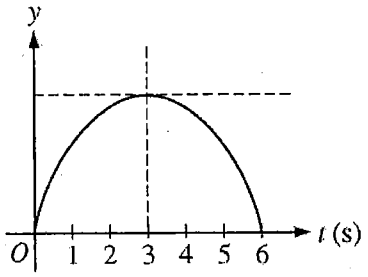
PHYSICS B
SECTION I
Time—90 minutes
70 Questions

2006

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 place the letter of your choice in the corresponding box on the student answer sheet.

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

Questions 1-4



A ball is thrown straight up by a student at rest on the surface of Earth. A graph of the position y as a function of time t, in seconds, is shown above. Air resistance is negligible.

1. At which of the following times is the ball farthest from the student?

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

2. At which of the following times is the speed of the ball the least?

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

3. Which of the following best describes the acceleration of the ball?

   (A) It is downward and constant from 0 to 6 s.
   (B) It is downward and increases in magnitude from 0 to 3 s, then decreases.
   (C) It is downward and decreases in magnitude from 0 to 3 s, then increases.
   (D) It is upward and increases in magnitude from 0 to 3 s, then decreases.
   (E) It is upward and decreases in magnitude from 0 to 3 s, then increases.

4. What is the initial speed of the ball?

   (A) 30 m/s
   (B) 45 m/s
   (C) 60 m/s
   (D) 90 m/s
   (E) 180 m/s

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5. Two boxes of different masses in an orbiting space station appear to float at rest—one above the other—with respect to the station. An astronaut applies the same force to both boxes. Can the boxes have the same acceleration with respect to the space station?

   (A) No, because the boxes are moving in orbits of different radius.
   (B) No, because the box of greater mass requires more force to reach the same acceleration.
   (C) Yes, because both boxes appear weightless.
   (D) Yes, because both boxes are accelerating toward Earth at the same rate.
   (E) It cannot be determined without knowing whether the boxes are being pushed parallel or perpendicular to Earth's gravity.

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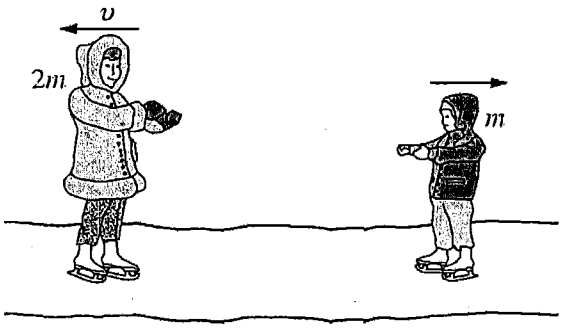
6. An object is dropped from rest from a certain height. Air resistance is negligible. After falling a distance d, the object's kinetic energy is proportional to which of the following?

(A) $1/d^2$
(B) $1/d$
(C) $\sqrt{d}$
(D) d
(E) d^2

7. An object is projected vertically upward from ground level. It rises to a maximum height H. If air resistance is negligible, which of the following must be true for the object when it is at a height $H/2$?

(A) Its speed is half of its initial speed.
(B) Its kinetic energy is half of its initial kinetic energy.
(C) Its potential energy is half of its initial potential energy.
(D) Its total mechanical energy is half of its initial value.
(E) Its total mechanical energy is half of its value at the highest point.

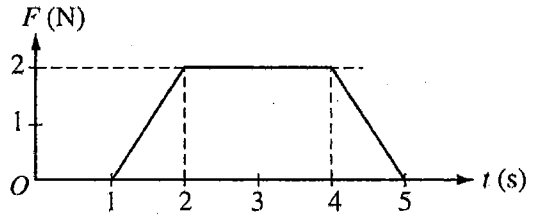


8. A boy of mass m and a girl of mass $2m$ are initially at rest at the center of a frozen pond. They push each other so that she slides to the left at speed v across the frictionless ice surface and he slides to the right as shown above. What is the total work done by the children?

(A) Zero
(B) mv
(C) mv^2
(D) $2mv^2$
(E) $3mv^2$

9. An object of mass M travels along a horizontal air track at a constant speed v and collides elastically with an object of identical mass that is initially at rest on the track. Which of the following statements is true for the two objects after the impact?

(A) The total momentum is Mv and the total kinetic energy is $\frac{1}{2}Mv^2$.
(B) The total momentum is Mv and the total kinetic energy is less than $\frac{1}{2}Mv^2$.
(C) The total momentum is less than Mv and the total kinetic energy is $\frac{1}{2}Mv^2$.
(D) The momentum of each object is $\frac{1}{2}Mv$.
(E) The kinetic energy of each object is $\frac{1}{4}Mv^2$.



