Physics Test

Practice Helps

The test that follows is an actual, recently administered SAT Subject Test in Physics. To get an idea of what it's like to take this test, practice under conditions that are much like those of an actual test administration.

- Set aside an hour when you can take the test uninterrupted. Make sure you complete the test in one sitting.

- Sit at a desk or table with no other books or papers. Dictionaries, other books, or notes are not allowed in the test room.

- Do not use a calculator. Calculators are not allowed for the Subject Test in Physics.

- Tear out an answer sheet from the back of this book and fill it in just as you would on the day of the test. One answer sheet can be used for up to three Subject Tests.

- Read the instructions that precede the practice test. During the actual administration you will be asked to read them before answering test questions.

- Time yourself by placing a clock or kitchen timer in front of you.

- After you finish the practice test, read the sections "How to Score the SAT Subject Test in Physics" and "How Did You Do on the Subject Test in Physics?"

- The appearance of the answer sheet in this book may differ from the answer sheet you see on test day.

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 circles:

   —Fill in circle 2 in the row labeled V.
   —Fill in circle 3 in the row labeled W.
   —Fill in circle 3 in the row labeled X.
   —Fill in circle C in the row labeled Y.

3. Please answer the three questions below by filling in the appropriate circles 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 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 B)   —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.

PHYSICS TEST

Note: To simplify calculations, you may use $g = 10$ m/s^2 in all problems.

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

    (A) Coefficient of linear expansion
    (B) Latent heat of fusion
    (C) Latent heat of vaporization
    (D) Specific heat
    (E) Coefficient of thermal conductivity

Select the quantity above that should be used in the calculation of each of the following.

1. The amount of heat required to change 100 grams of ice at 0° C into water at 0° C

2. The temperature at which a 0.5-centimeter gap between 1.0-meter concrete slabs in a sidewalk will close up completely

3. The time required for 100 joules of heat to pass through a copper rod of length 2 meters and cross-sectional area 0.5 square meter that connects two objects at different temperatures

### Questions 4-5 relate to the following particles.

    (A) Electron
    (B) Neutron
    (C) Proton
    (D) Neutrino
    (E) Photon

4. Which particle constitutes the nucleus of an ordinary hydrogen atom?

5. Which charged particle in the list is the least massive?

Questions 6-7

An automobile starts from rest and moves along a straight road. In the graph below, the distance x of the automobile from its starting point is given as a function of time t.
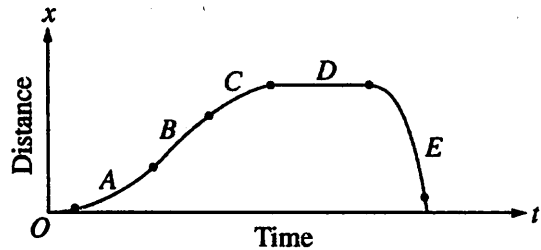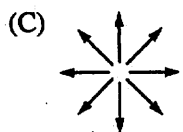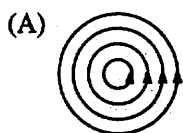

    (A) Interval A
    (B) Interval B
    (C) Interval C
    (D) Interval D
    (E) Interval E

6. During which interval is the automobile stationary and farthest from its starting position?

7. During which interval does the speed of the automobile have its maximum value?

K-3XAC

Questions 8-9 relate to the field lines that are shown in the following diagrams.

(A)

(B)

(C)

(D)

(E) ↑↑↑↑↑↑↑↑↑↑↑↑↑

8. Which diagram best represents the electric field produced by two oppositely charged particles?

9. Which diagram best represents an electric field produced by oppositely charged parallel plates that are large and close together?

Questions 10-12 relate to calculations or explanations based on the following principles.

(A) Conservation of energy alone
(B) Conservation of momentum alone
(C) Conservation of both energy and momentum
(D) Conservation of charge
(E) Mechanical equivalence of heat

10. Used to calculate the velocity of two moving freight cars, after they couple and move together, given the initial masses and velocities of the freight cars

11. Used to calculate the speed of a lump of clay that hits and sticks to a block of wood suspended as a pendulum, given the height to which the block swings and the masses of the block and the clay

12. Used to calculate the speed of a pendulum bob at the bottom of its swing given the height from which the bob is released from rest

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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 circle on the answer sheet.

13. A skydiver has been in the air long enough to be falling at a constant terminal speed of 50 meters per second. How much farther will the skydiver fall in the next 2.00 seconds?

    (A) 19.6 m
    (B) 50 m
    (C) 98 m
    (D) 100 m
    (E) 120 m

14. It takes about 1.0 second for an object to fall 5 meters vertically. If this same object is thrown horizontally with a speed of 30 meters per second from a roof-top 5 meters above ground, about how many meters from the base of the building will the object land?

