, and is inversely proportional to the thickness D of the wall. If the outside temperature is T_1 and the room is maintained at temperature T_2, the rate of heat loss is given by which of the following?

(A) $\frac{Ak(T_2 - T_1)}{D}$

(B) $\frac{D}{Ak(T_2 - T_1)}$

(C) $\frac{A + k + (T_2 - T_1)}{D}$

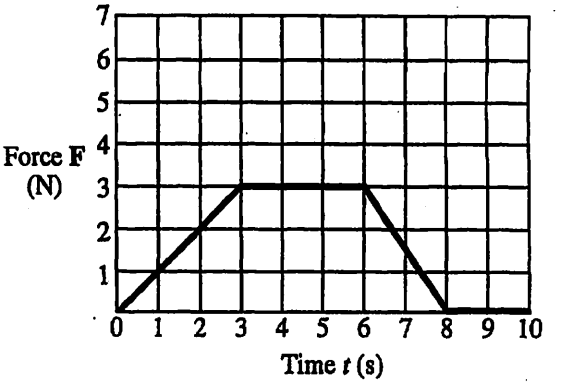
(D) $Ak(T_2 - T_1) - \frac{1}{D}$

(E) $A + k + (T_2 - T_1) + \frac{1}{D}$

53. A heat engine extracts 80 joules of energy from a hot reservoir, does work, then exhausts 60 joules of energy into a cold reservoir. What is the efficiency of the heat engine?

(A) 25%
(B) 33%
(C) 43%
(D) 57%
(E) 75%

Questions 54-55 relate to the graph below, which shows the net force **F** in newtons exerted on a 1-kilogram block as a function of time t in seconds. Assume that the block is at rest at $t = 0$ and that **F** acts in a fixed direction.



54. The acceleration of the block at $t = 4$ seconds is

(A) $\frac{1}{3}$ m/s^2

(B) 1 m/s^2

(C) 3 m/s^2

(D) 9 m/s^2

(E) 12 m/s^2

55. During which of the following time intervals is the speed of the block constant?

(A) 0 to 3 s
(B) 3 to 6 s
(C) 6 to 8 s
(D) 8 to 10 s
(E) None of the time intervals

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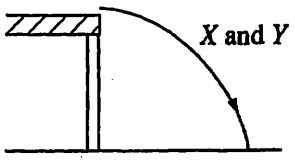
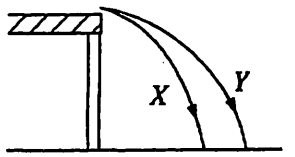
56. Ball X, with a large mass, and ball Y, with a small mass, simultaneously roll with identical horizontal velocities off a tabletop. Air friction is negligible. Which of the following shows their subsequent trajectories?

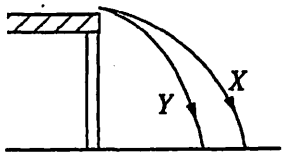
(A)



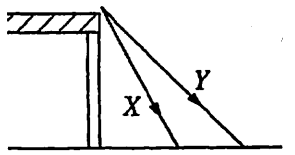
(B)



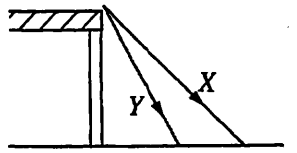
(C)

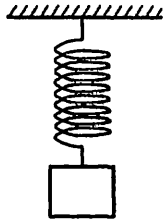


(D)



(E)





57. A mass is attached to one end of a spring. The othe end of the spring is attached to the ceiling, as show above. A person pulls the mass down and then releases it from rest. Just after the release, how do the energies of the system change?

	Kinetic Energy	Gravitational Potential Energy	Elastic Potential Energy
(A)	Increases	Increases	Increases
(B)	Increases	Increases	Decreases
(C)	Increases	Decreases	Increases
(D)	Increases	Decreases	Decreases
(E)	Decreases	Increases	Decreases

58. When a conductor is moved through a magnetic field, current is induced in the conductor. This phenomenon is used for practical purposes in the

(A) electric generator
(B) electric motor
(C) electroscope
(D) capacitor
(E) battery

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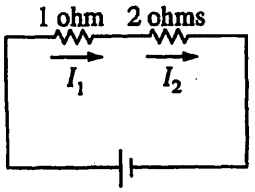


59. In the circuit shown above, the current I_1 in the 1-ohm resistor is related to the current I_2 in the 2-ohm resistor by which of the following equations?

