Exam
Name____________________________________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) How many electrons are necessary to produce 1.0 C of negative charge? ($e = 1.60 \times 10^{-19}$ C) 1) _______

A) 1.6×10^{19}
B) 6.0×10^{23}
C) 1.6×10^{9}
D) 6.3×10^{18}
E) 6.3×10^{9}

2) A piece of plastic has a net charge of +2.00 μC. How many more protons than electrons does this piece of plastic have? ($e = 1.60 \times 10^{-19}$ C) 2) _______

A) 2.50×10^{13}
B) 3.01×10^{23}
C) 1.25×10^{19}
D) 1.25×10^{13}
E) 2.50×10^{19}

3) What is the charge on 1.0 kg of protons?($e = 1.60 \times 10^{-19}$ C, $m_{proton} = 1.67 \times 10^{-27}$ kg) 3) _______

A) 1000 C
B) 6.0×10^{26} C
C) 9.6×10^{7} C
D) 6.0×10^{23} C
E) 1.0 C

4) If a charge generator builds a negative static charge of -11.00 μC, how many electrons are transferred to it during this process. ($e = 1.60 \times 10^{-19}$ C) 4) _______

A) 6.88×10^{13} B) 11.0 C) 68.8 D) 1.76×10^{-18}

5) An asteroid of mass 53,000 kg carrying a negative charge of 15 μC is 170 m from a second asteroid of mass 57,000 kg carrying a negative charge of 19 μC. What is the magnitude of the net force the asteroids exert upon each other, assuming we can treat them as point particles? ($G = 6.67 \times 10^{-11}$ N · m^2/kg^2, $k = 1/4\,\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 5) _______

A) 520,000 N B) 0.000082 N C) 0.0069 N D) 560,000 N

6) Two electrons are 28.0 mm apart at closest approach. What is the magnitude of the maximum electric force that they exert on each other? ($e = 1.60 \times 10^{-19}$ C, $k = 1/4\pi\varepsilon_0 = 9.0\ 10^9$ N · m^2/C^2) 6) _______

A) 1.2×10^{10} N B) 1.2 N C) 2.9×10^{-27} N D) 2.9×10^{-25} N

7) The force of attraction that a -40.0 μC point charge exerts on a +108 μC point charge has magnitude 4.00 N. How far apart are these two charges? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 7) _______

A) 3.12 m B) 2.10 m C) 1.13 m D) 3.67 m E) 2.49 m

8) When 1.0-μC point charge is 15 m from a second point charge, the force each one experiences a force of 1.0 μN. What is the magnitude of the second charge? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 8) _______

A) 25 nC B) 1.0 C C) 10 nC D) 25 C E) 0.025 C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

9) Consider a container of 2.0 g of hydrogen, $H2$ (one mole). Suppose you removed all the electrons and moved them to the other side of the earth (Earth's radius is 6380 km, $k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2, $N_A = 6.022 \times 10^{23}$ molecules/mol, $e = 1.60 \times 10^{-19}$ C) 9) ____________

(a) How much charge is left behind after you remove the electrons?

(b) What electric force do the protons exert on the electrons after they are separated as described?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

10) Two 10¢ coins (dimes) carrying identical charges are lying 2.5 m apart on a table. If each of these coins experiences an electrostatic force of magnitude 2.0 N due to the other coin, how large is the charge on each coin? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 10) ______

A) 26 μC B) 5.2 μC C) 2.6 μC D) 52 μC E) 6.7 μC

11) Two point charges each experience a 1-N electrostatic force when they are 2 cm apart. If they are moved to a new separation of 8 cm, what is the magnitude of the electric force on each of them? 11) ______

A) 2 N B) 1/8 N C) 1/2 N D) 1/4 N E) 1/16 N

12) A proton is located at the point (x = 4.0 nm, y = 0.0 nm) and an electron is located at the point (x = 0.0 nm, y = 1.0 nm). Find the magnitude of the electrostatic force that each one exerts on the other. ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2, $e = 1.6 \times 10^{-19}$ C) 12) ______

A) 5.3×10^8 N B) 5.9×10^{-15} N C) 1.4×10^{-11} N D) 5.3×10^{-18} N

13) The zirconium nucleus contains 40 protons, and an electron is 1.0 nm from the nucleus. What is the electric force on the electron due to the nucleus? ($e = 1.60 \times 10^{-19}$ C, $k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 13) ______

A) 1000 C B) 2.9 nN C) 9.2 nN D) 6.8 nN E) 3.7 nN

14) Two tiny particles carrying like charges of the same magnitude are 8.0 mm apart. If the electric force on one of them is 4.0 N, what is the magnitude of the charge on each of these particles?($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 14) ______

A) 5.6×10^{2} C B) 1.7×10^{-4} C C) 1.7×10^{-1} C D) 1.7×10^{-7} C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

15) How far apart should two protons be if the electrical force of repulsion on each one is equal to its weight on the earth? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2, $e = 1.6 \times 10^{-19}$ C, $m_{proton} = 1.67 \times 10^{-27}$ kg) 15) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

16) Suppose you wanted to hold up an electron against the force of gravity by the attraction of a fixed proton some distance above it. How far above the electron would the proton have to be? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2, $e = 1.6 \times 10^{-19}$ C, $m_{proton} = 1.67 \times 10^{-27}$ kg, $m_{electron} = 9.11 \times 10^{-31}$ kg) 16) ______

A) 3.7 m B) 1.5 m C) 5.1 m D) 2.3 m E) 4.6 m

17) Two equally charged tiny spheres of mass 1.0 g are placed 2.0 cm apart. When released, they begin to accelerate away from each other at 426 m/s^2. What is the magnitude of the charge on each sphere, assuming only that the electric force is present? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 17) ______

A) 97 nC B) 140 nC C) 120 nC D) 76 nC

18) Two tiny particles having charges of +6.00 μC and +8.00 μC are placed along the x-axis. The +5.00-μC particle is at x = 0.00 cm, and the other particle is at x = 100.00 cm. Where on the x-axis must a third charged particle be placed so that it does not experience any net electrostatic force due to the other two particles? 18) ______

A) 4.64 cm B) 46.4 cm C) 91.2 cm D) 50 cm E) 9.12 cm

19) Two tiny particles having charges of +7.00 μC and -9.00 μC are placed along the y-axis. The +7.00-μC particle is at y = 0.00 cm, and the other particle is at y = 40.00 cm. Where must a third charged particle be placed along the y-axis so that it does not experience any net electric force due to the other two particles? 19) ______

A) -2.99 m B) 0.187 m C) 2.99 m D) 0.200 m E) -0.187 m

20) A particle of charge +2q is placed at the origin and particle of charge -q is placed on the x-axis at x = 2a. Where on the x-axis can a third positive charge be placed so that the net electric force on it is zero? 20) ______

A) 1.0a B) 8.6a C) 3.4a D) 9.3a E) 6.8a

21) Two tiny beads, each of mass 3.2 g, carry equal-magnitude charges. When they are placed 6.4 cm apart and released in outer space, they begin to accelerate toward each other at 538 m/s^2. What is the magnitude of the charge on each bead? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 21) ______

A) 44 nC B) 1800 nC C) 1300 nC D) 510 nC E) 890 nC

22) Three point charges are located on the x-axis at the following positions: Q_1 = +2.00 μC is at x = 1.00 m, Q_2 = +3.00 μC is at x = 0.00, and Q_3 = -5.00 μC is at x = -1.00 m. What is the magnitude of the electric force on $Q2$? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 22) ______

A) 0.135 N B) 0.0810 N C) 0.189 N D) 0.0540 N E) 0.158 N

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

23) Three point charges are placed on the x-axis, as follows. A charge of +2.0 μC is at the origin, a charge of -2.0 μC is at x = 50 cm, and a charge of +4.0 μC is at x = 100 cm. What are the magnitude and direction of the electrostatic force on the charge at the origin due to the other two charges? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 23) ____________

24) A point charge Q_1 = +6.0 nC is at the point (0.30 m, 0.00 m); a charge Q_2 = -1.0 nC is at (0.00 m, 0.10 m), and a charge Q_3 = +5.0 nC is at (0.00 m, 0.00 m). What are the magnitude and direction of the net force on the +5.0-nC charge due to the other two charges? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 24) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

25) The three point charges +6.0 μC, -7.0 μC, and -13 μC are placed on the x-axis at the points x = 0 cm, x = 40 cm, and x = 120 cm, respectively. What is the x component of the electrostatic force on the -13 μC charge due to the other two charges? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 25) ______

A) 0.55 N B) 0.64 N C) -0.55 N D) 0.79 N E) -0.79 N

26) One point charge +Q is placed at the center of a square, and a second point charge -Q is placed at the upper-left corner of the square. It is observed that an electrostatic force of magnitude 2.0 N acts on the positive charge at the center. Now a third charge -Q is placed at the lower-left corner of the square, as shown in the figure. What is the magnitude of the net force that acts on

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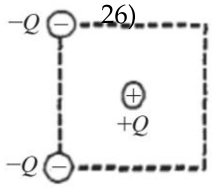
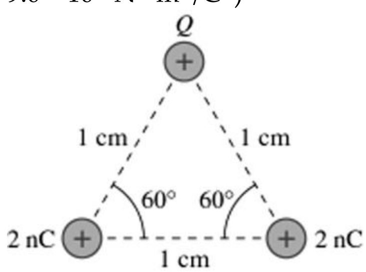


A) 0.0 N B) 4.0 N C) 2.8 N D) 5.3 N

27) Three identical 3.0-μC charges are placed at the vertices of an equilateral triangle that measures 30 cm on a side. What is the magnitude of the electrostatic force on any one of the charges? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ N \cdot m^2/C^2$) 27) ______

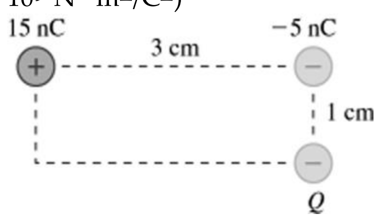
A) 1.8 N B) 1.6 N C) 2.2 N D) 2.0 N E) 2.4 N

28) As shown in the figure, three charges are at the vertices of an equilateral triangle. The charge Q is 5.2 nC, and all the other quantities are accurate to two significant figures. What is the magnitude of the net electric force on the charge Q due to the other two charges? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ N \cdot m^2/C^2$) 28) ______



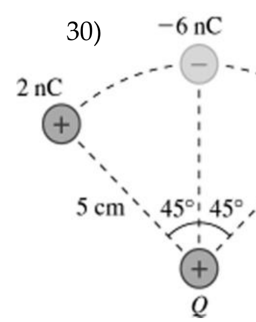
A) 8.1×10^{-4} N B) 1.1×10^{-3} N C) 9.4×10^{-4} N D) 1.6×10^{-3} N

29) As shown in the figure, three charges are at corners of a rectangle. The charge in the bottom right corner is Q = - 90 nC, and all the other quantities are accurate to two significant figures. What is the magnitude of the net electrical force on Q due to the other two charges? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ N \cdot m^2/C^2$) 29) ______



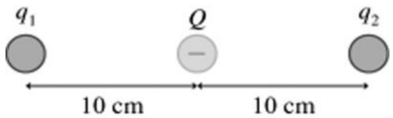
A) 3.8×10^{-2} N B) 7.1×10^{-2} N C) 2.8×10^{-2} N D) 5.3×10^{-2} N

30) As shown in the figure, three small charges are equally spaced on the arc of a circle that is centered at the charge Q, where Q = +4 nC and all the other quantities are accurate to two significant figures. What is the magnitude of the net electric force on the charge Q due to the other three charges? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ N \cdot m^2/C^2$) 30)



A) 5.4×10^{-5} N B) 2.9×10^{-5} N C) 3.7×10^{-5} N D) 4.6×10^{-5} N

31) As shown in the figure, the charge Q is midway between two other charges. If $Q = -8.2\text{ nC},$ what must be the charge $q1$ so that charge $q2$ remains stationary as Q and $q1$ are held in place? 31) ______



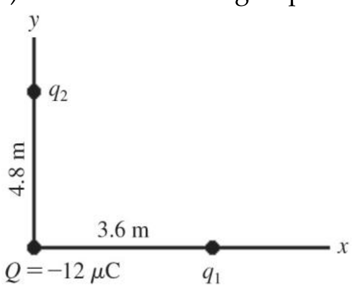
A) 33 nC B) 8.2 nC C) 66 nC D) 16 nC

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

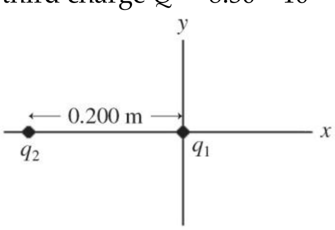
32) A point charge Q = -12 μC, and two other charges q_2 and q_2, are placed on x-y axes as shown in the figure. The electric force components on charge Q are F_x = +0.005 N and Fy = -0.003 N. ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2, $e = 1.6 \times 10^{-19}$ C) 32) ______

(a) How many excess electrons are there in charge Q?

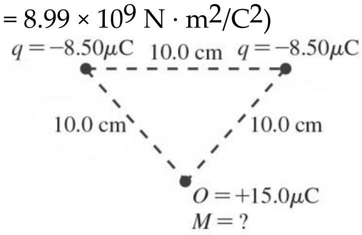
(b) What are the charges q1 and q2, including their signs?



33) As shown in the figure, charge $q_1 = 2.2 \times 10^{-6}$ C is placed at the origin and charge $q_2 = -4.80 \times 10^{-6}$ C is placed on the x-axis, at $x = -0.200$ m. Where along the x-axis can a third charge $Q = -8.30 \times 10^{-6}$ C be placed so that the resultant force on Q is zero? 33) ______



34) Two point charges q = -8.50 μC are fixed 10.0 cm apart along a horizontal bar, as shown in the figure. Their electrical forces will be used to balance the weight of a very small sphere carrying a charge $Q = +15.0\ \mu C,$ 10.0 cm from each of them in a place where g = 9.80 m/s2. What is the greatest mass M this sphere can have without falling? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 34) ______

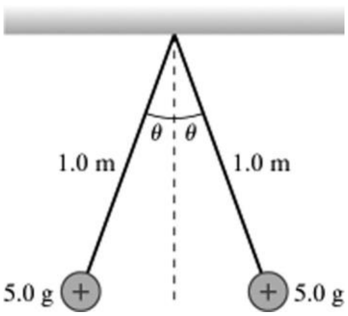


35) There is a +5.0-μC charge at three corners of a square having sides 70 mm long. What are the magnitude and direction of the net electrostatic force on +6.0 μC placed at the center of the square? (k =

$1/4\pi\varepsilon_0 =$ 35)
9.0×10^9
N ·
m^2/C^2)

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

36) The figure shows two tiny 5.0-g spheres suspended from very light 1.0-m-long threads. The spheres repel each other after each one is given the same positive charge and hang at rest when $\theta = 4.1°$. What is the charge on each sphere? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 36) ______



A) 22 nC B) 45 nC C) 89 nC D) 180 nC E) 360 nC

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

37) If a point charge of -30 μC experiences an electrostatic upward force of 27 mN at a certain location in the laboratory, what are the magnitude and direction of the electric field at that location? 37) ______________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

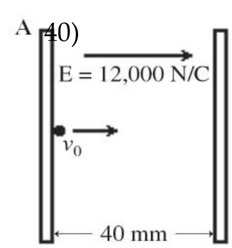
38) A small object with a 5.0-μC charge is accelerating horizontally on a friction-free surface at 0.0050 m/s2 due only to an electric field. If the object has a mass of 2.0 g, what is the magnitude of the electric field? 38) ______

A) 0.0040 N/C
B) 1.0 N/C
C) 0.0020 N/C
D) 4.0 N/C
E) 2.0 N/C

39) A small 0.050-kg insulating sphere carries a charge of -60 μC and is hanging by a vertical silk thread from a fixed point in the ceiling. An external uniform vertical electric field is now applied. If the applied electric field has a magnitude of 3000 N/C and is directed downward, what is the tension in the silk thread? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 39) ______

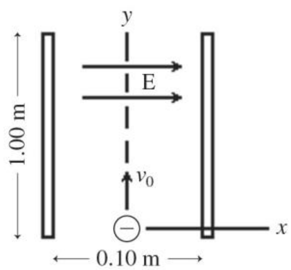
A) 0.52 N B) 0.41 N C) 0.19 N D) 0.31 N E) 0.71 N

40) A pair of charged conducting plates produces a uniform field of 12,000 N/C, directed to the right, between the plates. The separation of the plates is 40 mm. An electron is projected from plate A, directly toward plate B, with an initial speed of $v_0 = 2.0 \times 10^7$ m/s. What is the speed of the electron as it strikes plate B? ($e = 1.6 \times 10^{-19}$ C, $m_{electron} = 9.11 \times 10^{-31}$ kg) 40)



A) 2.4×10^{7} m/s
B) 1.2×10^{7} m/s
C) 1.8×10^{7} m/s
D) 2.1×10^{7} m/s
E) 1.5×10^{7} m/s

41) An electron is projected with an initial velocity $v_0 = 6.9 \times 10^{7}$ m/s along the y-axis, which is the centerline between a pair of charged plates, as shown in the figure. The plates are 1.0 m long and are separated by 0.10 m. A uniform electric field of magnitude E in the +x-direction is present between the plates. If the magnitude of the acceleration of the electron is measured to be 6.7×10^{15} m/s^2, what is the magnitude of the electric field between the plates? ($e = 1.6 \times 10^{-19}$ C, $m_{electron} = 9.11 \times 10^{-31}$ kg) 41) ______



A) 26,000 N/C
B) 38,000 N/C
C) 34,000 N/C
D) 22,000 N/C
E) 30,000 N/C

42) What is the magnitude of a the vertical electric field that will balance the weight of a plastic sphere of mass 8.1 g that has been charged to -3.0 nC? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^{9}$ N · m^2/C^2) 42) ______

A) 3.0×10^{6} N/C B) 5.7×10^{6} N/C C) 8.1×10^{6} N/C D) 2.6×10^{7} N/C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

43) An electron is placed in a uniform electric field of 4.5 × 104 N/C that points to the right. 43) ____________
($e = 1.6 \times 10^{-19}$ C, $m_{electron}$ = 9.11 × 10-31 kg)
(a) What are the magnitude and direction of the force on the electron?
(b) If the electron is released from rest, what is its speed after 3.0 ps?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

44) A proton is placed in an electric field of intensity 800 N/C. What are the magnitude and direction of the acceleration of the proton due to this field? ($e = 1.60 \times 10^{-19}$ C, $m_{proton} = 1.67 \times 10^{-27}$ kg) 44) ______

A) 7.66×10^{10} m/s^2 opposite to the electric field
B) 76.6×10^{10} m/s^2 in the direction of the electric field
C) 76.6×10^{10} m/s^2 opposite to the electric field
D) 7.66×10^{9} m/s^2 opposite to the electric field
E) 7.66×10^{10} m/s^2 in the direction of the electric field

45) A particle with a charge of +4.0 μC has a mass of 5.0 g. What magnitude electric field directed upward will exactly balance the weight of the particle? 45) ______

A) 8.2×10^4 N/C
B) 5.1×10^4 N/C
C) 1.2×10^4 N/C
D) 4.1×10^4 N/C
E) 4.4×10^4 N/C

46) A small styrofoam ball of mass 0.120 g is placed in an electric field of 6000 N/C pointing downward. What excess charge must be placed on the ball for it to remain suspended in the field? 46) ______

A) -18.0 nC B) -196 nC C) -57.2 nC D) -16.0 nC E) -125 nC

47) A small glass bead has been charged to 1.3 nC. What is the strength of the electric field 2.0 cm from the center of the bead? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 47) ______

A) 5.8×10^2 N/C B) 2.9×10^4 N/C C) 5.8×10^{-7} N/C D) 3.8×10^{-5} N/C

48) What is the magnitude of the electric field 2.8 cm from a tiny object that carries an excess charge of –16 nC? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 48) ______

A) -5100 N/C
B) 5100 N/C
C) 180,000 N/C
D) 1.8×10^{14} N/C
E) -180,000 N/C

49) Two tiny particles having charges +40.0 μC and -10.0 μC are separated by a distance of 20.0 cm. What are the magnitude and direction of electric field midway between these two charges? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 49) ______

A) 44.9×10^6 N/C directed towards the negative charge
B) 44.9×10^5 N/C directed towards the positive charge
C) 44.9×10^4 N/C directed towards the negative charge
D) 44.9×10^5 N/C directed towards the negative charge
E) 44.9×10^6 N/C directed towards the positive charge

50) The electric field at a point 7.2 cm from a small object points toward the object with a strength of 180,000 N/C. What is the object's charge q? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 50) ______

A) +110 nC B) +100 nC C) -100 nC D) -110 nC

51) A +5.00-μC point charge is placed at the 0.0 cm mark of a meter stick and a -4.00-μC point charge is placed at the 50.0 cm mark. At what point on a line through the ends of the meter stick is the electric field equal to zero? 51) ______

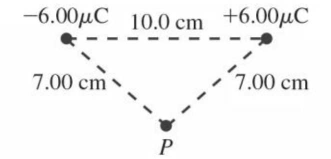
A) 1.4 m from the 0 cm mark
B) 4.7 m from the 0 cm mark
C) 2.9 m from the 0 cm mark
D) 3.3 m from the 0 cm mark
E) 2.5 m from the 0 cm mark

52) A +5.0-μC point charge is placed at the 0 cm mark of a meter stick and a -4.0-μC charge is placed at the 50 cm mark. What is the net electric field at the 30 cm mark? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 52)

A) 5.0×10^5 N/C B) 1.4×10^6 N/C C) 9.0×10^5 N/C D) 4.0×10^5 N/C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

53) An electric dipole consists of charges of ±6.00 μC that are 10.0 cm apart, as shown in the figure. Find the magnitude and direction of the electric field this dipole produces at point P, which is 7.00 cm from each charge. ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 53) ____________



54) A thin spherical copper shell of radius 9.5 cm carries an excess charge of -4.2 nC. How many excess electrons are on (a) the outer surface of the shell, and (b) the inner surface? (e = 1.60×10^{-19} C) 54) ____________

55) Two parallel square metal plates, 8.4 cm on each side, are 2.5 mm apart and carry equal but opposite charge uniformly distributed over their facing surfaces. How much excess charge is there on each plate if the electric field between the plates has a magnitude of 2.0×10^6 N/C? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 55) ____________

56) Two parallel square metal plates that are 1.5 cm apart and 22 cm on each side carry equal but opposite charges uniformly spread out over their facing surfaces. How many excess electrons are on the negative surface if the electric field between the plates has a magnitude of 18,000 N/C? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2, $e = 1.6 \times 10^{-19}$ C) 56) ____________

57) A tiny 0.0250-μg oil drop containing 15 excess electrons is suspended between two horizontally closely-spaced metal plates that carry equal but opposite charges on their facing surfaces. The plates are both circular with a radius of 6.50 cm. ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2, $e = 1.6 \times 10^{-19}$ C) 57) ____________
(a) How much excess charge must be on each plate to hold the oil drop steady?
(b) Which plate must be positive, the upper one or the lower one?

58) Two large closely-spaced parallel metal plates are uniformly and oppositely charged and the electric field between them is 7.6×10^6 N/C. 58) ____________
(a) What is the charge per unit area on each plate?
(b) If the plates are now moved two times farther apart, what is the electric field between the plates?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

59) A spherical conductor of radius 2.0 mm carries a charge of 7.1 nC. What is the magnitude of the electrical field at 6.0 mm from the center of the sphere? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 59) ______

A) 89×10^6 N/C
B) 25×10^6 N/C
C) 780×10^6 N/C
D) 1.8×10^6 N/C
E) 0.89×10^6 N/C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

60) A nonconducting sphere of mass 18.5 kg and diameter 25.0 cm has 8.10×10^{15} electrons re moved from it.

The points of removal are spread uniformly throughout the volume of this sphere. A tiny neutral plastic ball of mass 0.120 g is placed just outside the surface of the large sphere and is then released. How many electrons must be removed from the plastic ball so that its initial acceleration just after being released will be 1525 m/s2? You can neglect gravity. ($e = 1.6 \times 10^{-19}$ C, $k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9\ \mathrm{N \cdot m^2/C^2}$)

60) _______________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

61) A metal sphere of radius 10 cm carries an excess charge of +2.0 μC. What is the magnitude of the electric field 5.0 cm above the sphere's surface? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 61) ______

A) 8.0×10^5 N/C
B) 8.0×10^7 N/C
C) 4.0×10^7 N/C
D) 4.0×10^9 N/C
E) 4.0×10^5 N/C

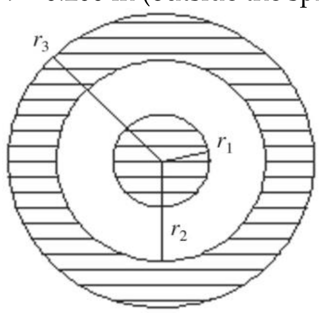
62) A metal sphere of radius 2.0 cm carries an excess charge of 3.0 μC. What is the electric field 6.0 cm from the center of the sphere? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 62) ______

A) 4.2×10^6 N/C
B) 5.7×10^6 N/C
C) 6.4×10^6 N/C
D) 9.3×10^6 N/C
E) 7.5×10^6 N/C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

63) A thin spherical metal shell of radius 8.0 cm carries 7.5 μC of excess charge. What is the magnitude of the electric field it produces at the following places? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 63) ____________
(a) at 1.0 cm above the surface
(b) at 7.0 cm from the center of the sphere

64) In the figure, a conducting sphere of radius $r_1 = 0.050$ m is placed at the center of a spherical conducting shell of inner radius $r_2 = 0.100$ m and outer radius $r_3 = 0.140$ m. The inner sphere carries an excess charge of -4.0 nC. The outer spherical shell carries a net excess charge of 3.0 nC. Calculate the magnitude of the electric field at the following distances r from the center of the spheres. ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 64) ____________
(a) $r = 0.075$ m (in the air space between spheres),
(b) $r = 0.120$ m (in the metal of the spherical shell), and
(c) $r = 0.200$ m (outside the spherical shell).



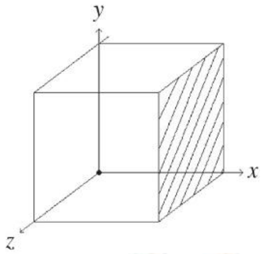
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

65) Two point charges of +6.00 μC and +9.00 μC are placed inside a cube having sides 0.100 m long. What is the net electric flux passing through the surface of the cube? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 65) ______

A) 0.450×10^6 Nm^2/C
B) 4.20×10^6 Nm^2/C

C) 3.80×10^6 Nm^2/C
D) 1.69×10^6 Nm^2/C
E) 0.340×10^6 Nm^2/C

66) A uniform electric field with a magnitude of 7×10^6 N/C i is directed along the +*x*-axis. A cube having edges of length 0.1 m is oriented as shown in the figure. What is the electric flux passing through the shaded face of the cube? 66) ______



A) 70×10^4 Nm^2/C
B) $700\ 0\times 10^4$ Nm^2/C
C) 0.7×10^4 Nm^2/C
D) 7×10^4 Nm^2/C
E) 700×10^4 Nm^2/C

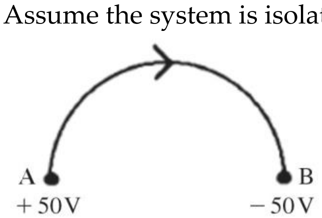
67) How much kinetic energy does a proton gain if it is accelerated, with no friction, through a potential difference of 1.00 V? The proton is 1836 times heavier than an electron, and $e = 1.60 \times 10^{-19}$ C. 67) ______

A) 1836 eV
B) 1836 J
C) 1.60×10^{-19} eV
D) 1.00 eV
E) 1.00 J

68) A tiny particle with charge + 5.0 μC is initially moving at 55 m/s. It is then accelerated through a potential difference of 500 V. How much kinetic energy does this particle gain during the period of acceleration? 68) ______

A) 100 J
B) 2500 J
C) 2.5×10^{-3} J
D) 1.0×10^4 J

69) How much work must we do on an electron to move it from point A, which is at a potential of +50V, to point B, which is at a potential of -50 V, along the semicircular path shown in the figure? Assume the system is isolated from outside forces. ($e = 1.60 \times 10^{-19}$ C) 69) ______



A) -1.6 J
B) 1.6 J
C) 1.60×10^{-17} J
D) -1.60×10^{-17} J
E) This cannot be determined because we do not know the distance traveled.

70) If an electron is accelerated from rest through a potential difference of 5200 V, what speed does it reach? ($e = 1.60 \times 10^{-19}$ C , $m_{electron} = 9.11 \times 10^{-31}$ kg) 70) ______

A) 4.3×10^7 m/s B) 2.8×10^7 m/s C) 3.6×10^7 m/s D) 2.1×10^7 m/s

71) A proton that is initially at rest is accelerated through an electric potential difference of magnitude 500 V. How much kinetic energy does it gain? ($e = 1.60 \times 10^{-19}$ C) 71) ______

A) 8.0×10^{-17} J B) 1.6×10^{-19} J C) 500 J D) 800 J

72) A proton that is initially at rest is accelerated through an electric potential difference of magnitude 500 V. What speed does the proton gain? ($e = 1.60 \times 10^{-19}$ C , $m_{proton} = 1.67 \times 10^{-27}$ kg) 72) ______

A) 2.2×10^5 m/s B) 9.6×10^5 m/s C) 1.1×10^5 m/s D) 3.1×10^5 m/s

73) A proton with a speed of 5.0 x 10^5 m/s accelerates through a potential difference and thereby increases its speed to 6.0 x 10^5 m/s. Through what magnitude potential difference did the proton accelerate? ($e = 1.60 \times 10^{-19}$ C , $m_{proton} = 1.67 \times 10^{-27}$ kg) 73) ______

A) 3200 V B) 660 V C) 1900 V D) 1300 V E) 570 V

74) After a proton with an initial speed of 1.50×10^5 m/s has increased its speed by accelerating through a potential difference of 0.100 kV, what is its final speed? ($e = 1.60 \times 10^{-19}$ C , $m_{proton} = 1.67 \times 10^{-27}$ kg) 74) ______

A) 3.55×10^5 m/s
B) 1.55×10^6 m/s
C) 8.80×10^5 m/s
D) 4.56×10^5 m/s
E) 2.04×10^5 m/s

75) How much work is needed to carry an electron from the positive terminal to the negative terminal of a 9.0-V battery. ($e = 1.60 \times 10^{-19}$ C , $m_{electron} = 9.11 \times 10^{-31}$ kg) 75) ______

A) 14.4×10^{-19} J/C
B) 17×10^{-19} J
C) 14.4×10^{-19} J
D) 9.0 J
E) 1.6×10^{-19} J

76) If it takes 0.58 J of energy to move 0.060 C of charge from point A to point B, what is the magnitude of the potential difference between points A and B? 76) ______

A) 0.10 V B) 9.7 V C) 6.3 V D) 0.030 V

77) A 4.0-g bead carries a charge of 20 μC. The bead is accelerated from rest through a potential difference *V*, and afterward the bead is moving at 2.0 m/s. What is the magnitude of the potential difference *V*? 77) ______

A) 400 kV B) 400 V C) 800 V D) 200 V E) 800 kV

78) If a Cu^{2+} ion that is initially at rest accelerates through a potential difference of 12 V without friction, how much kinetic energy will it gain? ($e = 1.60 \times 10^{-19}$ C) 78) ______

A) 3.0 eV. B) 12 eV. C) 6.0 eV. D) 24 eV.