    (A) 30 m
    (B) $30\sqrt{2}$ m
    (C) $30\sqrt{3}$ m
    (D) 60 m
    (E) 90 m
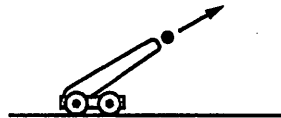
15. Assume that every projectile fired by the toy cannon shown above experiences a constant net force F along the entire length of the barrel. If a projectile of mass m leaves the barrel of the cannon with a speed v, at what speed will a projectile of mass $2m$ leave the barrel?
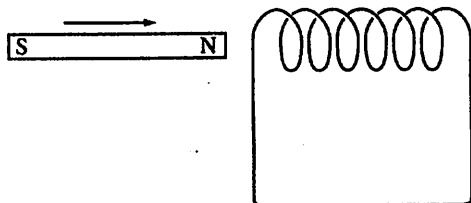
    (A) $\dfrac{v}{2}$

    (B) $\dfrac{v}{\sqrt{2}}$

    (C) v

    (D) $2v$

    (E) $4v$

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Questions 16-17

The following diagram shows a permanent magnet and a coil of copper wire that is part of a closed circuit.


16. What happens as the north pole of the magnet is moved at constant speed into the coil?

   (A) The magnet gains potential energy.
   (B) The magnet attracts the coil.
   (C) The coil attracts the magnet.
   (D) A current flows in the coil, producing a magnetic field.
   (E) The magnet loses kinetic energy.

17. Which of the following would be different if the magnet were turned around so the south pole moved into the coil at the same speed as before?

   (A) The direction of the forces on the magnet
   (B) The direction of the energy transfer
   (C) The direction of the current in the coil
   (D) The magnitude of the current in the coil
   (E) The sign of the charges moving in the coil

18. An electric current in a copper wire is the result of the motion of which of the following?

   (A) Copper atoms
   (B) Copper oxide molecules
   (C) Protons
   (D) Electrons
   (E) Neutrons

19. Eyeglasses, magnifying glasses, and optical microscopes depend for their operation primarily on the phenomenon of

   (A) reflection
   (B) refraction
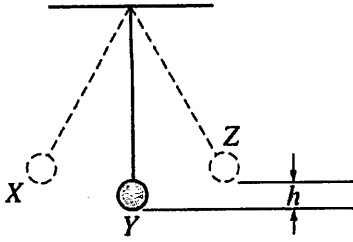   (C) interference
   (D) dispersion
   (E) diffraction
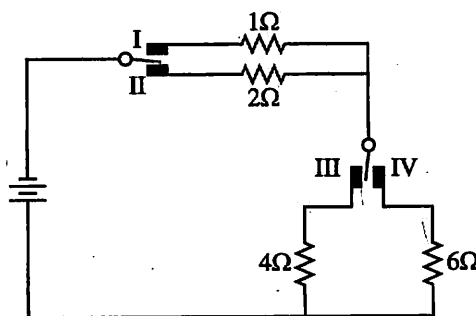
20. In the circuit shown above, the current through the battery will be greatest when the switches are in which of the following positions?

   (A) I and III
   (B) I and IV
   (C) II and III
   (D) II and IV
   (E) The current will be the same regardless of how the switches are positioned.

Questions 21-23

The diagram above shows a pendulum that swings to a maximum height h above its lowest point Y. The mass of the pendulum bob is 0.05 kilogram. At point Y, the bob has a speed of 3.0 meters per second.

21. The momentum of the pendulum bob as it passes through point Y is most nearly

    (A) 0.05 kg·m/s
    (B) 0.15 kg·m/s
    (C) 0.23 kg·m/s
    (D) 0.45 kg·m/s
    (E) 0.50 kg·m/s

22. The height h is most nearly

    (A) 0.15 m
    (B) 0.30 m
    (C) 0.45 m
    (D) 0.60 m
    (E) 0.90 m

23. If the potential energy of the pendulum bob is zero at point Y, the total energy (kinetic plus potential) of the pendulum bob is most nearly

    (A) 0.05 J
    (B) 0.15 J
    (C) 0.23 J
    (D) 0.45 J
    (E) 0.50 J

Questions 24-25
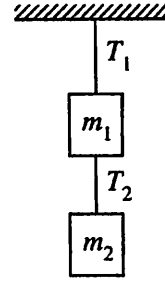
Two masses m_1 and m_2 are hung from the ceiling by two ropes as shown above. The tension in the upper rope is T_1 and the tension in the lower rope is T_2.

24. Which of the following is correct?

    (A) T_1 is always greater than T_2.
    (B) T_1 is always less than T_2.
    (C) T_1 is always equal to T_2.
    (D) T_1 is greater than T_2 only if m_1 is greater than m_2.
    (E) T_1 is greater than T_2 only if m_2 is greater than m_1.

25. Which of the following best represents the forces acting on m_2?

26. A boat that can move at 5 kilometers per hour in still water is crossing a river whose current is 2 kilometers per hour. The problem is to steer the boat so that it will land directly across the river from where it started. The solution to the problem is best represented by which of the following sketches in which the river is flowing to the right?

(A)

(B)

(C)

(D)

(E)

27. One harmonic of a note produced by a flute has a wavelength λ and an associated frequency f. If the wavelength of another harmonic of this note is 2λ, what is its associated frequency?