(A) $I_1 = \frac{1}{2}I_2$

(B) $I_1 = \frac{2}{3}I_2$

(C) $I_1 = I_2$

(D) $I_1 = \frac{3}{2}I_2$

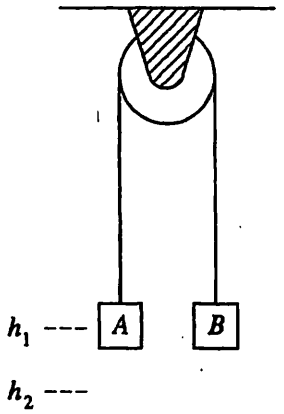
(E) $I_1 = 2\,I_2$

60. An object is placed 10 centimeters from a converging lens of focal length 15 centimeters. If the image is 30 centimeters from the lens, what is the magnification?

(A) 0.5
(B) 1.5
(C) 2.0
(D) 3.0
(E) 5.0

61. The speed with which sound waves in the air pass a stationary observer depends on the

(A) speed of the air relative to the observer
(B) speed of the source relative to the air
(C) frequency of the source
(D) wavelength of the sound in the air
(E) intensity of the sound in the air



62. Two blocks of equal mass are attached to a string that passes over a frictionless pulley, as shown above, and are initially at rest with block A at height h_1. A small mass m is placed on top of block A, causing it to move downward. When block A reaches height h_2, the small mass m is lifted from block A. True statements about the motion of block A include which of the following?

I. It moves with constant velocity between heights h_1 and h_2.
II. It moves with constant acceleration between heights h_1 and h_2.
III. It comes to rest immediately after m is removed at height h_2.

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

63. A proton of mass 1.7×10^{-27} kilogram and speed 3×10^7 meters per second is moving in a circle of radius 200 meters. Which of the following is the best estimate of the order of magnitude of the magnetic force needed to maintain this motion?

(A) 10^{-20} N
(B) 10^{-14} N
(C) 10^{-8} N
(D) 10^{-4} N
(E) 10^{0} N

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$$X + {}^{2}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$$

64. In an attempt to use fusion as a source of energy, physicists are studying the reaction represented above. Particle X is which of the following?

(A) ${}^{1}_{1}H$

(B) ${}^{2}_{1}H$

(C) ${}^{3}_{1}H$

(D) ${}^{3}_{2}H$

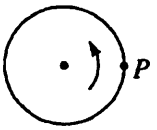
(E) ${}^{-1}_{0}e$

65. On the basis of the Bohr model, it can be predicted that the internal energy of a hydrogen atom will

(A) increase when any frequency of light impinges on the atom
(B) change by any amount as a result of collisions with other hydrogen atoms
(C) change only as a result of the emission of light
(D) be restricted to certain discrete values
(E) always be the same

66. If thin metallic foil a few atoms thick is bombarded by a narrow beam of alpha particles, it will be observed that

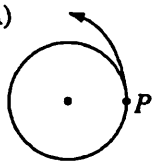
(A) all particles pass through undeflected
(B) none of the particles are deflected through more than 45°
(C) most particles are deflected through more than 45°
(D) occasional particles are deflected through 180°
(E) all particles are deflected through 180°



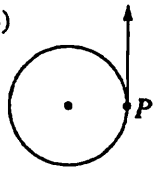
View From Above

67. A child sits at the outer edge of a merry-go-round that rotates at constant speed. The child releases a ball at point *P*, shown above. As seen by a perso who is at rest with respect to the Earth and lookin down from above the merry-go-round, the path followed by the ball is shown by the arrow in whic of the following?