79) A sphere with radius 2.0 mm carries a $+2.0\ \mu C$ charge. What is the potential difference, $V_B - V_A$, between point B, which is $5.0\ m$ from the center of the sphere, and point A, which is $10.0\ m$ from the center of the sphere? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ N \cdot m^2/C^2$) 79) ______

A) 200 V B) -1800 V C) 1800 V D) -0.54 V

80) Two 3.0 μC charges lie on the x-axis, one at the origin and the other at $28.0\ m$. What is the potential (relative to infinity) due to these charges at a point at $84.0\ m$ on the x-axis? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ N \cdot m^2/C^2$) 80) ______

A) 640 V B) 960 V C) 800 V D) 240 V

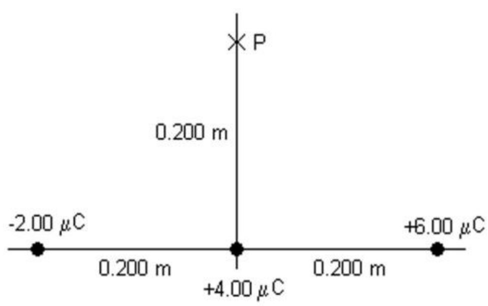
81) A 4.9 μC negative point charge has a positively charged particle in an elliptical orbit about it. If the mass of the positively charged particle is $1.0\ \mu g$ and its distance from the point charge varies from $3.0\ mm$ to $12.0\ mm$, what is the maximum potential difference through which the positive object moves? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ N \cdot m^2/C^2$) 81) ______

A) 11 MV B) 3.7 MV C) 18 MV D) -4.9 MV

82) Two very small +3.00-μC charges are at the ends of a meter stick. Find the electric potential (relative to infinity) at the center of the meter stick. ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9\ N \cdot m^2/C^2$) 82) ______

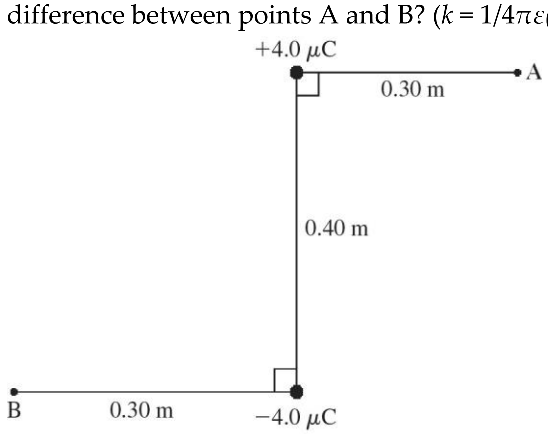
A) 0.00 V B) 5.40×10^4 V C) 2.70×10^4 V D) 1.08×10^5 V

83) Three point charges, -2.00 μC, +4.00 μC, and +6.00 μC, are located along the x-axis as shown in the figure. What is the electric potential (relative to infinity) at point P due to these charges? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9\ N \cdot m^2/C^2$) 83) ______



A) +154 kV B) +307 k V C) -307 kV D) 0.00 kV E) -154 kV

84) A +4.0-μC and a -4.0-μC point charge are placed as shown in the figure. What is the potential difference between points A and B? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ N \cdot m^2/C^2$) 84) ______



A) 96 kV B) 96 V C) 48 kV D) 0 V E) 48 V

85) Four 2.0-μC point are at the corners of a rectangle with sides of length 3.0 cm and 4.0 cm. What is the

electric potential (relative to infinity) at the midpoint of the rectangle? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ N \cdot m^2/C^2$) 85)

A) 7.8 MV B) 3.5 MV C) 1.3 MV D) 2.9 MV

86) A square is 1.0 m on a side. Point charges of +4.0 μC are placed in two diagonally opposite corners. In the other two corners are placed charges of +3.0 μC and -3.0 μC. What is the potential (relative to infinity) at the midpoint of the square? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ N \cdot m^2/C^2$) 86) ______

A) 1.0×10^6 V
B) infinite
C) 0 V
D) 1.0×10^4 V
E) 1.0×10^5 V

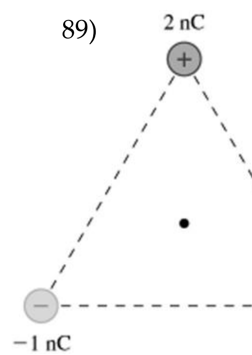
87) Two 5.0-μC point charges are 12 cm apart. What is the electric potential (relative to infinity) of this combination at the point where the electric field due to these charges is zero? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ N \cdot m^2/C^2$) 87) ______

A) 12.5 MV B) 0.75 MV C) 0.0 MV D) 25 MV E) 1.5 MV

88) A +5.0-μC point charge is 12 cm from a -5.0-μC point charge. What is the magnitude of the electric field they produce at the point on the line connecting them where their electric potential (relative to infinity) is zero? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ N \cdot m^2/C^2$) 88) ______

A) 12.5 MN/C
B) 25 MN/C
C) 0.75 MN/C
D) 0 N/C
E) 1.5 MN/C

89) The three point charges shown in the figure form an equilateral triangle with sides 6.1 cm long. What is the electric potential (relative to infinity) at the point indicated with the dot, which is equidistant from all three charges? Assume that the numbers in the figure are all accurate to two significant figures. ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ N \cdot m^2/C^2$) 89)



A) 510 V B) 1500 V C) 1000 V D) 0.00 V

90) Four +6.00-μC point charges are at the corners of a square 2.00 m on each side. What is the electric potential of these charges, relative to infinity, at the center of this square? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 90) ______

A) 153 kV B) 61.0 kV C) 76.4 kV D) 38.2 kV E) 306 kV

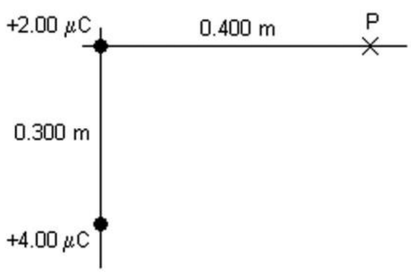
91) Four point charges of magnitude 6.00 μC and are at the corners of a square 2.00 m on each side. Two of the charges are positive, and two are negative. What is the electric potential at the center of this square, relative to infinity, due to these charges? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 91) ______

A) 153 kV B) 0 V C) 61.0 kV D) 306 kV E) 76.4 kV

92) Two +6.0-μC charges are placed at two of the vertices of an equilateral triangle having sides 2.0 m long. What is the electric potential at the third vertex, relative to infinity, due to these charges? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 92) ______

A) 0 V B) 90 kV C) 108 V D) 27 kV E) 54 kV

93) Two point charges of +2.00 μC and +4.00 μC are at the origin and at the point x = 0.000 m, y = -0.300 m, as shown in the figure. What is the electric potential due to these charges, relative to infinity, at the point P at x = 0.400 m on the x-axis? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 93) ______



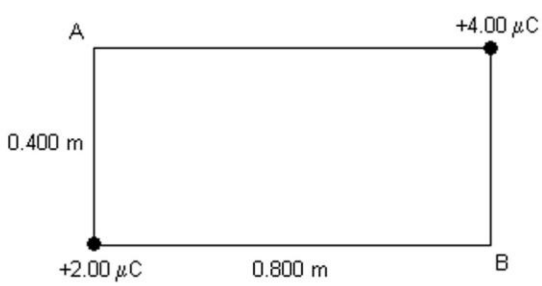
A) 117 kV B) 36.0 kV C) 11.7 kV D) 15.7 kV E) 56.0 kV

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

94) Three point charges are placed at the following points in a horizontal x-y plane: +9.0 μC is at (0.00 m, 0.20 m), +4.0 μC is at (0.60 m, 0.00 m), and −9.0 × μC is at (0.60 m, 0.20 m). Calculate the electrical potential (relative to infinity) at the origin due to these three point charges. ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 94) ____________

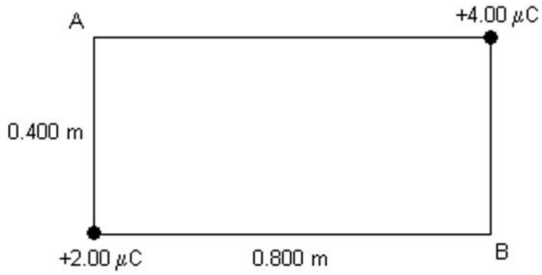
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

95) Point charges +4.00 μC and +2.00 μC are placed at the opposite corners of a rectangle as shown in the figure. What is the potential at point A, relative to infinity, due to these charges? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 95) ______



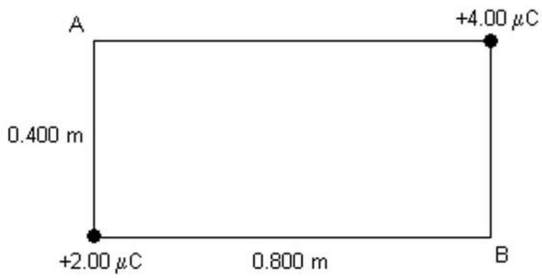
A) 8990 kV B) 0.899 kV C) 89.9 kV D) 899 kV E) 8.99 kV

96) Point charges +4.00 μC and +2.00 μC are placed at the opposite corners of a rectangle as shown in the figure. What is the potential at point B due to these charges? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 96) ______



A) 899 kV B) 89.9 kV C) 11.2 kV D) 112 kV E) 8.99 kV

97) Point charges +4.00 μC and +2.00 μC are placed at the opposite corners of a rectangle as shown in the figure. What is the potential difference $V_A - V_B$? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 97) ______



A) +22.5 kV B) 0.00 kV C) +203 kV D) -203 kV E) -22.5 kV

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

98) A very small 2.8-g particle carrying a charge of +3.7 μC is fired with an initial speed of 8.9 m/s directly toward a second small 7.8-g particle carrying a charge of +6.9 μC. The second particle is held fixed throughout this process. If these particles are initially very far apart, what is the closest they get to each other? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 98) ____________

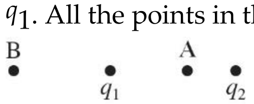
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

99) Two tiny grains of sand having charges of 4.0 μC and -4.0 μC are situated along the x-axis at x_1 = 2.0 m and x_2 = -2.0 m. What is electric potential energy of these grains relative to infinity? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 99) ______

A) -36 mJ B) 72 mJ C) -72 mJ D) 0 J E) 36 mJ

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

100) Two tiny particles having charges q_1 = +88.0 nC and q_2 = -77.0 nC are separated by 0.500 m and held in place, as shown in the figure. A third particle, having a charge of 14.0 nC is placed at the point A, which is 0.18 m to the left of q_2. How much work is needed to move the third particle from point A to point B, which is 0.40 m to the left of q_1. All the points in the figure lie on the same line. ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 100) ____________



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

101) A 5.0-μC point charge and a 10.0-μC point charge are initially extremely far apart. How much work does it take to bring the 5.0-μC point charge to the point x = 3.0 mm, y = 0.0 mm, and the 10.0-μC charge to the point point

$x = -3.0$ mm101) ______

$y = 0.0$ mm? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2)

A) 50 J B) 75 J C) 13 J D) 150 J

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

102) A +7.5-nC point charge is 5.0 cm from a -9.4-μC point charge in your laboratory in California. How much work would you have to do if you left the +7.5-nC charge in the lab but took the -9.4-μC charge to New York City? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 102) ______________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

103) An alpha particle (a helium nucleus, having charge +2*e* and mass 6.64×10^{-27} kg) moves head-on at a fixed gold nucleus (having charge +79*e*). If the distance of closest approach is 2.0×10^{-10} m, what was the speed of the alpha particle when it was very far away from the gold? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2, $e = 1.60 \times 10^{-19}$ C) 103) ______

A) 4.6×10^6 m/s B) 4.6×10^5 m/s C) 2.3×10^6 m/s D) 2.3×10^5 m/s

104) How much energy is necessary to place three +2.0-μC point charges at the vertices of an equilateral triangle of side 2.0 cm if they started out extremely far away? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 104) ______

A) 5.4 J B) 7.6 J C) 4.5 J D) 6.7 J

105) An electric dipole with ±9.0 μC point charges is positioned so that the positive charge is 1.0 mm to the right of the origin and the negative charge is at the origin. How much work does it take to bring a 6.0-μC point charge from very far away to the point $x = 3.0$ mm, $y = 0.0$ mm? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 105) ______

A) 68 J B) 410 J C) 81 J D) 180 J

106) A +3.0-μC point charge is initially extremely far from a positive point charge *Q*. You find that it takes 41 J of work to bring the +3.0-μC charge to the point $x = 3.0$ mm, $y = 0.0$ mm and the point charge *Q* to the point $x = -3.0$ mm, $y = 0.00$ mm. What is *Q*? ($k = \ldots$) 106) ______

A) 9.1 μC B) 4.6 μC C) 27 pC D) 55 nC

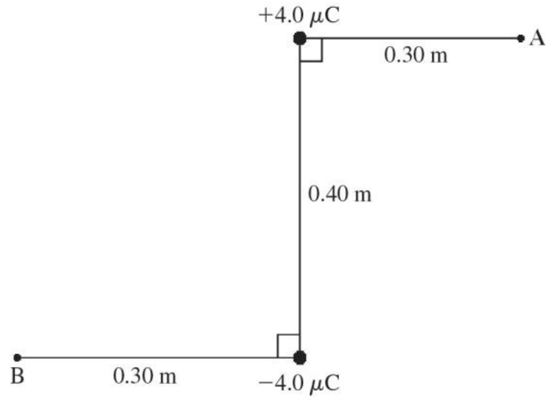
107) A point charge of +9.00 μC and a second charge *Q* are initially very far apart. If it takes 21.0 J of work to bring them to a final configuration in which the +9.00-μC charge is at the point $x = 1.00$ mm, $y = 1.00$ mm, and the second charge *Q* is at the point $x = 1.00$ mm, $y = 3.00$ mm, find the magnitude of the charge *Q*. ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 107) ______

A) 2.59 μC B) 0.52 μC C) 1.04 μC D) 1.04 nC

108) A +5.0-nC charge is at the point (0.00 m, 0.00 m) and a -2.0-nC charge is at (3.0 m, 0.00 m). What work is required to bring a 1.0-nC charge from very far away to point (0.00 m, 4.0 m)? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 108) ______

A) 15 nJ B) 7.7 nJ C) 3.6 nJ D) 11 nJ

109) In the figure, +4.0-μC and -4.0-μC point charges are located as shown. Now an additional +2.00-μC point charge is placed at point A. What is the electric potential energy of this system of three charges, relative to infinity? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 109) ______



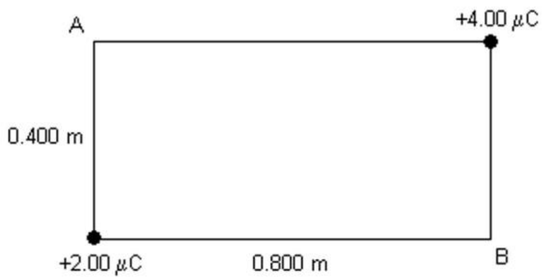
A) -26.4 mJ B) 0.00 J C) -264 mJ D) +26.4 mJ E) +264 mJ

110) A small 4.0-μC charge and a small 1.5-μC charge are initially very far apart. How much work does it take to bring them to a final configuration in which the 4.0-μC charge is at the point x = 1.0 mm, y = 1.0 mm, and the 1.5-μC charge is at the point x = 1.0 mm, y = 3.0 mm? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 110) ______

A) 13.5 kJ B) 27 J C) 54 J D) 13.5 J

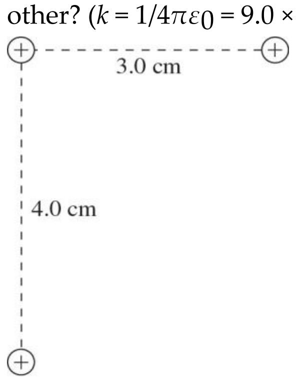
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

111) Point charges +4.00 μC and +2.00 μC are placed at the opposite corners of a rectangle as shown in the figure. If these charges are released and are free to move with no friction, what is the maximum amount of kinetic energy they will gain? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2) 111) ____________



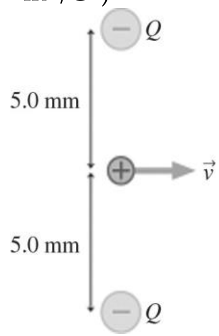
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

112) The figure shows a group of three particles, all of which have charge Q = 8.8 nC. How much work did it take to assemble this group of charges if they all started out extremely far from each other? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N · m^2/C^2) 112) ______



A) 5.7×10^{-5} J B) 6.2×10^{-5} J C) 5.5×10^{-5} J D) 5.9×10^{-5} J

113) The figure shows an arrangement of two particles each having charge Q = -3.9 nC and each separated by 5.0 mm from a proton.If the two particles are held fixed at their locations and the proton is set into motion as shown, what is the minimum speed the proton needs to totally escape from these particles? (m_{proton} = 1.67 × 10^{-27} kg, e = 1.60 × 10^{-19} C, $k = 1/4\pi\varepsilon_0$ = 9.0 × 10^{9} N · m^2/C^2) 113) _____



A) 1.3 × 10^{7} m/s B) 6.3 × 10^{6} m/s C) 1.6 × 10^{6} m/s D) 3.3 × 10^{6} m/s

114) An electron is released from rest at a distance of 9.00 cm from a fixed proton. How fast will the electron be moving when it is 3.00 cm from the proton? ($k = 1/4\pi\varepsilon_0$ = 8.99 × 10^{9} N · m^2/C^2, e = 1.60 × 10^{-19} C, $m_{electron}$ = 9.11 × 10^{-31} kg, m_{proton} = 1.67 × 10^{-27} kg) 114) _____

A) 4.64 × 10^{5} m/s
B) 130 m/s
C) 1.06 × 10^{3} m/s
D) 106 m/s
E) 75.0 m/s

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

115) The potential difference between two square parallel plates is 4.00 V. If the plate separation is 6.00 cm and they each measure 1.5 m by 1.5 m, what is the magnitude of the electric field between the plates? 115) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

116) In a region where the electric field is uniform and points in the +x direction, the electric potential is -2000 V at x = 8 m and is +400 V at x = 2 m. What is the magnitude of the electric field? 116) _____

A) 600 V/m B) 400 V/m C) 200 V/m D) 300 V/m E) 500 V/m

117) Two isolated copper plates, each of area 0.40 m^2, carry opposite charges of magnitude 7.08 × 10^{-10} C. They are placed opposite each other in parallel alignment, with a spacing of 4.0 cm between them. What is the potential difference between the plates? (ε_0 = 8.85 × 10^{-12} $C^2/N \cdot m^2$) 117) _____

A) 3.2 V B) 8.0 V C) 7.6 V D) 3.0 V E) 0.40 V

118) A space probe approaches a planet, taking measurements as it goes. If it detects a potential difference of 6000 MV between the altitudes of 253,000 km and 276,000 km above the planet's surface, what is the approximate electric field strength produced by the planet at 264,500 km above the surface? Assume the electric field strength is approximately constant at these altitudes. 118) _____

A) 261 N/C B) 0.261 N/C C) 493 μN/C D) 561 N/C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

119) A spherical oil droplet with nine excess electrons is held stationary in an electric field between two large horizontal plates that are 2.25 cm apart. The field is produced by maintaining a potential difference of 0.3375 kV across the plates, and the density of the oil is 824 kg/m^3. What is the radius of the oil drop? (e

= 1.60 × 119)
10^{-19} C)

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

120) A battery maintains the electrical potential difference of 12-V between two large parallel metal plates separated by 10 cm. What is the strength of the electric field between the plates? 120) ______

A) 1.2 V/m B) 120 V/m C) zero D) 12 V/m

121) A uniform electric field, with a magnitude of 500 V/m, is points in the $+x$ direction. If the potential at $x = 5.0$ m is 2500 V, what is the potential at $x = 2.0$ m? 121) ______

A) 4.0 kV B) 0.50 kV C) 1.0 kV D) 5.0 kV E) 2.0 kV

122) Consider a uniform horizontal electric field of 50 N/C directed toward the east. If the electric potential measured at a given point is 80 V, what is the potential at a point 1.0 m directly west of that point? 122) ______

A) 30 V B) 80 V C) 130 V D) 50 V

123) Consider a uniform horizontal electric field of 50 N/C directed toward the east. If the electric potential at a given point in the field is 80 V, what is the potential at a point 1.0 m directly east of the point? 123) ______

A) 90 V B) 130 V C) 30 V D) 15 V

124) Consider a uniform horizontal electric field of 50 N/C directed toward the east. If the electric potential at a given point in the field is 80 V, what is the potential at a point 1.0 m directly south of that point? 124) ______

A) 30 V B) 50 V C) 0 V D) 80 V

125) A proton moves 0.10 m along the direction of an electric field of magnitude 3.0 V/m. What is the change in kinetic energy of the proton? ($e = 1.60 \times 10^{-19}$ C) 125) ______

A) 1.6×10^{-20} J B) 4.8×10^{-20} J C) 8.0×10^{-21} J D) 3.2×10^{-20} J

126) Two very large parallel metal plates, separated by 0.20 m, are connected across a 12-V source of potential. An electron is released from rest at a location 0.10 m from the negative plate. When the electron arrives at a distance 0.050 m from the positive plate, how much kinetic energy has the electron gained? ($e = 1.60 \times 10^{-19}$ C) 126) ______

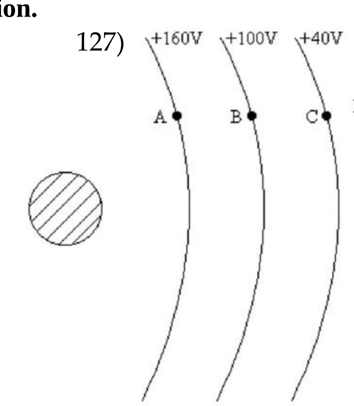
A) 9.6×10^{-19} J B) 2.4×10^{-19} J C) 7.2×10^{-19} J D) 4.8×10^{-19} J

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

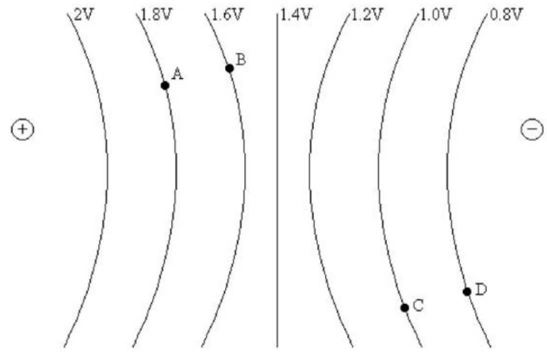
127) The equipotential surfaces for two point charges are shown in the figure, with the value of potential marked on the line for each surface. 127)

(a) What is the potential difference, $V_G - V_D$, between points G and D?

(b) What is the potential difference, $V_A - V_G$, between points A and G?



128) The equipotential surfaces for two spherical conductors are shown in the figure, with the value of potential marked on the line for each surface. 128) ____________
(a) If the distance between points A and B is 2.5 cm what is the approximate intensity of the electric field between these two points?
(b) If the distance between points C and D is 2.5 cm what is the approximate intensity of the electric field between these two points?



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

129) When the magnitude of the charge on each plate of an air-filled capacitor is 4 μC, the potential difference between the plates is 80 V. What is the capacitance of this capacitor? 129) ______

A) 0.1 μF B) 50 nF C) 100 μF D) 50 μF E) 20 μF

130) What charge accumulates on the plates of a 2.0-μF air-filled capacitor when it is charged until the potential difference across its plates is 100 V? 130) ______

A) 200 μC B) 50 μC C) 150 μC D) 100 μC

131) The potential difference between the plates of an ideal air-filled parallel-plate capacitor with a plate separation of 6.0 cm is 60 V. What is the strength of the electric field between the plates of this capacitor? 131) ______

A) 3600 V/m B) 1000 V/m C) 60 V/m D) 2000 V/m E) 500 V/m

132) An ideal air-filled parallel plate capacitor with plate a separation of 4.0 cm has a plate area of 0.040 m^2. What is the capacitance of this capacitor with air between these plates? ($\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N \cdot m^2$) 132) ______

A) 8.9 pF B) 8.9 μF C) 89 pF D) 0.89 pF E) 8.9 nF

133) An ideal air-filled parallel-plate capacitor with horizontal plates has a plate separation of 5.0 cm. If the potential difference between the plates is 2000 V, with the top plate at the higher potential, what are the magnitude and direction of the electric field between the plates? 133) ______

A) 40000 N/C upward B) 40000 N/C downward
C) 100 N/C upward D) 100 N/C downward

134) Each plate of an ideal air-filled parallel-plate capacitor has an area of 0.0010 m^2, and the separation of the plates is 0.060 mm. An electric field of 7.4×10^6 N/C is present between the plates. What is the surface charge density on the plates? ($\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N \cdot m^2$) 134) ______

A) 140 $\mu C/m^2$
B) 99 $\mu C/m^2$
C) 160 $\mu C/m^2$
D)

33 $\mu C/m^2$

E) 66 $\mu C/m^2$

135) Each plate of an ideal air-filled parallel-plate capacitor has an area of 0.0090 m^2, and the separation of the plates is 0.090 mm. An electric field of 2.4×10^6 V/m is present between the plates. What is the capacitance of this capacitor? ($\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N \cdot m^2$) 135) ______

A) 1500 pF B) 1800 pF C) 590 pF D) 1200 pF E) 890 pF

136) Two large parallel plates are separated by 1.0 mm of air. If the potential difference between them is 3.0 V, what is the magnitude of their surface charge densities? ($\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N \cdot m^2$) 136) ______

A) $3.3 \times 10^{-4}\ C/m^2$ B) $5.3 \times 10^{-8}\ C/m^2$

C) $1.6 \times 10^{-4}\ C/m^2$ D) $2.7 \times 10^{-8}\ C/m^2$

137) A 4.0-pFcapacitor consists of two large closely-spaced parallel plates that have surface charge densities of $\pm 3.0\ nC/mm^2$. If the potential across the plates is 27.0 kV with only air between them, find the surface area of each of the plates. ($\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N \cdot m^2$) 137) ______

A) 0.014 mm^2 B) 36 mm^2 C) 18 mm^2 D) 0.028 mm^2

138) An ideal air-filled parallel-plate capacitor consists of two circular plates, each of radius 0.40 mm How far apart should the plates be for the capacitance to be 700.0-pF? ($\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N \cdot m^2$) 138) ______

A) 0.0064 μm B) 0.00036 μm C) 0.00072 μm D) 0.0032 μm

139) When the potential difference between the plates of an ideal air-filled parallel plate capacitor is 40 V, the electric field between the plates has a strength of 800 V/m. If the plate area is $4.0 \times 10^{-2}\ m^2$, what is the capacitance of this capacitor? ($\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N \cdot m^2$) 139) ______

A) 7.1×10^{-10} F

B) 7.1×10^{-12} F

C) 7.1×10^{-11} F

D) 7.1×10^{-14} F

E) None of the other choices is correct.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

140) An ideal air-filled parallel-plate capacitor consists of plates that are 1.0 mm apart and have an area of $1.5 \times 10^{-4}\ m^2$. The capacitor is connected to a 12-V potential source (battery). ($\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N \cdot m^2$) 140) ____________

(a) What is the capacitance of this capacitor?

(b) How much charge is on each of its plates?

(c) What is the strength of the electric field between the plates?

141) An air-filled parallel-plate capacitor is constructed with a plate area of 0.40 m^2 and a plate separation of 0.10 mm. It is then charged to a potential difference of 12 V? ($\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N \cdot m^2$) 141) ____________

(a) How much charge is stored on each of its plates?

(b) How much energy is stored in it?

142) A 12.0-V battery (potential source) is connected across a 6.00-μF air-filled capacitor. (a) How much

energy can be stored this way? (b) How much excess charge is on each plate of the capacitor? 142) ____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

143) Measurements show that it takes 0.60 mJ of work to move 8.0-μC of charge from one plate to another of a certain air-filled capacitor while the potential difference between these plates is kept constant. What is the potential difference between the plates of this capacitor? 143) ______

A) 23 V B) 0 V C) 75 V D) 55 V E) 81 V

144) An air-filled 20-μF capacitor has a charge of 60 μC on its plates. How much energy is stored in this capacitor? 144) ______

A) 100 μJ B) 80 μJ C) 90 μJ D) 70 μJ E) 110 μJ

145) An air-filled capacitor has a potential difference between the plates of 80 V. If the charge on each of the plates of the capacitor has magnitude 8.0 μC, what is the electrical energy stored by this capacitor? 145) ______

A) 320 μJ B) 60 nJ C) 50 nJ D) 30 pJ E) 640 μJ

146) When a 4-μF capacitor has a potential drop of 20 V across its plates, how much electric potential energy is stored in this capacitor? 146) ______

A) 8000 μJ B) 80 μJ C) 0.8 μJ D) 800 μJ E) 8 μJ

147) When a 7.00-μF air-filled capacitor has a charge of ±50.0 μC on its plates, how much potential energy is stored in this capacitor? 147) ______

A) 149 μJ B) 169 μJ C) 159 μJ D) 143 μJ E) 179 μJ

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

148) An ideal, isolated, air-filled parallel-plate capacitor is not connected to a battery but has equal and opposite charges of 3.9 nC on its plates. The separation between the plates initially is 1.2 mm, and for this separation the capacitance is 3.1×10^{-11} F. How much work must be done to pull the plates apart until their separation becomes 7.7 mm? ($\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N \cdot m^2$) 148) ______________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

149) Two parallel circular plates, each with a radius of 8.0 mm and carrying equal-magnitude surface charge densities of ±2.0 μC/m², are separated by a distance of 1.0 mm with only air between them. How much energy is stored in these plates? ($\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N \cdot m^2$) 149) ______

A) 14 nJ B) 140 nJ C) 45 nJ D) 4.6 nJ

150) Two parallel plates that are initially uncharged are separated by 1.7 mm, have only air between them, and

150) each have surface areas of 16 cm^2. How much charge must be transferred from one plate to the other if 1.9 J of energy are to be stored in the plates? ($\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N \cdot m^2$) 150) ______

A) 8.0 μC B) 5.6 μC C) 4.0 μC D) 0.60 mC

151) When a 12.0-V battery causes 2.00 μC of charge to flow onto the plates of an air-filled capacitor, how much work did the battery do? 151) ______

A) 24.0 μJ B) 576 J C) 12.0 μJ D) 144 μJ

152) If you want to store 2.0 mJ of energy in a 10-μF capacitor, how much potential do you need to put across it? 152) ______

A) 15 V B) 5.0 V C) 20 V D) 10 V

153) A 6.0 μF capacitor has a potential difference of 5.0 V applied across its plates. If the potential difference across its plates is increased to 9.0 V, how much *additional* energy does the capacitor store? 153) ______

A) 96 μJ B) 170 μJ C) 48 μJ D) 340 μJ

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

154) A 15-μF capacitor is connected to a 50-V battery and becomes fully charged. The battery is removed and a slab of dielectric, having a dielectric constant of 5.0, is inserted between the plates and completely fills the space between them. 154) ______________

(a) What is the capacitance of the capacitor *after* the slab is inserted?

(b) What is the potential difference across the capacitor with the dielectric inserted.

155) A 12.6-μF isolated capacitor is constructed with Teflon, having a dielectric constant of 2.1, between the plates. The capacitor is initially charged to 1.5 volts, and then the Teflon is removed. 155) ______________

(a) How much excess charge was originally stored on the plates of the capacitor?

(b) After removing the Teflon, what is the potential difference across the capacitor plates?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

156) A parallel-plate capacitor consists of two parallel, square plates having dimensions 1.0 cm by 1.0 cm. The plates are separated by 1.0 mm and the space between them is filled with Teflon, which has a dielectric constant of 2.1. What is the capacitance of this capacitor? ($\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N \cdot m^2$) 156) ______

A) 0.89 pF B) 2.1 pF C) 1.9 pF D) 0.44 pF

157) A parallel-plate capacitor with plate separation of 4.0 cm has a plate area of 6.0 × 10^{-2} m^2.What is the capacitance of this capacitor if a dielectric material with a dielectric constant of 2.4 is placed between the plates, completely filling the space? ($\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N \cdot m^2$) 157) ______

A) 32 × 10^{-12} F
B) 3.7 × 10^{-14} F
C) 32 × 10^{-14} F
D) 16 × 10^{-14} F
E) 3.7 × 10^{-12} F

158) The square plates of a 6000-pF parallel-plate capacitor measure 30 mm by 30 mm and are separated by a dielectric that is 0.13 mm thickand totally fills the region between the plates. The voltage rating (the maximum safe voltage) of the capacitor is 700 V. What is the maximum energy that can be stored in this capacitor without damaging it? ($\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N \cdot m^2$) 158) ______

A) 1.5 mJ B) 2.2 mJ C) 2.6 mJ D) 1.8 mJ E) 2.9 mJ

159) The square plates of a 3000-pF parallel-plate capacitor measure 40 mm by 40 mm and are separated by a dielectric that is 0.29 mm thick and completely fills the region between the plates. What is the dielectric constant of the dielectric? ($\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N \cdot m^2$) 159) ______

A) 45 B) 61 C) 50 D) 56 E) 67

160) An air-filled capacitor carries enough charge to store 4.00 mJ of potential energy. It is then accidentally filled with water in such a way as not to discharge its plates. How much energy does it continue to store after it is filled? The dielectric constant for water is 78 and for air it is 1.0006. 160) ______

A) 4.00 mJ B) 0.03 mJ C) 0.051 mJ D) 312 mJ

161) A capacitor has a voltage of 261 V applied across its plates, and then the voltage source is removed. What is the potential difference across its plates if the space between them is then filled with mica, having a dielectric constant of 5.4? 161) ______

A) 428 V B) 12,466 V C) 48 V D) 1409 V

162) A 6.0-μF air-filled capacitor is connected across a 100-V potential source (a battery). After the battery fully charges the capacitor, it is left connected and the capacitor is immersed in transformer oil, which has a dielectric constant of 4.5. How much *additional* charge flows from the battery onto the capacitor during this process? 162) ______

A) 1.7 mC B) 2.1 mC C) 2.5 mC D) 1.2 mC

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

163) A parallel-plate air-filled capacitor is made from two plates that are 0.070 m on each side and spaced 3.0 mm apart. What must the potential difference between the plates be to prodan energy uce density of

0.097 J/m^3 163) in the region between them? (ε_0 = 8.85 × 10^{-12} $C^2/N \cdot m^2$)

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

164) A uniform electric field has the strength of 7.0 N/C. What is the electric energy density of this field? (ε_0 = 8.85 × 10^{-12} $C^2/N \cdot m^2$) 164) ______

A) 5.5 × 10^{12} J/m^3
B) 2.2 × 10^{-10} J/m^3
C) 3.1 × 10^{-11} J/m^3
D) 2.8 × 10^{12} J/m^3

165) Each plate of a parallel-plate air-filled capacitor has an area of 0.0050 m^2, and the separation of the plates is 0.030 mm. An electric field of 2.8 × 10^6 N/C is present between the plates. What is the energy density in the region between the plates? (ε_0 = 8.85 × 10^{-12} $C^2/N \cdot m^2$) 165) ______

A) 47 J/m^3
B) 71 J/m^3
C) 24 J/m^3
D) 35 J/m^3
E) 59 J/m^3

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

166) What the electric energy density at a point 1.0 cm from a proton? (e = 1.6 × 10-19 C, ε_0 = 8.85 × 10^{-12} $C^2/N \cdot m^2$, $k = 1/4\pi\varepsilon_0$ = 9.0 × 10^9 $N \cdot m^2/C^2$) 166) ______

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

167) A tiny particle carries a charge of 6.0 μC. What is the energy density in the electric field at a distance of 3.0 m from this charge? (ε_0 = 8.85 × 10^{-12} $C^2/N \cdot m^2$, $k = 1/4\pi\varepsilon_0$ = 9.0 × 10^9 $N \cdot m^2/C^2$) 167) ______

A) 4.3 mJ/m^3
B) 1.4 mJ/m^3
C) 0.48 mJ/m^3
D) 0.16 mJ/m^3

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

168) A -6.5-μC point charge is 8.0 cm from a -17-μC charge. What is the electric energy density at the point midway between them? (ε_0 = 8.85 × 10^{-12} $C^2/N \cdot m^2$, $k = 1/4\pi\varepsilon_0$ = 9.0 × 10^9 $N \cdot m^2/C^2$) 168) ______

169) A 25.0-V potential source (a battery) is connected across the plates of a 6.66-μF air-filled parallel-plate capacitor having plates that are 1.22 mm apart. What energy density does it produce between the plates? (ε_0 = 8.85 × 10^{-12} $C^2/N \cdot m^2$) 169) ______

170) A 10-A current flows through a wire for 2.0 min. (e = 1.60 × 10^{-19} C) 170) ______
(a) How much charge has passed through this wire?
(b) How many electrons have passed any point in the wire?

171) If a charge of 11.4 C passes through a computer in 1.75 min, what is the average current through the computer? 171) ______

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

172) A current of 3.0 A flows through an electrical device for 10 seconds. How many electrons flow thro ugh

this device during this time? (e = 1.60 × 10^{-19} C) 172) ______

A) 1.9×10^{20} B) 0.20 C) 20 D) 19×10^{20} E) 2.0

173) What current is flowing in a wire if 0.47 C of charge pass a point in the wire in 0.20 s? 173) ______

A) 2.4 A B) 0.094 A C) 0.47 A D) 0.20 A

174) A charge of 12 C passes through an electroplating apparatus in 2.0 min. What is the average current in the apparatus? 174) ______

A) 0.60 A B) 1.0 A C) 6.0 A D) 0.10 A

175) How much charge must pass by a point in a wire in 10 s for the current inb the wire to be 0.50 A? 175) ______

A) 20 C B) 2.0 C C) 0.050 C D) 5.0 C

176) A total of 2.0×10^{13} electrons pass a given point in a wire in 15 s. What is the current in the wire? ($e = 1.60 \times 10^{-19}$ C) 176) ______

A) 3.2 μA B) 1.3 A C) 0.21 μA D) 1.3 mA

177) What current is flowing in a resistor if 4.0×10^{16} electrons pass a point in the resistor in 0.50 s? ($e = 1.60 \times 10^{-19}$ C) 177) ______

A) 0.31 A B) 0.013 A C) 78 A D) 6.3 A

178) If 3.0×10^{15} electrons flow through a section of a wire of diameter 2.0 mm in 4.0 s, what is the current in the wire? ($e = 1.60 \times 10^{-19}$ C) 178) ______

A) 0.24 mA B) 7.5×10^{14} A C) 7.5×10^{7} A D) 0.12 mA

179) A electric heater that draws 13.5 A of dc current has been left on for 10 min. How many electrons that have passed through the heater during that time? ($e = 1.60 \times 10^{-19}$ C) 179) ______

A) 5.1×10^{22} B) 1.0×10^{23} C) 1.8×10^{3} D) 8.1×10^{3} E) 1.5×10^{22}

180) In an electroplating process, it is desired to deposit 40 mg of silver on a metal part by using a current of 2.0 A. How long must the current be allowed to run to deposit this much silver? The silver ions are singly charged, and the atomic mass of silver is 108 g/mol. ($e = 1.60 \times 10^{-19}$ C, $N_A = 6.02 \times 10^{23}$ atoms/mol) 180) ______

A) 16 s B) 20 s C) 18 s D) 22 s

181) A jeweler needs to electroplate gold, having an atomic mass of 196.97 g/mol, onto a bracelet. He knows that the charge carriers in the ionic solution are singly-ionized gold ions, Au^{+}, and has calculated that he must deposit 0.38 g of gold to reach the necessary thickness. How much current does he need to plate the bracelet in 3.0 hours? ($e = 1.60 \times 10^{-19}$ C, $N_A = 6.02 \times 10^{23}$ atoms/mol) 181) ______

A) 17 mA B) 3400 mA C) 1000 mA D) 62 A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

182) What potential difference is required across an 8.0-Ω resistor to cause 2.0 A to flow thro ugh it?