(A) $\frac{1}{4}f$

(B) $\frac{1}{2}f$

(C) f

(D) $2f$

(E) $4f$

28. Sound waves can exhibit which of the following wave properties?

    I. Interference
    II. Diffraction
    III. Refraction

(A) I only
(B) II only
(C) I and III only
(D) II and III only
(E) I, II, and III
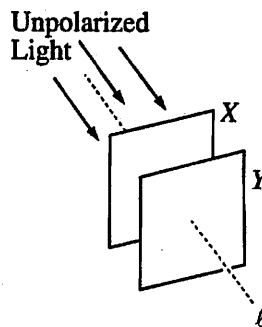
29. Polarizing sheets X and Y shown above are oriented so that none of the unpolarized light shining on X is transmitted through Y. Axis ℓ is perpendicular to both sheets. Which of the following will result in the transmission of light through Y?
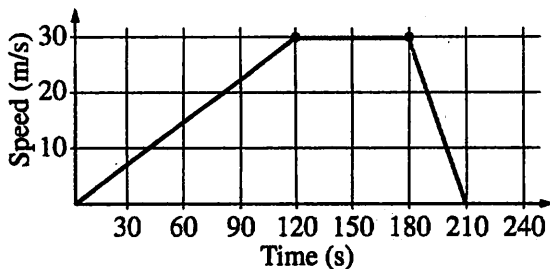
(A) Rotation of Y by 90° about axis ℓ
(B) Rotation of Y by 180° about axis ℓ
(C) Rotation of Y by 360° about axis ℓ
(D) Placement of a third polarizer between X and Y, with its polarizing axis oriented the same way as X
(E) Placement of a third polarizer between X and Y, with its polarizing axis oriented the same way as Y

Questions 30-32

An automobile with a mass of 1.5×10^3 kilograms is traveling on a flat, level road. The above graph shows the automobile's speed as a function of time.

30. The automobile's acceleration at the end of 60 seconds is

(A) 0.25 m/s^2
(B) 2.5 m/s^2
(C) 4 m/s^2
(D) 15 m/s^2
(E) 60 m/s^2

31. The constant braking force applied to stop the car is

(A) 1.7 N
(B) 50 N
(C) 1.5×10^3 N
(D) 4.5×10^4 N
(E) 1.4×10^5 N

32. The speed of the automobile 10 seconds after the brakes are applied is

(A) 1 m/s
(B) 10 m/s
(C) 15 m/s
(D) 20 m/s
(E) 30 m/s

33. An object of mass m is attached to a vertically mounted spring that has spring constant k. The object is displaced from its equilibrium position and allowed to oscillate. Assume that air resistance and friction are negligible. To increase the frequency of the motion, one could

(A) increase the amplitude of the motion
(B) change to a spring with a greater spring constant
(C) mount the spring horizontally
(D) attach an object of greater mass
(E) attach an object of the same mass but greater density
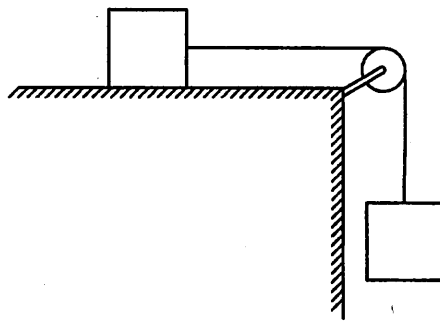
34. Two blocks of identical mass are connected by a light string as shown above. The surface is frictionless and the pulley is massless and frictionless. The acceleration of the two-block system is most nearly

(A) 20 m/s^2
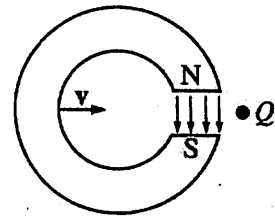(B) 15 m/s^2
(C) 10 m/s^2
(D) 5 m/s^2
(E) 2.5 m/s^2

35. Consider the following four forces involving an object at rest on a tabletop.

   I. The gravitational force on the object due to the Earth
   II. The gravitational force on the Earth due to the object
   III. The force on the tabletop due to the object
   IV. The force on the object due to the tabletop

Which, if any, of these forces are action-reaction pairs in accordance with Newton's third law?

(A) Pair I and II only
(B) Pair I and IV only
(C) Pair I and II, and pair III and IV
(D) Pair I and IV, and pair II and III
(E) There are no action-reaction pairs among these forces.

Questions 36-37

A heat engine operates between two reservoirs, one at a temperature of 300 K and the other at 200 K. In one cycle, the engine absorbs 600 joules of heat and does 150 joules of work.

36. How much heat is exhausted by the engine in one cycle?

(A) 150 J
(B) 450 J
(C) 550 J
(D) 600 J
(E) 750 J

37. The actual efficiency of the engine is most nearly

(A) 75%
(B) 67%
(C) 50%
(D) 33%
(E) 25%

38. A magnet, whose poles are shown in the figure above, moves with velocity **v** toward a small object of charge Q initially at rest. Which of the following is a correct statement about the force on the object due to the magnet as the object initially encounters the field?

(A) It is zero.
(B) It is perpendicular to the page.
(C) It is directed parallel to the magnetic field.
(D) It is in the same direction as **v**.
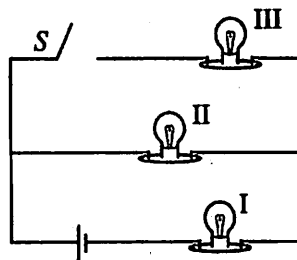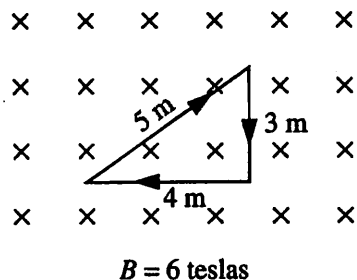(E) It is in the direction opposite to **v**.