10. A 2 kg object initially moving with a constant velocity is subjected to a force of magnitude F in the direction of motion. A graph of F as a function of time t is shown above. What is the increase, if any, in the velocity of the object during the time the force is applied?

(A) 0 m/s
(B) 2.0 m/s
(C) 3.0 m/s
(D) 4.0 m/s
(E) 6.0 m/s

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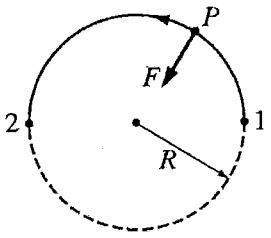


11. A particle P moves around the circle of radius R shown above under the influence of a radial force of magnitude F. What is the work done by the radial force as the particle moves from position 1 to position 2 halfway around the circle?

(A) Zero
(B) RF
(C) $2RF$
(D) πRF
(E) $2\pi RF$

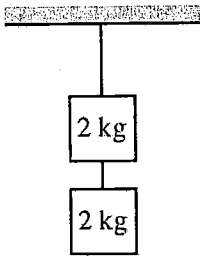
12. An object of mass m hanging from a spring of spring constant k oscillates with a certain frequency. What is the length of a simple pendulum that has the same frequency of oscillation?

(A) $\frac{mk}{g}$
(B) $\frac{mg}{k}$
(C) $\frac{kg}{m}$
(D) $\frac{k}{mg}$
(E) $\frac{g}{mk}$

13. A spherical planet has mass greater than that of Earth, but its density is unknown. The weight of an object on that planet compared with its weight on Earth is which of the following?

(A) Larger
(B) The same
(C) Smaller
(D) It cannot be determined without information about the planet's size.
(E) It cannot be determined without information about the planet's atmosphere.

Questions 14-15



Two blocks of wood, each of mass 2 kg, are suspended from the ceiling by strings of negligible mass, as shown above.

14. What is the tension in the upper string?

(A) 10 N
(B) 20 N
(C) 40 N
(D) 50 N
(E) 60 N

15. What is the force exerted on the upper block by the lower string?

(A) Zero
(B) 10 N upward
(C) 10 N downward
(D) 20 N upward
(E) 20 N downward

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16. A vertical force of 30 N is applied uniformly to a flat button with a radius of 1 cm that is lying on a table. Which of the following is the best order of magnitude estimate for the pressure applied to the button?

(A) 10 Pa
(B) 10^2 Pa
(C) 10^3 Pa
(D) 10^4 Pa
(E) 10^5 Pa

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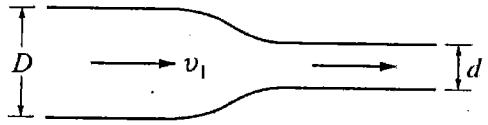
17. A ball that can float on water has mass 5.00 kg and volume 2.50×10^{-2} m^3. What is the magnitude of the downward force that must be applied to the ball to hold it motionless and completely submerged in freshwater of density 1.00×10^3 kg/m^3 ?

(A) 20.0 N
(B) 25.0 N
(C) 30.0 N
(D) 200 N
(E) 250 N



18. Water flows through the pipe shown above. At the larger end, the pipe has diameter D and the speed of the water is v_1. What is the speed of the water at the smaller end, where the pipe has diameter d?

(A) v_1
(B) $\left(\frac{d}{D}\right)v_1$
(C) $\left(\frac{D}{d}\right)v_1$
(D) $\left(\frac{d^2}{D^2}\right)v_1$
(E) $\left(\frac{D^2}{d^2}\right)v_1$

19. The floor of a building is made from a square, solid piece of concrete. When the temperature of the floor increases from 20°C to 28°C, each side of the square expands by 0.4 cm. If the temperature of the floor were to decrease from 20°C to 8°C, by how much would each side of the square contract?

(A) 0.2 cm
(B) 0.4 cm
(C) 0.6 cm
(D) 1.0 cm
(E) It cannot be determined without knowing the coefficient of linear expansion of the concrete.

20. The temperature of an ideal gas is directly proportional to which of the following?

(A) Average translational kinetic energy of the molecules
(B) Average velocity of the molecules
(C) Average potential energy of the molecules
(D) Average momentum of the molecules
(E) None of the above

21. A heat engine operates in a cycle between temperatures 700 K and 400 K. The heat input to the engine during each cycle is 2800 J. What is the maximum possible work done by the engine in each cycle?