182) ____________

183) The current through a piece of lab equipment must be limited to 2.75 A when it is run by a 120-V dc power supply. What must be the resistance of this equipment? 183) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

184) What potential difference is required to cause 4.00 A to flow through a resistance of 330 Ω? 184) _____

A) 12.1 V B) 334 V C) 82.5 V D) 1320 V

185) What is the voltage drop across a 5.0-Ω resistor if the current through it is 5.0 A? 185) _____

A) 4.0 V B) 25 V C) 100 V D) 1.0 V

186) A 4000-Ω resistor is connected across a 220-V power source. What current will flow through the resistor? 186) _____

A) 18 A B) 1.8 A C) 0.055 A D) 5.5 A

187) A light bulb operating at 110 V draws 1.40 A of current. What is its resistance? 187) _____

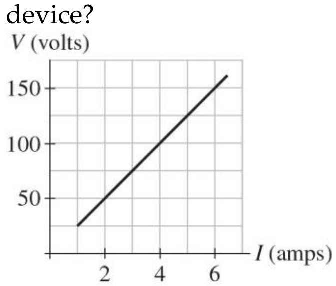
A) 12.7 Ω B) 154 Ω C) 109 Ω D) 78.6 Ω

188) A 12-V battery is connected across a 100-Ω resistor. How many electrons flow through the wire in 1.0 min? ($e = 1.60 \times 10^{-19}$ C) 188) _____

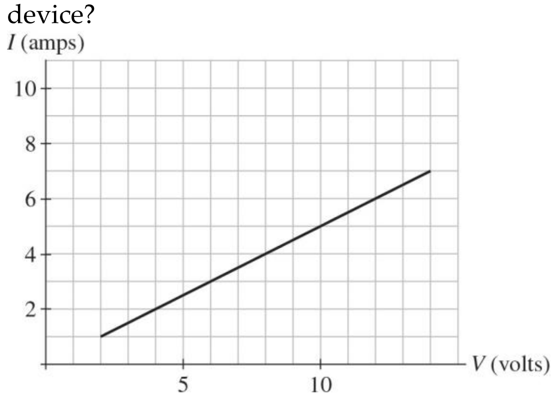
A) 2.5×10^{19} B) 4.5×10^{19} C) 1.5×10^{19} D) 3.5×10^{19}

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

189) The graph shown in the figure shows the results of measurements of the dc current through a circuit device for various potential differences across it. Assume that all the numbers shown are accurate to two significant figures. What is the resistance of this device? 189) ____________



190) The graph shown in the figure shows the results of measurements of the dc current through a circuit device for various potential differences across it. Assume that all the numbers shown are accurate to two significant figures. What is the resistance of this device? 190) ____________



191) When a thin copper wire that is 178 m long is connected between a 1.2-V potential difference, a

current of 2.0 amps flows through the wire. What is the diameter of this wire? The resistivity of copper is $1.72 \times 10^{-8}\ \Omega \cdot m$. 191) ______

192) A 25-m wire of diameter 0.30 mm draws 0.499 A when connected across a 3.0-V potential difference. 192) ______
(a) What is the resistance of the wire?
(b) What is the resistivity of the material from which the wire is made?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

193) A certain metal wire has a cross-sectional area of 1.0 cm^2 and a resistivity of $1.7 \times 10^{-8}\ \Omega \cdot m$. How long would it have to be to have a resistance of 1.0 Ω? 193) ______
A) 5.9 km
B) 590 m
C) 5.9 m
D) 5.9×10^6 m
E) 5.9×10^4 m

194) What is the resistance of 1.0 m of a solid cylindrical metal cable having a diameter of 0.40 inches and a resistivity of $1.68 \times 10^{-8}\ \Omega \cdot m$? 194) ______
A) 0.0012 Ω
B) 0.0021 Ω
C) 0.00021 Ω
D) 0.00012 Ω

195) What is the resistance of a cylindrical metal rod 1.0 cm in diameter and 45 m long, if the resistivity of the metal is $1.4 \times 10^{-8}\ \Omega \cdot m$? 195) ______
A) 0.0080 Ω
B) 0.80 Ω
C) 6.3 Ω
D) 0.0063 Ω

196) A certain metal has a resistivity of $1.68 \times 10^{-8}\ \Omega \cdot m$. You have a long spool of wire made from this metal. If this wire has a diameter of 0.15 mm, how long should you cut a segment so its resistance will be 15 Ω? 196) ______
A) 16 cm
B) 1.6 m
C) 16 m
D) 16 mm

197) A 120-m long metal wire having a resistivity of $1.68 \times 10^{-8}\ \Omega \cdot m$ has a resistance of 6.0 Ω. What is the diameter of the wire? 197) ______
A) 0.65 mm
B) 0.65 m
C) 0.65 cm
D) 0.065 mm

198) A rod is 4.0 m long and has a square cross-section that is 1.5 cm on each side. An ohmmeter measures 0.040 Ω across its ends. What is the resistivity of the material from which this rod is made? 198)

_____

A) $0.023\ \Omega \cdot m$ B) $2.3 \times 10^{-6}\ \Omega \cdot m$
C) $1.5 \times 10^{-4}\ \Omega \cdot m$ D) $0.015\ \Omega \cdot m$

199) Calculate the current through a 10.0-m long 22-gauge nichrome wire with a radius of 0.321 mm if it is connected across a 12.0-V battery. The resistivity of the nichrome is $1.00 \times 10^{-6}\ \Omega \cdot m$. 199) _____
A) 0.776 A B) 0.388 A C) 61.8 A D) 30.9 A

200) A metal bar is 20 cm long and has a rectangular cross-section measuring 1.0 cm × 2.0 cm. What is the voltage drop along its length when it carries a 4000-A current? The resistivity of the metal is $1.68 \times 10^{-8}\ \Omega \cdot m$. 200) _____
A) 0.67 V B) 0.34 V C) 0.034 V D) 0.067 V

201) A 1.0-m length of nichrome wire has a radius of 0.50 mm and a resistivity of $1.0 \times 10^{-6}\ \Omega \cdot m$. When this wire carries a current of 0.50 A, what is the voltage across its ends? 201) _____
A) 0.0030 V B) 1.6 V C) 0.32 V D) 0.64 V

202) A 1.0-mm diameter extension cord is made of metal having a resistivity of $1.68 \times 10^{-8}\ \Omega \cdot m$. When it carries a current of 15 A, what is the potential difference between two points in the cord that are 100 m apart? 202) _____
A) 23 V B) 41 V C) 32 V D) 12 V

203) The resistivity of gold is $2.44 \times 10^{-8}\ \Omega \cdot m$ at a temperature of 20°C. A gold wire that is 0.90 mm in diameter and 23 cm long carries a current of 260 mA. How many electrons each second pass a given cross section of the wire at 20°C? ($e = 1.60 \times 10^{-19}$ C) 203) _____
A) 1.6×10^{17} B) 1.6×10^{18} C) 9.2×10^{14} D) 3.8×10^{22} E) 6.3×10^{15}

204) How much current will be flowing through a 48.0-m length of copper wire with radius 4.8 mm if it is connected to a source supplying 65.0 V? The resistivity of the metal is $1.68 \times 10^{-8}\ \Omega \cdot m$. 204) _____
A) 38×10^{8} A B) 5800 A C) 3500 A D) 230 nA

205) When a 2.0-m length of metal wire is connected to a 1.5-V battery, a current of 2.0 mA flows through it. What is the diameter of the wire? The resistivity of the metal is $2.24 \times 10^{-8}\ \Omega \cdot m$. 205) _____
A) 12 μm B) 8.7 μm C) 4.4 μm D) 4.5 μm

206) The resistance of a 100-cm wire of cross sectional area $2 \times 10^{-6}\ m^2$ is 400 Ω. What is the resistivity of the material from which this wire is made? 206) _____
A) $8.0 \times 10^{-6}\ \Omega$v
B) $8.0 \times 10^{-4}\ \Omega \cdot m$
C) $0.80 \times 10^{-4}\ \Omega \cdot m$
D) $0.80 \times 10^{-6}\ \Omega \cdot m$
E) $0.80 \times 10^{-5}\ \Omega \cdot m$

207) The resistivity of the material of a wire is $1.76 \times 10^{-8}\ \Omega \cdot m$. If the diameter of the wire is 2.00 mm and its length is 2.00 m, what is its resistance? 207) _____
A) 1.12 Ω B) 112 Ω C) 11.2 Ω D) 0.0112 Ω E) 0.112 Ω

208) The resistivity of a 1.0 m long copper wire is $1.72 \times 10^{-8}\ \Omega \cdot m$ and its cross sectional area is $2.0 \times 10^{-6}\ m^2$. If the wire carries a current of 0.20 A, what is the voltage across the wire? 208) ______

A) 90 mV B) 1.7 mV C) 0.90 mV D) 17 mV E) 10 mV

209) How much current will flow through a 32.0-m length of metal wire with a radius of 3.2 mm if it is connected to a power source supplying 45.0 V? The resistivity of the metal is $1.68 \times 10^{-8}\ \Omega \cdot m$. 209) ______

A) 2700 A B) 27×10^8 A C) 1600 A D) 240 nA

210) When a potential difference is applied across a piece of wire made of metal A, a 1.0-mA current flows. If the metal-A wire is replaced with a wire made of metal B having twice the diameter of the metal-A wire, how much current will flow through the metal-B wire? The lengths of both wires are the same, and the voltage difference remains unchanged. The resistivity of metal A is $1.68 \times 10^{-8}\ \Omega \cdot m$, and the resistivity of metal B is $1.59 \times 10^{-8}\ \Omega \cdot m$. 210) ______

A) 4.2 mA B) 2.1 mA C) 3.8 mA D) 1.1 mA

211) A tube of mercury with resistivity $9.84 \times 10^{-7}\ \Omega \cdot m$ has a uniform electric field of 23 N/C inside the mercury. How much current is flowing in the tube, if the radius of the tube is 0.495 mm? 211) ______

A) 29 A B) 180 A C) 280 A D) 18 A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

212) The power rating of a 400-Ω resistor is 0.800 W. 212) ____________

(a) What is the maximum safe voltage across this resistor?

(b) What is the maximum current the resistor can safely draw?

213) A resistor operated at 120 V dc is rated at 1.40 kW. 213) ____________

(a) What is the normal operating current through the resistor?

(b) What is the resistance of the resistor?

214) A flashlight draws 0.133 A from a 3.0-V battery pack. In 2.0 minutes (a) how much charge flows from the battery, (b) how much energy does the battery supply, and (c) how many electrons have passed any point in the circuit every second? 214) ____________

215) An instrument is rated at 250 W if it is connected across a 120-V dc power supply. 215) ____________

(a) What current does it draw under normal operation?

(b) What is its resistance?

(c) How many kilowatt-hours does it use in a day if it is left on all the time?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

216) A 200-W light bulb is connected across a 110-V dc power supply. What current will flow through this bulb? 216) ______

A) 0.36 A B) 0 A C) 1.8 A D) 0.90 A E) 0.60 A

217) A 100-W resistance heater is connected to a 110-V dc source. What current flows through the heater? 217) ______

A) 4.4 A B) 0.91 A C) 2.2 A D) 1.1 A E) 3.3 A

218) A 100-W light bulb is operated by a 110-V dc source. What is the resistance of this bulb? 218) ______

A) 120 Ω

B) 100 Ω

C) $6.0 \times 10^{-3}\ \Omega$

D) $8.0 \times 10^{-3}\ \Omega$

E) 240 Ω

219) If the power rating of a 400-Ω resistor is 0.800 W, what is the maximum voltage that can safely be connected across the resistor? 219) ______

A) 110 V B) 170 V C) 17.9 V D) 1.80 V

220) If the power rating of a 400-Ω resistor is 0.80 W, what is the maximum current it can safely draw? 220) ______

A) 45 mA B) 4.4 mA C) 320 mA D) 2.0 mA E) 18 mA

221) A light bulb operating at a dc voltage of 120 V has a power rating of 60 W. How much current is flowing through this bulb? 221) ______

A) 1.5 A B) 1.0 A C) 2.5 A D) 0.50 A E) 2.0 A

222) A light bulb operating at a dc voltage of 120 V has a resistance of 200 Ω. How much power is dissipated in this bulb? 222) ______

A) 60 W B) 72 W C) 7.2 W D) 14 mW E) 100 W

223) The power rating of a 400-Ω resistor is 0.25 W. What is the maximum voltage you can safely connect across its ends? 223) ______

A) 20 V B) 10 V C) 40 V D) 50 V E) 30 V

224) When 5.00 A is flowing through an 10.0-Ω device, how much power is being dissipated in the device? 224) ______

A) 250 W B) 500 W C) 50.0 W D) 2.50 kW

225) A resistance heater is rated at 1200 W when operating at 110 V dc. What current will it draw? 225) ______

A) 12 A B) 0.090 A C) 1.0 A D) 11 A

226) A 150-W light bulb is designed to operate at 110 V dc. How much current does it draw? 226) ______

A) 1.4 A B) 0.73 A C) 2.0 A D) 15 A

227) What is the resistance of a 0.100-kW light bulb designed to be used in a 120-V circuit dc? 227) ______

A) 144 Ω B) 1.2 Ω C) 0.83 Ω D) 12.0 Ω

228) A toaster is rated at 800 W when operating at 120 V dc. What is the resistance of its heating element? 228) ______

A) 16 Ω B) 0.15 Ω C) 6.7 Ω D) 18 Ω

229) A 200-Ω resistor is rated at 1/4 W. What is the maximum current it can safely draw? 229) ______

A) 0.35 A B) 0.035 A C) 0.25 A D) 50 A

230) A 25-W soldering iron runs on 110 V dc. What is its resistance? 230) ______

A) 0.48 kΩ B) 2.8 kΩ C) 4.4 Ω D) 0.0020 Ω

231) How much does it cost to operate a 25-W soldering iron for 8.0 hours if energy costs 8.0¢/kWh? 231) ______

A) 16¢ B) $1.50 C) 1.6¢ D) 25¢

232) How much energy does a 100-W light bulb use in 8.0 hours? 232) ______

A) 0.0080 kWh B) 0.80 kWh C) 800 kWh D) 13 kWh

233) A 1500-W heater is connected to a 120-V line for 2.0 hours. How much heat energy is prod uced?

233) ______

A) 1.5 kJ B) 11 MJ C) 0.18 MJ D) 3.0 kJ

234) A battery is rated at 12 V and 160 A-h. How much energy does this battery store? 234) ______

A) 6.9 MJ B) 6.0 kJ C) 1.9 kJ D) 1.9 MJ

235) An electronic component with a 3-Ω resistor is rated for use at power levels not exceeding 11 W. How much current can safely flow through the component? 235) ______

A) 33 A B) 0.27 A C) 1.91 A D) 1.11 A

236) A 100-W driveway light bulb is on 10 hours per day. If the power company charges 10¢ for each kilowatt-hour of electricity used, estimate the yearly cost to operate the bulb if it is used every day for a 365-day year. 236) ______

A) $37 B) $3.65 C) $73 D) $7.30

237) A 400-W computer (including its monitor) is turned on for 8.0 hours per day. If electricity costs 10¢ per kWh, how much does it cost to run the computer annually for a 365-day year? 237) ______

A) $1200 B) $15 C) $150 D) $120

238) The nichrome heating element in an electric drier operates on 240 V and generates heat at the rate of 2.0 kW. The heating element shorts out and, in repairing it, the repairman shortens the nichrome wire by 10%. (Assume the temperature is unchanged. In reality, the resistivity of the wire will depend on its temperature.) What effect will the repair have on the power dissipated in the heating element? 238) ______

A) The power increases to 2.2 kW.
B) The power decreases to 1.8 kW.
C) The power is still 2.0 kW.
D) None of the given answers is correct.

239) When a 14.0-A current flows through an 8.00-Ω device for 24.0 hours, how much does this cost if energy costs $0.0900 per kW · h? 239) ______

A) $1.04 B) $3.39 C) $2.16 D) $0.24

240) A 9.0-V battery costs $1.49 and will run a portable CD player for 6.0 hours before running down and needing to be replaced. If this battery supplies a current of 25 mA to the player, what is the cost of the energy provided by the battery in dollars per kWh? 240) ______

A) $1100/kWh B) $11,000/kWh C) $110/kWh D) $11/kWh

241) A 200-Ω resistor is rated at 1/4 W. What is the maximum voltage that can safely be connected across it? 241) ______

A) 0.71 V B) 0.25 V C) 7.1 V D) 50 V

242) A simple circuit has a total resistance of 30 Ω. If a 2.0-A current is maintained in this circuit, how much energy is dissipated in this circuit in 4.0 seconds? 242) ______

A) 24 J B) 48 J C) 480 J D) 4.8 J E) 6.0 J

243) The resistivity of gold is $2.44 \times 10^{-8}\ \Omega \cdot m$ at a temperature of 20°C. A gold wire, 1.3 mm in diameter and 43 cm long, carries a current of 880 mA. What power is dissipated in this wire at 20°C? 243) ______

A) 3.8 mW B) 6.1 mW C) 1.5 mW D) 5.0 mW E) 2.7 mW

244) A 120-Ω laboratory resistor is rated at 0.25 W. How much current can safely flow through the resistor? 244) ______

A) 2.1 mA B) 22 mA C) 46 mA D) 30 A

245) The voltage drop across a metal bar is 3.0 V while a current of 3.0 mA flows through it. How much power does this bar dissipate? 245) ______
A) 3.0 kW B) 1.0 kW C) 27 μW D) 9.0 mW

246) A battery is rated such that it provides 3.0 mW of power at 10.0 V when fully charged. How much current can it deliver? 246) ______
A) 0.30 mA B) 0.55 mA C) 33 kA D) 3.3 kA

247) A device with a resistance of 200.0 kΩ is connected to a 10.0-V battery. How much power does the device use? 247) ______
A) 20,000 kW B) 0.50 mW C) 0.050 mW D) 2000 kW

248) A 5.0-V battery that can store 900.0 J of energy is connected to a resistor. How much charge must flow between the battery's terminals to completely drain the battery if it is fully charged? Assume that the voltage of the battery remains the same until it is totally drained. 248) ______
A) 0.010 C B) 0.03 C C) 180 C D) 4500 C

249) The heating element of a toaster is a 7.0-m length of nichrome wire of diameter 0.22 mm. The resistivity of nichrome at the operating temperature of the toaster is 1.3×10^{-6} Ω · m. The toaster is designed to operate at a voltage of 120 V. How much power does it draw in normal operation? 249) ______
A) 62 W B) 58 W C) 66 W D) 60 W E) 64 W

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

250) A battery supplies 6.0 mA to a 12-Ω resistor for 1.5 h. How much electric energy does this resistor dissipate in this time? 250) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

251) A 5.0-V battery storing 75.0 kJ of energy supplies 1.5 A of current to a circuit. How much energy does the battery have left after powering the circuit for 1.0 h? 251) ______
A) 75 kJ B) 27 kJ C) 48 kJ D) 73 kJ

252) A carbon resistor has a resistance of 18 Ω at a temperature of 20°C. What is its resistance at a temperature of 120°C? The temperature coefficient of resistivity for carbon is -5.0×10^{-4}/C°. 252) ______
A) 15 Ω B) 16 Ω C) 17 Ω D) 18 Ω

253) The temperature coefficient of resistivity of platinum is 3.9×10^{-3}/C°. If a platinum wire has a resistance of R at a temperature of 23°C, to what temperature must it be heated in order to double its resistance to $2R$? 253) ______
A) 300°C B) 280°C C) 730°C D) 930°C

254) A platinum wire is used to determine the melting point of indium. The resistance of the platinum wire is 2.000 Ω at 20°C and increases to 3.072 Ω as indium just starts to melt. What is the melting point of indium? The temperature coefficient of resistivity for platinum is 3.927×10^{-3}/C°. 254) ______
A) 156°C B) 136°C C) 351°C D) 116°C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

255) A tungsten wire is 1.50 m long and has a diameter of 1.00 mm. At 20°C a current of 50 mA flows through this wire. The temperature coefficient of resistivity for this tungsten is 4.5×10^{-3}/C°, and its resistivity at 20°C is 5.6×10^{-8} Ω · m.

(a) What is the potential difference across the ends of this wire at

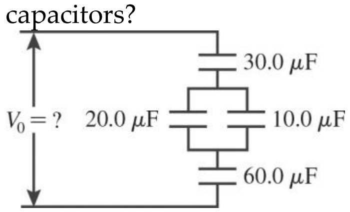
20°C? (b) If the wire temperature increases by 100 C°, what potential difference across its ends is now required to produce a current of 50 mA?

255) ______

256) A 4.0-μF capacitor and an 8.0-μF capacitor are connected together. What is the equivalent capacitance of the combination if they are connected (a) in series or (b) in parallel? 256) ______

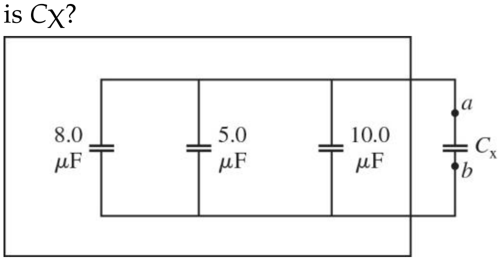
257) You have three capacitors with capacitances of 4.00 μF, 7.00 μF, and 9.00 μF. What is the equivalent capacitance if they are connected (a) in series and (b) in parallel? 257) ______

258) A network of capacitors is connected across a potential difference V_0 as shown in the figure. 258) ______
(a) What should V_0 be so that the 60.0-μF capacitor will have 18.0 μC of charge on each of its plates?
(b) Under the conditions of part (a), how much total energy is stored in this network of capacitors?



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

259) A network of capacitors is mostly inside a sealed box, but one capacitor C_X is sticking out, as shown in the figure. When you connect a multimeter across points *a* and *b*, it reads 27.0 μF. What is C_X? 259) ______



A) 2.4 μF B) 27.0 μF C) 4.0 μF D) 23.0 μF E) 2.2 μF

260) A 2.0-μF capacitor and a 4.0-μF capacitor are connected in series across an 8.0-V potential source. Wha t is the

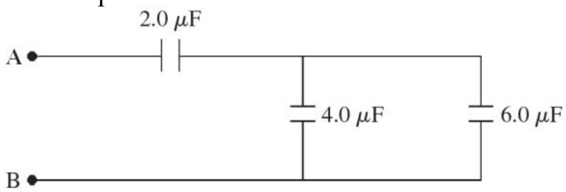
260) potential difference across the 2.0-μF capacitor?

A) 0 V B) 3.6 V C) 8.0 V D) 5.3 V E) 2.7 V

261) A 2.0-μF capacitor and a 4.0-μF capacitor are connected in series across an 8.0-V potential source. What is the charge on the 2.0-μF capacitor? 261) ______

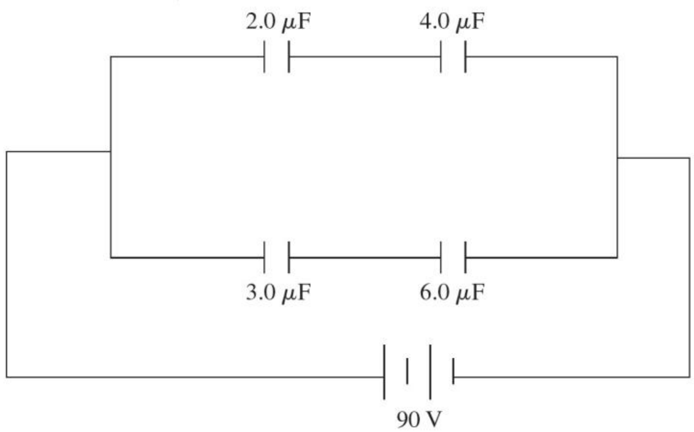
A) 2.0 μC B) 4.0 μC C) 25 μC D) 11 μC E) 12 μC

262) Three capacitors are connected as shown in the figure. What is the equivalent capacitance between points A and B? 262) ______



A) 4.0 μC B) 12 μF C) 7.1 μF D) 8.0 μF E) 1.7 μF

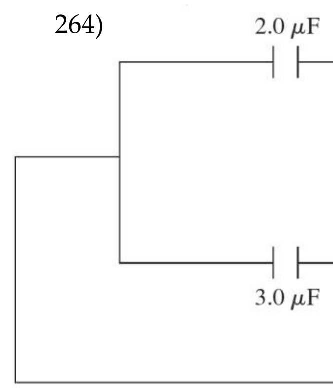
263) A system of four capacitors is connected across a 90-V voltage source as shown in the figure. What is the equivalent capacitance of this system? 263) ______



A) 15 μF B) 1.5 μF C) 3.6 μF D) 3.3 μF

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

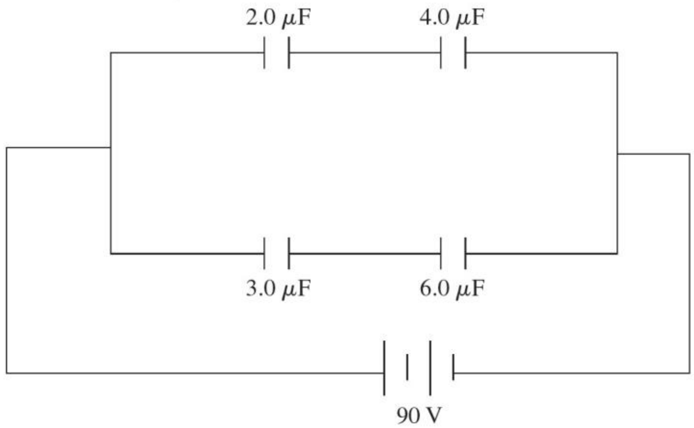
264) A system of four capacitors is connected across a 90-V voltage source as shown in the figure.
(a) What is the charge on the 4.0-μF capacitor?
(b) What is the charge on the 2.0-μF capacitor? 264)



265) A system of four capacitors is connected across a 90-V voltage source as shown in the figure. 265) ____________

(a) What is the potential difference across the plates of the 6.0-μF capacitor?

(b) What is the charge on the 3.0-μF capacitor?



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

266) A 3.0-μF, a 12-μF, and a 26-μF capacitor are connected in parallel. How much capacitance would a single capacitor need to have to replace the three capacitors? 266) ______

A) 41 μF B) 12 μF C) 3.0 μF D) 26 μF

267) A 5.0-μF, a 14-μF, and a 21-μF capacitor are connected in series. How much capacitance would a single capacitor need to have to replace the three capacitors? 267) ______

A) 2.0 μF B) 3.6 μF C) 40 μF D) 3.1 μF

268) A 4.0-μF and a 15.0-μF capacitor are connected in series, and the series arrangement is connected in parallel to a 28.0-μF capacitor. How much capacitance would a single capacitor need to replace this combination of three capacitors? 268) ______

A) 36 μF B) 19 μF C) 31 μF D) 14 μF

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

269) Four 16-μF capacitors are connected in combination. What is the equivalent capacitance of this combination if they are connected 269) ____________

(a) in series?

(b) in parallel?

(c) such that two of them are in parallel with each other and that combination is in series with the remaining two capacitors?

270) Three capacitors of capacitance 5.00 μF, 10.0 μF, and 50.0 μF are connected in series across a 12.0-V potential difference (a battery). 270) ____________

(a) How much charge is stored in the 5.00-μF capacitor?

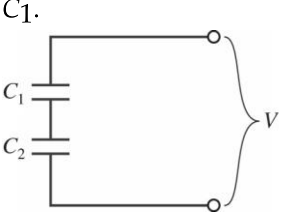
(b) What is the potential difference across the 10.0-μF capacitor?

271) A 1.0-μF capacitor and a 2.0-μF capacitor are connected together, and then that combination is connected across a 3.0-V potential source (a battery). What is the potential difference across the 2.0-μF capacitor if the capacitors are connected (a) in series or (b) in parallel? 271) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

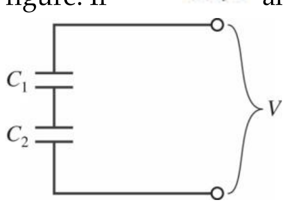
272) Two capaci

272) tors are connected as shown in the figure, with C_1 = 4.0 μF and C_2 = 7.0 μF. If a voltage source V = 90 V is applied across the combination, find the potential difference across C_1. 272) ______



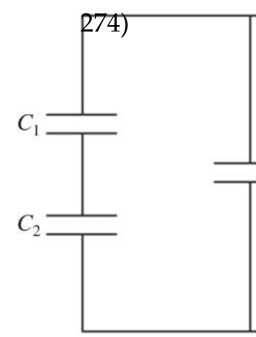
A) 9.0 V B) 36 V C) 57 V D) 60 V

273) A potential difference of V = 100 V is applied across two capacitors in series, as shown in the figure. If C_1 = 2.0 μF and the voltage drop across it is 75 V, what is the capacitance of C_2? 273) ______



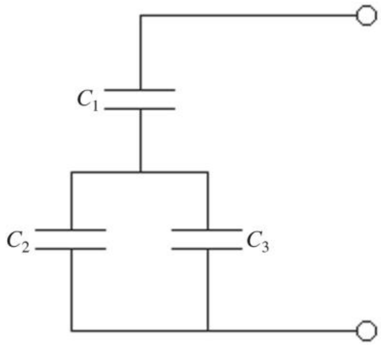
A) 0.50 μF B) 1.5 μF C) 0.67 μF D) 6.0 μF

274) Three capacitors of equal capacitance are arranged as shown in the figure, with a voltage source across the combination. If the voltage drop across C_1 *is* 60.0 V, what is the voltage drop across C_3? 274)



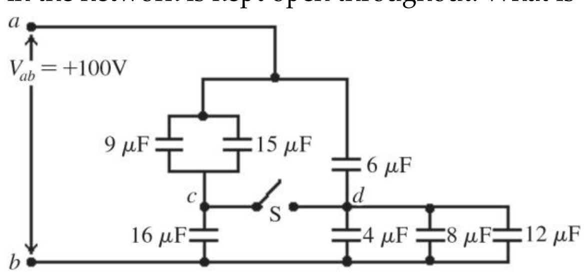
A) 120 V　　B) 180 V　　C) 60.0 V　　D) 240 V

275) Three capacitors are arranged as shown in the figure, with a voltage source connected across the combination. C_1 has a capacitance of 5.0 pF, C_2 has a capacitance of 10.0 pF, and C_3 has a capacitance of 15.0 pF. Find the potential drop across the entire arrangement if the potential drop across C_2 is 172.0 V. 275) ______



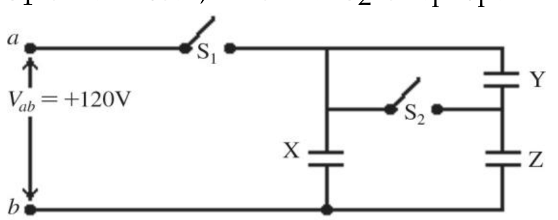
A) 690 V　　B) 320 V　　C) 1000 V　　D) 290 V

276) The capacitive network shown in the figure is assembled with initially uncharged capacitors. Assume that all the quantities in the figure are accurate to two significant figures. The switch S in the network is kept open throughout. What is the total energy stored in the seven capacitors? 276) ______



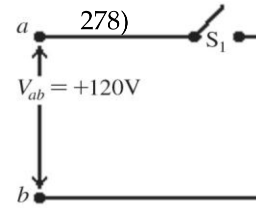
A) 48 mJ　　B) 96 mJ　　C) 120 mJ　　D) 144 mJ　　E) 72 mJ

277) The network shown is assembled with uncharged capacitors X , Y, and Z, with $C_X = 5.0\ \mu F$, $C_Y = 4.0\ \mu F$ and $C_Z = 3.0\ \mu F$. The switches S_1 and S_2 are initially open, and a potential difference V_{ab} = 120 V is applied between points *a* and *b*. After the network is assembled, switch S_1 is then closed, but switch S_2 is kept open. How much energy is finally stored in capacitor X? 277) ______



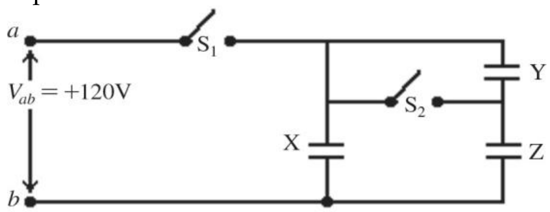
A) 1.5 mJ　　B) 36 mJ　　C) 72 mJ　　D) 0.60 mJ　　E) 0.30 mJ

278) The network shown is assembled with uncharged capacitors X , Y, and Z, with $C_X = 3.\text{–}\ \mu F$, $C_Y = 2.\text{–}\ \mu F$ and $C_Z = 3.0\ \mu F$. The switches S_1 and S_2 are initially open, and a potential difference V_{ab} = 120 V is applied between points *a* and *b*. After the network is assembled, switch S_1 is then closed, but switch S_2 is kept open. How much charge is finally stored in capacitor Y? 278)



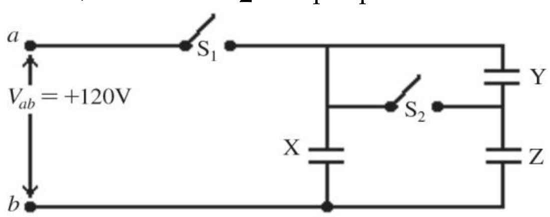
A) 180 μC B) 72 μC C) 110 μC D) 220 μC E) 140 μC

279) The network shown is assembled with uncharged capacitors X , Y, and Z, with $C_X = 9.0\ \mu F$, $C_Y = 7.0\ \mu F$ and $C_Z = 6.0\ \mu F$. The switches S_1 and S_2 are initially open, and a potential difference V_{ab} = 120 V is applied between points *a* and *b*. After the network is assembled, switch S_1 is then closed, but switch S_2 is kept open. What is the final potential difference across capacitor Z? 279) ______



A) 25 V B) 65 V C) 42 V D) 140 V E) 31 V

280) The network shown is assembled with uncharged capacitors X , Y, and Z, with C_X = 4.0 μF, C_Y = 6.0 μF, and C_Z = 5.0 μF. The switches S_1 and S_2 are initially open, and a potential difference V_{ab} = 120 V is applied between points *a* and *b*. After the network is assembled, switch S_1 is then closed, but switch S_2 is kept open. What is the final potential difference across capacitor X? 280) ______



A) 75 V B) 67 V C) 60 V D) 82 V E) 120 V

281) A group of 1.0-μF, 2.0-μF, and 3.0-μF capacitors is connected in parallel across a 24-V potential difference (a battery). How much energy is stored in this three-capacitor combination when the capacitors are fully charged? 281) ______

A) 1.7 mJ B) 4.8 mJ C) 2.1 mJ D) 7.1 mJ

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

282) A 9.00-μF and a 12.0-μF capacitor are connected together, and this combination is connected across a 25.0-V potential difference. How much electric energy is stored in the combination if they are connected (a) in parallel or (b) in series? 282) ______________

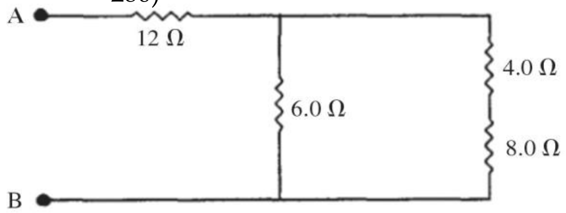
283) What different resistances can be obtained by using two 2.0-Ω resistors and one 4.0-Ω resistor? You must use all three of them in each possible combination. 283) ______________

284) Two resistors in series are equivalent to 9.0 Ω, and in parallel they are equivalent to 2.0 Ω. What are the resistances of these two resistors? 284) ______________

285) What resistance must be connected in parallel with a 633-Ω resistor to produce an equivalent resistance of 205 Ω? 285) ______________

286) What is the equivalent resistance between points A and B of the network shown in the figure?