$B = 6$ teslas

39. A loop of wire shaped into a triangle, shown above, carries a current of 2 amperes in a clockwise direction. A magnetic field of 6 teslas is directed into the paper. What are the magnitude and direction of the force applied by the magnetic field to the 5-meter edge of the triangle?

	Magnitude	Direction
(A)	60 N	↖
(B)	60 N	↑
(C)	48 N	↖
(D)	48 N	↘
(E)	36 N	↘

40. If two electrically charged particles repel each other with forces of equal magnitude, then the charges must

(A) have different magnitudes
(B) have the same magnitude
(C) have different signs
(D) have the same sign
(E) be separated by unit distance

41. A battery and three identical lightbulbs are connected as shown in the figure above. With the switch S closed, the brightness of each lightbulb is noted. When switch S is opened, the brightness of which of the lightbulbs will change?

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

42. All of the following scientists made significant contributions to the field of nuclear physics EXCEPT

(A) Galileo
(B) Rutherford
(C) Becquerel
(D) Curie
(E) Fermi

43. Which of the following distinguishes an atom of one isotope of an element from an atom of a different isotope of the same element?

(A) The addition or loss of a beta particle
(B) The addition or loss of an alpha particle
(C) The amount of nuclear charge
(D) The number of orbital electrons
(E) The amount of nuclear mass

44. A hydrogen atom, originally in its ground state, absorbs a photon and goes into an excited state. The atom will then most likely

    (A) be ionized
    (B) emit a photon
    (C) emit an electron
    (D) always be in that excited state
    (E) undergo nuclear fission

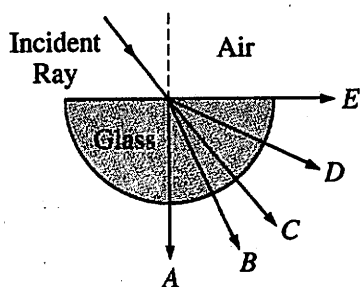45. A worker hits a metal pipe with a hammer. The ratio of the intensity of loudness as heard by people standing 100 meters away from the worker to the intensity as heard by people standing 200 meters away from the worker is

    (A) 4:1
    (B) 2:1
    (C) 1:1
    (D) 1:2
    (E) 1:4

46. A light ray is incident from air upon a semicircular piece of glass as shown above. Which of the labeled rays best represents the subsequent path of the light?

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

47. Huygens' principle states that every point on a wave front is the source of a new wave front. To which of the following types of waves does Huygens' principle apply?

    I. Water waves
    II. Sound waves
    III. Electromagnetic waves

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

48. When coal burns, it produces heat in the amount of 2.5×10^4 joules per gram. About 4,000 joules of heat is required to raise the temperature of one kilogram of water by one degree. The amount of coal required to heat 5 kilograms of water from 10°C to 60°C is most nearly

    (A) 10 grams
    (B) 40 grams
    (C) 100 grams
    (D) 400 grams
    (E) 1,600 grams

49. When a person touches the metal part of a bicycle handlebar on a cold day, the metal seems much colder than the plastic handgrip, even though both are at the same temperature. This phenomenon is due primarily to which of the following?

    (A) The thermal conductivity of the metal is greater than that of the plastic.
    (B) The thermal conductivity of the metal is less than that of the plastic.
    (C) The density of the metal is greater than that of the plastic.
    (D) The density of the metal is less than that of the plastic.
    (E) The latent heat of fusion of the metal is greater than that of the plastic.

50. An object of mass m rests on a horizontal frictionless surface. A force F making an angle θ with the horizontal is then applied to the object to move it along the surface. The acceleration of the object is

    (A) $\dfrac{F}{m}$

    (B) $\dfrac{F}{2m}$

    (C) $\dfrac{F \cos \theta}{m}$

    (D) $\dfrac{F \sin \theta}{m}$

    (E) $\dfrac{F \tan \theta}{m}$

Questions 51-52

A person is standing on a scale that is located on a platform at the surface of Earth. The platform is supported by a machine that can move the platform up and down at various accelerations while keeping it level.

51. At what acceleration of the platform does the machine have to exert the LEAST force on the platform?

    (A) Zero
    (B) 4.9 m/s^2 down
    (C) 9.8 m/s^2 up
    (D) 9.8 m/s^2 down
    (E) 19.6 m/s^2 up

52. If the person's weight has apparently doubled according to the reading on the scale, what is the acceleration of the platform?

    (A) About 9.8 m/s^2 up
    (B) About 9.8 m/s^2 down
    (C) About 19.6 m/s^2 up
    (D) About 19.6 m/s^2 down
    (E) It cannot be determined without knowing the mass of the person.
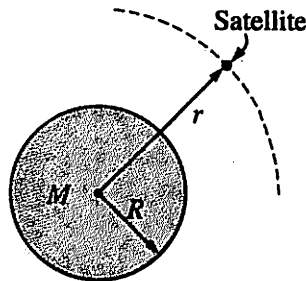
53. A satellite moves in a circular orbit of radius r around a planet of mass M and radius R, as shown above. The speed of the satellite would be greater if M and r were changed in which of the following ways?