(A) 1200 J
(B) 1600 J
(C) 2100 J
(D) 2800 J
(E) 4400 J

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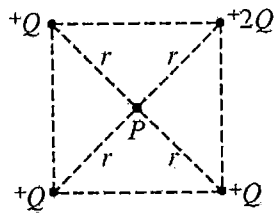
Questions 22-23



Four positive charges are fixed at the corners of a square, as shown above. Three of the charges have magnitude Q, and the fourth charge has a magnitude $2Q$. Point P is at the center of the square at a distance r from each charge.

22. What is the electric potential at point P ?

(A) Zero

(B) $\frac{kQ}{r}$

(C) $\frac{2kQ}{r}$

(D) $\frac{4kQ}{r}$

(E) $\frac{5kQ}{r}$

23. What is the magnitude of the electric field at point P ?

(A) Zero

(B) $\frac{kQ}{r^2}$

(C) $\frac{2kQ}{r^2}$

(D) $\frac{4kQ}{r^2}$

(E) $\frac{5kQ}{r^2}$

24. Conducting sphere X is initially uncharged. Conducting sphere Y has twice the diameter of sphere X and initially has charge q. If the spheres are connected by a long thin wire, which of the following is true once equilibrium has been reached?

(A) Sphere Y has half the potential of sphere X.
(B) Spheres X and Y have the same potential.
(C) Sphere Y has twice the potential of sphere X.
(D) Sphere Y has half the charge of sphere X.
(E) Spheres X and Y have the same charge.

25. If the separation between the plates of an isolated charged parallel-plate capacitor is increased slightly, which of the following also increases?

(A) The capacitance
(B) The stored electrostatic energy
(C) The force of attraction between the plates
(D) The magnitude of the charge on each plate
(E) The magnitude of the electric field in the region between the plates

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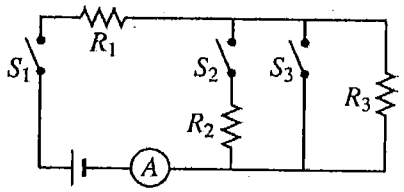
Questions 26-28



In the circuit above, the resistors all have the same resistance. The battery, wires, and ammeter have negligible resistance. A closed switch also has negligible resistance.

26. Closing which of the switches will produce the greatest power dissipation in R_2 ?

(A) S_1 only
(B) S_2 only
(C) S_1 and S_2 only
(D) S_1 and S_3 only
(E) S_1, S_2, and S_3

27. Closing which of the switches will produce the greatest reading on the ammeter?

(A) S_1 only
(B) S_2 only
(C) S_3 only
(D) S_1 and S_2
(E) S_1 and S_3

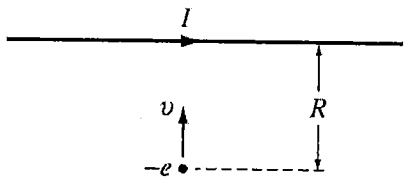
28. Closing which of the switches will produce the greatest voltage across R_3 ?

(A) S_1 only
(B) S_2 only
(C) S_1 and S_2 only
(D) S_1 and S_3 only
(E) S_1, S_2, and S_3

29. Two cables can be used to wire a circuit. Cable A has a lower resistivity, a larger diameter, and a different length than cable B. Which cable should be used to minimize heat loss if the same current is maintained in either cable?

(A) Cable A
(B) Cable B
(C) The heat loss is the same for both.
(D) It cannot be determined without knowing the length of each cable.
(E) It cannot be determined without knowing the materials contained in each cable.

Questions 30-31



An electron of charge $-e$ and a long straight wire carrying a current I to the right are both in the plane of the page, as shown above. In the position shown, the electron is a distance R from the wire and is moving directly toward it with speed v.