286)



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

287) A combination of a 2.0-Ω resistor in series with 4.0-Ω resistor is connected in parallel with a 3.0-Ω resistor. What is the equivalent resistance of this system? 287) ______

A) 9.0 Ω B) 4.0 Ω C) 2.0 Ω D) 3.0 Ω

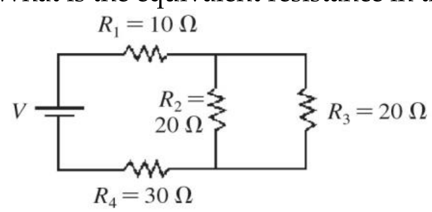
288) Two 4.0-Ω resistors are connected in parallel, and this combination is connected in series with 3.0 Ω. What is the equivalent resistance of this system? 288) ______

A) 1.2 Ω B) 7.0 Ω C) 5.0 Ω D) 11 Ω

289) A 2.0-Ω resistor is in series with a parallel combination of 4.0-Ω, 6.0-Ω, and 12-Ω resistors. What is the equivalent resistance of this system? 289) ______

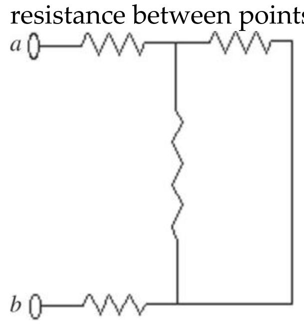
A) 2.7 Ω B) 4.0 Ω C) 24 Ω D) 1.8 Ω

290) What is the equivalent resistance in the circuit shown in the figure? 290) ______



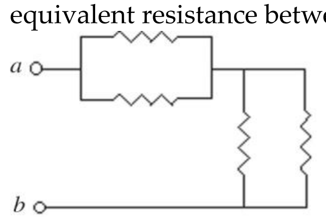
A) 50 Ω B) 35 Ω C) 80 Ω D) 55 Ω

291) Each of the resistors shown in the figure has a resistance of 400.0 Ω. What is the equivalent resistance between points *a* and *b* of this combination? 291) ______



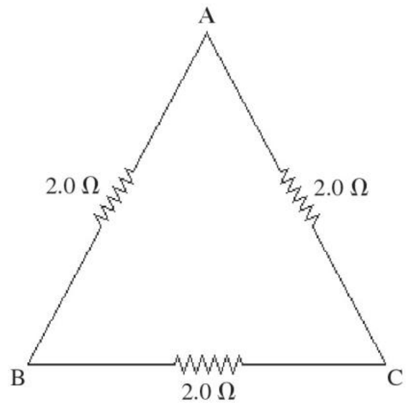
A) 1600 Ω B) 1000 Ω C) 400.0 Ω D) 1200 Ω

292) The resistors in the circuit shown in the figure each have a resistance of 600 Ω. What is the equivalent resistance between points *a* and *b* of this combination? 292) ______



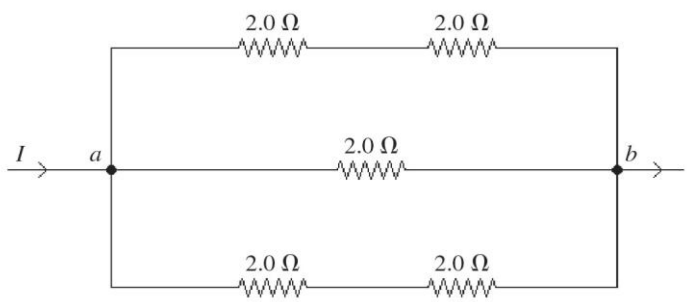
A) 1200 Ω B) 150 Ω C) 2400 Ω D) 600 Ω

293) Three 2.0-Ω resistors are connected to form the sides of an equilateral triangle ABC as shown in the figure. What is the equivalent resistance between any two points, AB, BC, or AC, of this circuit? 293) ______



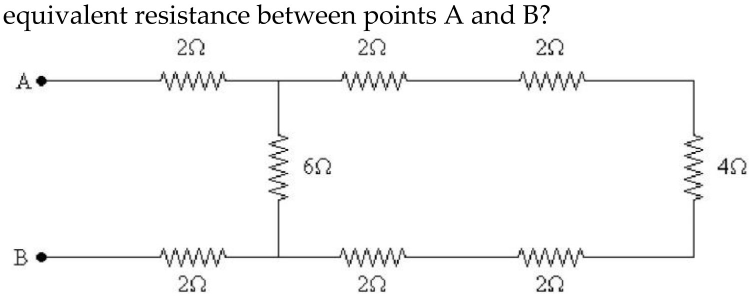
A) 2.0 Ω B) 1.3 Ω C) 4.3 Ω D) 6.0 Ω E) 3.3 Ω

294) Five 2.0-Ω resistors are connected as shown in the figure. What is the equivalent resistance of this combination between points *a* and *b*? 294) ______



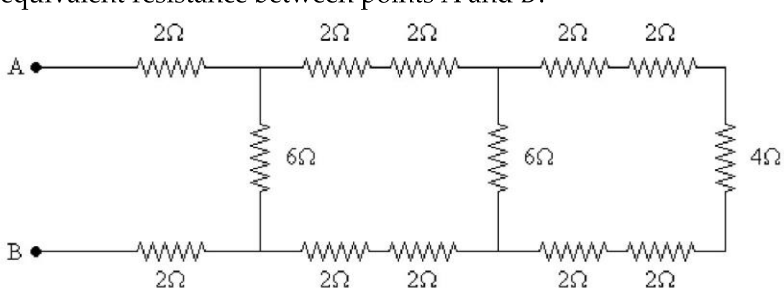
A) 0.40 Ω B) 2.0 Ω C) 10.0 Ω D) 6.0 Ω E) 1.0 Ω

295) A number of resistors are connected across points A and B as shown in the figure. What is the equivalent resistance between points A and B? 295) ______



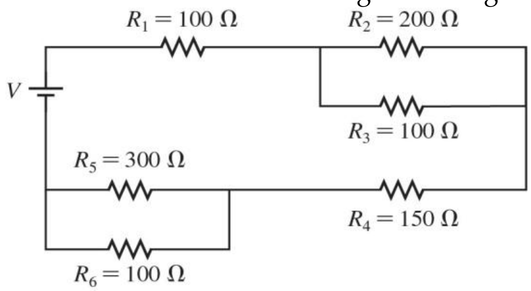
A) 12 Ω B) 8 Ω C) 10 Ω D) 6 Ω E) 4 Ω

296) A number of resistors are connected across points A and B as shown in the figure. What is the equivalent resistance between points A and B? 296) ______



A) 6 Ω B) 4 Ω C) 10 Ω D) 12 Ω E) 8 Ω

297) What is the equivalent resistance of the circuit shown in the figure? The battery is ideal and all resistances are accurate to 3 significant figures. 297) ______



A) 392 Ω B) 450 Ω C) 950 Ω D) 257 Ω

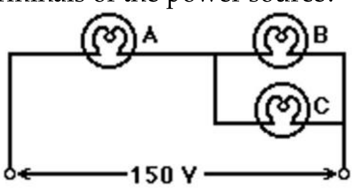
298) Three light bulbs, A, B, and C, have electrical ratings as follows: 298) ______

Bulb A: 96.0 W, 1.70 A

Bulb B: 80.0 V, 205 W

Bulb C: 120 V, 0.400 A

These three bulbs are connected in a circuit across a 150-V voltage power source, as shown in the figure. Assume that the filament resistances of the light bulbs are constant and independent of operating conditions. What is the equivalent resistance of this combination of bulbs between the terminals of the power source?



A) 364 Ω B) 86.2 Ω C) 61.5 Ω D) 74.0 Ω E) 15.3 Ω

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

299) A heating element having a resistance (at its operating temperature) of 421 Ω is connected to a battery having an emf of 781 V and unknown internal resistance.It is found that heat energy is being generated in the resistance of the heating element at a rate of 66.0 W. What is the rate at which heat energy is being generated in the internal resistance of the battery? 299) ____________

300) When an external resistor of resistance R_1 = 14 Ω is connected across the terminals of a battery, a current of 6.0 A flows through the resistor. When a different external resistor of resistance R_2 = 64.4 Ω is connected instead, the current is 2.0 A. Calculate (a) the emf of the battery and (b) the internal resistance of the battery. 300) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

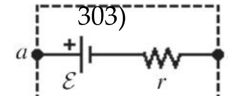
301) A battery you buy at the store has an internal emf of 3.0 V. If it has an internal resistance of 16.0 Ω, what current will this battery put out if it is short-circuited? 301) ______

A) 140 A B) 48 A C) 5.3 A D) 0.19 A

302) A 4.0-Ω resistor is connected across the terminals of a battery having an internal emf of 10 V. If 0.50-A current flows, what is the internal resistance of the battery? 302) ______

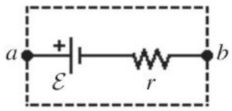
A) 24.0 Ω B) 10.8 Ω C) 16 Ω D) 20 Ω

303) A battery has an emf ε = 26.0 V and an internal resistance r = 7.0 Ω, as shown in the figure. A current of 8.2 A is drawn from the battery when a resistor R is connected across the terminals a and b. The power dissipated by the resistor R is closest to 303)



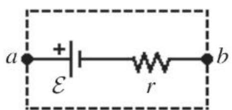
A) 96 W. B) -140 W. C) -22 W. D) -260 W. E) 210 W.

304) A battery has an emf ε = 93.0 V and an internal resistance r = 5.0 Ω, as shown in the figure. When the terminal voltage V_{ab} is equal to 53.9 V, the current through the battery, including its direction, is closest to 304) ______



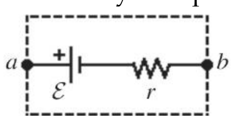
A) 7.8 A, from *a* to *b*.
B) 11 A, from *a* to *b*.
C) 11 A, from *b* to *a*.
D) 7.8 A, from *b* to *a*.
E) 19 A, from *b* to *a*.

305) A battery has an emf ε = 12 V and an internal resistance r = 2.0 Ω, as shown in the figure. When a current of 6.0 A is drawn from the battery, the terminal voltage of the battery V_{ab} is closest to 305) ______



A) +24 V. B) 2.0 V. C) 10 V. D) +12 V. E) 0 V.

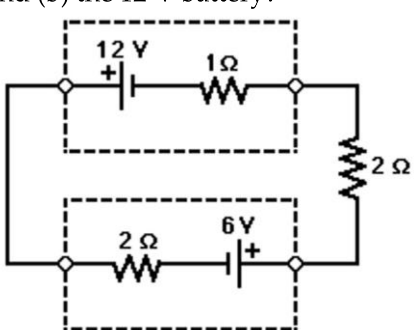
306) A battery has an emf ε = 12 V and an internal resistance r = 2.0 Ω, as shown in the figure. When a 3.0-Ω cable is connected across the battery terminals *a* and *b*, the rate at which chemical energy in the battery is depleted is closest to 306) ______



A) 32 W. B) 34 W. C) 27 W. D) 24 W. E) 29 W.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

307) A circuit contains two batteries and a 2.0-Ω resistor as shown in the figure. The emfs and internal resistances of these batteries are indicated in the figure, and all numbers are accurate to two significant figures. What are the terminal voltages of (a) the 6.0-V battery and (b) the 12-V battery? 307) ____________

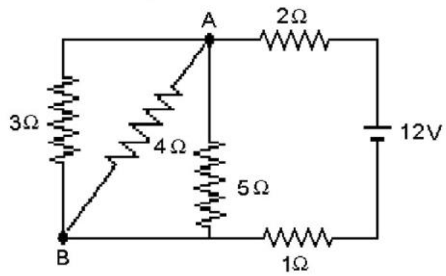


308) Three resistors of 12 Ω, 12 Ω, and 6.0 Ω are connected together, and an ideal 12-V battery is connected across the combination. What is the current from the battery if they are connected (a) in series or (b) in parallel? 308) ____________

309) Two resistors with resistances of 5.0 Ω and 9.0 Ω are connected in parallel. A 4.0-Ω resistor is then connected in series with this parallel combination. An ideal 6.0-V battery is connected then across the

series-pa 309)
rallel
combinat
ion.
What is
the
current
through
(a) the
4.0-Ω
resistor
and (b)
the 5.0-Ω
resistor?

310) For the circuit shown in the figure, the battery is ideal and all quantities are accurate to two significant figures. Find the current through (a) the 1.0-Ω resistor, (b) the 3.0-Ω resistor, and (c) the 4.0-Ω resistor. 310) ____________



311) Two 100-W light bulbs of fixed resistance are to be connected to an ideal 120-V source. What are the current, potential difference, and dissipated power for each bulb when they are connected 311) ____________

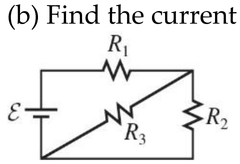
(a) in parallel (the normal arrangement)?

(b) in series?

312) For the circuit shown in the figure, R_1 = 5.6 Ω, R_2 = 5.6 Ω, R_3 = 14 Ω, and ε = 6.0 V, and the battery is ideal. 312) ____________

(a) What is the equivalent resistance across the battery?

(b) Find the current through each resistor.



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

313) A 22-A current flows into a parallel combination of 4.0-Ω, 6.0-Ω, and 12-Ω resistors. What current flows through the 12-Ω resistor? 313) ______

A) 11 A B) 7.3 A C) 3.7 A D) 18 A

314) A 6.0-Ω and a 12-Ω resistor are connected in parallel across an ideal 36-V battery. What power is dissipated by the 6.0-Ω resistor? 314) ______

A) 490 W B) 48 W C) 220 W D) 24 W

315) The following three appliances are connected in parallel across an ideal 120-V dc power source: 1200-W toaster, 650-W coffee pot, and 600-W microwave. If all were operated at the same time what curren total t

would they draw from the source? 315) _____

A) 4.0 A B) 5.0 A C) 20 A D) 10 A

316) A certain 20-A circuit breaker trips when the current in it equals 20 A. What is the maximum number of 100-W light bulbs you can connect in parallel in an ideal 120-V dc circuit without tripping this circuit breaker? 316) _____

A) 23 B) 11 C) 17 D) 27

317) A15-Ω resistor is connected in parallel with a 30-Ω resistor. If this combination is now connected in series with an ideal 9.0-V battery and a 20-Ω resistor, what is the current through the 15-Ω resistor? 317) _____

A) 0.13 A B) 0.26 A C) 0.20 A D) 0.10 A

318) Three resistors of resistances 4.0 Ω, 6.0 Ω, and 10 Ω are connected in parallel. If this combination is now connected in series with an ideal 12-V battery and a 2.0-Ω resistor, what is the current through the 10-Ω resistor? 318) _____

A) 0.59 A B) 11 A C) 16 A D) 2.7 A

319) Two resistors having resistances of 5.0 Ω and 9.0 Ω are connected in parallel. A 4.0-Ω resistor is then connected in series with the parallel combination. An ideal 6.0-V battery is then connected across the series-parallel combination. What is the current through the 9.0-Ω resistor? 319) _____

A) 0.53 A B) 0.35 A C) 0.83 A D) 0.30 A E) 0.67 A

320) A 3.0-Ω resistor is connected in parallel with a 6.0-Ω resistor. This combination is then connected in series with a 4.0-Ω resistor. The resistors are connected across an ideal 12-volt battery. How much power is dissipated in the 3.0-Ω resistor? 320) _____

A) 12 W B) 5.3 W C) 6.0 W D) 2.7 W

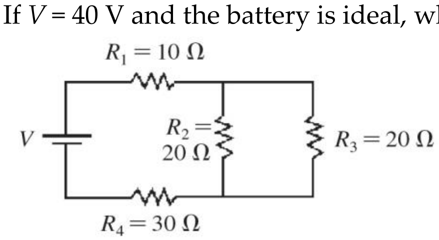
321) Four resistors having resistances of 20 Ω, 40 Ω, 60 Ω, and 80 Ω are connected in series across an ideal dc voltage source. If the current through this circuit is 0.50 A, what is the voltage of the voltage source? 321) _____

A) 60 V B) 40 V C) 80 V D) 100 V E) 20 V

322) Four resistors having resistances of 20 Ω, 40 Ω, 60 Ω, and 80 Ω are connected in series across an ideal 50-V dc source. What is the current through each resistor? 322) _____

A) 4.0 A B) 2.0 A C) 0.25 A D) 0.50 A E) 0.75 A

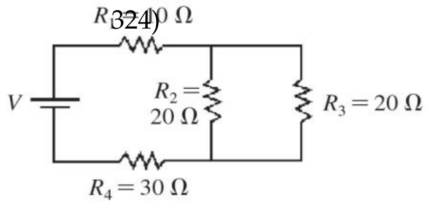
323) If $V = 40$ V and the battery is ideal, what is the potential difference across R_1 in the figure? 323) _____



A) 6.7 V B) 10 V C) 8.0 V D) 20 V

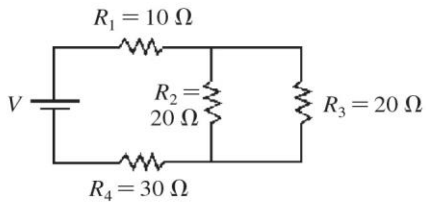
324) If $V = 20$ V and the battery is ideal, what is the current through R_3 in the figure?

324)



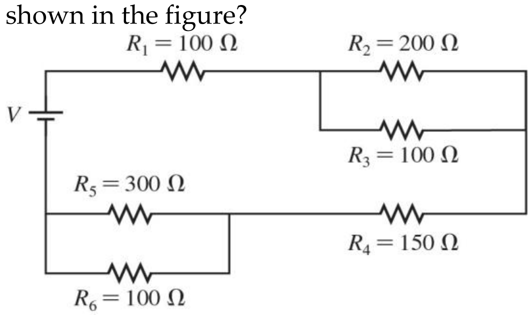
A) 0.20 A B) 4.0 A C) 1.0 A D) 0.050 A

325) If 1.5 A flows through R_2, what is the emf V of the ideal battery in the figure? 325) ______



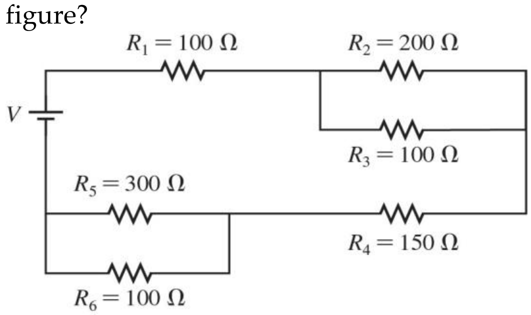
A) 150 V B) 75 V C) 30 V D) 60 V

326) If emf of the ideal battery is $V = 100$ V, what is the potential difference across R_5 for the circuit shown in the figure? 326) ______



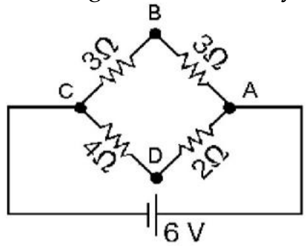
A) 19 V B) 40 V C) 77 V D) 75 V

327) If emf of the ideal battery is $V = 4.0$ V, what is the current through R_6 for the circuit shown in the figure? 327) ______



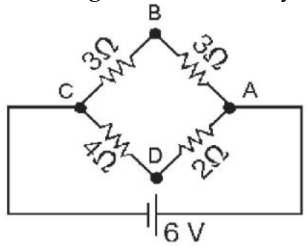
A) 4.0 A B) 0.0077 A C) 0.017 A D) 0.040 A

328) What is the magnitude of the potential difference between points A and C for the circuit shown in the figure? The battery is ideal, and all the numbers are accurate to two significant figures. 328) ______



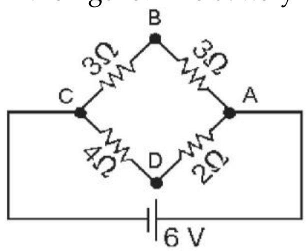
A) 6.0 V B) 4.0 V C) 3.0 V D) 2.0 V

329) What is the magnitude of the potential difference between points B and C for the circuit shown in the figure? The battery is ideal, and all the numbers are accurate to two significant figures. 329) ______



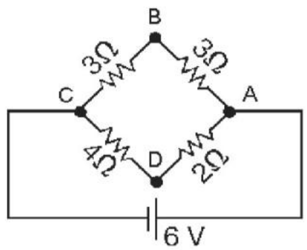
A) 6.0 V B) 4.0 V C) 3.0 V D) 2.0 V

330) What is the magnitude of the potential difference between points C and D for the circuit shown in the figure? The battery is ideal, and all the numbers are accurate to two significant figures. 330) ______



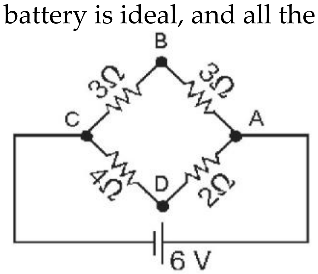
A) 6.0 V B) 4.0 V C) 3.0 V D) 2.0 V

331) What current flows from the battery in the circuit shown in the figure? The battery is ideal, and all the numbers are accurate to two significant figures. 331) ______



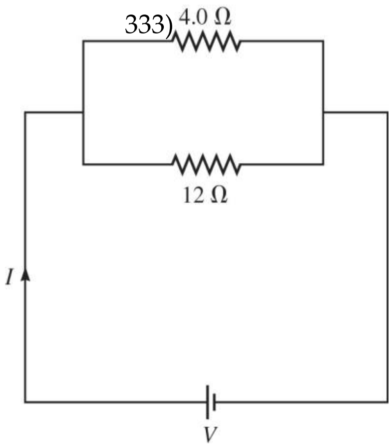
A) 2.5 A B) 2.0 A C) 0.35 A D) 3.0 A

332) What is the potential drop from point A to point B for the circuit shown in the figure? The battery is ideal, and all the numbers are accurate to two significant figures. 332) ______



A) 3.0 V B) 2.5 V C) 0.35 V D) 2.0 V

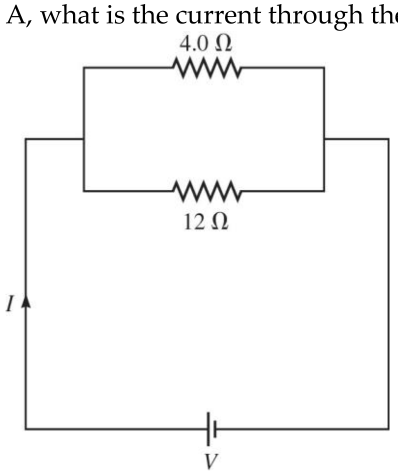
333) A 4.0-Ω resistor is connected to a 12-Ω resistor and this combination is connected to an ideal dc power supply with voltage V as shown in the figure. If the total current in this circuit is I = 2.0 A, what is the value of voltage V?

333) 

333) ____

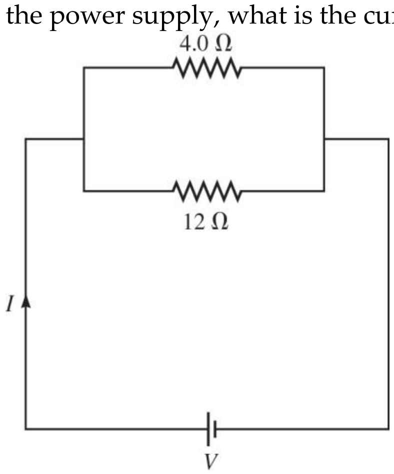
A) 6.0 V B) 3.0 V C) 1.5 V D) 2.0 V E) 8.0 V

334) A 4.0-Ω resistor is connected with a 12-Ω resistor and both of these are connected across an ideal dc power supply with voltage V as shown in the figure. If the total current in this circuit is $I = 2.0$ A, what is the current through the 4.0-Ω resistor? 334) ____



A) 1.5 A B) 0.5 A C) 2.5 A D) 3.0 A E) 2.0 A

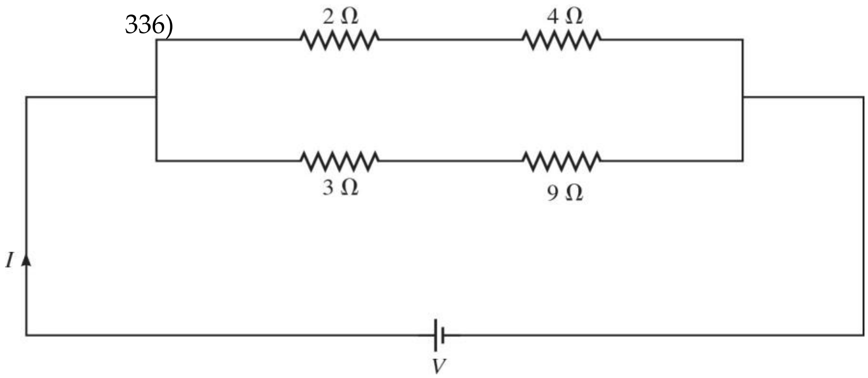
335) A 4.0-Ω resistor is connected with a 12-Ω resistor and this combination is connected across an ideal dc power supply with $V = 6.0$ V, as shown in the figure. When a total current I flows from the power supply, what is the current through the 12-Ω resistor? 335) ____



A) 2.5 A B) 0.50 A C) 1.5 A D) 3.0 A E) 2.0 A

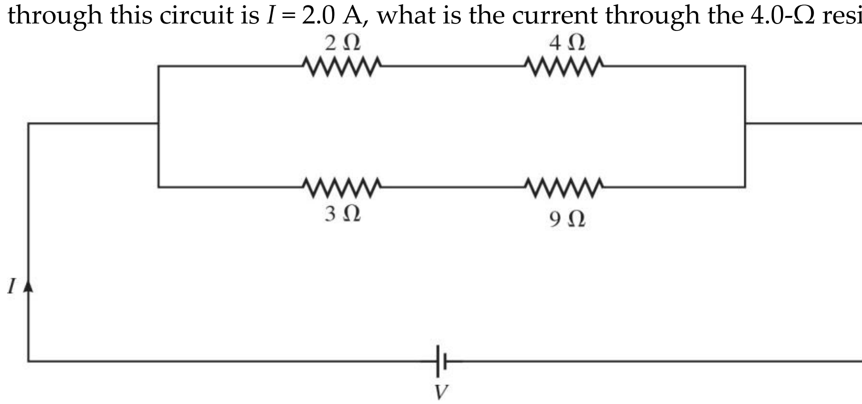
336) Four resistors are connected across an ideal dc battery with voltage V, as shown in the figure. If the total current in this circuit is $I = 1$ A, what is the value of the voltage V?

336)



A) 10 V B) 2 V C) 4 V D) 8 V E) 6 V

337) Four resistors are connected across an ideal dc battery with voltage V as shown in the figure. Assume that all quantities shown are accurate to two significant figures. If the total current through this circuit is $I = 2.0$ A, what is the current through the 4.0-Ω resistor? 337) ______

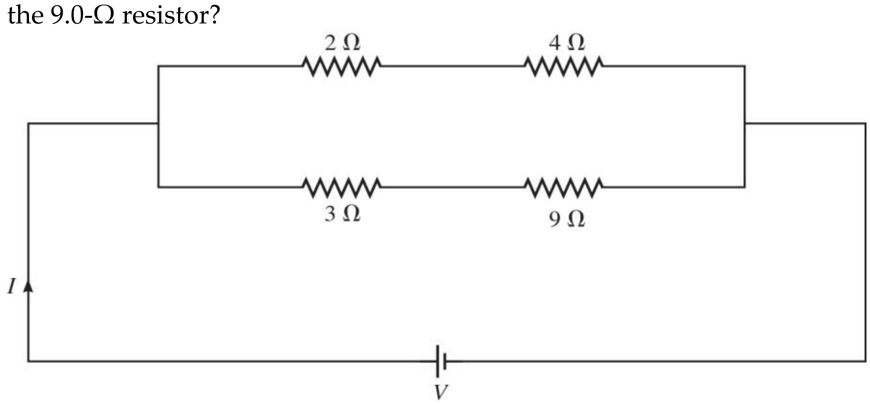


A) 2.4 A B) 1.0 A C) 2.0 A D) 3.0 A E) 1.3 A

338) An ideal 100-V dc battery is applied across a series combination of four resistors having resistances of 20 Ω, 40 Ω, 60 Ω, and 80 Ω. What is the potential difference across the 40-Ω resistor? 338) ______

A) 100 V B) 20 V C) 40 V D) 60 V E) 80 V

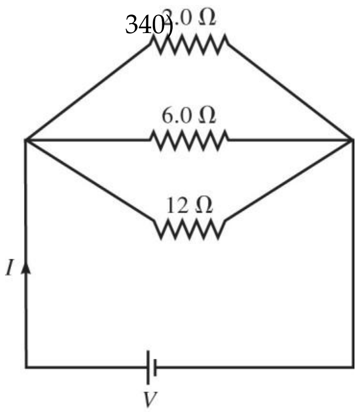
339) Four resistors are connected across an ideal dc source of $V = 8.0$ V, as shown in the figure. Assume all resistances shown are accurate to two significant figures. What is the current through the 9.0-Ω resistor? 339) ______



A) 2.0 A B) 1.0 A C) 0.67 A D) 0.90 A E) 0.50 A

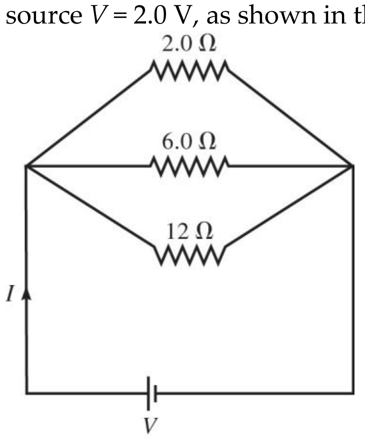
340) Three resistors with resistances of 2.0 Ω, 6.0 Ω, and 12 Ω are connected across an ideal dc voltage source V as shown in the figure. If the total current through the circuit is $I = 2.0$ A, what is the applied voltage V?

340)



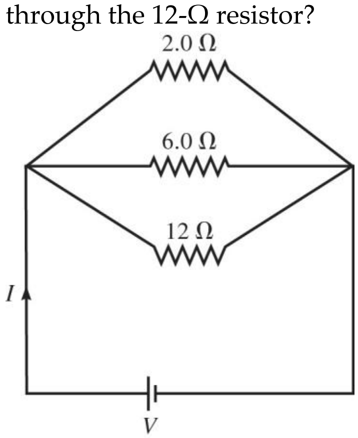
A) 2.0 V B) 2.7 V C) 3.0 V D) 1.5 V E) 6.0 V

341) Three resistors with resistances of 2.0 Ω, 6.0 Ω, and 12 Ω are connected across an ideal dc voltage source $V = 2.0$ V, as shown in the figure. What is the total current I in this circuit? 341) ______



A) 0.70 A B) 6.0 A C) 1.5 A D) 3.0 A E) 2.0 A

342) Three resistors with resistances of 2.0 Ω, 6.0 Ω, and 12 Ω are connected across an ideal dc voltage source V, as shown in the figure. If the total current in the circuit is $I = 5.0$ A, what is the current through the 12-Ω resistor? 342) ______

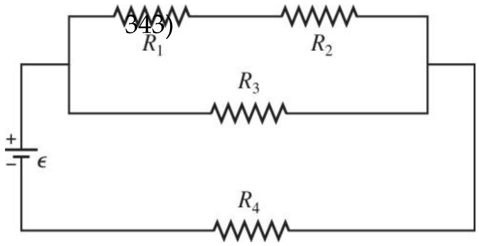


A) 0.56 A B) 2.5 A C) 1.7 A D) 0.75 A E) 5.0 A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

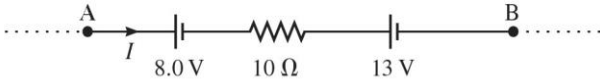
343) For the circuit shown in the figure, the ideal battery has an emf ε = 20 V. The four resistors have resistances of $R_1 = 13\,\Omega,\ R_2 = 16\,\Omega,\ R_3 = 20\,\Omega,$ and $R_4 = 13\,\Omega.$ Calculate the rate at which heat is being generated in the resistor R_4.

343)



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

344) A portion of a circuit is shown in the figure, and the batteries are ideal. What is the potential difference $V_A - V_B$ if $I = 5.0$ A? 344) ______

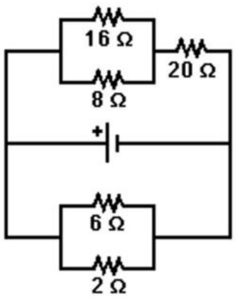


A) 45 V B) 71 V C) 55 V D) 35 V E) 63 V

345) An ideal 10.0-V dc is connected across a 220.0−Ω, resistor in series with an 340.0−Ω resistor. What is the potential drop across the 220.0 Ω resistor? 345) ______

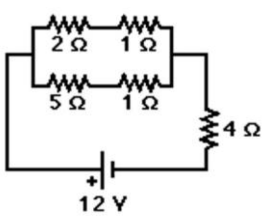
A) 6.5 V B) 6.1 V C) 3.9 V D) 15 V

346) For the circuit shown in the figure, the current in the 8.0-Ω resistor is 0.50A. What is the current in the 2.0-Ω resistor? All the numbers shown are accurate to two significant figures. 346) ______



A) 0.75 A B) 4.5 A C) 6.4 A D) 9.5 A E) 2.25 A

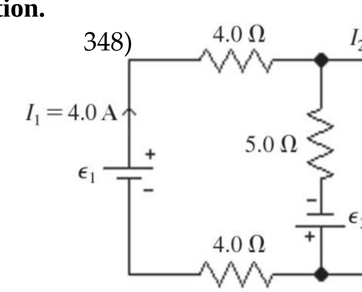
347) For the circuit shown in the figure, what is the power dissipated in the 2.0-Ω resistor? All the numbers shown are accurate to three significant figures. 347) ______



A) 6.67 W B) 8.00 W C) 2.67 W D) 3.56 W E) 5.33 W

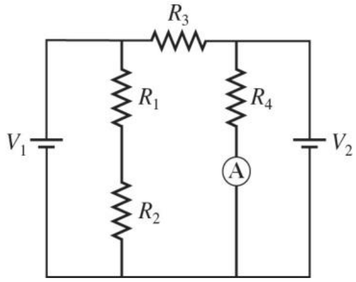
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

348) For the circuit shown in the figure, calculate the emf's ε_1 and ε_3, assuming that the batteries are ideal. Note that two currents are shown. 348)



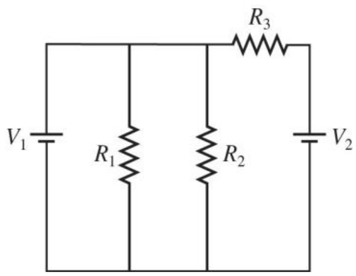
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

349) In the circuit shown in the figure, $R_1 = R_2 = 80.0\ \Omega$, $R_3 = R_4 = 40.0\ \Omega$, $V_1 = 9.0$ V, $V_2 = 2.0$ V, and the batteries are both ideal. What current does the ammeter read? 349) _____



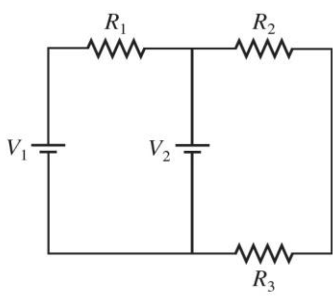
A) 0.050 A B) 0.22 A C) 0.34 A D) 0.18 A

350) In the circuit shown in the figure, $R_1 = 60\ \Omega$, $R_2 = 120\ \Omega$, $R_3 = 180\ \Omega$, $V_1 = 3.0$ V, $V_2 = 6.0$ V, and the batteries are both ideal. What is the current through R_1? 350) _____



A) 0.050 A B) 0.030 A C) 2.68 A D) 0.00 A

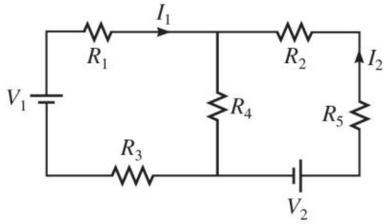
351) In the circuit shown in the figure, $R_1 = 10\ \Omega$, $R_2 = 12\ \Omega$, $R_3 = 20\ \Omega$, $V_1 = 1.0$ V, $V_2 = 7.0$ V, and the batteries are both ideal. What is the current through R_1? 351) _____



A) 0.60 A B) 0.18 A C) 0.13 A D) 0.80 A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

352) For the circuit shown in the figure, $R_1 = 18\ \Omega$, $R_2 = 44\ \Omega$, $R_3 = 33\ \Omega$, $R_4 = 14\ \Omega$, $R_5 = 12\ \Omega$, $V_1 = 18$ V, $V_2 = 12$ V, and the batteries are ideal. Determine I_1 and I_2. 352) ____________

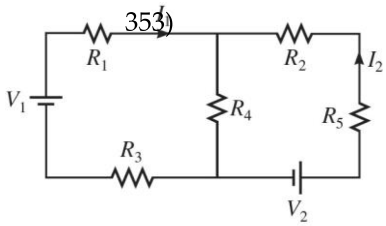


353) For the circuit shown in the figure, $R_1 = 50\ \Omega$, $R_2 = 20\ \Omega$, $R_3 = 35\ \Omega$, $R_4 = 10\ \Omega$, $R_5 = 68\ \Omega$, $I_1 = 0.111$ A, $I_2 = 0.142$ A, and the batteries are ideal.

(a) Determine V_1 and V_2.

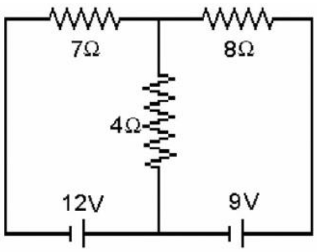
(b) What is the potential difference across R_4?