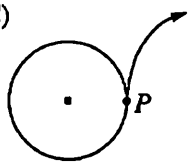
(A)



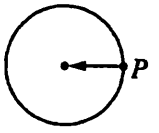
(B)



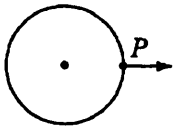
(C)



(D)



(E)



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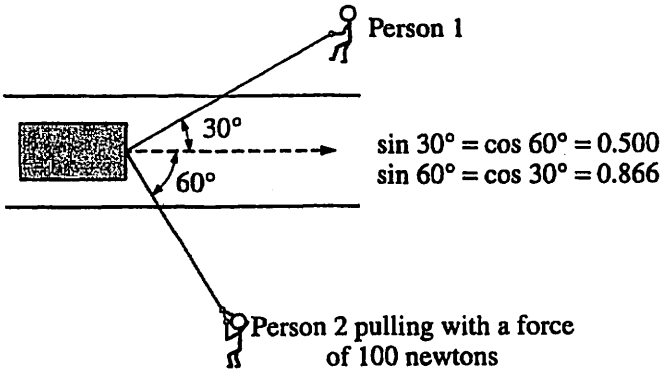

68. Two people are pulling a box that is on a sheet of ice. The box moves in the direction shown by the broken line in the diagram above. If the ice offers no resistance and if Person 2 is pulling with a force of 100 newtons, with what force must Person 1 be pulling?

(A) 173 N
(B) 158 N
(C) 100 N
(D) 58 N
(E) 0 N

69. In the kinetic theory of gases, which of the following is true about the relationship between the speed of the molecules and the temperature of the gas?

(A) At any specified temperature, all molecules have the same speed.
(B) As the temperature of the gas is doubled, the speed of each molecule is also doubled.
(C) As the temperature of the gas is doubled, the speed of each molecule is halved.
(D) All molecules have speeds larger than a certain minimum and this minimum depends on the temperature of the gas.
(E) Molecular speeds are distributed over a wide range with a mean value that depends on the temperature of the gas.

70. How much heat is required to melt 1.0 kilogram of ice at 0°C and raise the temperature of the resulting water to 20°C? (Heat of fusion of ice = 3.3×10^5 joules per kilogram; specific heat of water = 4.2×10^3 joules per kilogram · °C)

(A) 4.1×10^5 J
(B) 3.3×10^5 J
(C) 8.7×10^4 J
(D) 8.4×10^4 J
(E) 7.5×10^3 J

71. Of the following observable phenomena, which can be explained by using the wave model of light, but not the particle model?

(A) Energy is transmitted by a light beam.
(B) Pressure is exerted by a light beam.
(C) A region receiving light from two small coherent sources can have points of zero intensity of light.
(D) All of the energy emitted by an atom as light can later be completely transferred to another atom.
(E) Light incident on a plane reflecting surface at a given angle is reflected at the same angle.

72. A ray of light obliquely incident on a plane boundary between air and glass is partially reflected and partially refracted. Which of the following characteristics is the same for both the incident ray and the refracted ray?

(A) Frequency
(B) Wavelength
(C) Speed
(D) Power transmitted
(E) Direction

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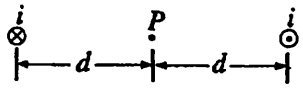
73. A 12-kilogram object initially has 24 joules of kinetic energy. How far will the object move against a net resisting force of 6 newtons?

(A) 2 m
(B) 4 m
(C) 12 m
(D) 16 m
(E) 24 m

74. Two bodies collide on a horizontal frictionless surface. Which of the following is true about the conservation of momentum and kinetic energy for such a collision?

	Momentum Conserved	Kinetic Energy Conserved
(A)	Always	Always
(B)	Always	Not always
(C)	Not always	Always
(D)	Not always	Not always
(E)	Not always	Never



75. Two parallel wires are located a distance $2d$ apart and carry equal currents i in opposite directions perpendicular to the page, as shown above. The magnitude of the magnetic field at point P due to each wire alone is 2 tesla. The resultant magnetic field at point P due to both wires is

(A) zero
(B) 4 T perpendicular to the page
(C) 4 T downward in the plane of the page
(D) 4 T to the right in the plane of the page
(E) 4 T to the left in the plane of the page

S T O P

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 Physics Subject Test, your answer sheet will be "read" by a scanning machine that will record your responses 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 lists the correct answers for all the questions on the SAT 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 test score.