30. What is the direction of the magnetic force on the electron when it is in this position?

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

31. What is the magnitude of the magnetic force on the electron when it is in this position?

(A) $\frac{\mu_0}{2\pi}\frac{Iev}{R}$
(B) $\frac{\mu_0}{2\pi}\frac{I^2ev}{R}$
(C) $\frac{\mu_0}{2\pi}\frac{Ie^2v}{R}$
(D) $\frac{\mu_0}{2\pi}\frac{Iev^2}{R}$
(E) $\frac{\mu_0}{2\pi}\frac{Iev}{R^2}$

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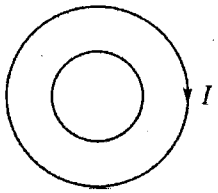

32. Two concentric, circular wire loops lie in the same plane, as shown above. The current I in the outer loop is clockwise and increasing with time. The induced current in the inner loop is

(A) zero
(B) clockwise
(C) counterclockwise
(D) alternating between clockwise and counterclockwise
(E) either clockwise or counterclockwise, depending on the ratio of the radii of the loops

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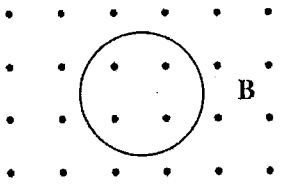
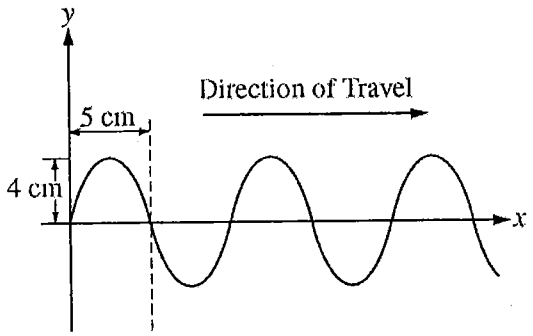


33. A uniform magnetic field **B** is directed out of the page, as shown above. A loop of wire of area 0.40 m^2 is in the plane of the page. At a certain instant the field has a magnitude of 3.0 T and is decreasing at the rate of 0.50 T/s. The magnitude of the induced emf in the wire loop at this instant is most nearly

(A) 0.20 V
(B) 0.60 V
(C) 1.2 V
(D) 1.5 V
(E) 2.8 V

Questions 34-35



The figure above shows a transverse wave traveling to the right at a particular instant of time. The period of the wave is 0.2 s.

34. What is the amplitude of the wave?

(A) 4 cm
(B) 5 cm
(C) 8 cm
(D) 10 cm
(E) 16 cm

35. What is the speed of the wave?

(A) 4 cm/s
(B) 25 cm/s
(C) 50 cm/s
(D) 100 cm/s
(E) 200 cm/s

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36. Which of the following statements are true for both sound waves and electromagnetic waves?

I. They can undergo refraction.
II. They can undergo diffraction.
III. They can produce a two-slit interference pattern.
IV. They can produce standing waves.

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

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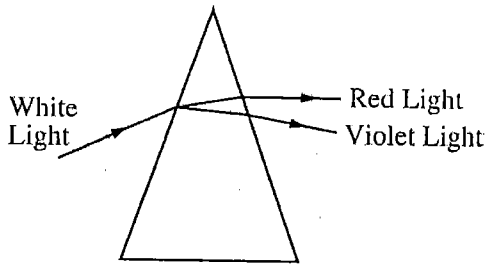
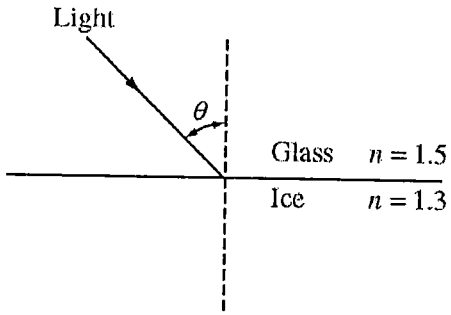


37. As shown above, a beam of white light is separated into separate colors when it passes through a glass prism. Red light is refracted through a smaller angle than violet light because red light has a

(A) slower speed in glass than violet light
(B) faster speed in glass than violet light
(C) slower speed in the incident beam than violet light
(D) faster speed in the incident beam than violet light
(E) greater intensity than violet light

38. If one of the two slits in a Young's double-slit demonstration of the interference of light is covered with a thin filter that transmits only half the light intensity, which of the following occurs?

(A) The fringe pattern disappears.
(B) The bright lines are brighter and the dark lines are darker.
(C) The bright lines and the dark lines are all darker.
(D) The bright lines and the dark lines are all brighter.
(E) The dark lines are brighter and the bright lines are darker.



39. A ray of light in glass that is incident on an interface with ice, as shown above, is partially reflected and partially refracted. The index of refraction n for each of the two media is given in the figure. How do the angle of reflection and the angle of refraction compare with the angle of incidence θ ?