353)



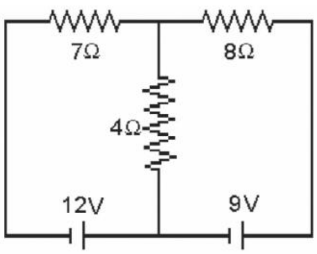
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

354) Determine the current in the 7.0-Ω resistor for the circuit shown in the figure. Assume that the batteries are ideal and that all numbers are accurate to two significant figures. 354) ______



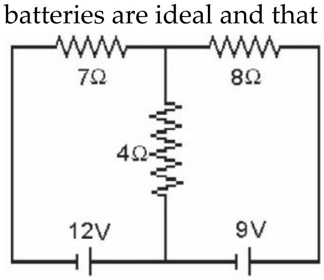
A) 0.28 A B) 1.6 A C) 1.3 A D) 2.1 A

355) Determine the current in the 8.0-Ω resistor for the circuit shown in the figure. Assume that the batteries are ideal and that all numbers are accurate to two significant figures. 355) ______



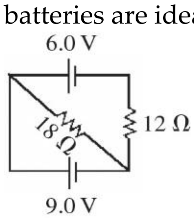
A) 2.1 A B) 0.28 A C) 1.3 A D) 1.6 A

356) Determine the current in the 4.0-Ω resistor for the circuit shown in the figure. Assume that the batteries are ideal and that all numbers are accurate to two significant figures. 356) ______



A) 1.3 A B) 0.28 A C) 1.6 A D) 2.1 A

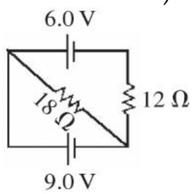
357) Determine the current in the 12-Ω resistor for the circuit shown in the figure assuming that the batteries are ideal. 357) ______



A) 0.50 A B) 0.75 A C) 1.0 A D) 0.25 A

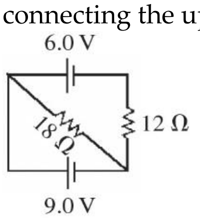
358) Determine the current in the 18-Ω resistor for the circuit shown in the figure assuming that the batte ries

are ideal. 358)



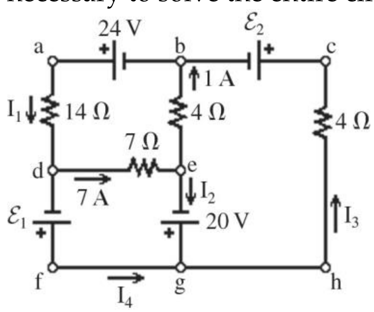
A) 0.75 A B) 0.50 A C) 1.0 A D) 0.25 A

359) For the circuit shown in the figure, both batteries are ideal. What current flows in the solid wire connecting the upper left and lower left corners of the circuit? 359) ______



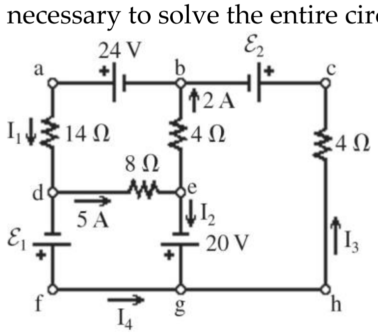
A) 0.75 A B) 0.50 A C) 0.25 A D) 1.0 A

360) A multiloop circuit is shown in the figure. Find the current I_1 if the batteries are ideal. (It is not necessary to solve the entire circuit.) 360) ______



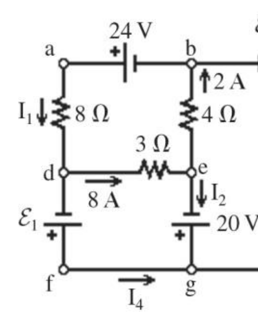
A) 2 A B) 6 A C) -2 A D) -5 A E) 0 A

361) A multiloop circuit is shown in the figure. Find the current I_2 if the batteries are ideal. (It is not necessary to solve the entire circuit.) 361) ______



A) -3 A B) 7 A C) -7 A D) 3 A E) 0 A

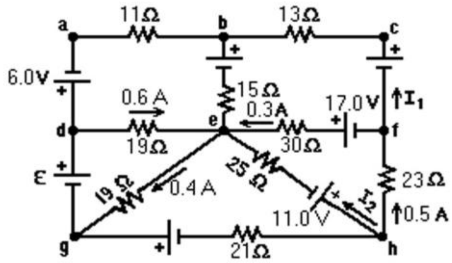
362) A multiloop circuit is shown in the figure. Find the emf ε_1 if the batteries are ideal. (It is not necessary to solve the entire circuit.)



362) ______

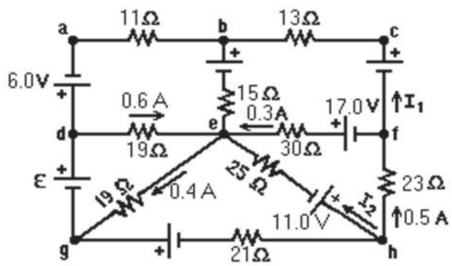
A) 44 V B) -52 V C) 52 V D) -4 V E) 4 V

363) A multiloop circuit is shown in the figure, but some quantities are not labeled. Find the emf ε if the batteries are ideal. (It is not necessary to solve the entire circuit.) 363) ______



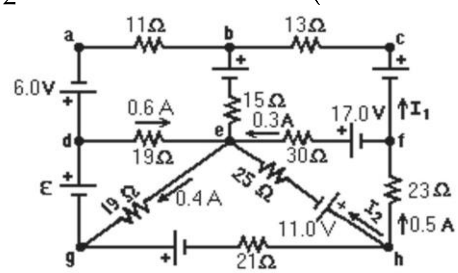
A) +3 V B) -3 V C) +19 V D) -10 V E) -19 V

364) A multiloop circuit is shown in the figure, but some quantities are not labeled. Find the current I_1 if the batteries are ideal. (It is not necessary to solve the entire circuit.) 364) ______



A) 0 A B) -0.4 A C) +0.2 A D) +0.4 A E) -0.2 A

365) A multiloop circuit is shown in the figure, but some quantities are not labeled. Find the current I_2 if the batteries are ideal. (It is not necessary to solve the entire circuit.) 365) ______



A) -0.1 A B) +0.3 A C) +0.1 A D) -0.3 A E) +0.5 A

366) A 4.0-μF uncharged capacitor is connected in series with a 2.0-kΩ resistor, an ideal 20-V dc source, and an open switch. If the switch is closed at time t = 0.0 s, what is the charge on the capacitor at t = 9.0 ms? 366) ______

A) 0 C
B) 96% of the maximum charge
C) 37% of the minimum charge
D) 68% of the minimum charge
E) 68% of the maximum charge

367) A 2.0-μF capacitor that is initially uncharged is charged through a 50-kΩ resistor. How long does it take for the capacitor to reach 90% of its full charge? 367) ______

A) 2.2 s B) 0.90 s C) 0.23 s D) 2.3 s

368) A fully charged 37-μF capacitor is discharged through a 1.0-kΩ resistor. If the voltage across the capa citor is

reduced to 7.6 volts after just 20 ms, what was the original potential across the capacitor? 368) ______

A) 8.0 V B) 16 V C) 9.0 V D) 11 V E) 13 V

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

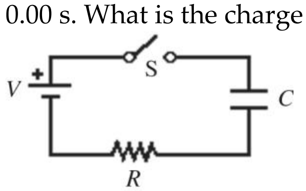
369) When an initially uncharged capacitor is charged through a 25-kΩ resistor by a 75-V dc ideal power source, it takes 0.23 ms for the capacitor to reach 50% of its maximum charge? What is the capacitance of this capacitor? 369) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

370) A 2.0-μF capacitor is charged to 12 V and then discharged through a 4.0-MΩ resistor. How long will it take for the voltage across the capacitor to drop to 3.0 V? 370) ______

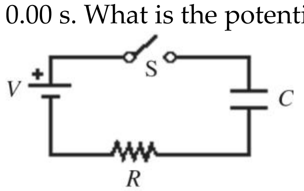
A) 11 s B) 22 s C) 24 s D) 8.0 s

371) For the circuit shown in the figure, V = 30 V, C = 60 μF, R = 0.40 MΩ, and the battery is ideal. Initially the switch S is open and the capacitor is uncharged. The switch is then closed at time t = 0.00 s. What is the charge on the capacitor 8.0 s after closing the switch? 371) ______



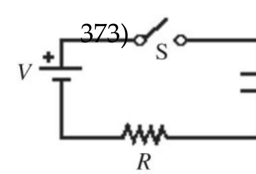
A) 410 μC B) 510 μC C) 710 μC D) 820 μC E) 610 μC

372) For the circuit shown in the figure, V = 60 V, C = 60 μF, R = 0.60 MΩ, and the battery is ideal. Initially the switch S is open and the capacitor is uncharged. The switch is then closed at time t = 0.00 s. What is the potential difference across the resistor 20 s after closing the switch? 372) ______



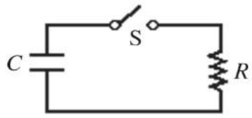
A) 55 V B) 41 V C) 48 V D) 62 V E) 34 V

373) For the circuit shown in the figure, V = 20 V, C = 90 μF, R = 0.80 MΩ, and the battery is ideal. Initially the switch S is open and the capacitor is uncharged. The switch is then closed at time t = 0.00 s. At a given instant after closing the switch, the potential difference across the capacitor is twice the potential difference across the resistor. At that instant, what is the charge on the capacitor? 373)



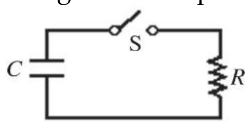
A) 900 μC B) 1000 μC C) 1200 μC D) 670 μC E) 450 μC

374) For the circuit shown in the figure, $C = 12$ μF and $R = 8.5$ MΩ. Initially the switch S is open with the capacitor charged to a voltage of 80 V. The switch is then closed at time $t = 0.00$ s. What is the charge on the capacitor, when the current in the circuit is 3.3 μA? 374) ______



A) 620 μC B) 480 μC C) 700 μC D) 350 μC E) 340 μC

375) For the circuit shown in the figure, $C = 77$ μF and $R = 5.4$ MΩ. Initially the switch S is open with the capacitor charged to a voltage of 80 V. The switch is then closed at time $t = 0.00$ s. What is the charge on the capacitor 40 s after closing the switch? 375) ______



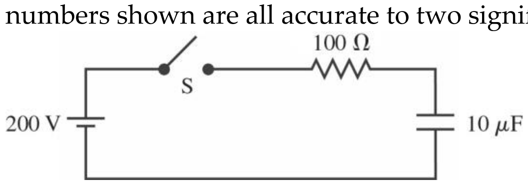
A) 11,000 μC B) 10,000 μC C) 14,000 μC D) 13,000 μC E) 12,000 μC

376) A 1.0-μF capacitor is charged until it acquires a potential difference of 200.0 V across its plates, and then the emf source is removed. If the capacitor is then discharged through a 100.0-kΩ resistance, what is the voltage drop across the capacitor 7.0 ms after beginning the discharge? 376) ______

A) 14 V B) 210 V C) -15 V D) 190 V

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

377) The capacitor shown in the circuit in the figure is initially uncharged when the switch S is suddenly closed, and the battery is ideal. After one time constant has gone by, find (a) the current through the resistor and (b) the charge on the capacitor. Assume that the numbers shown are all accurate to two significant figures. 377) ______



378) A circuit contains a 2.0-MΩ resistor in series with an uncharged capacitor. When this combination is connected across an ideal battery, the capacitor reaches 25% of its maximum charge in 1.5 s. What is its capacitance? 378) ______

379) A series circuit consists of a 2.5-μF capacitor, a 7.6-MΩ resistor, and an ideal 6.0-V dc power source. 379) ______

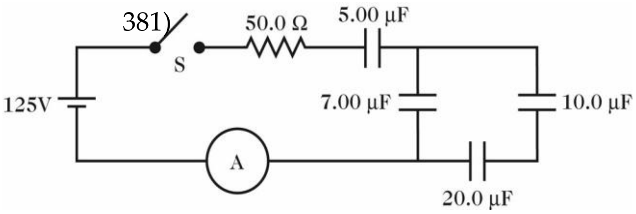
(a) What is the time constant for charging the capacitor?

(b) What is the potential difference across the capacitor 25 s after charging begins?

380) A resistor with a resistance of 360 Ω is in a series circuit with a capacitor of capacitance 7.3×10^{-6} F. What capacitance must be placed in parallel with the original capacitance to change the capacitive time constant of the combination to three times its original value? 380) ______

381) In the circuit shown in the figure, all the capacitors are initially uncharged when the switch S is suddenly closed, and the battery is ideal. Find (a) the maximum reading of the ammeter and (b) the maximum charge on the 5.00-μF capacitor.

381)



______
______
______

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

382) A galvanometer has an internal resistance of 100 Ω and deflects full-scale at 2.00 mA. What size resistor should be added to it to convert it to a milliammeter capable of reading up to 4.00 mA? 382) ______

A) 100 Ω in series
B) 50.0 Ω in parallel
C) 100 Ω in parallel
D) 50.0 Ω in series

383) A galvanometer has a coil with a resistance of 24.0 Ω, and a current of 180 μA causes full-scale deflection. If the galvanometer is to be used to construct an ammeter that deflects full scale for 10.0 A, what shunt resistor is required? 383) ______

A) 423 μΩ
B) 234 μΩ
C) 342 μΩ
D) 432 μΩ

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

384) A galvanometer that gives a full-scale deflection when 150 μA runs through it is used to make an ammeter that reads a maximum of 1.00 A. To do this, a 3.3-mΩ shunt was required. What is the resistance of just the galvanometer? 384) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

385) A galvanometer has an internal resistance of 100 Ω and deflects full-scale at 2.00 mA. What size resistor should be added to it to convert it to a millivoltmeter capable of reading up to 400 mV? 385) ______

A) 100 Ω in series
B) 50.0 Ω in series
C) 50.0 Ω in parallel
D) 100 Ω in parallel

386) A galvanometer with a coil resistance of 40.0 Ω deflects full scale for a current of 2.0 mA. What series resistance should be used with this galvanometer in order to construct a voltmeter that deflects full scale for 50 V? 386) ______

A) 29 kΩ
B) 27 kΩ
C) 31 kΩ
D) 25 kΩ

387) A galvanometer with a coil resistance of 80 Ω deflects full-scale for a current of 2.0 mA. What series resistance is required to convert it to a voltmeter reading full scale for 200 V. 387) ______

A) 100 mΩ
B) 100 kΩ
C) 13 MΩ
D) 0.80 mΩ
E) 250 kΩ

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

388) You have available a galvanometer that gives a full-scale deflection for a 333-μA current and has a coil resistance of 33 Ω. 388) ____________

(a) What shunt resistance is needed to convert this galvanometer to a 5.0-A ammeter?
(b) What series resistance is needed to convert this galvanometer to a 5.0-V voltmeter?

389) A proton moving at 5.0×10^4 m/s horizontally enters a region where a magnetic field of 0.12 T is present, directed vertically downward. What magnitude force acts on the proton due to this field? 389) ____________

($e = 1.60 \times 10^{-19}$ C)

390) A geophysicist measures the magnetic force on a proton that is moving vertically downward at a point 1.996 km/s at the earth's equator. At that location, the earth's magnetic magnetic field is horizontal and has a strength of 0.40×10^{-4} T. What are the mag nitu de and direction of the force she will measure?

($e = 1.60 \times 10^{-19}$ C) 390) ____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

391) An electron moves with a speed of 3.0×10^4 m/s perpendicular to a uniform magnetic field of magnitude 0.40 T. What is the magnitude of the magnetic force on the electron? ($e = 1.60 \times 10^{-19}$ C) 391) ____

A) 5×10^{-20} N
B) 4.8×10^{-14} N
C) zero
D) 1.9×10^{-15} N
E) 2.2×10^{-24} N

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

392) An electron traveling toward the magnetic north with speed 400 km/s enters a region where the earth's magnetic field has the magnitude 5.0×10^{-5} T and is directed downward at 45° below horizontal. What magnitude magnetic force acts on the electron? ($e = 1.60 \times 10^{-19}$ C) 392) ____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

393) A proton travels at a speed of 5.0×10^7 m/s through a 1.0-T magnetic field. What is the magnitude of the magnetic force on the proton if the angle between the proton's velocity and the magnetic field vector is 30°? ($e = 1.60 \times 10^{-19}$ C) 393) ____

A) 2.0×10^{-12} N B) 4.0×10^{-14} N C) 2.0×10^{-14} N D) 4.0×10^{-12} N

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

394) A proton, with mass 1.67×10^{-27} kg and charge $+1.6 \times 10^{-19}$ C, is sent with velocity 6.2×10^4 m/s in the $+x$ direction into a region where there is a uniform electric field of magnitude 740 V/m in the $+y$ direction. What must be the magnitude and direction of the uniform magnetic field in the region if the proton is to pass through undeflected? Assume that the magnetic field has no x component and neglect gravitational effects. 394) ____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

395) A proton is projected with a velocity of 7.0 km/s into a magnetic field of 0.60 T perpendicular to the motion of the proton. What is the magnitude of the magnetic force that acts on the proton? ($e = 1.60 \times 10^{-19}$ C) 395) ____

A) 0 N
B) 3.4×10^{-16} N
C) 6.7×10^{-16} N
D) 4.2×10^{-16} N
E) 13×10^{-16} N

396) A proton moving eastward with a velocity of 5.0 km/s enters a magnetic field of 0.20 T pointing northward. What are the magnitude and direction of the force that the magnetic field exerts on the proton? ($e = 1.60 \times 10^{-19}$ C) 396) ____

A) 1.1×10^{-16} N eastwards
B) 0 N
C) 4.4×10^{-16} N westwards
D) 1.6×10^{-16} N upwards
E) 1.6×10^{-16} N downwards

397) A proton moving with a velocity of 4.0×10^4 m/s enters a magnetic field of 0.20 T. If the angle between the velocity of the proton and the direction of the magnetic field is 60°, what is the magnitude of the magnetic force on the proton? ($e = 1.60 \times 10^{-19}$ C) 397) ______

A) 2.2×10^{-15} N
B) 1.8×10^{-15} N
C) 3.3×10^{-15} N
D) 0.60×10^{-15} N
E) 1.1×10^{-15} N

398) A proton moving with a velocity of 4.0×10^4 m/s along the +*y*-axis enters a magnetic field of 0.20 T directed towards the -*x*-axis. What is the magnitude of the magnetic force acting on the proton? ($e = 1.60 \times 10^{-19}$ C) 398) ______

A) 8.0×10^{-15} N
B) 2.6×10^{-15} N
C) 1.3×10^{-15} N
D) 3.9×10^{-15} N
E) 0 N

399) An electron moves with a speed of 4.0×10^4 m/s perpendicular to a uniform magnetic field of 0.50 T. What is the magnitude of the magnetic force on the electron? ($e = 1.60 \times 10^{-19}$ C) 399) ______

A) 5.1×10^{-14} N
B) 3.2×10^{-15} N
C) 4.4×10^{-24} N
D) 0 N
E) 5×10^{-20} N

400) An electron moves with a speed of 8.0×10^6 m/s along the +*x*-axis. It enters a region where there is a magnetic field of 2.5 T, directed at an angle of 60° to the +*x*-axis and lying in the *xy*-plane. Calculate the magnitude of the magnetic force on the electron. ($e = 1.60 \times 10^{-19}$ C) 400) ______

A) 3.2×10^{-10} N
B) 0 N
C) 2.8×10^{-12} N
D) 2.8×10^{-10} N
E) 3.2×10^{-12} N

401) An electron moves with a speed of 8.0×10^6 m/s along the +*x*-axis. It enters a region where there is a magnetic field of 2.5 T, directed at an angle of 60° to the +*x*-axis and lying in the *xy*-plane. Calculate the magnitude of the acceleration of the electron. ($e = 1.60 \times 10^{-19}$ C, m_{e1} = 9.11×10^{-31} kg) 401) ______

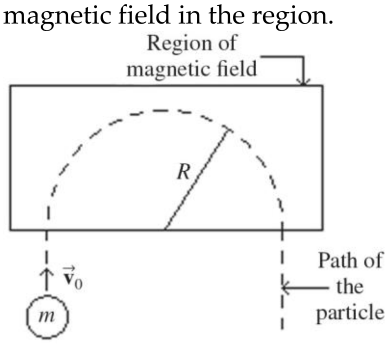
A) 3.0×10^{18} m/s^2
B) 1.3×10^{-18} m/s^2
C) 0 m/s^2
D) 3.0×10^{-18} m/s^2
E) 1.3×10^{18} m/s^2

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

402) A proton is accelerated from rest through 0.50 kV. It then enters a uniform magnetic field of 0.30 T that is oriented perpendicular to its direction of motion. (a) t is the radius Whaof the path the

proton follows in the magnetic field?
(b) How long does it take the proton to make one complete circle in the magnetic field?. 402) ____

403) In the figure, a small particle of charge -4.1 x 10^{-6} C and mass $m = 3.1 \times 10^{-12}$ kg has speed $v_0 = 5.5 \times 10^3$ m/s as it enters a region of uniform magnetic field. The particle is initially traveling perpendicular to the magnetic field and is observed to travel in the semicircular path shown with radius R = 5.0 cm. Find the magnitude and direction of the magnetic field in the region. 403) ____



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

404) A proton having a speed of 3.0×10^6 m/s in a direction perpendicular to a uniform magnetic field moves in a circle of radius 0.20 m within the field. What is the magnitude of the magnetic field? ($e = 1.60 \times 10^{-19}$ C, $m_{proton} = 1.67 \times 10^{-27}$ kg) 404) ____

A) 0.24 T B) 0.080 T C) 0.16 T D) 0.36 T E) 0.32 T

405) An electron moving perpendicular to a uniform magnetic field of 3.2×10^{-2} T moves in a circle of radius 0.40 cm. How fast is this electron moving? ($e = 1.60 \times 10^{-19}$ C, $m_{electron} = 9.11 \times 10^{-31}$kg) 405) ____

A) 1.9×10^6 m/s
B) 0.80×10^7 m/s
C) 2.2×10^7 m/s
D) 1.9×10^7 m/s
E) 3.0×10^7 m/s

406) An electron moving perpendicular to a uniform magnetic field of 0.22 T moves in a circle with a speed of 1.5×10^7 m/s. What is the radius of the circle? ($e = 1.60 \times 10^{-19}$ C, $m_{electron} = 9.11 \times 10^{-31}$kg) 406) ____

A) 2.2 mm B) 0.39 mm C) 1.5 mm D) 0.22 mm E) 3.9 mm

407) An electron is accelerated from rest through a potential difference of 3.75 kV. It enters a region where a uniform 4.0-mT magnetic field is perpendicular to the velocity of the electron. Calculate the radius of the path this electron will follow in the magnetic field. ($e = 1.60 \times 10^{-19}$ C, $m_{electron} = 9.11 \times 10^{-31}$ kg) 407) _____

A) 4.2 cm B) 2.2 cm C) 5.2 cm D) 1.2 cm E) 3.2 cm

408) A doubly charged ion with speed 6.9×10^{6} m/s enters a uniform 0.80-T magnetic field, traveling perpendicular to the field. Once in the field, it moves in a circular arc of radius 30 cm. What is the mass of this ion? ($e = 1.60 \times 10^{-19}$ C) 408) _____

A) 3.3×10^{-27} kg B) 6.7×10^{-27} kg C) 11×10^{-27} kg D) 8.2×10^{-27} kg

409) A proton, starting from rest, accelerates through a potential difference of 1.0 kV and then moves into a magnetic field of 0.040 T at a right angle to the field. What is the radius of the proton's resulting orbit? ($e = 1.60 \times 10^{-19}$ C, $m_{proton} = 1.67 \times 10^{-27}$ kg) 409) _____

A) 0.14 m B) 0.11 m C) 0.080 m D) 0.17 m

410) A charged particle of mass 0.0010 kg is subjected to a 3.0-T magnetic field which acts at a right angle to its motion. If the particle moves in a circle of radius 0.10 m at a speed of 2.0 m/s, what is the magnitude of the charge on the particle? 410) _____

A) 150 C B) 10,000 C C) 0.00010 C D) 0.0067 C

411) Alpha particles, each having a charge of +2*e* and a mass of 6.64×10^{-27} kg, are accelerated in a uniform 0.80-T magnetic field to a final orbit radius of 0.30 m. The field is perpendicular to the velocity of the particles. How long does it take an alpha particle to make one complete circle in the final orbit? ($e = 1.60 \times 10^{-19}$ C) 411) _____

A) 0.33 μs B) 0.25 μs C) 0.49 μs D) 0.15 μs E) 0.40 μs

412) Alpha particles, each having a charge of +2*e* and a mass of 6.64×10^{-27} kg, are accelerated in a uniform 0.50 T magnetic field to a final orbit radius of 0.30 m. The field is perpendicular to the velocity of the particles. What is the kinetic energy of an alpha particle in the final orbit? (1 eV = 1.60×10^{-19} J, $e = 1.60 \times 10^{-19}$ C) 412) _____

A) 0.92 MeV B) 1.4 MeV C) 1.6 MeV D) 1.1 MeV E) 1.2 MeV

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

413) A wire along the *z*-axis carries a current of 2.7 A in the +*z* direction. Find the magnitude and direction of the force exerted on a 3.7-cm long length of this wire by a uniform magnetic field pointing in the -*x* direction having a magnitude 0.66 T. 413) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

414) A 2.0-m straight wire carrying a current of 0.60 A is oriented parallel to a uniform magnetic field of 0.50 T. What is the magnitude of the magnetic force on it? 414) _____

A) 0.15 N B) zero C) 0.60 N D) 0.30 N

415) A straight wire carries a current of 10 A at an angle of 30° with respect to the direction of a uniform 0.30-T magnetic field. Find the magnitude of the magnetic force on a 0.50-m length of the wire. 415) _____

A) 6.0 N B) 3.0 N C) 0.75 N D) 1.5 N

416) What is the force per meter on a straight wire carrying 5.0 A when it is placed in a magnetic field of 0.020

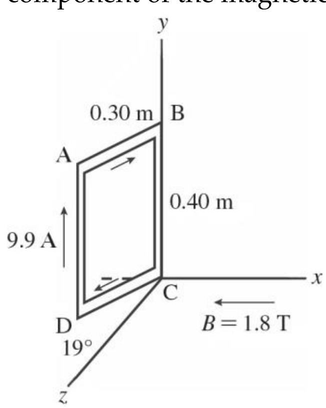
T so that the wire makes an angle of 27° with respect to the magnetic field lines. 416) ______

A) 0.17 N/m B) 0.26 N/m C) 0.045 N/m D) 0.022 N/m

417) A thin copper rod 1.0 m long has a mass of 0.050 kg and is in a magnetic field of 0.10 T. What minimum current in the rod is needed in order for the magnetic force to balance the weight of the rod? 417) ______

A) 1.2 A B) 2.5 A C) 9.8 A D) 4.9 A

418) A rigid rectangular loop, measuring 0.30 m by 0.40 m, carries a current of 9.9 A, as shown in the figure. A uniform external magnetic field of magnitude 1.8 T in the -*x* direction is present. Segment CD is in the *xz*-plane and forms a 19° angle with the *z*-axis, as shown. What is the *y* component of the magnetic force on segment AB of the loop? 418) ______



A) +1.7 N B) 0.0 N C) -1.7 N D) -5.1 N E) +5.1 N

419) A straight wire that is 0.60 m and carrying a current of 2.0 A is placed at an angle with respect to the magnetic field of strength 0.30 T. If the wire experiences a force of magnitude 0.18 N, what angle does the wire make with respect to the magnetic field? 419) ______

A) 30° B) 35° C) 25° D) 20° E) 60°

420) A straight wire is carrying a current of 2.0 A. It is placed at an angle of 60° with respect to a magnetic field of strength 0.20 T. If the wire experiences a force of 0.40 N, what is the length of the wire? 420) ______

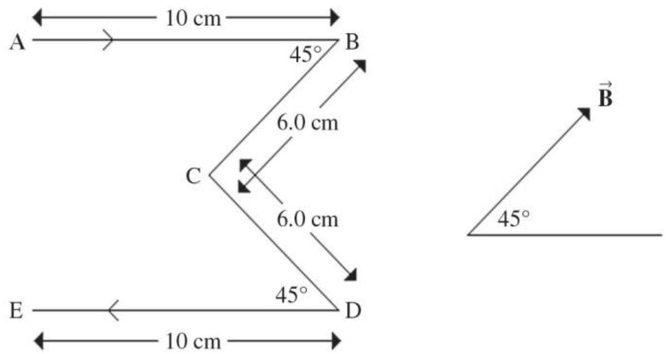
A) 1.8 m B) 1.6 m C) 1.4 m D) 1.0 m E) 1.2 m

421) A straight 1.0-m long wire is carrying a current. The wire is placed perpendicular to a magnetic field of strength 0.20 T. If the wire experiences a force of 0.60 N, what is the current in the wire? 421) ______

A) 4.0 A B) 3.0 A C) 2.0 A D) 5.0 A E) 1.0 A

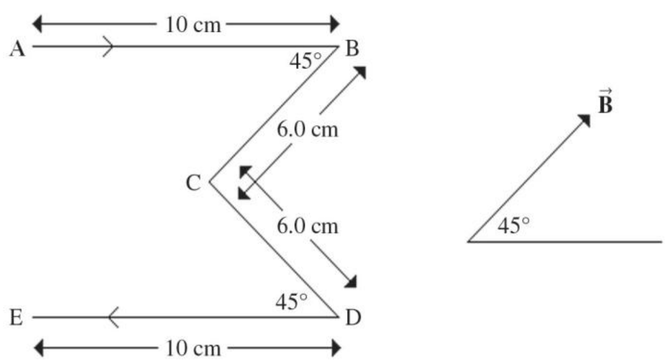
422) A wire in the shape of an "M" lies in the plane of the paper. It carries a current of 2.0 A, flowing from A to E, as shown in the figure. It is placed in a uniform magnetic field of 0.75 T in the same plane, directed as shown on the right side of the figure. The figure indicates the dimensions of the wire. Note that AB is parallel to DE and to the baseline from which the magnetic field direction is measured. What are the

magnitude and direction of the force acting on section AB of this wire? 422) ______



A) 0.11 N perpendicular out of the page
B) 0.11 N perpendicular into the page
C) 0.20 N perpendicular into the page
D) 0.20 N perpendicular out of the page
E) 0.40 N perpendicular out of the page

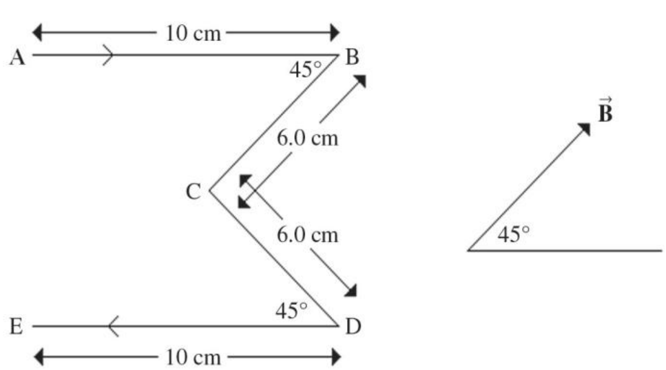
423) A wire in the shape of an "M" lies in the plane of the paper. It carries a current of 2.0 A, flowing from A to E, as shown in the figure. It is placed in a uniform magnetic field of 0.65 T in the same plane, directed as shown on the right side of the figure. The figure indicates the dimensions of the wire. Note that AB is parallel to DE and to the baseline from which the magnetic field direction is measured. What are the magnitude and direction of the force acting on section BC of this wire? 423) ______



A) 0 N
B) 0.090 N perpendicular into the page
C) 0.060 N perpendicular out of the page
D) 0.090 N perpendicular out of the page
E) none of the above

424) A wire in the shape of an "M" lies in the plane of the paper. It carries a current of 2.0 A, flowing from A to E, as shown in the figure. It is placed in a uniform magnetic field of 0.55 T in the same plane, directed as

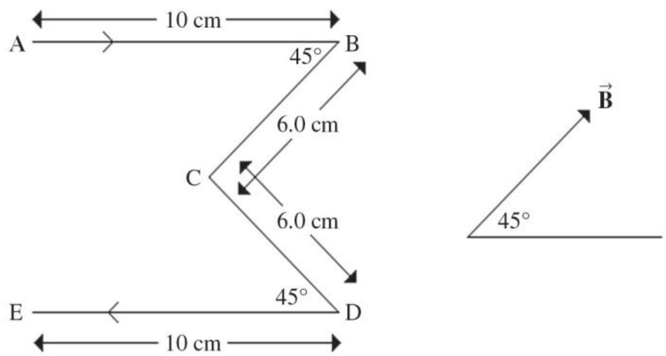
shown on the right side of the figure. The figure indicates the dimensions of the wire. Note that AB is parallel to DE and to the baseline from which the magnetic field direction is measured. What are the magnitude and direction of the force acting on section CD of this wire? 424)



A) 0.40 N perpendicular out of the page

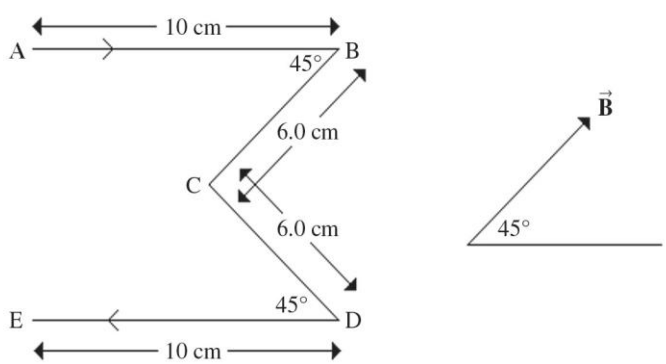
B) 0.20 N perpendicular out of the page
C) 0.40 N perpendicular into the page
D) 0.066 N perpendicular into the page
E) 0.066 N perpendicular out of the page

425) A wire in the shape of an "M" lies in the plane of the paper. It carries a current of 2.0 A, flowing from A to E, as shown in the figure. It is placed in a uniform magnetic field of 0.75 T in the same plane, directed as shown on the right side of the figure. The figure indicates the dimensions of the wire. Note that AB is parallel to DE and to the baseline from which the magnetic field direction is measured. What are the magnitude and direction of the force acting on section DE of this wire? 425) ______



A) 0.20 N perpendicular out of the page
B) 0.11 N perpendicular into the page
C) 0.30 N perpendicular out of the page
D) 0.30 N perpendicular into the page
E) 0.11 N perpendicular out of the page

426) A wire in the shape of an "M" lies in the plane of the paper. It carries a current of 2.0 A, flowing from A to E. It is placed in a uniform magnetic field of 0.65 T in the same plane, directed as shown on the right side of the figure. The figure indicates the dimensions of the wire. Note that AB is parallel to DE and to the baseline from which the magnetic field direction is measured. What are the magnitude and direction of the net force acting on this wire? 426) ______



A) 0.40 N perpendicular out of the page
B) 0.20 N perpendicular out of the page
C) 0.080 N perpendicular into the page
D) 0.40 N perpendicular into the page
E) 0.080 N perpendicular out of the page

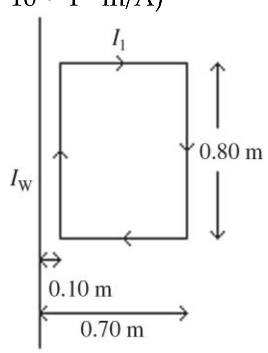
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

427) Two long parallel wires separated by 15 cm each carry 10 A in opposite directions. ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) (a) Wha t magnetic force per

length acts on each of the wires? Is it attractive or repulsive?
(b) Find the magnitude of the magnetic field midway between the two wires.

427) ____
____
____

428) In the figure, a rectangular current loop is carrying current I_1 = 8.0 A, in the direction indicated, near a long wire carrying a current I_W. The long wire is parallel to the sides of the rectangle. The rectangle loop has length 0.80 m and its sides are 0.10 m and 0.70 m from the wire. If the net force on the loop is to have magnitude 5.5×10^{-6} N and is to be directed towards the wire, what must be the magnitude and direction (from top to bottom or from bottom to top in the sketch) of the current I_W in the wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 428) ____



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

429) Two parallel straight wires are 7.0 cm apart and 50 m long. Each one carries a 18-A current in the same direction. One wire is securely anchored, and the other is attached in the center to a movable cart. If the force needed to move the wire when it is not attached to the cart is negligible, with what magnitude force does the wire pull on the cart? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 429) ____

A) 37 mN B) 66 mN C) 93 mN D) 46 mN

430) Two long parallel wires that are 0.30 m apart carry currents of 5.0 A and 8.0 A in the opposite direction. Find the magnitude of the force per unit length that each wire exerts on the other wire and indicate if the force is attractive or repulsive. ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 430) ____

A) 3.4×10^{-5} N attractive
B) 2.7×10^{-5} N attractive
C) 2.7×10^{-5} N repulsive

D) 7.2×10^{-5} N attractive
E) 7.2×10^{-5} N repulsive

431) Two long parallel wires are 0.400 m apart and carry currents of 4.00 A and 6.00 A. What is the magnitude of the force per unit length that each wire exerts on the other wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 431) _____

A) 16.0 μN/m B) 5.00 μN/m C) 2.00 μN/m D) 38.0 μN/m E) 12.0 μN/m

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

432) A flat circular coil has 250 identical loops of very thin wire. Each loop has an area of 0.12 m^2 and carries 15 mA of current. This coil is placed in a magnetic field of 0.050 T oriented at 30° to the plane of the loop. What is the magnitude of the magnetic moment of the coil? 432) _____________

433) A flat coil containing 25 identical loops carries 6.4 A of current. When it is placed in a uniform magnetic field of 0.22 T that is oriented parallel to the plane of the coil, the magnetic torque on it is 3.7 N · m. 433) _____________
(a) What is the magnetic moment of the coil?
(b) What is the area of each loop?