	$\underline{M}$	$\underline{r}$
(A)	Decreased	No change
(B)	Decreased	Increased
(C)	No change	No change
(D)	No change	Increased
(E)	Increased	No change

54. A circuit consists of a battery of voltage V and a resistor of resistance R. The current through the circuit is I. If the battery is changed to one of voltage $2V$ and the resistor to one with resistance $4R$, the current through the circuit is

    (A) $4I$

    (B) $2I$

    (C) I

    (D) $\dfrac{I}{2}$

    (E) $\dfrac{I}{4}$

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55. An electrically charged, insulated metal rod is observed to attract a neutral pith ball and, after contact is made, to repel the ball. Which of the following can be concluded about the rod?

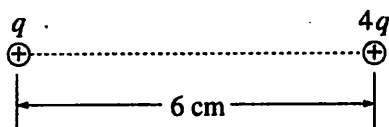   (A) The rod had a positive charge before contact and a negative charge after contact.
    (B) The rod had a negative charge before contact and a positive charge after contact.
    (C) The rod's charge before and after contact had the same sign.
    (D) The rod had a charge before contact, but no charge after contact.
    (E) The rod had less charge before contact than after contact.

$$q \cdot \qquad\qquad\qquad 4q$$
$$\oplus\text{----------------------------}\oplus$$
$$\vdash\!\!-\!\!-\!\!-\!\! 6\text{ cm }\!\!-\!\!-\!\!-\!\!\dashv$$

56. Two positive charges of magnitudes q and $4q$ are 6 centimeters apart, as shown above. If the electric field is zero at a point P (not shown) located on the line segment joining the charges, what is the distance of point P from the charge of magnitude q?

    (A) 1 cm
    (B) 2 cm
    (C) 3 cm
    (D) 4 cm
    (E) 5 cm

57. A beam of light traveling through the air strikes the surface of a material in which the speed of light is different from what it is in the air. Which of the following is true of the light as it passes into the new medium?

    (A) The frequency changes but the wavelength stays the same.
    (B) The wavelength changes but the frequency stays the same.
    (C) Neither the frequency nor the wavelength change.
    (D) Both the frequency and the wavelength change.
    (E) Since the speed of light is a universal constant, the speed in the new material is the same as it was in air.
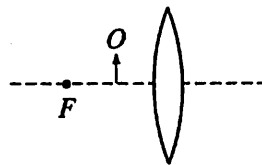
58. A convex lens is used as a magnifier when a real object O is placed inside the focus F, as shown above. The image produced is

    (A) real and inverted
    (B) real and upright
    (C) virtual and inverted
    (D) virtual and upright
    (E) none of the above

59. The separation of white light into colors by a glass prism is a result of

    (A) interference
    (B) diffraction
    (C) total internal reflection
    (D) variation of absorption with wavelength
    (E) variation of index of refraction with frequency

60. An object with a mass of 5 kilograms is placed at rest on an imaginary planet where the gravitational field is 4 newtons per kilogram. One can be certain that the object on this planet, as compared to the object when it is on Earth, will

    (A) require a greater force to accelerate it on a horizontal surface at 1 m/s^2
    (B) have less weight
    (C) have less mass
    (D) have greater mass
    (E) have greater acceleration during free fall

GO ON TO THE NEXT PAGE

61. A car travels around a circular track that has a radius of 1 kilometer. If the car completes 3 trips around the track in 5 minutes, which of the following expressions gives the average speed of the car in kilometers per hour?

(A) $\dfrac{(3)(2\pi)(1)}{5(1/60)}$

(B) $\dfrac{(5)(60)(2\pi)(1)}{3}$

(C) $\dfrac{(3)(2\pi)(1)}{5(60)}$

(D) $\dfrac{(5)(2\pi)(1)}{(3)(60)}$

(E) $\dfrac{(3\pi)(1)}{5(1/60)}$
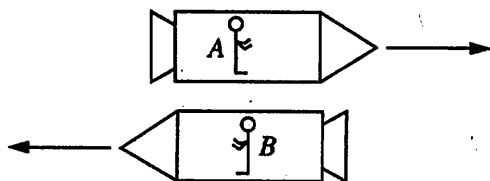
62. Two identical, human-looking robots are standing and facing forward in separate spaceships. Both ships are moving at $0.8c$ but are traveling in opposite directions, as shown above. If a person on the spaceship with robot A could make measurements on both robots, which of the following would the person observe to be different?

(A) The robots' heights
(B) The length of the robots' feet from toe to heel
(C) The width of the robots' faces
(D) The length of the robots' legs
(E) The width of the robots' shoulders

63. The experimental study of the photoelectric effect and its analysis by Einstein confirmed the assumption of the

(A) photon aspect of light
(B) crystal structure of materials
(C) discrete charge on the electron
(D) energy-mass relationship of special relativity
(E) uncertainty principle of position and momentum

64. The radius of the first Bohr orbit of an electron in a hydrogen atom is about 10^{-11} meter. The radius of the nucleus is about 10^{-15} meter. If a model of the hydrogen atom were built with the diameter of the electron orbit equal to the width of a classroom (about 10 meters), which of the following would most closely represent the size of the nucleus?

(A) The chair you are sitting in
(B) Your head
(C) The eraser on the end of a new pencil
(D) The point of a ball point pen
(E) A red blood cell

65. Which of the following is true of any material in a superconducting state that carries a current?

(A) It has a large internal magnetic field.
(B) It has no external magnetic field.
(C) It has no resistance.
(D) It has a temperature of absolute zero.
(E) It has a very high temperature.