	Angle of Reflection	Angle of Refraction
(A)	Same	Larger
(B)	Same	Smaller
(C)	Smaller	Same
(D)	Smaller	Smaller
(E)	Larger	Larger

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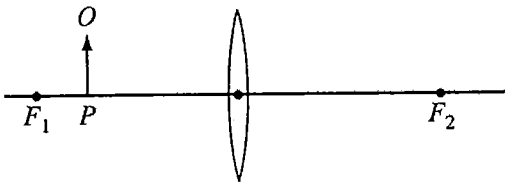
Questions 40-41



An object O is located at point P to the left of a converging lens, as shown in the figure above. F_1 and F_2 are the focal points of the lens.

40. If the focal length of the lens is 0.40 m and point P is 0.30 m to the left of the lens, where is the image of the object located?

(A) 1.2 m to the left of the lens
(B) 0.17 m to the left of the lens
(C) At the lens
(D) 0.17 m to the right of the lens
(E) 1.2 m to the right of the lens

41. Which of the following characterizes the image when the object is in the position shown?

(A) Real, inverted, and smaller than the object
(B) Real, upright, and larger than the object
(C) Real, inverted, and larger than the object
(D) Virtual, upright, and larger than the object
(E) Virtual, upright, and smaller than the object

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42. The work function for a metal is ϕ. What is the threshold frequency of incident light required for the emission of photoelectrons from a cathode made of that metal?

(A) $\frac{\phi}{h}$

(B) $\frac{h}{\phi}$

(C) ϕh

(D) $\frac{\phi}{hc}$

(E) $\frac{hc}{\phi}$

43. Two monochromatic light beams, one red and one green, have the same intensity and the same cross-sectional area. How does the energy of each photon and the number of photons crossing a unit area per second in the red beam compare with those of the green beam?

	Energy of Photon	Number of Photons Crossing Unit Area per Second
(A)	Same	Same
(B)	Greater for red	Less for red
(C)	Greater for red	Greater for red
(D)	Less for red	Less for red
(E)	Less for red	Greater for red

44. $^{226}_{88}\mathrm{Ra}$ decays into $^{222}_{86}\mathrm{Rn}$ plus

(A) a proton
(B) a neutron
(C) an electron
(D) a helium nucleus $\left(^{4}_{2}\mathrm{He}\right)$
(E) a deuteron $\left(^{2}_{1}\mathrm{H}\right)$

45. In any physically correct equation, the units of any two quantities must be the same whenever these quantities are

(A) added or multiplied only
(B) subtracted or divided only
(C) multiplied or divided only
(D) added or subtracted only
(E) added, subtracted, multiplied, or divided

46. On a day when the speed of sound is 340 m/s, a ship sounds its whistle. The echo of the sound from the shore is heard at the ship 6.0 s later. How far is the ship from the shore?

(A) 56.7 m
(B) 113 m
(C) 1020 m
(D) 2040 m
(E) 4080 m

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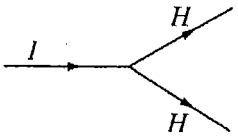
47. An isolated pair of charged particles X and Y, with masses m_X and $m_Y = 2m_X$, repel one another. The electrostatic force is the only force between them. If particle X accelerates at $2.2\ \text{m/s}^2$, what is the acceleration of particle Y?

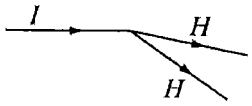
(A) $0\ \text{m/s}^2$
(B) $0.55\ \text{m/s}^2$
(C) $1.1\ \text{m/s}^2$
(D) $2.2\ \text{m/s}^2$
(E) $4.4\ \text{m/s}^2$

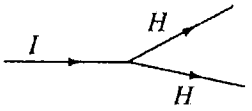
48. An object initially at rest is subjected to a constant net force. Measurements are taken of its velocity v at different distances d from the starting position. A graph of which of the following should exhibit a straight-line relationship?

(A) d^2 versus v^{-2}
(B) d^2 versus v
(C) d versus v
(D) d versus v^{-1}
(E) d versus v^2

49. A disk slides to the right on a horizontal, frictionless air table and collides with another disk that was initially stationary. The figures below show a top view of the initial path I of the sliding disk and a hypothetical path H for each disk after the collision. Which figure shows an impossible situation?