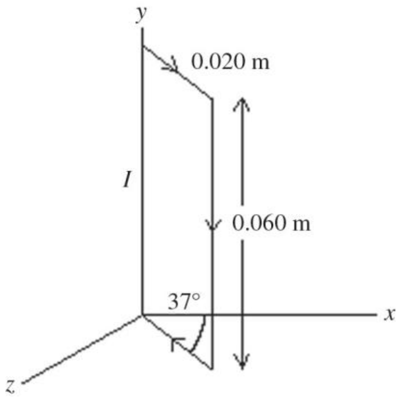
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

434) What is the magnetic moment of a rectangular loop having 120 turns that carries 6.0 A if its dimensions are 4.0 cm × 8.0 cm? 434) _____

A) 0.23 A · m^2 B) 23 A · m^2 C) 2.3 A · m^2 D) 230 A · m^2

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

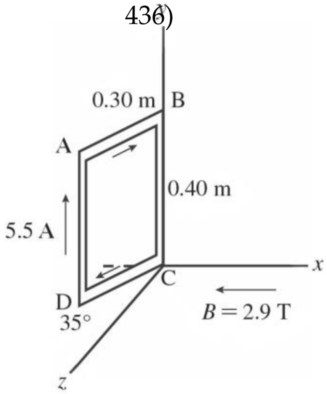
435) In the figure, the rectangular loop is pivoted about one side (of length 0.060 m), that coincides with the *y*-axis. The end (length 0.020 m) of the loop that lies in the *xz*-plane makes an angle of 37° with the *x*-axis as shown. The loop carries a current of I = 69 A in the direction shown. (In the side of the loop that is along the *y*-axis the current is in the +*y* direction.) If there is a uniform magnetic field of magnitude 9.7 T in the -*x* direction, find the magnitude of the torque that this magnetic field exerts on the loop. 435) _____________



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

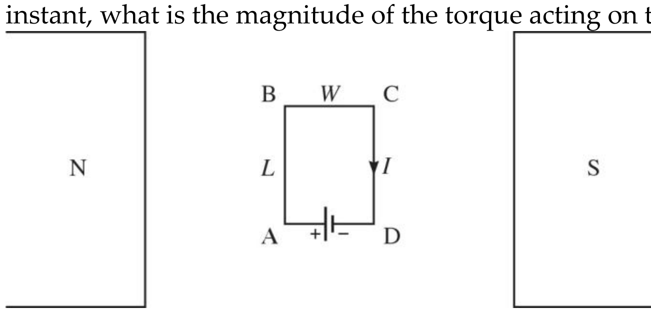
436) A rigid rectangular loop, measuring 0.30 m by 0.40 m, carries a current of 5.5 A, as shown in the figure. A uniform external magnetic field of magnitude 2.9 T in the -*x* direction is present. Segment CD is in the *xz*-plane and forms a 35° angle with the *z*-axis, as shown. What is the magnitude of the torque that the magnetic field exerts on the loop?

436)



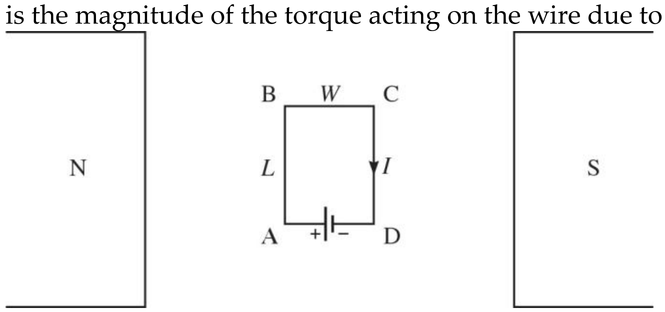
A) 1.4 N · m B) 0.73 N · m C) 1.6 N · m D) 1.1 N · m E) 1.3 N · m

437) A flat rectangular loop of wire is placed between the poles of a magnet, as shown in the figure. It has dimensions $w = 0.60$ m and $L = 1.0$ m, and carries a current $I = 2.0$ A in the direction shown. The magnetic field due to the magnet is uniform and of magnitude 0.80 T. The loop rotates in the magnetic field and at one point the plane of the loop makes a 30° angle with the field. At that instant, what is the magnitude of the torque acting on the wire due to the magnetic field? 437) ______



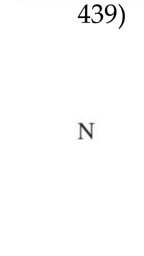
A) 0.40 N · m B) 0.30 N · m C) 0.96 N · m D) 0.83 N · m E) 0.48 N · m

438) A flat rectangular loop of wire is placed between the poles of a magnet, as shown in the figure. It has dimensions $w = 0.60$ m and $L = 1.0$ m, and carries a current $I = 2.0$ A in the direction shown. The magnetic field due to the magnet is uniform and of magnitude 0.80 T. The loop rotates in the magnetic field and at one point the plane of the loop is parallel to the field. At that instant, what is the magnitude of the torque acting on the wire due to the magnetic field? 438) ______



A) 0.83 N · m B) 0.48 N · m C) 0.96 N · m D) 0.00 N · m E) 0.40 N · m

439) A flat rectangular loop of wire is placed between the poles of a magnet, as shown in the figure. It has dimensions $w = 0.60$ m and $L = 1.0$ m, and carries a current $I = 2.0$ A in the direction shown. The magnetic field due to the magnet is uniform and of magnitude 0.80 T. The loop rotates in the magnetic field and at one point the plane of the loop is perpendicular to the field. At that instant, what is the magnitude of the torque acting on the wire due to the magnetic field? 439)



A) 0.83 N · m B) 0.48 N · m C) 0.96 N · m D) 0.00 N · m E) 0.40 N · m

440) A flat circular coil of wire having 200 turns and diameter 2.0 cm carries a current of 4.0 A. It is placed in a magnetic field of 0.80 T with the plane of the coil making an angle of 30° with the magnetic field. What is the magnitude of the magnetic torque on the coil? 440) _____

A) 0.087 N · m
B) 0.46 N · m
C) 0.10 N · m
D) 0.33 N · m
E) 0.17 N · m

441) A flat circular coil has 200 identical loops of very thin wire. Each loop has an area of 0.12 m^2 and carries 0.50 A of current. This coil is placed in a magnetic field of 0.050 T oriented at 30° to the plane of the loop. What is the magnitude of the magnetic torque on the coil? 441) _____

A) 0.52 N · m B) 5.2 N · m C) 2.5 N · m D) 0.25 N · m

442) A flat circular loop carrying a current of 2.0 A is in a magnetic field of 3.5 T. The loop has an area of 0.12 m^2 and its plane is oriented at a 37° angle to the field. What is the magnitude of the magnetic torque on the loop? 442) _____

A) 46 N · m B) 0.51 N · m C) 0.67 N · m D) 0.10 N · m

443) A flat circular loop of wire is in a uniform magnetic field of 0.30 T. The diameter of the loop is 1.0 m, and a 2.0-A current flows in it. What is the magnitude of the magnetic torque on the loop when the plane of the loop is parallel to the magnetic field? 443) _____

A) 0.00 N · m B) 0.52 N · m C) 0.47 N · m D) 0.41 N · m

444) A flat rectangular loop of wire carrying a 4.0-A current is placed in a uniform 0.60-T magnetic field. The magnitude of the torque acting on this loop when the plane of the loop makes a 30° angle with the field is measured to be 1.1 N · m. What is the area of this loop? 444) _____

A) 0.80 m^2 B) 0.40 m^2 C) 0.20 m^2 D) 0.26 m^2 E) 0.53 m^2

445) A flat circular loop of wire of radius 0.50 m that is carrying a 2.0-A current is in a uniform magnetic field of 0.30 T. What is the magnitude of the magnetic torque on the loop when the plane of its area is perpendicular to the magnetic field? 445) _____

A) 0.52 N · m B) 0.58 N · m C) 0.41 N · m D) 0.00 N · m E) 0.47 N · m

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

446) A flat square coil of wire measures 9.5 cm on each side and contains 175 turns of very thin wire. It carries a current of 6.3 A in a uniform 0.84-T magnetic field. What angle less than 90° should the plane of this coil make with the magnetic field direction so that the magnitude of the magnetic torque on it is 6.5 N · m? 446) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

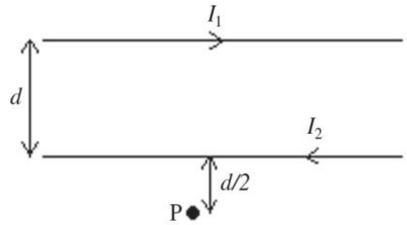
447) A flat circular wire loop of area 0.25 m^2 carries a current of 5.0 A. This coil lies on a horizontal table with the current flowing in the counterclockwise direction when viewed from above. At this point, the earth's magnetic field is 1.2×10^{-5} T directed 60° below the horizontal. What is the magnitude of the torque that the earth's magnetic field exerts on this loop? 447) _____

A) 2.5×10^{-6} N · m B) 1.0×10^{-5} N · m
C) 7.5×10^{-6} N · m D) 5.0×10^{-6} N · m

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

448) At a point 10 m away from a long straight thin wire, the magnetic field due to the wire is 0.10 mT. What current flows through the wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 448) ____________

449) In the figure, the two long straight wires are separated by a distance of $d = 0.60$ m. The currents are I_1 = 3.0 A to the right in the upper wire and I_2 = 8.0 A to the left in the lower wire. What are the magnitude and direction of the magnetic field at point P, that is a distance $d/2 = 0.30$ m below the lower wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 449) ____________



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

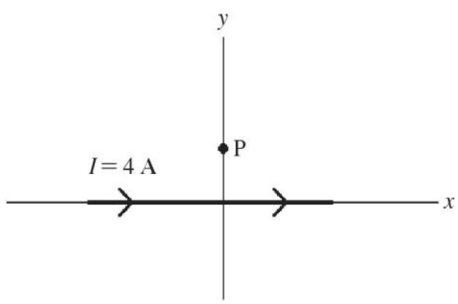
450) A high power line carries a current of 1.0 kA. What is the strength of the magnetic field this line produces at the ground, 10 m away? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 450) _____

A) 6.4 μT B) 4.7 μT C) 56 μT D) 20 μT

451) A long wire carrying a 2.0-A current is placed along the *y*-axis. What is the magnitude of the magnetic field at a point that is 0.60 m from the origin along the *x*-axis? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 451) _____

A) 0.67 μT B) 0.12 μT C) 12 T D) 1.3 μT E) 6.7 T

452) A long straight wire carrying a 4-A current is placed along the *x*-axis as shown in the figure. What is the magnitude of the magnetic field at a point P, located at $y = 2$ cm, due to the current in this wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 452) _____



A) 20 μT B) 50 μT C) 60 μT D) 40 μT E) 30 μT

453) At point P the magnetic field due to a long straight wire carrying a current of 2.0 A is 1.2 μT. How far is P from the wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 453) _____

A) 22 cm B) 55 cm C) 33 cm D) 44 cm E) 11 cm

454) The magnetic field due to the current in a long, straight wire is 8.0 μT at a distance of 4.0 cm from the center of the wire. What is the current in the wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 454) _____

A) 3.2 A B) 0.40 A C) 0.20 A D) 0.80 A E) 1.6 A

455) The magnetic field at point P due to a 2.0-A current flowing in a long, straight, thin wire is 8.0 μT. How far is point P from the wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 455) _____

A) 2.0 cm B) 5.0 cm C) 10 cm D) 4.0 cm E) 2.5 cm

456) The magnitude of the magnetic field that a long and extremely thin current-carrying wire produces at a distance of 3.0 μm from the center of the wire is 2.0×10^{-3} T. How much current is flowing throu

gh the wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)

456) ____

A) 19 mA B) 380 mA C) 190 mA D) 30 mA

457) A very long thin wire produces a magnetic field of 0.0030×10^{-4} T at a distance of 3.0 mm from the wire. What is the magnitude of the current? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 457) ______

A) 2000 mA B) 4.5 mA C) 1.0 mA D) 14,000 mA

458) How much current must flow through a long straight wire for the magnetic field strength to be 1.0 mT at 1.0 cm from a wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 458) ______

A) 50 mA B) 9.2 A C) 5.0 mA D) 16 A E) 50 A

459) At what distance from a long straight wire carrying a current of 5.0 A is the magnitude of the magnetic field due to the wire equal to the strength of Earth's magnetic field of about 5.0×10^{-5} T? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 459) ______

A) 3.0 cm B) 4.0 cm C) 1.0 cm D) 2.0 cm E) 1.0 mm

460) Two long parallel wires that are 0.40 m apart carry currents of 10 A in opposite directions. What is the magnetic field strength in the plane of the wires at a point that is 20 cm from one wire and 60 cm from the other? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 460) ______

A) 33 μT B) 67 μT C) 3.3 μT D) 6.7 μT

461) Two long parallel wires carry currents of 20 A and 5.0 A in opposite directions. The wires are separated by 0.20 m. What is the strength of the magnetic field midway between the two wires? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 461) ______

A) 1.0×10^{-5} T
B) 2.0×10^{-5} T
C) 4.0×10^{-5} T
D) 5.0×10^{-5} T
E) 3.0×10^{-5} T

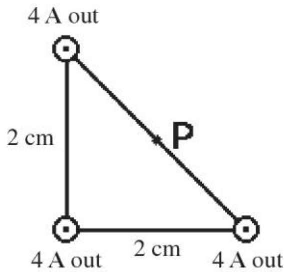
462) Two long parallel wires carry currents of 20 A and 5.0 A in opposite directions. The wires are separated by 20 cm. At what point between the two wires do they produce the same strength magnetic field? 462) ______

A) 18 cm from the 20 A wire
B) 12 cm from the 20 A wire
C) 8.0 cm from the 20 A wire
D) 4.0 cm from the 20 A wire
E) 16 cm from the 20 A wire

463) Three long parallel wires each carry 2.0-A currents in the same direction. The wires are oriented vertically, and they pass through three of the corners of a horizontal square of side 4.0 cm. What is the magnitude of the magnetic field at the fourth (unoccupied) corner of the square due to these wires? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 463) ______

A) 21 μT B) 12 μT C) 2.1 μT D) 0 T E) 1.2 μT

464) Three very long, straight, parallel wires each carry currents of 4.0 A, directed out of the page as shown in the figure. These wires pass through the vertices of a right isosceles triangle as shown. Assume that all the quantities shown in the figure are accurate to two significant figures. What is the magnitude of the magnetic field at point P at the midpoint of the hypotenuse of the triangle? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 464) _____



A) 18 μT B) 57 μT C) 130 μT D) 4.4 μT E) 1.8 μT

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

465) An ideal solenoid having 200 turns and carrying a current of 2.0 A is 25 cm long. What is the magnitude of the magnetic field at the center of the solenoid? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 465) _____________

466) In order to trap the starship Enterprise, the diabolical Klingons build a huge ideal solenoid 10 light-years long with a diameter of 2.0 million kilometers. Every kilometer of length of the solenoid contains 100 turns of wire. What magnetic field strength is produced near the center of the solenoid using a current of 2.00 kA? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 466) _____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

467) An ideal solenoid 20 cm long is wound with 5000 turns of very thin wire. What strength magnetic field is produced at the center of the solenoid when a current of 10 A flows through it? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 467) _____

A) 3.2 T B) 0.31 T C) 0.20 T D) 0.0063 T E) 4.8 T

468) An ideal solenoid having a coil density of 5000 turns per meter is 10 cm long and carries a current of 4.0 A. What is the strength of the magnetic field at its center? 468) _____

A) 3.1 mT B) 25 mT C) 13 mT D) 6.2 mT

469) An ideal solenoid of length 11 cm consists of a wire wrapped tightly around a wooden core. The magnetic field strength is 3.0 T inside the solenoid. If the solenoid is stretched to 21 cm by applying a force to it, what does the magnetic field become? 469) _____

A) 5.7 T B) 3.0 T C) 1.6 T D) 20 T

470) An ideal solenoid that is 34.0 cm long is carrying a current of 2.00 A. If the magnitude of the magnetic field generated at the center of the solenoid is 9.00 mT, how many turns of wire does this solenoid contain? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 470) _____

A) 3180 B) 1220 C) 2320 D) 1590 E) 860

471) How much current must pass through a 400-turn ideal solenoid that is 4.0 cm long to generate a 1.0-T magnetic field at the center? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 471) _____

A) 0.013 A B) 22 A C) 80 A D) 40 A E) 13 A

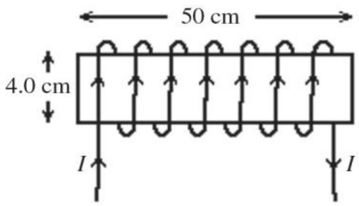
472) How many turns should a 10-cm long ideal solenoid have if it is to generate a 1.5-mT magnetic field when 1.0 A of current runs through it? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 472) _____

A) 1200 B) 15 C) 3200 D) 120 E) 12

473) An ideal solenoid with 400 turns has a radius of 0.040 m and is 40 cm long. If this solenoid carries a current of 12 A, what is the magnitude of the magnetic field at the center of the solenoid? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 473) ______

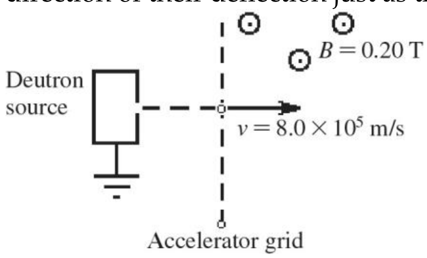
A) 6.0 mT B) 16 mT C) 9.0 mT D) 15 mT E) 4.9 mT

474) An ideal solenoid is wound with 210 turns on a wooden form that is 4.0 cm in diameter and 50 cm long. The windings carry a current in the sense shown in the figure. The current produces a magnetic field of magnitude 4.2 mT, at the center of the solenoid. What is the current *I* in the solenoid windings? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 474) ______



A) 8.0 A B) 7.0 A C) 9.0 A D) 6.0 A E) 10 A

475) The figure shows a mass spectrograph that is operated with deuterons, which have a charge of +*e* and a mass of 3.34×10^{-27} kg. The deuterons emerge with negligible velocity from the source, which is grounded. The speed of the deuterons as they pass through the accelerator grid is 8.0×10^5 m/s. A uniform magnetic field of magnitude *B* = 0.20 T, directed out of the plane, is present to the right of the grid and is perpendicular to the velocity of the deuterons. The deuterons make a circular orbit in the magnetic field. What is the radius of this orbit, and what is the initial direction of their deflection just as they enter the magnetic field? ($e = 1.60 \times 10^{-19}$ C) 475) ______

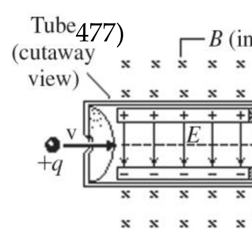


A) 69 mm, downward
B) 84 mm, downward
C) 71 mm, upward
D) 62 mm, downward
E) 62 mm, upward

476) In a mass spectrometer, a single-charged particle has a speed of 1.00×10^6 m/s and enters a uniform magnetic field of 0.200 T at a right angle to the field. The radius of the resulting circular orbit is 20.75 cm. What is the mass of the particle? ($e = 1.60 \times 10^{-19}$ C) 476) ______

A) 6.64×10^{-27} kg B) 1.67×10^{-27} kg C) 3.20×10^{-27} kg D) 9.11×10^{-31} kg

477) The figure shows a velocity selector that can be used to measure the speed of a charged particle. A beam of particles of charge +*q* is directed along the axis of the instrument. A parallel plate capacitor sets up an electric field *E* which is oriented perpendicular to a uniform magnetic field *B*. If the plates are separated by 3.0 mm and the value of the magnetic field is 0.20 T, what potential difference between the plates will allow particles of speed $v = 5.0 \times 10^5$ m/s to pass straight through without deflection? 477)



A) 2800 V B) 290 V C) 5700 V D) 900 V E) 140 V

478) A beam of electrons is accelerated through a potential difference of 1.0 kV before entering a velocity selector. If the magnetic field of the velocity selector has a magnitude of 0.010 T, what magnitude of the electric field is required if the electrons are not to be deflected as they pass through the velocity selector? (($e = 1.60 \times 10^{-19}$ C, $m_{electron} = 9.11 \times 10^{-31}$ kg) 478) _____

A) 6.0×10^{5} V/m
B) 7.2×10^{6} V/m
C) 5.9×10^{3} V/m
D) 1.9×10^{5} V/m
E) 1.1×10^{5} V/m

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

479) A singly-charged ion enters a velocity selector that has a 0.19-T magnetic field perpendicular to an electric field of 1.9 kV/m, with both fields perpendicular to the velocity of the ion. The same magnetic field is then used to deflect the ion into a circular path of radius 14.3 cm. ($e = 1.60 \times 10^{-19}$ C) 479) ____________
(a) What velocity was selected by the velocity selector?
(b) What was the mass of the ion?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

480) A flat circular loop of radius 0.10 m is rotating in a uniform magnetic field of 0.20 T. Find the magnetic flux through the loop when the plane of the loop and the magnetic field vector are parallel. 480) _____

A) 5.5×10^{-3} T · m^2 B) 0 T · m^2
C) 3.1×10^{-3} T · m^2 D) 6.3×10^{-3} T · m^2

481) A flat circular loop of radius 0.10 m is rotating in a uniform magnetic field of 0.20 T. Find the magnetic flux through the loop when the plane of the loop and the magnetic field vector are perpendicular. 481) _____

A) 5.5×10^{-3} T · m^2 B) 3.1×10^{-3} T · m^2
C) 0 T · m^2 D) 6.3×10^{-3} T · m^2

482) A flat circular loop of radius 0.10 m is rotating in a uniform magnetic field of 0.20 T. Find the magnetic flux through the loop when the plane of the loop and the magnetic field vector are at an angle of 30°. 482) _____

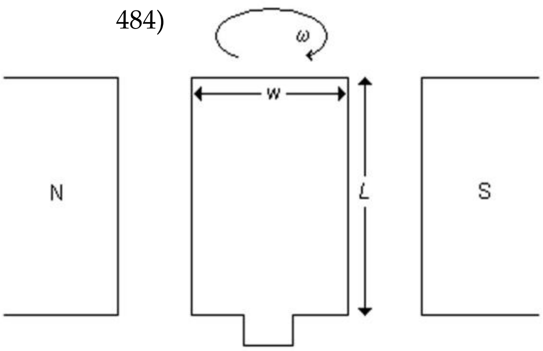
A) 5.5×10^{-3} T · m^2 B) 6.3×10^{-3} T · m^2
C) 3.1×10^{-3} T · m^2 D) 0 T · m^2

483) A 2.00-m long metal wire is formed into a square and placed in the horizontal *xy*-plane. A uniform magnetic field is oriented at 30° above the horizontal with a strength of 0.344 T. What is the magnetic flux through the square due to this field? 483) _____

A) 0.0745 T · m^2 B) 0.0430 T · m^2 C) 0.172 T · m^2 D) 0.298 T · m^2

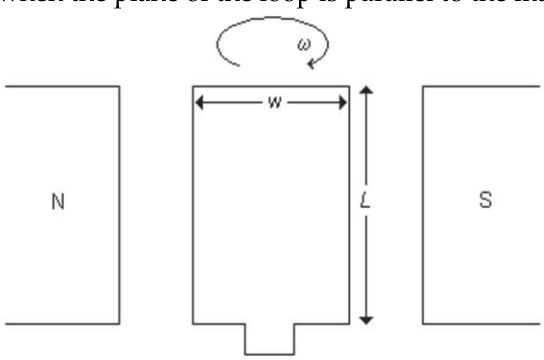
484) A rectangular loop of wire that can rotate about an axis through its center is placed between the poles of a magnet in a magnetic field with a strength of 0.40 T, as shown in the figure. The length of the loop L is 0.16 m and its width w is 0.040 m. What is the magnetic flux through the loop when the plane of the loop is perpendicular to the magnetic field?

484)



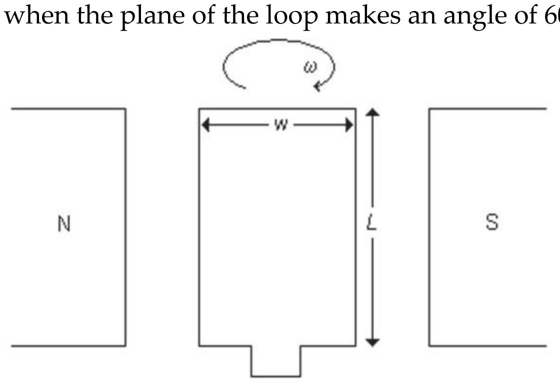
A) 2.6×10^3 T · m^2
B) 2.6×10^{-3} T · m^2
C) 0.80 T · m^2
D) 0 T · m^2
E) 13×10^{-3} T · m^2

485) A rectangular loop of wire that can rotate about an axis through its center is placed between the poles of a magnet in a magnetic field with a strength of 0.40 T, as shown in the figure. The length of the loop L is 0.16 m and its width w is 0.040 m. What is the magnetic flux through the loop when the plane of the loop is parallel to the magnetic field? 485) ______



A) 13×10^{-3} T · m^2
B) 0 T · m^2
C) 2.6×10^3 T · m^2
D) 2.6×10^{-3} T · m^2
E) 0.80 T · m^2

486) A rectangular loop of wire that can rotate about an axis through its center is placed between the poles of a magnet in a magnetic field with a strength of 0.40 T, as shown in the figure. The length of the loop L is 0.16 m and its width w is 0.040 m. What is the magnetic flux through the loop when the plane of the loop makes an angle of 60° with the magnetic field? 486) ______



A) 1.3×10^{-3} T · m^2
B) 0 T · m^2
C) 2.2×10^{-3} T · m^2
D) 0.80 T · m^2
E) 2.6×10^{-3} T · m^2

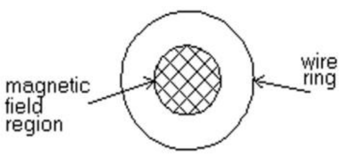
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

487) A flat circular loop having one turn and radius 5.0 cm is positioned with its plane perpendicular to a uniform 0.60-T magnetic field. The area of the loop is suddenly reduced to essentially zero in 0.50 ms. What emf is induced in the loop? 487) ____________

488) A flat coil having 40 turns, each one of cross-sectional area 12.0 cm^2, is oriented with its plane perpendicular to a uniform magnetic field. The field varies steadily from 0.00 T to 1.20 T in 20.0 ms. What emf is induced in the coil during this time? 488) ____________

489) A flat circular coil having 16 turns, each of diameter 20 cm, is in a uniform and steady 0.13-T magnetic field. 489) ____________
(a) Find the total magnetic flux through the coil when the field is perpendicular to the plane of the coil.
(b) If the coil is rotated in 10 ms so its plane is parallel to the field, find the average induced emf in the coil.

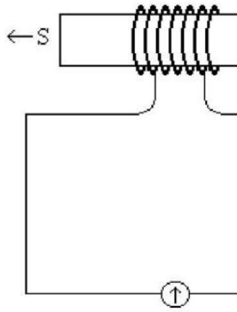
490) As shown in the figure, a uniform magnetic field *B* is confined to a cylindrical volume of radius 0.090 m. This field is directed into the plane of the page and is increasing at a constant rate of 0.200 T/s. Calculate the magnitude and direction (clockwise or counterclockwise) of the current induced in a circular wire ring of radius 0.16 m and resistance 5.3 Ω that encircles the magnetic field region. 490) ____________



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

491) A flux of 4.0×10^{-5} T · m^2 is maintained through a coil of area 7.5 cm^2 for 0.50 s. What emf is induced in this coil during this time by this flux? 491) ______
A) 2.0×10^{-5} V
B) 3.0×10^{-5} V
C) 4.0×10^{-5} V
D) 8.0×10^{-5} V
E) No emf is induced in this coil.

492) A bar magnet is pushed through a coil of wire of cross-sectional area 0.020 m^2 as shown in the figure. The coil has seven turns, and the rate of change of the strength of the magnetic field in it due to the motion of the bar magnet is 0.040 T/s. What is the magnitude of the induced emf in that coil of wire?



492) _____

A) 5.6×10^{-5} V
B) 5.6×10^{-1} V
C) 5.6×10^{-4} V
D) 5.6×10^{-3} V
E) 5.6×10^{-2} V

493) A circular conducting loop with a radius of 0.40 m and a small gap filled with a 10.0-Ω resistor is oriented in the xy-plane. If a uniform magnetic field of 3.0 T, making an angle of 30° with the z-axis, increases to 8.0 T, in 3.0 s, what is the magnitude of the current that will be caused to flow in the loop if it has negligible resistance? 493) _____

A) 0.073 A B) 0.17 A C) 0.042 A D) 0.0073 A

494) A closed flat loop conductor with radius 2.0 m is located in a changing uniform magnetic field. If the emf induced in the loop is 7.0 V, what is the rate at which the magnetic field strength is changing if the magnetic field is oriented perpendicular to the plane in which the loop lies? 494) _____

A) 0.080 T/s B) 3.5 T/s C) 7.0 T/s D) 0.56 T/s

495) A conductor is formed into a flat loop that encloses an area of $2.0\,m^2$. The plane of the loop is oriented at a 30.0° angle with the xy-plane. A uniform time-varying magnetic field is oriented parallel to the z-axis. If the emf induced in the loop is 20.0 V, what is the rate at which the magnetic field strength is changing? 495) _____

A) 12 T/s B) 5 T/s C) 20 T/s D) 9 T/s

496) A circular coil of 60 turns and radius 4.0 cm is placed with its plane oriented at 90° to a uniform magnetic field of 0.10 T. The field is now increased at a steady rate, reaching a value of 0.30 T after 3.0 seconds. What emf is induced in the coil? 496) _____

A) 0.039 V B) 0.020 V C) 0.033 V D) 0.046 V E) 0.026 V

497) The magnetic flux through a coil changes steadily from $4.0 \times 10^{-5}\ T \cdot m^2$ to $6.0 \times 10^{-5}\ T \cdot m^2$ in 0.10 s. What emf is induced in this coil? 497) _____

A) 6.0×10^{-4} V
B) 2.0×10^{-4} V
C) 4.0×10^{-4} V
D) None of the given answers are correct.

498) A flat coil is wrapped with 200 turns of very thin wire on a square frame with sides 18 cm long. A uniform magnetic field is applied perpendicular to the plane of the coil. If the field changes uniformly from 0.50 T to 0.00 T in 8.0 s, find the emf induced in the coil. 498) _____

A) 2.1 mV B) 0.21 V C) 0.41 V D) 4.1 mV

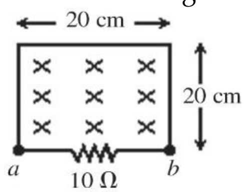
499) A flat square coil of wire with 15 turns and an area of $0.40\ m^2$ is placed with the plane of its area parallel to a magnetic field of 0.75 T. The coil is flipped so its plane is perpendicular to the magnetic field in a time of 0.050 s. What is the magnitude of the average induced emf in the coil? 499) _____

A) 45 V B) 6.0 V C) 36 V D) 90 V

500) A flat coil having 160 turns, each with an area of $0.20\ m^2$, is placed with the plane of its area perpendicular to a magnetic field of 0.40 T. The magnetic field changes uniformly from 0.40 T in the $+x$ direction to 0.40 T in the $-x$ direction in 2.0 s. If the resistance of the coil is 16 Ω, at what rate is power generated in the coil during this change? 500) _____

A) 15 W B) 5.0 W C) 10 W D) 20 W

501) As shown in the figure, a wire and a 10-Ω resistor are used to form a circuit in the shape of a square with dimensions 20 cm by 20 cm. A uniform but non-steady magnetic field is directed into the plane of the circuit. The magnitude of the magnetic field is steadily decreased from 0.30 T to 0.10 T in a time interval of 52 ms. What is the induced current in the circuit, and what is its direction through the resistor? 501) ______



A) 15 mA, from *b* to *a*
B) 9.2 mA, from *b* to *a*
C) 9.2 mA, from *a* to *b*
D) 15 mA, from *a* to *b*
E) 23 mA, from *a* to *b*

502) A round flat conducting loop is placed perpendicular to a uniform 0.70 T magnetic field. If the area of the loop increases at a rate of $3.4 \times 10^{-3}\ m^2$/s, what is the induced emf in the loop? 502) ______

A) 2.4 mV B) 0 mV C) 4.3 mV D) 1.7 mV E) 5.5 mV

503) The area of a rectangular loop of wire is $3.0 \times 10^{-3}\ m^2$. The loop is placed in a uniform magnetic field that changes steadily from 0.20 T to 0.80 T in 1.6 s. The plane of the loop is perpendicular to the direction of the magnetic field. What is the magnitude of the induced emf in that loop? 503) ______

A) 1.1×10^{-3} V
B) 3.0×10^{-3} V
C) 1.8×10^{-3} V
D) 0 V
E) 2.8×10^{-3} V

504) A constant uniform magnetic field of 0.50 T is applied at right angles to the plane of a flat rectangular loop of area $3.0 \times 10^{-3}\ m^2$. If the area of this loop changes steadily from its original value to a new value of $1.6 \times 10^{-3}\ m^2$ in 1.6 s, what is the emf induced in the loop? 504) ______

A) 9.0×10^{-2} V
B) 4.4×10^{-4} V
C) 0 V
D) 7.5×10^{-2} V
E) 1.6×10^{-2} V

505) A flat rectangular coil with dimensions of 5.0 cm × 10 cm is dropped from a zero magnetic field position into a 0.80-T magnetic field in 0.10 s. The coil has 60 turns and is perpendicular to the magnetic field. What is the average induced emf in the coil as a result of this action? 505) ______

A) 6.7 V B) 0 V C) 3.6 V D) 2.4 V E) 5.0 V

506) A single-turn loop of wire, having a resistance of 8.00 Ω and a cross-sectional area 200 cm^2, is perpendicular to a uniform magnetic field that increases steadily from 0.200 T to 2.800 T in 2.20 seconds. What is the magnitude of the induced current in the loop? 506) ______

A) 2.95 mA B) 3.18 A C) 3.18 mA D) 2.95 A E) 0 A

507) A round flat metal coil has 140 turns and negligible resistance. It is connected in a series circuit with a $12\text{-}\Omega$ resistor, with nothing else in the circuit. You measure that a 4.0-A current flows through the resistor when a magnetic field through the coil, perpendicular to its area, is changing at $3.0\ \text{T/s}$. What is the radius of the coil? 507) _____

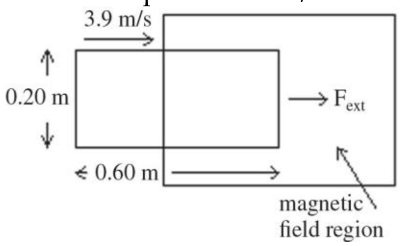
A) 0.016 m B) 0.19 m C) 0.048 m D) 0.33 m

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

508) As shown in the figure, a region of space contains a uniform magnetic field. The magnitude of this field is 2.2 T, and it is directed straight into the plane of the page in the region shown. Outside this region the magnetic field is zero. A rectangular loop measuring 0.20 m by 0.60 m and having a resistance of 5 Ω is being pulled into the magnetic field by an external force, as shown. 508) ____________

(a) What is the direction (clockwise or counterclockwise) of the current induced in the loop?

(b) Calculate the magnitude of the external force F_{ext} that is required to move the loop at a constant speed of 3.9 m/s.



509) A airplane having a metal surface and a wingspan of 18.0 m flies horizontally at 210. m/s where the earth's magnetic field is vertical with magnitude 46.0 μT. 509) ____________

(a) What emf is induced across the wings?

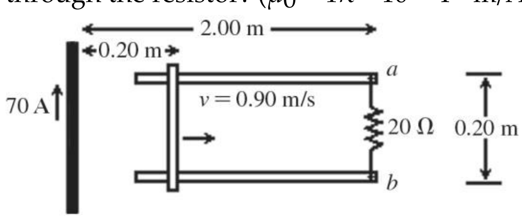
(b) What wingspan would the plane need to produce 1.00-V emf across its wings?

(c) The plane now reverses direction. Does the polarity of the wingtip emf change? That is, if the left wing was positive before, does it now become negative?