66. The graphs below represent velocity as a function of time t for five different particles, each moving along a straight line. Which particle experiences the greatest displacement between $t = 0$ and $t = 1$ second?

(A)   Velocity (m/s)
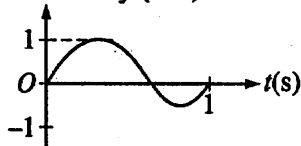
(B)   Velocity (m/s)
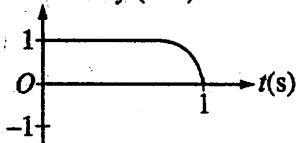
(C)   Velocity (m/s)
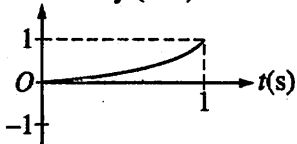
(D)   Velocity (m/s)
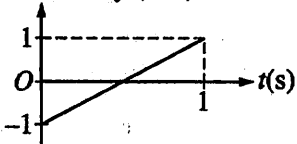
(E)   Velocity (m/s)
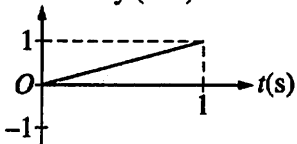
67. The density of a certain material is 3 grams per cubic centimeter. What is the density of the material expressed in kilograms per cubic meter?

(A) 0.3 kg/m^3
(B) 3 kg/m^3
(C) 30 kg/m^3
(D) 300 kg/m^3
(E) $3,000 \text{ kg/m}^3$

68. A system consists of two pucks moving without friction on a horizontal surface. If the pucks collide elastically, properties of the system that are the same before and after the collision include which of the following?

   I. Momentum
   II. Kinetic energy
   III. Total energy

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

69. It takes an amount of work W to stretch a spring a distance x beyond its natural length. If the spring obeys Hooke's law, how much work is required to stretch the spring a distance $2x$ beyond its natural length?

(A) W
(B) $2W$
(C) $3W$
(D) $4W$
(E) $6W$

70. A child on a swing can greatly increase the amplitude of the swing's motion by "pumping" at the natural frequency of the swing. This is an example of which of the following?

(A) Conservation of momentum
(B) Newton's first law of motion
(C) Newton's third law of motion
(D) Resonance
(E) Interference
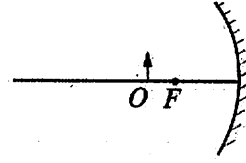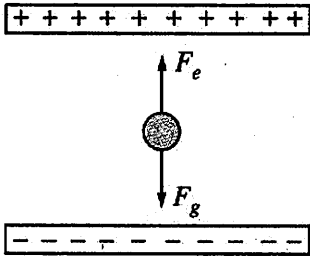
71. A negatively charged oil drop is maintained at rest between charged parallel plates, as shown above, by balancing the downward gravitational force F_g on the drop with an upward electric force F_e. If the mass of the oil drop is 1×10^{-6} kilogram and the electric field strength between the plates is 10 newtons per coulomb, then the charge on the oil drop is most nearly

(A) 1×10^{-3} C
(B) 1×10^{-4} C
(C) 1×10^{-5} C
(D) 1×10^{-6} C
(E) 1×10^{-19} C

72. An object O is just outside the focal point F of a concave mirror, as shown in the diagram above. As the object is moved away from the mirror, the image will do which of the following?

(A) Decrease in size and move closer to the mirror.
(B) Decrease in size and move farther from the mirror.
(C) Increase in size and move closer to the mirror.
(D) Increase in size and move farther from the mirror.
(E) It cannot be determined without knowing the exact focal length.
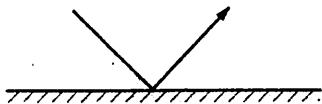
73. Which of the following occurs when light is reflected from a smooth flat glass surface, as shown above?

    (A) The light is somewhat intensified.
    (B) The light is somewhat polarized.
    (C) The light is focused.
    (D) The velocity of the light is reduced.
    (E) The color of the light is shifted toward the blue end of the spectrum.
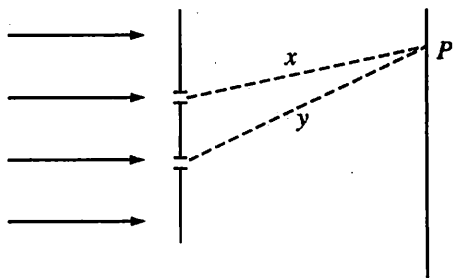
74. Light of wavelength λ is incident from the left on a pair of narrow slits, as shown above. If point P is a bright spot (maximum intensity) on a distant screen, one can be certain that the difference between distances x and y is

    (A) zero

    (B) $\lambda/2$

    (C) $n\lambda$, where n is an integer

    (D) $\left(n + \dfrac{1}{2}\right)\lambda$, where n is an integer

    (E) $\left(n - \dfrac{1}{2}\right)\lambda$, where n is an integer
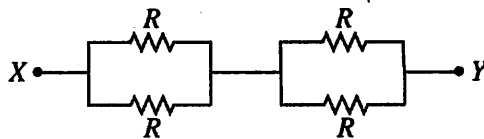
75. Four resistors of equal resistance R are connected as shown above. What is the total resistance between points X and Y?