(A)


(B)


(C)


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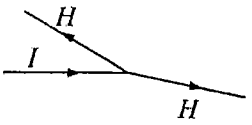
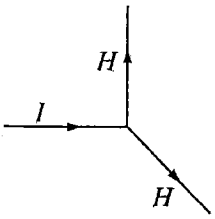


(E)


50. A meterstick of negligible mass is placed on a fulcrum at the 0.60 m mark, with a 2.0 kg mass hung at the 0 m mark and a 1.0 kg mass hung at the 1.0 m mark. The meterstick is released from rest in a horizontal position. Immediately after release, the magnitude of the net torque on the meterstick about the fulcrum is most nearly

(A) 2.0 N·m
(B) 8.0 N·m
(C) 10 N·m
(D) 14 N·m
(E) 16 N·m

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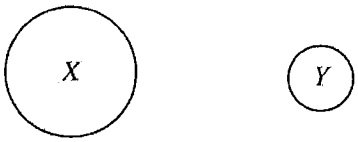
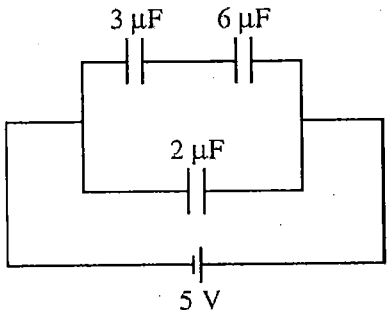


51. The two charged metal spheres X and Y shown above are far apart, and each is isolated from all other charges. The radius of sphere X is greater than that of sphere Y, and the magnitudes of the electric fields just outside their surfaces are the same. How does the charge on sphere X compare with that on sphere Y?

(A) It is greater.
(B) It is less.
(C) It is the same.
(D) It cannot be determined without knowing the actual radii of the spheres.
(E) It cannot be determined without knowing the actual value of the electric field just outside the spheres.

Questions 52-53



Three capacitors are connected to a 5 V source, as shown in the circuit diagram above.

52. The equivalent capacitance for the circuit is

(A) $\frac{1}{11}$ μF
(B) $\frac{11}{18}$ μF
(C) 1 μF
(D) 4 μF
(E) 11 μF

53. How do the charge Q_3 stored in the 3 μF capacitor and the voltage V_3 across it compare with those of the 6 μF capacitor?

	Charge	Voltage
(A)	$Q_3 < Q_6$	$V_3 = V_6$
(B)	$Q_3 = Q_6$	$V_3 < V_6$
(C)	$Q_3 = Q_6$	$V_3 > V_6$
(D)	$Q_3 > Q_6$	$V_3 = V_6$
(E)	$Q_3 > Q_6$	$V_3 > V_6$

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54. An ion with a charge $+Q$ moves with constant speed v in a circular path of radius R in a uniform magnetic field of magnitude B. What is the mass of the ion?

(A) $\frac{2QB}{v}$

(B) $\frac{QBR}{v}$

(C) $\frac{2QB}{v^2}$

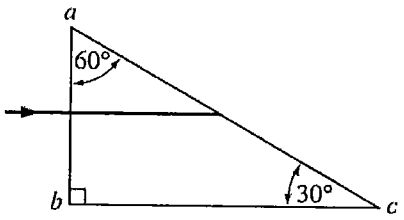
(D) $\frac{QBR}{v^2}$

(E) $\frac{2QBR}{v^2}$

55. A standing wave pattern is created on a guitar string as a person tunes the guitar by changing the tension in the string. Which of the following properties of the waves on the string will change as a result of adjusting only the tension in the string?

I. Speed of the traveling wave that creates the pattern
II. Frequency of the standing wave
III. Wavelength of the standing wave

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



56. A ray of light in air is incident on a 30°-60°-90° prism, perpendicular to face ab, as shown in the diagram above. The ray enters the prism and strikes face ac at the critical angle. What is the index of refraction of the prism?

(A) $\frac{1}{2}$

(B) $\sqrt{\frac{3}{2}}$

(C) $\frac{2\sqrt{3}}{3}$

(D) 2

(E) 3

57. Correct statements about the binding energy of a nucleus include which of the following?

I. It is the energy needed to separate the nucleus into its individual protons and neutrons.
II. It is the energy liberated when the nucleus is formed from the original nucleons.
III. It is the energy equivalent of the apparent loss of mass of its nucleon constituents.

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

58. A car of mass 900 kg is traveling at 20 m/s when the brakes are applied. The car then comes to a complete stop in 5 s. What is the average power that the brakes produce in stopping the car?