510) An eagle, with a wingspread of 2.0 m, flies toward the north at 8.0 m/s in a region where the vertical component of the earth's magnetic field is 0.20×10^{-4} T. What emf would be developed between the eagle's wing tips? (It has been speculated that this phenomenon could play a role in the navigation of birds, but the effect is too small, in all likelihood.) 510) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

511) A long vertical wire carries a steady 70 A current. As shown in the figure, a pair of horizontal rails are 0.20 m apart. A 20-Ω resistor connects points *a* and *b*, at the end of the rails. A bar is in contact with the rails, and is moved by an external force with a constant horizontal velocity of 0.90 m/s to the right, as shown. The bar and the rails have negligible resistance. At the instant that the bar is 0.20 m from the wire, what are the induced current in the resistor and its direction through the resistor? ($\mu_0 = 4\pi \times 10^{-7}\ \text{T} \cdot \text{m/A}$) 511) _____



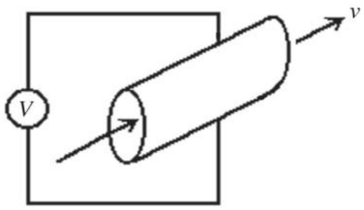
A) 0.63 μA, from *a* to *b*

B) 0.32 μA, from *b* to *a*

C) 0.63 μA, from *b* to *a*

D) 0.32 μA, from *a* to *b*
E) 1.9 μA, from *b* to *a*

512) An electromagnetic flowmeter is useful when it is desirable not to interrupt the system in which the fluid is flowing (such as the blood in an artery during heart surgery). Such a device is illustrated in the figure. The conducting fluid moves with speed v in a tube of diameter d. Perpendicular to this tube is a magnetic field B. A voltage V is induced between opposite sides of the tube due to the motion of the conducting fluid in the magnetic field. For a certain case, B = 0.120 T, d = 1.2 cm, and the measured voltage is $V = 9.43$ mV. Determine the speed of the fluid. 512) ______

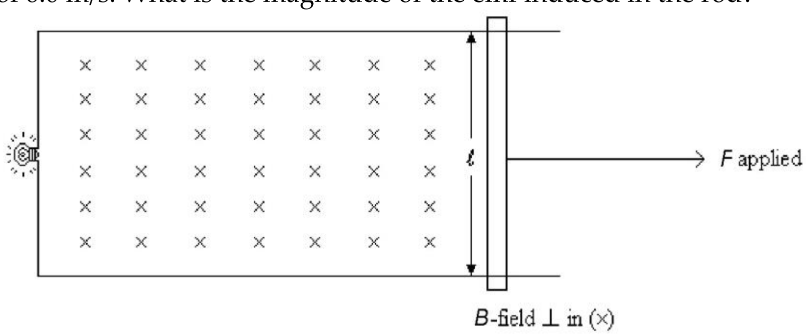


A) 0.25 m/s B) 35 m/s C) 3.5 m/s D) 750 m/s E) 6.5 m/s

513) It is known that birds can detect the earth's magnetic field, but the mechanism of how they do this is not known. It has been suggested that perhaps they detect a motional emf as they fly north to south, but it turns out that the induced voltages are small compared to the voltages normally encountered in cells, so this is probably not the mechanism involved. To check this out, calculate the induced voltage across the wingtips of a wild goose with a wingspan of 1.1 m if it is flying directly south at 15 m/s at a point where the earth's magnetic field is 5.0×10^{-5} T directed downward from the horizontal by 17°. 513) ______

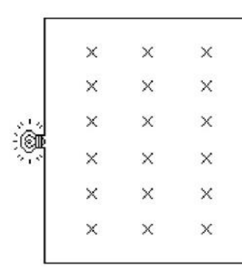
A) 0.83 mV B) 0.24 mV C) 0.079 mV D) 0.79 mV E) 0.12 mV

514) A conducting rod of length ℓ= 25 cm is placed on a U-shaped metal wire that is connected to a lightbulb having a resistance of 8.0 Ω, as shown in the figure. The wire and the rod are in the plane of the page. A constant uniform magnetic field of strength 0.40 T is applied perpendicular to and into the paper. An applied external force pulls the rod to the right with a constant speed of 6.0 m/s. What is the magnitude of the emf induced in the rod? 514) ______



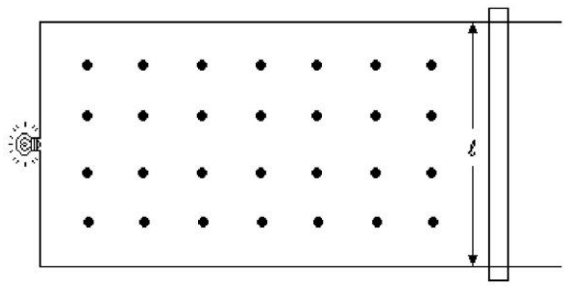
A) 0.40 V B) 0.60 V C) 0.30 V D) 0.20 V E) 0.50 V

515) A conducting rod with a length ℓ = 25 cm is placed on a U-shaped metal wire that is connected to a lightbulb having a resistance of 8.0 Ω as shown in the figure. The wire and the rod are in the plane of the page. A constant uniform magnetic field of strength 0.40 T is applied perpendicular to and into the paper. An external applied force moves the rod to the right with a constant speed of 6.0 m/s. What are the magnitude and direction of the induced current in the circuit?



515) ______
A) 75 mA clockwise
B) 17 mA counterclockwise
C) 17 mA clockwise
D) 52 mA clockwise
E) 75 mA counterclockwise

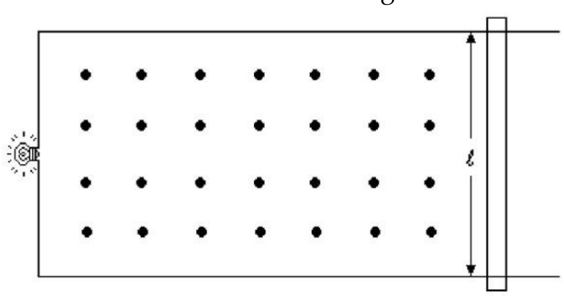
516) A conducting rod whose length is ℓ = 25 cm is placed on a U-shaped metal wire that is connected to a lightbulb having a resistance of 8.0 Ω as shown in the figure. The wire and the rod are in the plane of the page. A constant uniform magnetic field of strength 0.40 T is applied perpendicular to and out of the paper. An external applied force moves the rod to the left with a constant speed of 12 m/s. What are the magnitude and direction of the induced current in the circuit? 516) ______



B-field ⊥ out (•)

A) 34 mA counterclockwise
B) 100 mA clockwise
C) 150 mA counterclockwise
D) 150 mA clockwise
E) 34 mA clockwise

517) A conducting rod whose length is ℓ = 1.60 m is placed on frictionless U-shaped metal rails that is connected to a lightbulb having a resistance of 4.00 Ω as shown in the figure. The rails and the rod are in the plane of the page. A constant uniform magnetic field of strength 2.20 T is applied perpendicular to and out of the paper. What is the magnitude of the external applied force needed to move the rod to the right with a constant speed of 6.00 m/s? 517) ______

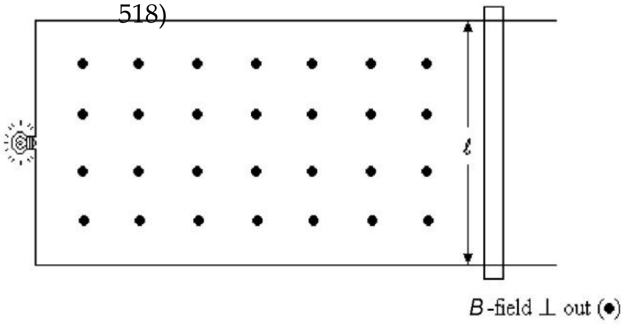


B-field ⊥ out (•)

A) 8.60 N B) 9.30 N C) 18.6 N D) 12.6 N E) 10.6 N

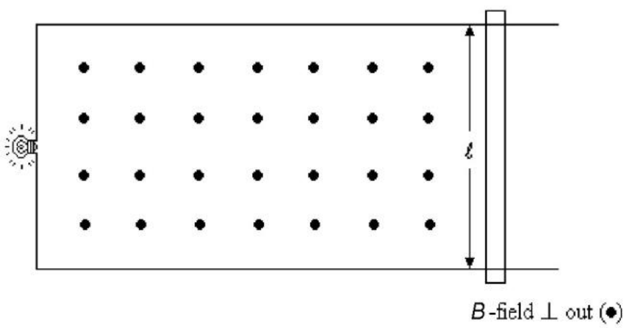
518) A conducting rod whose length is ℓ = 1.60 m is placed on frictionless U-shaped metal rails that is connected to a lightbulb having a resistance of 4.00 Ω as shown in the figure. The rails and the rod are in the plane of the page. A constant uniform magnetic field of strength 2.20 T is applied perpendicular to and out of the paper. An external applied force moves the rod to the right with a constant speed of 6.00 m/s. At what rate is energy dissipated in the lightbulb?

518)



A) 11.5 W B) 112 W C) 60.0 W D) 21.2 W E) 121 W

519) A conducting rod whose length is ℓ = 27.0 cm is placed on frictionless U-shaped metal rails that is connected to a lightbulb having a resistance of 5.00 Ω as shown in the figure. The rails and the rod are in the plane of the page. A constant uniform magnetic field of strength 1.20 T is applied perpendicular to and out of the paper. An external applied force moves the rod to the right with a constant speed. At what speed should the rod be pulled so that the lightbulb will consume energy at a rate of 1.10 W? 519) ______



A) 4.26 m/s B) 2.00 m/s C) 7.24 m/s D) 3.50 m/s E) 6.00 m/s

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

520) You wish to construct a simple ac generator with a maximum output of 12 V when rotated at 60 Hz. A magnetic field of 0.050 T is available. If the area of the rotating coil is 100 cm^2, how many turns are needed? 520) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

521) You are designing an ac generator with a maximum emf of 8.0 V. If the generator coil has 200 turns, each with a cross-sectional area of 0.030 m^2, what should be the frequency of the generator in a magnetic field of 0.030 T? 521) ______

A) 7.1 Hz B) 44 Hz C) 7.5 Hz D) 8.0 Hz

522) The coil of an ac generator has 80 loops and a cross-sectional area of 0.40 m^2. What is the maximum emf that can be generated by this generator if it is spinning with an angular speed of 2.0 rad/s in a 1.25-T magnetic field? 522) ______

A) 60 V B) 120 V C) 100 V D) 80 V

523) An ac generator consists of 100 loops of wire, each of area 0.090 m^2, and has a *total* resistance 12 Ω. The loops rotate about a diameter in a magnetic field of 0.50 T at a constant angular speed of 60 revolutions per second. Find the maximum induced emf in the generator. 523) ______

A) 0.54 kV B) 3.4 kV C) 0.27 kV D) 1.7 kV

524) An ac generator contains 80 flat rectangular loops of wire, each of which is 12 cm long and 8 cm wide. The loops rotate at 1200 rpm about an axis through the center and parallel to the long side. magne If the tic

field in which the loop rotates is uniform, has magnitude 0.30 T, and is perpendicular to the axis of rotation, what will be the maximum output voltage of this generator?

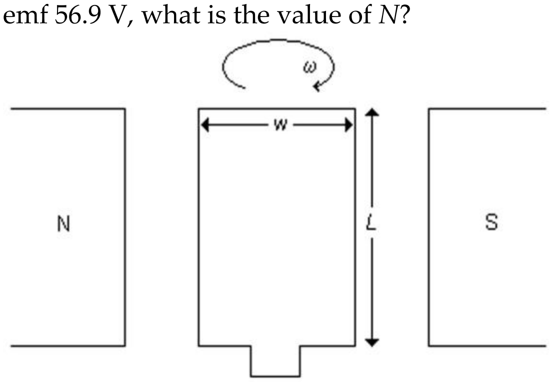
524) ______

A) 35 V B) 29 V C) 27 V D) 20 V

525) An ac generator with a *total* resistance of 12 Ω contains 100 flat loops of wire, each with an area of 0.090 m^2. The loops rotate at 60 rev/s in a magnetic field of magnitude 0.50 T. What is the maximum possible induced current? 525) ______

A) 0.28 kA B) 0.14 kA C) 23 A D) 46 A

526) A rectangular coil of *N* turns, length *L* = 25 cm, and width *w* = 15 cm, as shown in the figure, is rotating in a magnetic field of 1.6 T with a frequency of 75 Hz. If the coil develops a maximum emf 56.9 V, what is the value of *N*? 526) ______



A) 4 B) 6 C) 10 D) 2 E) 8

527) A circular coil with 600 turns has a radius of 15 cm. The coil is rotating about an axis perpendicular to a magnetic field of 0.020 T. If the maximum induced emf in the coil is 1.6 V, at what angular frequency is the coil rotating? 527) ______

A) 0.60 rad/s B) 1.4 rad/sec C) 1.9 rad/s D) 0.30 rad/s E) 0.90 rad/s

528) The primary coil of an ideal transformer has 100 turns and its secondary coil has 400 turns. If the ac voltage applied to the primary coil is 120 V, what voltage is present in its secondary coil? 528) ______

A) 70 V B) 400 V C) 30 V D) 100 V E) 480 V

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

529) An ideal transformer has 60 turns on its primary coil and 300 turns on its secondary coil. If 120 V at 2.0 A is applied to the primary, 529) ____________
(a) what voltage is present in the secondary?
(b) what current is present in the secondary?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

530) An ideal step-up transformer doubles a primary voltage of 110 V. What is the ratio of the number of turns in its primary coil to the number of turns in the secondary coil? 530) _____
A) 2:1 B) 1:2 C) 1:8 D) 4:1 E) 1:4

531) When 5.0 A at 110 V flows in the primary of an ideal transformer, how many amps at 24 V can flow in the secondary? 531) _____
A) 1.1 A B) 4.6 A C) 23 A D) 5.0 A

532) The secondary coil of an ideal neon sign transformer provides 7500 V at 10.0 mA. The primary coil operates on 120 V. What current does the primary draw? 532) _____
A) 1.66 A B) 0.160 A C) 0.625 A D) 0.625 mA

533) The primary coil of an ideal transformer has 100 turns and its secondary coil has 400 turns. If the ac current in the secondary coil is 2 A, what is the current in its primary coil? 533) _____
A) 1/4 A B) 1/2 A C) 2 A D) 4 A E) 8 A

534) The primary coil of an ideal transformer has 600 turns and its secondary coil has 150 turns. If the current in the primary coil is 2 A, what is the current in its secondary coil? 534) _____
A) 2 A B) 8 A C) 1/4 A D) 4 A E) 1/2 A

535) A current of 2.0 A in the 100-turn primary of an ideal transformer causes 14 A to flow in the secondary. How many turns are in the secondary? 535) _____
A) 14 B) 4 C) 700 D) 114

536) In an ideal transformer, how many turns are necessary in a 110-V primary if the 24-V secondary has 100 turns? 536) _____
A) 22 B) 458 C) 110 D) 240

537) An ideal transformer consists of a 500-turn primary coil and a 2000-turn secondary coil. If the current in the secondary is 3.0 A, what is the current in the primary? 537) _____
A) 48 A B) 1.3 A C) 12 A D) 0.75 A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

538) An ideal step-down transformer is needed to reduce a primary voltage of 120 V to 6.0 V. What must be the ratio of the number of turns in the secondary to the number of turns in the primary? 538) ____________

539) An ideal transformer steps down 120 V to 5.0 V and the 1226.-turn secondary supplies 3.6 A. 539) ____________
(a) Determine the current in the primary.
(b) Determine the turns ratio.
(c) What is the ratio of output power to input power?

540) An ideal transformer with 120 turns in its secondary supplies 12 V at 220 mA to a toy train. The primary is connected across a 120-V wall outlet. (a) w many turns
Ho are in the

primary? 540) ____
(b) What is the primary current? ____
(c) What power is delivered by the wall outlet? ____

541) An ideal transformer has 60 turns on its primary coil and 300 turns on its secondary coil. If 120 V at 2.0 A is applied to the primary, what voltage and current are present in the secondary? 541) ____________

542) You need an ideal transformer to reduce a voltage of 150 V in the primary circuit to 25 V in the secondary circuit. The primary circuit has 130 windings and the secondary circuit is completed through a 55-Ω resistor. How many windings should the secondary circuit contain? 542) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

543) The primary of an ideal transformer has 100 turns and its secondary has 200 turns. If the input current at the primary is 100 A, we can expect the output current at the secondary to be 543) ______

A) 200 A. B) 100 A.
C) 50 A. D) none of the given answers.

544) The primary of an ideal transformer has 100 turns and its secondary has 200 turns. If the input voltage to the primary is 100 V, we can expect the output voltage of the secondary to be 544) ______

A) 50 V. B) 200 V.
C) 100 V. D) none of the given answers.

545) The primary of an ideal transformer has 100 turns and its secondary has 200 turns. Neglecting frictional losses, if the power input to the primary is 100 W, we can expect the power output of the secondary to be 545) ______

A) 100 W. B) 200 W.
C) 50 W. D) none of the given answers.

546) A generator produces 60 A of current at 120 V. The voltage is usually stepped up to 4500 V by an ideal transformer and transmitted through a power line of total resistance 1.0 Ω. Find the number of turns in the secondary if the primary has 200 turns. 546) ______

A) 200 B) 4500 C) 5 D) 7500

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

547) The mutual inductance between two coils is 10 mH. The current in the first coil changes uniformly from 2.7 A to 5.0 A in 160 ms. If the second coil has a resistance of 0.60 Ω, what is the magnitude of the induced current in the second coil? 547) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

548) A 18-mH solenoid inductor is wound on a form that is 0.80 m long and 0.10 m in diameter. A coil having a resistance of 7.2 Ω is tightly wound around the solenoid at its center. The mutual inductance of the coil and solenoid is 12 μH. At a given instant, the current in the solenoid is 760 mA and is decreasing at the rate of 2.5 A/s.

At the given instant, what is the induced current in the coil? 548) ____

A) 5.8 μA B) 6.7 μA C) 4.2 μA D) 5.0 μA E) 3.3 μA

549) What is the self-inductance of an ideal solenoid that is 300 cm long with a cross-sectional area of 1.00×10^{-4} m^2 and has 1000 turns of wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 549) ____

A) 4.19 μH B) 4.19 nH C) 41.9 nH D) 4.19 pH E) 41.9 μH

550) A coil with a self-inductance of 6.0 H has a constant current of 2.0 A flowing through it for 2.0 s. What is the emf induced in this coil? 550) ____

A) 8.0 V B) 0.0 V C) 12 V D) 6.0 V E) 4.0 V

551) A coil with a self-inductance of 6.0 H is connected to a dc battery through a switch. As soon as the switch is closed, the rate of change of current is 2.0 A/s. What is the emf induced in this coil at this instant? 551) ____

A) 0.0 V B) 12 V C) 3.0 V D) 0.33 V E) 6.0 V

552) The inductance of a solenoid that is 14.0 cm long and has a cross-sectional area of 1.00×10^{-4} m^2 is 0.800 mH. How many turns of wire does this solenoid have? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 552) ____

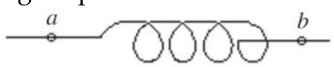
A) 282 B) 318,000 C) 159,000 D) 150 E) 944

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

553) The figure shows a solenoid having no appreciable resistance. When the current in this solenoid is decreasing at a rate of 2.1 A/s, the self-induced emf in the solenoid is measured to be 2.5 V. 553) ____

((a) What is the self-inductance of this solenoid?

(b) If the current is in the direction from *b* to *a* in the figure, which point, *a* or *b*, is at higher potential?



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

554) The current flowing through a circuit is changing at a rate of 6.0 A/s. If the circuit contains a 190-H inductor, what is the emf across the inductor? 554) ____

A) 32 V B) 32 mV C) 11 mV D) 1100 V

555) An ideal solenoid with 3000 turns is 70.0 cm long. If its self-inductance is 25.0 mH, what is its radius? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 555) ____

A) 52.0 m B) 0.0222 m C) 327 m D) 0.00199 m

556) You need an inductor that will store 20 J of energy when a 3.0-A current flows through it. What should be its self-inductance? 556) ____

A) 60 H B) 3.7 H C) 4.4 H D) 90 H

557) A 4.0-mH coil carries a current of 5.0 A. How much energy is stored in its magnetic field? 557) _____

A) 10 mJ
B) 2.0 mJ
C) 20 mJ
D) none of the given answers

558) A large electromagnet has a 28 T magnetic field between its poles. What is the magnetic energy density in that region of space? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A) 558) _____

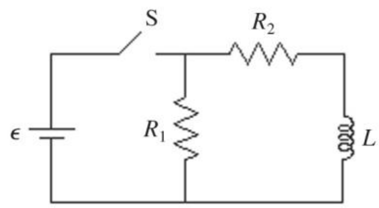
A) 390 J/cm^3
B) 110 J/cm^3
C) 49,000 J/cm^3
D) 310 J/cm^3

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

559) The figure shows a circuit. The ideal battery has a constant terminal voltage of ε = 23 V, the inductance is $L = 0.50$ H, and the resistances are $R_1 = 12\ \Omega$ and $R_2 = 9.0\ \Omega$. Initially the switch S is open with no currents flowing. Then the switch is suddenly closed. 559) ____________

(a) What is the current in the resistor R_1 the instant after the switch is closed?

(b) After leaving the switch has been closed for a very long time, it is opened again. Just after it is opened, what is the current in R_1?



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

560) A series circuit contains a 1.0-k Ω resistor, a 5.0-mH inductor, and an ideal 25-V power supply. What is the time constant for the circuit? 560) _____

A) 5.0 μs
B) 1.6 μs
C) 1.6 s
D) 5.0 s

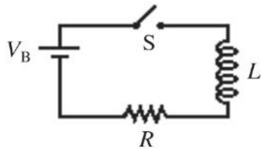
561) A simple series circuit contains a 6.0-Ω resistor, an ideal 15-V DC power supply, and an 18-H inductor. What the time constant of this circuit? 561) _____

A) 0.33 s
B) 110 s
C) 3.0 s
D) None of the given answers are correct.

562) What resistance should be added in series with a 1.0 H inductor to give a circuit with a time constant of 3.0 ms? 562) _____

A) 0.33 Ω
B) 3.0 Ω
C) 1.1 Ω
D) 0.33 kΩ

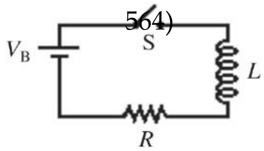
563) The series circuit shown in the figure contains an ideal battery with a constant terminal voltage $V_B = 60$ V, an ideal inductor $L = 45$ H, a resistor $R = 19$ ohm resistor, and a switch S. Initially, the switch is open, and there is no current in the inductor. At time $t = 0$ s, the switch is suddenly closed. What is the current in the circuit 0.237 s after closing the switch? 563) _____



A) 3.2 A
B) 0.30 A
C) 0.25 A
D) 0.20 A
E) 1.7 A

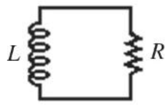
564) The series circuit shown in the figure contains an ideal battery with a constant terminal voltage $V_B = 60$ V, an ideal inductor $L = 59$ H, a resistor $R = 19$ ohm resistor, and a switch S.Initially, the switch is open, and there is no current in the inductor. At time $t = 0$ s, the switch is suddenly closed. What is the current in the circuit when the voltage across the resistor is equal to the voltage across the inductor?

564) ____



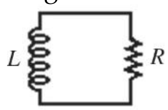
A) 1.6 A B) 0.95 A C) 1.3 A D) 0.63 A E) 1.9 A

565) As shown in the figure, a circuit consists of a resistor $R = 22\,\Omega$ in series with an ideal inductor $L = 44\,\text{H}$ having no resistance. At time $t = 0$ s, there is a 12-A current in the circuit. At that instant, what is the rate of change of the current? 565) ____



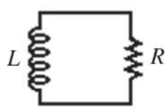
A) -6.0 A/s B) -20 A/s C) -24 A/s D) -11 A/s E) -15 A/s

566) As shown in the figure, a circuit consists of a resistor $R = 13\,\Omega$ in series with an ideal inductor $L = 33\,\text{H}$ having no resistance. At time $t = 0$ s, there is a 12-A current in the circuit. When the magnetic energy of the inductor is 1600 J, what is the rate of dissipation of energy in the resistor? 566) ____



A) 630 W B) 320 W C) 1300 W D) 1600 W E) 950 W

567) As shown in the figure, a circuit consists of a resistor $R = 20\,\Omega$ in series with an ideal inductor $L = 42\,\text{H}$ having no resistance. At time $t = 0$ s, there is a 12-A current in the circuit. At time $t = 5.0$ s, what is the emf across the inductor? 567) ____



A) 24 V B) 20 V C) 22 V D) 18 V E) 26 V

568) A 25-mH inductor is connected in series with a 20-Ω resistor through an ideal 15-V dc power supply and a switch. If the switch is closed at time $t = 0$ s, what is the current when $t = 2.0$ ms? 568) ____

A) 0.60 A B) 0.80 A C) 0.40 A D) 0.70 A E) 0.50 A

569) A 40-mH inductor is connected in series with a 50-Ω resistor through an ideal 15-V dc power supply and an open switch. What is the current 7.0 ms after closing the switch? 569) ____

A) 550 mA B) 850 mA C) 280 mA D) 300 mA E) 650 mA

570) In a series circuit containing a resistor and an inductor connected to an ideal dc source and a switch, the inductor gets 40% of its maximum current 1.8 s after the switch is closed. What is the time constant of this circuit? 570) ____

A) 0.80 s B) 5.5 s C) 2.5 s D) 1.5 s E) 3.5 s

571) A 1.50-H inductor is connected in series with a 200-Ω resistor through an ideal 15.0-V dc power supply and an open switch. How much energy is contained in the inductor 20.0 ms after closing the switch? 571) ____

A) 0.910 mJ B) 5.48 mJ C) 1.83 mJ D) 3.65 mJ E) 7.31 mJ

572) A 1.5-H inductor is connected in series with a 200-Ω resistor through an ideal 15-V dc power supply and an open switch. After closing the, what is the maximum energy that will be contain the ined induct

or? 572) ____

A) 2.2 mJ B) 4.2 mJ C) 1.2 mJ D) 5.2 mJ E) 3.2 mJ

573) A series circuit consists of an open switch, an ideal emf source ε_0, a $4.0\text{-k}\Omega$ resistor, and a 5.0-H inductor. If the potential across the resistor is 48.0 V at 9.0 ms after the switch is closed, find the source emf, ε_0. 573) ____

A) 23 V B) 24 V C) 100 V D) 48 V

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

574) American power plants usually supply 120 V ac. 574) ____
(a) At what frequency is this voltage supplied?
(b) What is the maximum voltage?

575) A 100-W light bulb is powered by 120 V ac 60.0-Hz household connection. Determine the rms current and the current amplitude. 575) ____

576) The peak current and voltage outputs of a generator are 20 A and 240 V, respectively. What average power is provided by the generator? 576) ____

577) The potential applied to a 20-Ω resistor is $v = (60\text{ V})\cos(33t)$. What is the rms current through this resistor? 577) ____

578) The current through a 50-Ω resistor is $I = (0.80\text{ A})\sin(240t)$. What are (a) the current amplitude and (b) the rms current? 578) ____

579) A 0.150-kW lamp is plugged into a 120-V ac wall outlet. What are (a) the peak current through the lamp, (b) the rms current through the lamp, and (c) the resistance of the lamp? 579) ____

580) The potential applied to a 20-Ω resistor is $(60\text{ V})\cos(33t)$. What is the average power consumed in the resistor? 580) ____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

581) If the maximum voltage of an ac signal is 8.0 V, what is the rms value of this voltage? 581) ____

A) 16.0 V B) 4.0 V C) 5.7 V D) 6.2 V E) 2.8 V

582) A 120-V rms voltage at 60.0 Hz is applied across an inductor, capacitor and a 100-Ω resistor in series. If the maximum value of the current in this circuit is 1.60 A, what is the rms value of the current in this circuit? 582) ____

A) 1.82 A B) 1.13 A C) 1.60 A D) 2.26 A E) 2.66 A

583) An alternating current is supplied to an electronic component with a rating that the voltage across it can *never*, even for an instant, exceed 10 V. What is the highest rms voltage that can be supplied to this component while staying below the voltage limit? 583) ____

A) $10\sqrt{2}$ V B) 5 V C) $5\sqrt{2}$ V D) 100 V

584) What is the peak voltage in an ac circuit where the rms voltage is 120 V? 584) ____

A) 170 V B) 84.8 V C) 120 V D) 240 V

585) A 150-W lamp is placed into a 120-V ac outlet. What is the peak current? 585) ____

A) 1.2 A B) 0.80 A C) 0.88 A D) 1.8 A

586) A 10-Ω resistor is connected to a 120-V ac power supply. What is the peak current through the resistor? 586) ______

A) 12 A B) 17 A C) 0.12 A D) 0.083 A

587) The current through a 50-Ω resistor is I = (0.80 A) sin(240t), where t is measured in seconds. What is the rms current? 587) ______

A) 0.80 A B) 1.1 A C) 0.57 A D) 1.6 A

588) The current through a 50-Ω resistor is I = (0.80 A) sin(240t), where t is measured in seconds. How much power on average is dissipated in the resistor? 588) ______

A) 32 W B) 64 W C) 45 W D) 16 W

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

589) At what frequency does a 10-μF capacitor have a reactance of 0.12 kΩ? 589) ____________

590) At what frequency will the inductive reactance of a 44-mH inductor be equal to the capacitive reactance of a 27-pF capacitor? 590) ____________

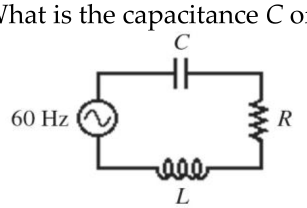
591) A 0.10-μF capacitor is connected to a 120-V rms 60-Hz source. 591) ____________
(a) What is its capacitive reactance?
(b) What is the rms current to the capacitor?
(c) If both the capacitance and the frequency were doubled, what would be the rms current?

592) A 0.200-H inductor is connected to a 60.0-Hz 120-V rms source. 592) ____________
(a) What is the inductive reactance?
(b) What is the rms current to the inductor?
(c) If both the inductance and the frequency were doubled, what would be the rms current?

593) What capacitance will have the same reactance as a 100-mH inductance of both of them are in a 120-V 60-Hz circuit? 593) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

594) In the circuit shown in the figure, the 60-Hz ac source has a voltage amplitude of 120 V, the capacitive reactance is 860 Ω, the inductive reactance is 310 Ω, and the resistance is 420 Ω. What is the capacitance C of the capacitor? 594) ______



A) 6.0 μF B) 8.9 μF C) 19 μF D) 12 μF E) 3.1 μF

595) The reactance of a capacitor is 4.0 kΩ at a frequency of 0.10 kHz. What is the capacitance? 595) ______

A) 0.398 μF B) 0.563 μF C) 15.7 μF D) 2.50 μF

596) A 5.0-μF capacitor is connected to an ac signal with a frequency of 60 Hz. If the maximum voltage applied to the capacitor is 8.0 V, what is its capacitive reactance? 596) ______

A) 160 Ω
B) 5.0 Ω

C) 530 Ω
D) 740 Ω
E) 7.5×10^{-6} Ω

597) The capacitive reactance of a 64-μF capacitor in an ac circuit is 4.0×10^2 Ω. What is the frequency of the applied signal? 597) _____
A) 80 Hz B) 2.2 Hz C) 800 Hz D) 6.2 Hz E) 17 Hz

598) A 120-V rms voltage is applied across a 6.0-μF capacitor. If the frequency of the generator is 60 Hz, what is the rms value of the current in the circuit? 598) _____
A) 0.27 A B) 0.17 A C) 0.47 A D) 0.071 A E) 0.37 A

599) At what frequency does a 10-μF capacitor have a reactance of 1200 Ω? 599) _____
A) 60 Hz B) 42 Hz C) 83 Hz D) 13 Hz

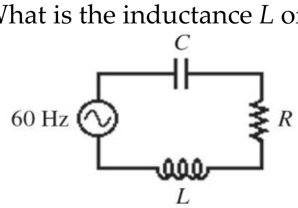
600) At what frequency will the capacitive reactance of a 0.010-μF capacitor be 100 Ω? 600) _____
A) 0.31 MHz B) 16 kHz C) 1.0 kHz D) 0.16 MHz

601) What is the rms current through a 0.0010-μF capacitor at 1000 Hz and 5.0 V? 601) _____
A) 3.1 mA B) 5.4 μA C) 10 mA D) 31 μA

602) What is the reactance of a 20-mH inductor at a frequency of 60 Hz? 602) _____
A) 7.5 mΩ B) 0.13 Ω C) 7.5 Ω D) 1.2 mΩ E) 1.2 Ω

603) At what frequency is the reactance of a 20.0-mH inductor equal to 120 Ω? 603) _____
A) 637 Hz B) 796 Hz C) 318 Hz D) 955 Hz E) 1110 Hz

604) In the circuit shown in the figure, the 60-Hz ac source has a voltage amplitude of 120 V, the capacitive reactance is 960 Ω, the inductive reactance is 270 Ω, and the resistance is 590 Ω. What is the inductance L of the inductor? 604) _____



A) 3400 mH B) 720 mH C) 1600 mH D) 4500 mH E) 2700 mH

605) What is the reactance of a 1.0-mH inductor at 60 Hz? 605) _____
A) 5.3 Ω B) 0.19 Ω C) 0.38 Ω D) 2.7 Ω

606) What is the inductive reactance of a 2.50-mH coil at 1000 Hz? 606) _____
A) 2.50 Ω B) 2500 Ω C) 15.7 Ω D) 796 Ω

607) At what frequency will a 14.0-mH coil have 14.0 Ω of inductive reactance? 607) _____
A) 159 Hz B) 505 Hz C) 1000 Hz D) 257 Hz

608) The inductor in a radio receiver carries a current of amplitude 0.200 A when an ac voltage of amplitude 2.40 V is across it at a frequency of 1400 Hz. What is the value of the inductance? 608) _____
A) 1.97 mH B) 1.36 mH C) 9.20 mH D) 1.43 mH E) 4.42 mH

609) At what frequency will a 20.0-mH inductor have an inductive reactance of 100 Ω? 609) _____

A) 796 Hz
B) 655 Hz
C) 225 Hz
D) 457 Hz
E) None of the other answers is correct.