    (A) $\dfrac{R}{4}$

    (B) $\dfrac{R}{2}$

    (C) R

    (D) $2R$

    (E) $4R$

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 SAT Subject Test in Physics, 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 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.

Table A

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	B			54	33	B			57
2	A			76	34	D			28
3	E			80	35	C			66
4	C			72	36	B			59
5	A			63	37	E			61
6	D			89	38	B			38
7	E			55	39	A			30
8	D			76	40	D			65
9	E			60	41	E			40
10	B			70	42	A			64
11	C			65	43	E			56
12	A			69	44	B			33
13	D			83	45	A			40
14	A			67	46	B			58
15	B			14	47	E			38
16	D			80	48	B			49
17	C			69	49	A			77
18	D			87	50	C			71
19	B			71	51	D			65
20	A			61	52	A			46
21	B			87	53	E			57
22	C			49	54	D			69
23	C			58	55	C			35
24	A			76	56	B			39
25	A			61	57	B			37
26	C			60	58	D			37
27	B			62	59	E			32
28	E			44	60	B			65
29	A			42	61	A			48
30	A			78	62	B			34
31	C			66	63	A			41
32	D			74	64	D			29

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	C			40	71	D			30
66	B			51	72	A			24
67	E			42	73	B			28
68	E			56	74	C			33
69	D			43	75	C			51
70	D			43					

* These percentages are based on an analysis of the answer sheets of a representative sample of 2,410 students who took this test in January 2003, and whose mean score was 628. 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 that question correctly on this edition of the 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 200–800. 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 41 on this particular edition of the Subject Test in Physics corresponds to a scaled score of 670.

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 the tests may be slightly easier or more difficult than others, College Board 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

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

How Did You Do on the Subject Test in Physics?

After you score your test and analyze your performance, think about 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 Subject Test in Physics 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 ones, 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 easier question. For example, 89 percent of the students answered question 6 correctly. But only 14 percent answered question 15 correctly.

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

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

CollegeBoard SAT

SAT Subject Tests™

DO NOT USE A MECHANICAL PENCIL

COMPLETE MARK ●   EXAMPLES OF
                    INCOMPLETE MARKS

You must use a No. 2 pencil. It is very important that you fill in the entire circle darkly and completely. If you change your response, erase as completely as possible. Incomplete marks or erasures may affect your score. It is very important that you follow these instructions when filling out your answer sheet.

1 Your Name:
(Print)

Last   First   M.I.

I agree to the conditions on the back of the SAT Subject Tests™ booklet. I also agree to use only a No. 2 pencil to complete my answer sheet.

Signature: _____   Date: __/__/__

Home Address: _____
                Number and Street   City   State   Zip Code

Home Phone: ( )_____ Center: _____
                        (Print)   City   State/Country

2 YOUR NAME
Last Name (First 6 Letters)   First Name (First 4 Letters)   Mid. Init.

3 DATE OF BIRTH
MONTH   DAY   YEAR
○ Jan
○ Feb
○ Mar
○ Apr
○ May
○ Jun
○ Jul
○ Aug
○ Sep
○ Oct
○ Nov
○ Dec

5 SEX
○ Female   ○ Male

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○ I turned in my registration form today.

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| COMPLETE MARK ● | EXAMPLES OF INCOMPLETE MARKS ◑ ⊗ ⊖ ◐ ⊜ ⊘ ⊘ ⊛ | | You must use a No. 2 pencil. Do not use a mechanical pencil. It is very important that you fill in the entire circle darkly and completely. If you change your response, erase as completely as possible. Incomplete marks or erasures may affect your score. |

If there are more answer spaces than you need, leave them blank.	Test Code	
	V	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
	W	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
	X	① ② ③ ④ ⑤
	Y	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
	Q	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

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If you are taking a Language Test select:
○ Reading Only
○ Reading and Listening

1 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   26 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   51 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   76 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
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13 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   38 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   63 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   88 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
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15 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   40 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   65 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   90 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
16 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   41 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   66 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   91 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
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23 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   48 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   73 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   98 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
24 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   49 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   74 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   99 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
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Quality Assurance Mark ●

Chemistry *Fill in circle CE only if II is correct explanation of I.

	I	II	CE*		I	II	CE*
101	Ⓣ Ⓕ	Ⓣ Ⓕ	○	109	Ⓣ Ⓕ	Ⓣ Ⓕ	○
102	Ⓣ Ⓕ	Ⓣ Ⓕ	○	110	Ⓣ Ⓕ	Ⓣ Ⓕ	○
103	Ⓣ Ⓕ	Ⓣ Ⓕ	○	111	Ⓣ Ⓕ	Ⓣ Ⓕ	○
104	Ⓣ Ⓕ	Ⓣ Ⓕ	○	112	Ⓣ Ⓕ	Ⓣ Ⓕ	○
105	Ⓣ Ⓕ	Ⓣ Ⓕ	○	113	Ⓣ Ⓕ	Ⓣ Ⓕ	○
106	Ⓣ Ⓕ	Ⓣ Ⓕ	○	114	Ⓣ Ⓕ	Ⓣ Ⓕ	○
107	Ⓣ Ⓕ	Ⓣ Ⓕ	○	115	Ⓣ Ⓕ	Ⓣ Ⓕ	○
108	Ⓣ Ⓕ	Ⓣ Ⓕ	○				