(A) 1800 W
(B) 3600 W
(C) 7200 W
(D) 36,000 W
(E) 72,000 W

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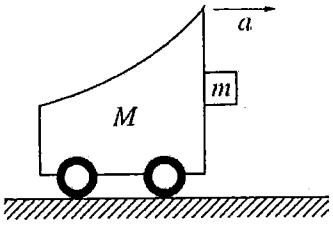


59. The figure above shows a cart of mass M accelerating to the right with a block of mass m held to the front surface only by friction. The coefficient of friction between the surfaces is μ. What is the minimum acceleration a of the cart such that the block will not fall?

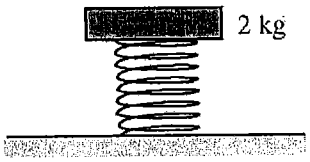
(A) μg

(B) $\frac{g}{\mu}$

(C) $\frac{gm}{\mu(M+m)}$

(D) $\frac{gM}{\mu(M+m)}$

(E) $\frac{\mu gM}{M+m}$



60. A platform of mass 2 kg is supported by a spring of negligible mass as shown above. The platform oscillates with a period of 3 s when the platform is pushed down and released. What must be the mass of a block that when placed on the platform doubles the period of oscillation to 6 s?

(A) 1 kg
(B) 2 kg
(C) 4 kg
(D) 6 kg
(E) 8 kg

61. The acceleration of a satellite of mass m in a circular orbit of radius R around a planet of mass M is equal to which of the following?

(A) $G\frac{M}{R^2}$

(B) $G\frac{m}{R^2}$

(C) $G\frac{mM}{R^2}$

(D) $G\frac{mM}{R}$

(E) $GmMR$

62. Two identical containers hold two different ideal gases, X and Y, at the same temperature. The number of moles of each gas is the same. The molecular mass of gas X is twice that of gas Y. The ratio of the pressure of X to that of Y is

(A) 1/2
(B) 1
(C) $\sqrt{2}$
(D) 2
(E) 4

63. If three resistors with unequal resistance are connected in parallel in a DC circuit, which of the following is true of the total resistance?

(A) It is higher than the value of the highest resistance.
(B) It is equal to the middle resistance.
(C) It is equal to the average of the three resistances.
(D) It is lower than the value of the lowest resistance.
(E) It cannot be determined without knowing the emf applied across the combination.

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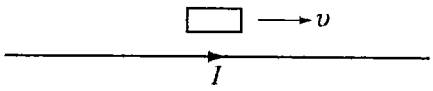
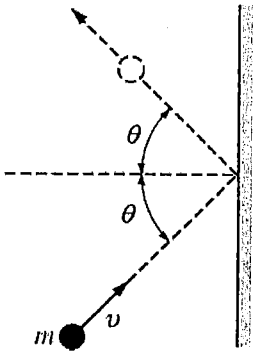
64. A tuning fork is used to create standing waves in a tube open at the top and partially filled with water. A resonance is heard when the water level is at a certain height. The next resonance is heard when the water level has been lowered by 0.5 m. If the speed of sound is equal to 340 m/s, the frequency of the tuning fork is

(A) 170 Hz
(B) 226 Hz
(C) 340 Hz
(D) 680 Hz
(E) 2450 Hz



65. A rectangular loop of wire moves at constant speed v parallel to a long wire carrying a current I, as shown above. Which of the following describes the current, if any, induced in the loop?

(A) A constant clockwise current
(B) A constant counterclockwise current
(C) An increasing current
(D) A decreasing current
(E) No current



66. A ball of mass m with speed v strikes a wall at an angle θ with the normal, as shown above. It then rebounds with the same speed and at the same angle. The impulse delivered by the ball to the wall is

(A) zero
(B) $mv\sin\theta$
(C) $mv\cos\theta$
(D) $2mv\sin\theta$
(E) $2mv\cos\theta$

67. In an x-ray tube, electrons striking a target are brought to rest, causing x-rays to be emitted. In a particular x-ray tube, the maximum frequency of the emitted continuum x-ray spectrum is f_0. If the voltage across the tube is doubled, the maximum frequency is

(A) $\frac{f_0}{2}$
(B) $\frac{f_0}{\sqrt{2}}$
(C) f_0
(D) $\sqrt{2}f_0$
(E) $2f_0$

68. A diffraction grating is illuminated by light of wavelength 600 nm. On a screen 100 cm away is a series of bright spots spaced 10 cm apart. If the screen is now placed 30 cm from the diffraction grating, the new spacing between adjacent bright spots on the screen is most nearly