610) What rms current flows in a 60-mH inductor when 120-V rms ac at a frequency of 20 kHz is applied to it? 610) ______
A) 16 mA B) 32 mA C) 8.0 mA D) 24 mA

611) What is the rms current through a 2.50-mH coil due to a 110-V rms, 60-Hz source? 611) ______
A) 0.94 A B) 117 A C) 2.5 A D) 104 A

612) A series ac circuit has a resistance of 9.0 Ω, a capacitive reactance of 25Ω, and an inductive reactance of 15Ω. Find the impedance of the circuit. 612) ______
A) 31 Ω B) 19 Ω C) 13.5 Ω D) 49 Ω

613) For a series ac circuit consisting of a resistance of 18.0 kΩ, a capacitance of 7.0 μF, and an inductance of 32.0 H, what frequency is needed to minimize the impedance if the voltage amplitude is 110 V? 613) ______
A) 2.9 kHz B) 0.011 kHz C) 0.067 kHz D) 16 kHz

614) A 120-V rms voltage is applied across a 6.00-μF capacitor and a 100-Ω resistor. If the frequency of the generator is 60.0 Hz, what is the impedance of this circuit? 614) ______
A) 453 Ω B) 553 Ω C) 353 Ω D) 153 Ω E) 253 Ω

615) A 10-Ω resistor is connected in series with a 20-μF capacitor. What is the impedance at 1.0 kHz? 615) ______
A) 10 Ω B) 8.0 Ω C) 13 Ω D) 15 Ω

616) What is the impedance of an ac series circuit with 12.0 Ω of resistance, 15.0 Ω of inductive reactance, and 10.0 Ω of capacitive reactance? 616) ______
A) 13.0 Ω B) 21.9 Ω C) 27.7 Ω D) 11.6 Ω

617) What is the impedance at 1500 Hz if a 100-Ω resistor, 20-mH coil, and 1.0-μF capacitor are connected in series? 617) ______
A) 0.11 kΩ B) 0.19 kΩ C) 82 Ω D) 0.13 kΩ

618) If a 1.0-kΩ resistor is connected in series with a 20-mH inductor, what is the impedance at 1.0 kHz? 618) ______
A) 0.13 MΩ B) 1.1 kΩ C) 1.0 kΩ D) 0.13 kΩ

619) What resistance is needed in a series circuit with a 20-mH coil and 1.0-μF capacitor for a total impedance of 100 Ω at 1.5 kHz? 619) ______
A) 82 Ω B) 57 Ω C) 0.16 kΩ D) 18 Ω

620) Which one of the following capacitances in series with a 100-Ω resistor and 15-mH coil will give a total impedance of 110 Ω at 2.0 kHz? 620) ______
A) 0.56 μF B) 46 μF C) 10 μF D) 0.14 mF

621) What resistance must be put in series with a 450-mH inductor at 5000 Hz for a total impedance of 40000 Ω? 621) ______
A) 37 kΩ B) 40 kΩ C) 26 kΩ D) 45 kΩ

622) What inductance must be put in series with a 100-kΩ resistor at 1.0-MHz for a total impedance of 150 kΩ? 622) ______

A) 0.17 H B) 18 mH C) 0.15 H D) 1.5 H

623) What resistance is needed in series with a 10-μF capacitor at 1.0 kHz for a total impedance of 45 Ω? 623) ______

A) 29 Ω B) 61 Ω C) 42 Ω D) 1.8 Ω

624) The impedance of an *RC* circuit containing a 35.0-μF capacitor is 800 Ω. If the frequency of the applied ac voltage is 16.0 Hz, what is the resistance of the resistor? 624) ______

A) 848 Ω B) 548 Ω C) 800 Ω D) 748 Ω E) 648 Ω

625) The impedance of an *RC* circuit with a 300-Ω iresistor s 1060 Ω. If the frequency of the applied ac voltage is 40.0 Hz, what is the capacitance of the capacitor? 625) ______

A) 3.91 μF B) 2.91 μF C) 4.91 μF D) 5.91 μF E) 300 μF

626) A 120-V rms voltage at 1.00 kHz is applied to a resistor and an inductor in series. If the impedance of this circuit is 110 Ω, what is the maximum value of the current? 626) ______

A) 1.04 A B) 1.84 A C) 1.09 A D) 1.54 A

627) A 200-Ω resistor, a 25-mH inductor, and a capacitor are connected in series across an ac voltage source at 1000 Hz. If the impedance of this circuit is 240 Ω, which one of the following quantities could be the capacitance of the capacitor? 627) ______

A) 7.5 μF B) 3.2 μF C) 6.5 μF D) 4.2 μF E) 5.5 μF

628) A 25.0-mH inductor, a 2.00-μF capacitor, and a certain resistor are connected in series across an ac voltage source at 1.00 kHz. If the impedance of this circuit is 200 Ω, what is the value of the resistor? 628) ______

A) 552 Ω B) 100 Ω C) 184 Ω D) 200 Ω E) 579 Ω

629) A 120-V rms voltage at 1000 Hz is applied to a series *RLC* circuit with an equal value of inductive and capacitive reactance and a 200-Ω resistance. What is the impedance of this circuit? 629) ______

A) 240 Ω B) 100 Ω C) 200 Ω D) 0 Ω E) 120 Ω

630) A 120-V rms voltage at 60 Hz is applied across an inductor and a 200-Ω resistor. If the impedance of this circuit is 216 Ω, what is the rms value of the current? 630) ______

A) 0.446 A B) 0.667 A C) 0.767 A D) 0.336 A E) 0.556 A

631) A 100-Ω resistor is connected in series with a 10.0-mH inductor across an ac source operating at 1.00 kHz. What is the impedance of this circuit? 631) ______

A) 236 Ω B) 100 Ω C) 200 Ω D) 118 Ω E) 1000 Ω

632) What resistance must be put in series with a 35-mH inductor at 4000 Hz to have a total impedance of 9.0×10^4 Ω? 632) ______

A) 6.0×10^4 Ω

B) 8.0×10^4 Ω

C) 35×10^4 Ω

D) 9.0×10^4 Ω

E) 7.0×10^4 Ω

633) What inductance must be put in series with a 200-Ω resistor at 4.00 kHz to have a total impedance of 240 Ω? 633) ______

A) 6.28 mH B) 3.28 mH C) 5.28 mH D) 12 mH E) 4.28 mH

634) A 120-V rms signal at 60.0 Hz is applied across a series combination of a 30.0-mH inductor and a resistor. If the rms value of the current in this circuit is 0.600 A, what is the resistance of the resistor? 634) ______

A) 268 Ω B) 80.0 Ω C) 30.0 Ω D) 143 Ω E) 200 Ω

635) A 120-V rms signal at 60 Hz is applied across a series combination of a 30-mH inductor and a 100-Ω resistor. What is the rms value of the current in this circuit? 635) ______

A) 0.80 A B) 1.6 A C) 1.2 A D) 1.8 A E) 1.4 A

636) A 120-V rms signal at 60 Hz is applied across a series combination of a 30-mH inductor and a 100-Ω resistor. What is the rms value of the voltage across the resistor? 636) ______

A) 150 V B) 60 V C) 100 V D) 120 V E) 0.70 V

637) A 120-V rms voltage is applied across a 6.0-μF capacitor and a series combination of a 100-Ω resistor. If the frequency of the power source is 60 Hz, what is the rms value of the current in the circuit? 637) ______

A) 0.46 A B) 0.76 A C) 0.36 A D) 0.56 A E) 0.26 A

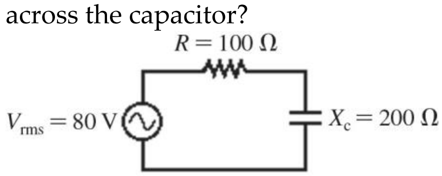
638) A 120-V rms voltage at 60 Hz is applied across a series combination of a 20-μF capacitor and an unknown resistor. If the rms value of the current in the circuit is 0.60 A, what is the resistance of the resistor? 638) ______

A) 200 Ω B) 180 Ω C) 120 Ω D) 150 Ω E) 60 Ω

639) A 120-V rms signal at 60.0 Hz is applied across a series combination of a 40.0-mH inductor and a 100-Ω resistor. What is the rms value of the voltage across the inductor? 639) ______

A) 100 V B) 120 V C) 119 V D) 17.9 V E) 0.700 V

640) As shown in the figure, an ac source whose rms voltage is 80 V is in series with a 100-Ω resistor and a capacitor whose reactance is 200 Ω at the frequency of the source. What is the rms voltage across the capacitor? 640) ______



A) 72 V B) 68 V C) 70 V D) 66 V E) 74 V

641) A 120-V rms voltage at 1000 Hz is applied to a 2.0-mH inductor, a 1.0-μF capacitor, and a 100-Ω resistor. What is the rms value of the current in this circuit? 641) ______

A) 2.5 A B) 0.68 A C) 3.5 A D) 0.48 A E) 1.5 A

642) A 120-V rms voltage at 1000 Hz is applied to an inductor, a 2.00-μF capacitor and a 100-Ω resistor. If the rms value of the current in this circuit is 0.680 A, what is the inductance of the inductor? 642) ______

A) 22.8 mH B) 11.4 mH C) 35.8 mH D) 17.9 mH E) 34.2 mH

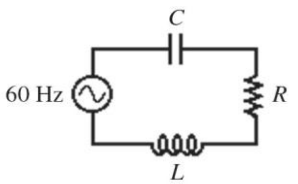
643) A 120-V rms voltage at 1.0 kHz is applied to a 2.0-mH inductor, a 4.0-μF capacitor and a resistor. If the rms value of the current in this circuit is 0.40 A, what is the value of the resistor? 643) ______

A) 420 Ω B) 300 Ω C) 120 Ω D) 240 Ω E) 95 Ω

644) A series circuit has a sinusoidal voltage supplied to it at 434 kHz with a peak voltage of 338 V. It also contains a 27-kΩ resistance, a 13-μF capacitance, and a 64-H inductance. What is the peak current for this circuit? 644) ______

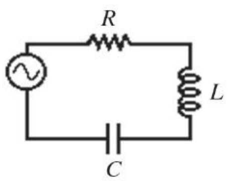
A) 1.9 μA B) 5.9 μA C) 13 μA D) 3.3 μA

645) In the circuit shown in the figure, the 60-Hz ac source has a voltage amplitude of 120 V, the capacitive reactance is 950 Ω, the inductive reactance is 220 Ω, and the resistance is 440 Ω. What is the rms current in the circuit? 645) ______



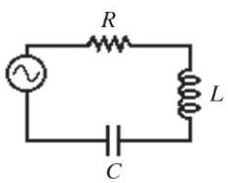
A) 0.19 A B) 0.11 A C) 0.13 A D) 0.16 A E) 0.10 A

646) The figure shows a series ac circuit. The inductor has a reactance of 60 Ω and an inductance of 210 mH. A 90-Ω *R* and a capacitor *C* whose reactance is 160 Ω are also in the circuit, and the rms current in the circuit is 1.5 A. What is the rms voltage of the source? 646) ______



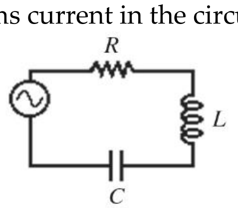
A) 190 V B) 150 V C) 200 V D) 140 V E) 170 V

647) The figure shows a series ac circuit. The inductor has a reactance of 80 Ω and an inductance of 200 mH. A 30-Ω resistor and a capacitor whose reactance is 150 Ω are also in the circuit, and the rms current in the circuit is 2.3 A. What is the capacitance of the capacitor? 647) ______



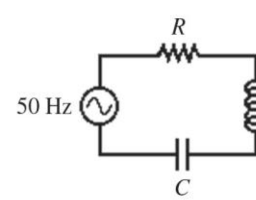
A) 18 μF B) 16 μF C) 17 μF D) 13 μF E) 14 μF

648) The figure shows a series ac circuit. The inductor has a reactance of 50 Ω and an inductance of 200 mH. An 90-Ω resistor and a capacitor whose reactance is 150 Ω are also in the circuit, and the rms current in the circuit is 1.5 A. What is the voltage amplitude across the capacitor? 648) ______



A) 230 V B) 500 V C) 320 V D) 410 V E) 140 V

649) A series circuit has a 50-Hz ac source, a 20-Ω resistor, a 0.90-H inductor, and a 50-μF capacitor, as shown in the figure. The rms current in the circuit is 2.4 A. What is the voltage amplitude of the source?



649) ______

A) 530 V B) 750 V C) 430 V D) 640 V E) 370 V

650) A series circuit has a 100-Ω resistor, a 0.100-μF capacitor, and a 2.00-mH inductor connected across a 120 V rms ac source operating at resonant frequency. What is the rms value of the voltage across the inductor? 650) ______

A) 533 V B) 120 V C) 170 V D) 54.0 V E) 150 V

651) A series circuit has a 100-Ω resistor, a 0.100-μF capacitor, and a 2.00-mH inductor connected across a 120-V rms ac source operating at resonant frequency. What is the rms value of the voltage across the capacitor? 651) ______

A) 150 V B) 170 V C) 54.0 V D) 533 V E) 120 V

652) A series circuit has a 100-Ω resistor, a 0.100-μF capacitor, and a 2.00-mH inductor connected across a 120-V rms ac source operating at 1000/π Hz. What is the rms voltage across the inductor? 652) ______

A) 120 mV B) 200 mV C) 96.1 mV D) 87.1 mV E) 302 mV

653) A series circuit consists of a 100-Ω resistor, a 10.0-μF capacitor, and a 0.350-H inductor. The circuit is connected to a 120-V rms, 60-Hz power supply. What is the rms current in the circuit? 653) ______

A) 0.62 A B) 0.52 A C) 0.72 A D) 0.42 A

654) A resistance of 55 Ω, a capacitor of capacitive reactance 30 Ω, and an inductor of inductive reactance 30 Ω are connected in series to a 110-V rms, 60-Hz power source. What rms current flows in this circuit? 654) ______

A) more than 2.0 A B) 2.0 A
C) less than 2.0 A D) none of the given answers

655) A resistance of 55 Ω, a capacitor of capacitive reactance 30 Ω, and an inductor of inductive reactance 30 Ω are connected in series to a 110-V rms 60-Hz power source. What rms current flows in this circuit? 655) ______

A) more than 2.0 A but less than 4.0 A
B) more than 4.0 A
C) less than 2.0 A
D) 4.0 A
E) 2.0 A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

656) A series circuit consists of a 0.810-H inductor, a 380.0-Ω resistor, a 2.50-μF capacitor, and an ac voltage source of amplitude 250.0 V. Find the rms voltage across the capacitor when the circuit operates at resonance. 656) ______________

657) A 120-mH inductor is in series with a 20-Ω resistor and a variable capacitor that can range from 0.110 μF to 0.400 μF. 657) ______________
(a) What is the range of possible resonance frequencies?
(b) If the power supply is a 24-V rms source, what rms current flows at resonance?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

658) What is the resonance frequency of a series ac circuit consisting of a 40.0 μF capacitor, a 55-Ω resistor, and a 0.030 H inductor? 658) ______

A) 6.9 kHz B) 0.15 kHz C) 6 kHz D) 0.9 kHz

659) A series ac circuit has a resonance frequency of 9.0 kHz. If the inductor in the circuit has a value of 2.0 H, and the resistance is 75 Ω, what is the capacitance of the circuit? 659) ______

A) 156 pF B) 17.7 pF C) 0.16 pF D) 6.2 pF

660) An ac circuit has a 100-Ω resistor in series with a 4.9-μF capacitor and a 700-mH inductor. At what frequency does the circuit act like a pure resistance? 660) ______

A) 86 Hz B) 1.9 MHz C) 0.29 MHz D) 12 MHz E) 0.54 kHz

661) A series *RLC* circuit has a 100-Ω resistor, a 0.100-μF capacitor and a 2.00-mH inductor connected across a 120-V rms ac voltage source operating at 1000/π Hz. What is the resonant frequency of this circuit? 661) ______

A) 22.5 kHz B) 11.3 kHz C) 35.3 kHz D) 17.9 kHz E) 70.7 kHz

662) What size capacitor should be placed in series with a 30-Ω resistor and a 40-mH inductive coil if the resonant frequency of the circuit is to be 1.0 kHz? 662) ______

A) 4.5 μF B) 6.0 μF C) 2.0 μF D) 0.63 μF E) 3.3 μF

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

663) A 50-Ω resistor is placed in series with a 40-mH inductor. At what frequency will the current in this circuit lag the applied voltage by exactly 45°? 663) ____________

664) A series circuit containing an inductor and a resistor is driven by a 120-V 60-Hz voltage source. The resistance is equal to 20.0 Ω and the inductance is 160 mH. What is the phase angle between the current the the applied voltage? 664) ____________

665) An series circuit consists of an ac voltage source, a resistor of resistance 770 Ω, and an inductor. (There is no capacitance in the circuit.) The current amplitude is 0.70 A, and the phase angle between the source voltage and the current has magnitude 20°. 665) ____________

(a) Does the source voltage lag or lead the current?

(b) What is the voltage amplitude of the source?

666) A series circuit consists of an ac voltage source of frequency 60 Hz and source voltage amplitude 345 V, a resistor of resistance 970 Ω, a capacitor of capacitance 4.9×10^{-6} F, and an inductor of inductance *L*. 666) ____________

(a) What must be the value of *L* for the phase angle of the circuit to be zero?

(b) When *L* has the value calculated in part (a), what is the current amplitude in the circuit?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

667) A 10-Ω resistor is in series with a 100-μF capacitor at 120 Hz. What is the phase angle? 667) ______

A) -37° B) -4.7° C) -82° D) +37° E) -53°

668) A 40.0-mH inductor is connected in series with a 2000-Ω resistor in an ac circuit. What is the phase angle at 2000 Hz? 668) ______

A) -14.1° B) -75.9° C) 75.9° D) 90.0° E) 14.1°

669) The phase angle of a series *RL* ac circuit with a 100-Ω resistor and a 20.0-mH inductor is 70.0°. What is the inductive reactance of this circuit? 669) ______

A) 150 Ω B) 275 Ω C) 200 Ω D) 100 Ω E) 175 Ω

670) The phase angle of a series *RL* ac circuit with a 20.0-mH inductor and a certain resistor at 1000 Hz is 20.0°. What is the resistance in this circuit? 670) ______

A) 245 Ω B) 145 Ω C) 200 Ω D) 345 Ω E) 100 Ω

671) The phase angle in a series *RL* circuit at 1.0 kHz with a 0.20-kΩ resistor and a certain inductor is 40°. What is the inductance in this circuit? 671) ______
A) 84 mH B) 27 mH C) 58 mH D) 37 mH E) 74 mH

672) A 20.0-mH inductor is connected in series with a 100-Ω resistor at 1.00 kHz in an ac circuit. What is the phase angle of this circuit? 672) ______
A) 51.5° B) 90.0° C) 38.5° D) 0° E) 45°

673) A 200-Ω resistor, a 40-mH inductor, and a 2.0-μF capacitor are connected in series with a 120-V rms source at 1.0 kHz. What is the phase angle of this circuit? 673) ______
A) 90° B) 0° C) 41° D) 45° E) 49°

674) The phase angle of an *RLC* series ac circuit with an inductive reactance of 200 Ω and a capacitive reactance of 100 Ω is 40.0°. What is the resistance of the resistor in this circuit? 674) ______
A) 100 Ω B) 119 Ω C) 156 Ω D) 265 Ω E) 200 Ω

675) At 1.00 kHz, the phase angle of an *RLC* series circuit with an inductive reactance of 200 Ω, a resistance of 200 Ω and a certain capacitor is 40.0°. What is the capacitance of the capacitor in this circuit? 675) ______
A) 5.95 μF B) 1.95 μF C) 3.95 μF D) 4.95 μF E) 2.95 μF

676) At 1.0 kHz, the phase angle of an *RLC* series circuit with a capacitive reactance of 40 Ω, a resistance of 100 Ω, and a certain inductor is 40°. What is the inductance in this circuit? 676) ______
A) 62 mH B) 210 mH C) 20 mH D) 12 mH E) 120 mH

677) A series ac circuit has a resistance of 2.0 kΩ, a capacitance of 8.0 μF, and an inductance of 9.0 H. If the frequency of the alternating current is 4.0/π kHz, by what angle does the voltage lead the current? 677) ______
A) +36 rad B) +3.1 rad C) -3.1 rad D) +1.5 rad E) -1.8 rad

678) A series ac circuit has voltage supplied to it at a frequency of 19.0 kHz with a phase difference between the current and the voltage of magnitude 0.70 rad. If the circuit has a capacitance of 5.0 μF and an inductance of 0.050 H, find the resistance of the circuit. 678) ______
A) 7.1 kΩ B) 0.36 kΩ C) 1.41 kΩ D) 24 kΩ

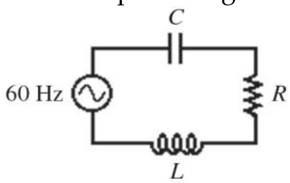
679) A 60.0-μF capacitor is in series with a 100-Ω resistor connected across an ac source of frequency 120 Hz. What is the phase angle? 679) ______
A) +12.5° B) +77.6° C) 90.0° D) -12.5° E) -77.6°

680) A capacitor with a capacitive reactance of 40.0 Ω is connected in series with a 100-Ω resistor across an ac source of frequency 60.0 Hz. What is the phase angle? 680) ______
A) 90.0° B) +68.2° C) -21.8° D) +21.8° E) -68.2°

681) A 120-V rms voltage at 60 Hz is applied across an *RC* circuit. The rms value of the current in the circuit is 0.60 A, and it leads the voltage by 60°. What is the resistance in this circuit? 681) ______
A) 100 Ω B) 150 Ω C) 60 Ω D) 120 Ω E) 200 Ω

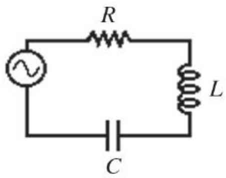
682) A 120-V rms voltage at 60 Hz is applied across an *RC* circuit. The rms value of the current in the circuit is 0.60 A, and it leads the voltage by 60°. What is the capacitance in this circuit? 682) ______
A) 17 μF B) 13 μF C) 16 μF D) 15 μF E) 14 μF

683) In the circuit shown in the figure, the 60-Hz ac source has a voltage amplitude of 120 V, the capacitive reactance is $760\ \Omega$, the inductive reactance is $310\ \Omega$, and the resistance is $480\ \Omega$. What is the phase angle? 683) ______



A) +68° B) -43° C) -22° D) +43° E) -68°

684) The figure shows a series ac circuit. The inductor has a reactance of 90 Ω and an inductance of 190 mH. A 70-Ω resistor and a capacitor whose reactance is 150 Ω are also in the circuit, and the rms current in the circuit is 1.9 A. What is the phase angle of the circuit? 684) ______



A) +90° B) 41° C) -41° D) 49° E) -49°

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

685) A series circuit consists of an ac voltage source of voltage amplitude *V* and frequency 60 Hz, a resistor of resistance $662\ \Omega$, and a capacitor of capacitance 7.4×10^{-6} F. What must the source voltage amplitude *V* be for the average electrical power consumed in the resistor to be 436 watts? (There is no inductance in the circuit.) 685) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

686) A series circuit contains a 20-Ω resistor, a 200-mH inductor, a 10-μF capacitor, and an ac power source. At what frequency should the power source drive the circuit in order to have maximum power transferred from the driving source? 686) ______

A) 0.96 kHz B) 0.28 kHz C) 0.45 kHz D) 0.11 kHz E) 0.17 kHz

687) A series ac circuit containing a resistor, inductor, and a capacitor has a peak voltage of 157 V and a peak current of 4.00 A. If the current lags the voltage by 22.0°, what is the average power of the circuit? 687) ______

A) 582 W B) 254 W C) 291 W D) 127 W

688) A series ac circuit has a reactance of $14\ k\Omega$ due to its capacitance, a reactance of $6\ k\Omega$ due to its inductance, and a resistance of $28\ k\Omega$. What is the power factor of this circuit? 688) ______

A) 0.28 B) 0.48 C) 0.96 D) 1.04

689) A series ac circuit has a peak current of 3.0 A with a frequency of 81 kHz. If the resistance of the circuit is $51\ k\Omega$, the capacitance of the circuit is 15 μF, and the inductance of the circuit is 23 H, determine the average power of the circuit over one cycle. 689) ______

A) 69,000 W B) 230,000 W C) 37,000 W D) 690,000 W

690) A 120-V rms voltage at 60.0 Hz is applied across a capacitor and a 100-Ω resistor. If the impedance of this circuit is 200 Ω, what is the average power of this circuit? 690) ______

A) 72.0 W B) 36.0 W C) 100 W D) 278 W E) 200 W

691) The circuit power factor of an *RC* circuit is 0.620. The rms value of the ac voltage applied to this signal is 120 V and the impedance is 200 Ω. What is the average power of this circuit? 691) ______

A) 124 W B) 60.0 W C) 89.2 W D) 0.620 W E) 44.6 W

692) A series circuit has a 100-Ω resistor, 2.00-mH inductor and a 4.00-μF capacitor connected across a 120-V rms ac source at 1000/π Hz. What is the power dissipated by the circuit? 692) ______

A) 91.8 W B) 184 W C) 18.6 W D) 58.4 W E) 180 W

693) A series circuit has a 100-Ω resistor, 4.00-mH inductor and a 0.100-μF capacitor connected across a 120-V rms ac source at the resonance frequency. What is the power dissipated by the circuit? 693) ______

A) 160 W B) 120 W C) 45.8 W D) 144 W E) 100 W

694) What is the power output in an ac series circuit with 12.0 Ω of resistance, 15.0 Ω of inductive reactance, and 10.0 Ω of capacitive reactance, when the circuit is connected to a 120-V rms power supply? 694) ______

A) 6.00 kW B) 4.49 kW C) 3.21 kW D) 1.02 kW

695) The phase angle of an ac circuit is 63°. What is the power factor? 695) ______

A) 0.55 B) 0.45 C) 0.11 D) 0.89

696) An ac series circuit has an impedance of 60 Ω and a resistance of 30 Ω. What is the power factor of this circuit? 696) ______

A) 1.4 B) 0.50 C) 0.71 D) 1.0

697) What is the power factor for a series ac circuit containing a 50-Ω resistor, a 10-μF capacitor, and a 0.45-H inductor, when connected to a 60-Hz power supply? 697) ______

A) 0.46 B) 1.0 C) 0.79 D) 0.00

698) A series *RLC* circuit has a 100-Ω resistor, 2.0-mH inductor and a 4.0-μF capacitor connected across a 120-V rms ac source at 1000/π Hz. What is the power factor of this circuit? 698) ______

A) 0.84 B) 0.74 C) 0.64 D) 0.54 E) 0.94

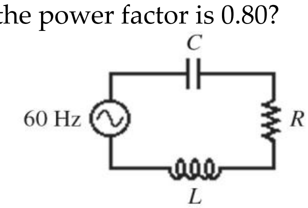
699) An ac signal is applied across a 40-mH inductor and a 100-Ω resistor. If the power factor of this circuit is 0.40, what is the frequency of the ac signal? 699) ______

A) 910 Hz B) 200 Hz C) 600 Hz D) 160 Hz E) 410 Hz

700) The power factor of an ac *RL* circuit with a 100-Ω resistor and a certain inductor is 0.60. What is the impedance of the circuit? 700) ______

A) 100 Ω B) 340 Ω C) 60 Ω D) 170 Ω E) 85 Ω

701) In the circuit shown in the figure, the 60-Hz ac source has a voltage amplitude of 120 V, the capacitive reactance is 760 Ω, and the inductive reactance is 280 Ω. What is the resistance *R* if the power factor is 0.80? 701) ______

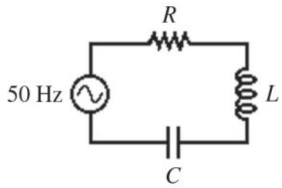


A) 360 Ω B) 640 Ω C) 510 Ω D) 580 Ω E) 430 Ω

702) What is the power factor of an *RLC* ac series circuit with an inductive reactance of 174 Ω, a capacitive reactance of 60 Ω and a resistance of 0.10 kΩ? 702) ______

A) 0.29 B) 0.76 C) 0.56 D) 0.66 E) 0.46

703) A series circuit has a 50-Hz ac source, a 50-Ω resistor, a 0.40-H inductor, and a 40-μF capacitor, as shown in the figure. The rms current in the circuit is 2.7 A. What is the power factor of the circuit? 703) ______



A) 0.66 B) 0.62 C) 0.74 D) 0.59 E) 0.70

704) A certain ac signal at 1000 Hz is applied across an inductor and a 100-Ω resistor. If the power factor of the circuit is 0.400, what is the impedance of this circuit? 704) ______

A) 200 Ω B) 250 Ω C) 300 Ω D) 100 Ω E) 150 Ω

1) D
2) D
3) C
4) A
5) B
6) D
7) A
8) A
9) (a) 1.9×10^5 C (b) 2.1 MN
10) D
11) E
12) C
13) C
14) D
15) 12 cm
16) C
17) B
18) B
19) A
20) E
21) E
22) C
23) 0.072 N, toward the right
24) 5.4 μN at 56° above -*x*-axis
25) D
26) C
27) B
28) D
29) A
30) D
31) A
32) (a) 7.5×10^{13} electrons (b) q_1 = +600 nC, q_2 = -640 nC
33) 0.41 m
34) 20.3 kg
35) 110 N toward the empty corner
36) C
37) 0.90 kN/C downward
38) E
39) D
40) E
41) B
42) D
43) (a) 7.2×10^{-15} N to the left (b) 24 km/s
44) E
45) C
46) B
47) B
48) C
49) A
50) C
51) B

52) B
53) 1.57×10^{7} N/C, to the left parallel to the line connecting the two charges
54) (a) 2.60×10^{10} electrons (b) zero
55) 120 nC
56) 4.8×10^{-19} electrons
57) (a) 12.0 μC (b) upper plate
58) (a) ±67 $\mu C/m^2$ (b) 7.6×10^{6} N/C (unchanged)
59) D
60) 1.53×10^{9} electrons
61) A
62) E
63) (a) 8.3×10^{6} N/C (b) 0 N/C
64) (a) 6.4×10^{3} N/C (b) 0 N/C (c) 2.2×10^{2} N/C
65) D
66) D
67) D
68) C
69) C
70) A
71) A
72) D
73) E
74) E
75) C
76) B
77) B
78) D
79) C
80) C
81) A
82) D
83) B
84) A
85) D
86) E
87) E
88) B
89) D
90) A
91) B
92) E
93) A
94) 340,000 V
95) C
96) D
97) E
98) 2.1 m
99) A
100) 3.6×10^{-5} J
101) B

102) 13 mJ
103) D
104) A
105) C
106) A
107) B
108) B
109) C
110) B
111) 80.4 mJ
112) C
113) C
114) D
115) 66.7 N/C
116) B
117) B
118) A
119) 8.61 μm
120) B
121) A
122) C
123) C
124) D
125) B
126) D
127) (a) -160 V (b) 320 V
128) (a) 8 V/m (b) 8 V/m
129) B
130) A
131) B
132) A
133) B
134) E
135) E
136) D
137) B
138) A
139) B
140) (a) 1.3 pF (b) 16 pC (c) 12 kN/C
141) (a) 0.42 μC (b) 2.5 μJ
142) (a) 432 μJ (b) 72.0 μC
143) C
144) C
145) A
146) D
147) E
148) 1.3 μJ
149) C
150) B
151) C
152) C
153) B

154) (a) 75 μF (b) 10 V
155) (a) 19 μC (b) 3.2 V
156) C
157) A
158) A
159) B
160) C
161) C
162) B
163) 440 V
164) B
165) D
166) 9.2×10^{-22} J/m^3
167) D
168) 1.5×10^4 J/m^3
169) $1.86 \times$ J/m^3
170) (a) 1200 C (b) 7.5×10^{21}
171) 0.109 A
172) A
173) A
174) D
175) D
176) C
177) B
178) D
179) A
180) C
181) A
182) 16 V
183) 43.6 Ω
184) D
185) B
186) C
187) D
188) B
189) 25 Ω
190) 2.0 Ω
191) 2.5 mm
192) (a) 6.0 Ω (b) 1.7×10^{-8} Ω · m
193) A
194) C
195) A
196) C
197) A
198) B
199) B
200) D
201) D
202) C
203) B
204) B
205) B

206) B
207) D
208) B
209) A
210) A
211) D
212) (a) 17.9 V (b) 44.7 mA
213) (a) 11.7 A (b) 10.3 Ω
214) (a) 16 C (b) 48 J (c) 8.3×10^{17}
215) (a) 2.1 A (b) 58 Ω (c) 6.0 kWh
216) C
217) B
218) A
219) C
220) A
221) D
222) B
223) B
224) A
225) D
226) A
227) A
228) D
229) B
230) A
231) C
232) B
233) B
234) A
235) C
236) A
237) D
238) A
239) B
240) A
241) C
242) C
243) B
244) C
245) D
246) A
247) B
248) C
249) D
250) 2.3 J
251) C
252) C
253) B
254) A
255) (a) 5.3 mV (b) 7.8 mV
256) (a) 2.7 μF (b) 12.0 μF
257) (a) 1.98 μF (b) 20.00 μF

258) (a) 1.50 V (b) 13.5 μJ
259) C
260) D
261) D
262) E
263) D
264) (a) 120 μC (b) 120 μC
265) (a) 30 V (b) 180 μC
266) A
267) D
268) C
269) (a) 4.0 μF (b) 64 μF (c) 6.4 μF
270) (a) 37.5 μC (b) 3.75 V
271) (a) 1.0 V (b) 3.0 V
272) C
273) D
274) A
275) C
276) E
277) B
278) E
279) B
280) E
281) A
282) (a) 6.56 mJ (b) 1.61 mJ
283) 0.80 Ω, 1.5 Ω, 2.0 Ω, 3.3 Ω, 5.0 Ω, 8.0 Ω
284) 3.0 Ω and 6.0 Ω
285) 303 Ω
286) 16 Ω
287) C
288) C
289) B
290) A
291) B
292) D
293) B
294) E
295) B
296) E
297) A
298) C
299) 243 W
300) (a) 150 V (b) 11 Ω
301) D
302) C
303) D
304) D
305) E
306) E
307) (a) -1.2 V (the terminal polarity is opposite from the polarity of the internal emf) (b) 8.4 V
308) (a) 0.40 A (b) 4.0 A
309) (a) 0.83 A (b) 0.53 A

310) (a) 2.8 A (b) 1.2 A (c) 0.90 A
311) (a) 0.83 A in each; 120 V for each; 100 W in each (200 W total)
(b) 0.42 A in each; 60 V for each; 25 W in each (50 W total)
312) (a) 9.6 Ω (b) I_1 = 0.63 A, I_2 = 0.45 A, I_3 = 0.18 A
313) C
314) C
315) C
316) A
317) C
318) A
319) D
320) B
321) D
322) C
323) C
324) A
325) A
326) A
327) B
328) A
329) C
330) B
331) B
332) A
333) A
334) A
335) B
336) C
337) E
338) B
339) C
340) B
341) C
342) A
343) 8.4 W
344) A
345) C
346) D
347) D
348) ε_1 = 28 V, ε_3 = 44 V
349) A
350) A
351) A
352) I_1 = 0.25 A, I_2 = 0.12 A
353) (a) V_1 = 12 V, V_2 = 15 V (b) 2.5 V
354) B
355) C
356) B
357) D
358) B
359) A
360) C

361) A
362) D
363) C
364) C
365) D
366) E
367) C
368) E
369) 13 nF
370) A
371) B
372) E
373) C
374) E
375) C
376) D
377) (a) 0.74 A (b) 1.3 mC
378) 2.6 μF
379) (a) 19 s (b) 4.4 V
380) 15×10^{-6} F
381) (a) 2.50 A (b) 458 μC
382) C
383) D
384) 22 Ω
385) A
386) D
387) B
388) (a) 2.2 mΩ (b) 15 kΩ
389) 9.6×10^{-16} N
390) 1.3×10^{-20} N, toward the east
391) D
392) 2.3×10^{-18} N
393) D
394) 1.2×10^{-2} T, +z direction
395) C
396) D
397) E
398) C
399) B
400) C
401) A
402) (a) 11 mm (b) 0.22 μs
403) 0.083 T, into the paper
404) C
405) C
406) E
407) C
408) C
409) B
410) D
411) D

412) D
413) 0.066 N, -*y* direction
414) B
415) C
416) C
417) D
418) E
419) A
420) E
421) B
422) A
423) A
424) E
425) B
426) E
427) (a) 13 × 10^{-5} N/m, repulsive (b) 5.3 × 10^{-5} T
428) 0.50 A, from bottom to top
429) D
430) C
431) E
432) 0.45 A · m^2
433) (a) 17 A · m^2 (b) 0.11 m^2
434) C
435) 0.64 N · m
436) D
437) E
438) C
439) D
440) E
441) A
442) C
443) C
444) E
445) D
446) 39°
447) C
448) 5.0 kA
449) B = 4.7×10^{-6} T, out of the plane of the paper.
450) D
451) A
452) D
453) C
454) E
455) B
456) D
457) B
458) E
459) D
460) D
461) D
462) E

463) A
464) B
465) 2.0 mT
466) 251 μT
467) B
468) B
469) C
470) B
471) C
472) D
473) D
474) A
475) B
476) A
477) D
478) D
479) (a) 10. km/s (b) 4.4 × 10^{-25} kg
480) B
481) D
482) C
483) B
484) B
485) B
486) C
487) 9.4 V
488) 2.88 V
489) (a) 0.065 T · m^2 (b) 6.5 V
490) 9.6×10^{-4} A, counterclockwise
491) E
492) D
493) A
494) D
495) A
496) B
497) B
498) C
499) D
500) C
501) A
502) A
503) A
504) B
505) D
506) A
507) B
508) (a) counterclockwise (b) 2×10^{-1} N
509) (a) 0.174 V (b) 104. m (c) no polarity change
510) 0.32 mV
511) A
512) E

513) B
514) B
515) E
516) C
517) C
518) B
519) C
520) 64
521) A
522) D
523) D
524) B
525) B
526) D
527) C
528) E
529) (a) 240 V (b) 0.40 A
530) B
531) C
532) C
533) E
534) B
535) A
536) B
537) C
538) 1 to 20
539) (a) 0.15 A (b) 1.0:24. (c) 1:1 for ideal transformer
540) (a) 1200 (b) 22 Ma (c) 2.6 W
541) 600 V, 0.40 A
542) 22
543) C
544) B
545) A
546) D
547) 0.24 A
548) C
549) E
550) B
551) B
552) E
553) (a) 1.2 H (b) point *b*
554) D
555) B
556) C
557) D
558) D
559) (a) 1.9 A (b) 2.6 A
560) A
561) C
562) D
563) B
564) A

565) A
566) C
567) C
568) A
569) D
570) E
571) D
572) B
573) D
574) (a) 60 Hz (b) 170 V (120 V is the rms voltage)
575) 0.833 A rms, 1.18 A amplitude
576) 2.4 kW
577) 2.1 A
578) (a) 0.80 A (b) 0.57 A
579) (a) 1.77 A (b) 1.25 A (c) 96.0 Ω
580) 90 W
581) C
582) B
583) C
584) A
585) D
586) B
587) C
588) D
589) 0.13 kHz
590) 0.15 MHz
591) (a) 27 kΩ (b) 4.5 mA (c) 18 mA
592) (a) 75.4 Ω (b) 1.59 A (c) 0.398 A
593) 70 μF
594) E
595) A
596) C
597) D
598) A
599) D
600) D
601) D
602) C
603) D
604) B
605) C
606) C
607) A
608) B
609) A
610) A
611) B
612) C
613) B
614) A
615) C
616) A

617) D
618) C
619) B
620) A
621) A
622) B
623) C
624) D
625) A
626) D
627) C
628) C
629) C
630) E
631) D
632) D
633) C
634) E
635) C
636) D
637) E
638) D
639) D
640) A
641) B
642) C
643) B
644) A
645) E
646) C
647) C
648) C
649) B
650) C
651) B
652) C
653) C
654) B
655) E
656) 265 V
657) (a) 0.726 kHz to 1.39 kHz (b) 1.20 A
658) B
659) C
660) A
661) B
662) D
663) 0.20 kHz
664) The current lags by 72°
665) (a) The source voltage leads the current. (b) 570 V
666) (a) 1.4 H (b) 0.356 A
667) E
668) E

669) B
670) D
671) B
672) A
673) C
674) B
675) D
676) C
677) D
678) A
679) D
680) C
681) A
682) D
683) B
684) C
685) 860 V
686) D
687) C
688) C
689) B
690) B
691) E
692) D
693) D
694) D
695) B
696) B
697) A
698) C
699) A
700) D
701) B
702) D
703) C
704) B