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Test Code

V	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
W	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
X	① ② ③ ④ ⑤
Y	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
Q	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

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If you are taking a Language Test select:
○ Reading Only
○ Reading and Listening

1 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   26 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   51 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   76 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
2 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   27 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   52 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   77 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
3 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   28 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   53 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   78 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
4 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   29 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   54 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   79 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
5 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   30 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   55 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   80 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
6 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   31 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   56 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   81 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
7 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   32 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   57 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   82 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
8 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   33 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   58 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   83 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
9 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   34 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   59 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   84 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
10 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   35 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   60 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   85 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
11 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   36 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   61 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   86 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
12 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   37 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   62 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   87 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
13 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   38 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   63 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   88 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
14 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   39 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   64 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   89 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
15 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   40 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   65 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   90 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
16 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   41 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   66 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   91 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
17 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   42 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   67 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   92 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
18 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   43 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   68 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   93 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
19 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   44 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   69 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   94 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
20 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   45 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   70 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   95 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
21 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   46 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   71 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   96 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
22 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   47 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   72 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   97 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
23 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   48 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   73 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   98 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
24 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   49 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   74 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   99 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
25 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   50 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   75 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   100 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

Quality Assurance Mark ●

8 BOOK CODE
(Copy and grid as on back of test book.)

9 BOOK ID
(Copy from back of test book.)

10 BOOK SERIAL NUMBER
(Copy from front of test book.)

Chemistry *Fill in circle CE only if II is correct explanation of I.

	I	II	CE*		I	II	CE*
101	Ⓣ Ⓕ	Ⓣ Ⓕ	○	109	Ⓣ Ⓕ	Ⓣ Ⓕ	○
102	Ⓣ Ⓕ	Ⓣ Ⓕ	○	110	Ⓣ Ⓕ	Ⓣ Ⓕ	○
103	Ⓣ Ⓕ	Ⓣ Ⓕ	○	111	Ⓣ Ⓕ	Ⓣ Ⓕ	○
104	Ⓣ Ⓕ	Ⓣ Ⓕ	○	112	Ⓣ Ⓕ	Ⓣ Ⓕ	○
105	Ⓣ Ⓕ	Ⓣ Ⓕ	○	113	Ⓣ Ⓕ	Ⓣ Ⓕ	○
106	Ⓣ Ⓕ	Ⓣ Ⓕ	○	114	Ⓣ Ⓕ	Ⓣ Ⓕ	○
107	Ⓣ Ⓕ	Ⓣ Ⓕ	○	115	Ⓣ Ⓕ	Ⓣ Ⓕ	○
108	Ⓣ Ⓕ	Ⓣ Ⓕ	○				

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If there are more answer spaces than you need, leave them blank.

Test Code

V	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
W	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
X	① ② ③ ④ ⑤
Y	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
Q	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Print Subject Test Name:

If you are taking a Language Test select:
○ Reading Only
○ Reading and Listening

1 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   26 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   51 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   76 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
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25 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   50 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   75 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ   100 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

8 BOOK CODE
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9 BOOK ID
(Copy from back of test book.)

10 BOOK SERIAL NUMBER
(Copy from front of test book.)

⓪ ⓪ ⓪ ⓪ ⓪ ⓪
① ① ① ① ① ①
② ② ② ② ② ②
③ ③ ③ ③ ③ ③
④ ④ ④ ④ ④ ④
⑤ ⑤ ⑤ ⑤ ⑤ ⑤
⑥ ⑥ ⑥ ⑥ ⑥ ⑥
⑦ ⑦ ⑦ ⑦ ⑦ ⑦
⑧ ⑧ ⑧ ⑧ ⑧ ⑧
⑨ ⑨ ⑨ ⑨ ⑨ ⑨

Quality
●
Assurance Mark

Chemistry *Fill in circle CE only if II is correct explanation of I.

	I	II	CE*		I	II	CE*
101	Ⓣ Ⓕ	Ⓣ Ⓕ	○	109	Ⓣ Ⓕ	Ⓣ Ⓕ	○
102	Ⓣ Ⓕ	Ⓣ Ⓕ	○	110	Ⓣ Ⓕ	Ⓣ Ⓕ	○
103	Ⓣ Ⓕ	Ⓣ Ⓕ	○	111	Ⓣ Ⓕ	Ⓣ Ⓕ	○
104	Ⓣ Ⓕ	Ⓣ Ⓕ	○	112	Ⓣ Ⓕ	Ⓣ Ⓕ	○
105	Ⓣ Ⓕ	Ⓣ Ⓕ	○	113	Ⓣ Ⓕ	Ⓣ Ⓕ	○
106	Ⓣ Ⓕ	Ⓣ Ⓕ	○	114	Ⓣ Ⓕ	Ⓣ Ⓕ	○
107	Ⓣ Ⓕ	Ⓣ Ⓕ	○	115	Ⓣ Ⓕ	Ⓣ Ⓕ	○
108	Ⓣ Ⓕ	Ⓣ Ⓕ	○				

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R/C	W/S1	FS/S2	CS/S3	W/S

Page 4

SERIAL #