(A) 30 cm
(B) 10 cm
(C) 3 cm
(D) 1 cm
(E) 3 mm

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AP Practice Exam Answers

if viewed as vectors, C if only considering magn. of vel

1984 MC

1	C	2	A	3	C	4	D	5	D	6	E	7	C	8	B	9	B	10	E
11	E	12	E	13	B	14	E	15	B	16	E	17	E	18	B	19	D	20	C
21	A	22	B	23	C	24	A	25	A	26	A	27	D	28	B	29	C	30	B
31	C	32	B	33	C	34	C	35	B	36	E	37	E	38	A	39	E	40	B
41	D	42	A	43	E	44	A	45	D	46	D	47	A	48	C	49	A	50	C
51	D	52	C	53	E	54	C	55	A	56	D	57	B	58	C	59	E	60	D
61	A	62	D	63	D	64	C	65	C	66	A	67	A	68	C	69	D	70	b

1988

1	A	2	D	3	C	4	B	5	C	6	E	7	E	8	B	9	C	10	B
11	E	12	D	13	D	14	C	15	A	16	A	17	E	18	D	19	B	20	C
21	C	22	C	23	A	24	C	25	D	26	B	27	B	28	B	29	D	30	B
31	A	32	A	33	A	34	C	35	D	36	C	37	C	38	D	39	e	40	E
41	A	42	E	43	C	44	B	45	D	46	B	47	C	48	D	49	A	50	C
51	C	52	B	53	A	54	C	55	E	56	A	57	A	58	D	59	E	60	B
61	E	62	B	63	D	64	E	65	B	66	A	67	E	68	E	69	D	70	b

1993

1	D	2	B	3	E	4	E	5	C	6	C	7	E	8	E	9	A	10	D
11	B	12	B	13	C	14	A	15	D	16	B	17	B	18	E	19	E	20	D
21	C	22	A	23	C	24	C	25	B	26	B	27	D	28	B	29	B	30	A
31	E	32	B	33	A	34	D	35	E	36	D	37	C	38	C	39	D	40	C
41	A	42	C	43	A	44	E	45	B	46	E	47	D	48	D	49	B	50	B
51	C	52	E	53	D	54	A	55	A	56	A	57	D	58	C	59	A	60	C
61	D	62	C	63	B	64	D	65	E	66	A	67	A	68	B	69	D	70	E

1998

1	B	2	C	3	E	4	C	5	C	6	E	7	A	8	D	9	A	10	A
11	B	12	A	13	A	14	E	15	A	16	E	17	C	18	D	19	C	20	D
21	A	22	A	23	A	24	C	25	B	26	B	27	E	28	D	29	B	30	D
31	A	32	B	33	D	34	B	35	A	36	A	37	A	38	D	39	E	40	B
41	A	42	E	43	B	44	C	45	D	46	A	47	C	48	D	49	C	50	D
51	D	52	B	53	C	54	B	55	B	56	D	57	C	58	C	59	E	60	D
61	D	62	C	63	C	64	B	65	D	66	C	67	D	68	A	69	B	70	E

2004

1	E	2	B	3	E	4	E	5	B	6	A	7	E	8	E	9	C	10	B
11	D	12	C	13	A	14	C	15	A	16	A	17	B	18	E	19	D	20	D
21	E	22	D	23	C	24	B	25	B	26	A	27	C	28	E	29	A	30	C
31	E	32	B	33	B	34	A	35	D	36	C	37	E	38	A	39	E	40	B
41	A	42	B	43	E	44	E	45	D	46	D	47	C	48	D	49	A	50	E
51	A	52	A	53	E	54	E	55	D	56	D	57	A	58	E	59	E	60	C
61	C	62	B	63	D	64	D	65	D	66	D	67	C	68	E	69	C	70	A

2006

1	C	2	C	3	A	4	A	5	B	6	D	7	B	8	E	9	A	10	C
11	A	12	B	13	D	14	C	15	E	16	E	17	D	18	E	19	C	20	A
21	A	22	E	23	B	24	B	25	B	26	C	27	E	28	A	29	D	30	E
31	A	32	C	33	A	34	A	35	C	36	E	37	B	38	E	39	A	40	A
41	D	42	A	43	E	44	D	45	D	46	C	47	C	48	E	49	B	50	B
51	A	52	D	53	C	54	B	55	C	56	C	57	E	58	D	59	B	60	D
61	A	62	B	63	D	64	C	65	E	66	E	67	E	68	C	69	B	70	D