TABLE A

Answers to the SAT Subject Test in Physics, Form 3RAC2, and Percentage of Students Answering Each Question Correctly

Question Number	Correct Answer	Right	Wrong	Percentage of Students Answering the Question Correctly*	Question Number	Correct Answer	Right	Wrong	Percentage of Students Answering the Question Correctly*
1	C			74	33	E			67
2	A			62	34	D			28
3	E			34	35	B			76
4	A			92	36	A			51
5	E			66	37	D			35
6	D			62	38	E			47
7	C			42	39	C			90
8	C			71	40	B			66
9	B			61	41	D			85
10	D			67	42	C			68
11	C			50	43	E			67
12	B			36	44	D			52
13	B			86	45	B			80
14	A			72	46	B			48
15	E			86	47	E			81
16	D			65	48	B			46
17	A			58	49	C			64
18	D			87	50	D			37
19	A			76	51	D			49
20	D			89	52	A			74
21	C			92	53	A			36
22	E			66	54	C			80
23	E			74	55	D			60
24	C			56	56	A			62
25	E			53	57	B			58
26	D			60	58	A			55
27	C			56	59	C			45
28	E			48	60	D			46
29	E			90	61	A			21
30	E			73	62	B			65
31	C			82	63	B			30
32	B			53	64	C			62

Table A continued on next pag

Table A continued from previous page

Question Number	Correct Answer	Right	Wrong	Percentage of Students Answering the Question Correctly*	Question Number	Correct Answer	Right	Wrong	Percentage of Students Answering the Question Correctly*
65	D			24	71	C			38
66	D			42	72	A			35
67	B			78	73	B			46
68	A			39	74	B			52
69	E			42	75	C			28
70	A			41					

* These percentages are based on an analysis of the answer sheets for a random sample of 3,239 students who took this form of the test in November 1995 and whose mean score was 653. 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 SAT Subject Test in Physics candidate will answer correctly that question on this edition of this test.

Finding Your Scaled Score

When you take SAT Subject Tests, the scores sent to the colleges you specify are reported on the College Board scale, which ranges from 200 to 800. You can convert your practice test score to a scaled score by using Table B. To find your scaled score, locate your raw score in the left-hand column of Table B; the corresponding score in the right-hand column is your scaled score. For example, a raw score of 60 on this particular edition of the SAT Subject Test in Physics corresponds to a scaled score of 780.

Raw scores are converted to scaled scores to ensure that a score earned on any one edition of a particular Subject Test is comparable to the same scaled score earned on any other edition of the same Subject Test. Because some editions of tests may be slightly easier or more difficult than others, scaled scores are adjusted so that they indicate the same level of performance regardless of the edition of the test taken and the ability of the group that takes it. Thus, for example, a score of 400 on one edition of a test taken at a particular administration indicates the same level of achievement as a score of 400 on a different edition of the test taken at a different administration.

When you take the SAT Subject Tests during a national administration, your scores are likely to differ somewhat from the scores you obtain on the tests in this book. People perform at different levels at different times for reasons unrelated to the tests themselves. The precision of any test is also limited because it represents only a sample of all the possible questions that could be asked.

TABLE B

Scaled Score Conversion Table
Physics Subject Test (Form 3RAC2)

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

Reviewing Your Performance on the Physics Subject Test

After you score your test, analyze your performance—consider the following questions:

Did you run out of time before reaching the end of the test?

If so, you may need to pace yourself better. For example, maybe you spent too much time on one or two hard questions. A better approach might be to skip the ones you can't answer right away and try answering all the questions that remain on the test. Then if there's time, go back to the questions you skipped.

Did you take a long time reading the directions?

You will save time when you take the test by learning the directions to the Physics Subject Test ahead of time. Each minute you spend reading directions during the test is a minute that you could use to answer questions.

How did you handle questions you were unsure of?

If you were able to eliminate one or more of the answer choices as wrong and guess from the remaining choices, your approach probably worked to your advantage. On the other hand, making haphazard guesses or omitting questions without trying to eliminate choices could cost you valuable points.

How difficult were the questions for you compared with other students who took the test?

Table A shows you how difficult the multiple-choice questions were for the group of students who took this test during its national administration. The right-hand column gives the percentage of students that answered each question correctly.

A question answered correctly by almost everyone in the group is obviously an easy question. For example, 92 percent of the students answered question 21 correctly. But only 21 percent answered question 61 correctly.

Keep in mind that these percentages are based on just one group of students. They would probably be different if another group of students took the test.

If you missed several easy questions, go back and try to find out why: Did the questions cover material you haven't reviewed yet? Did you misunderstand the directions?