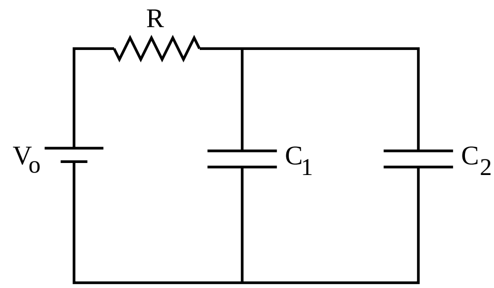
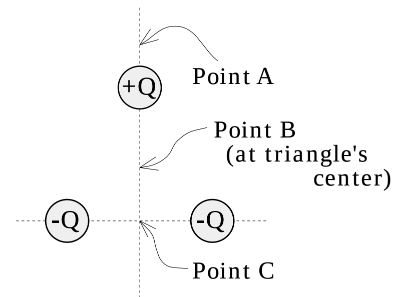
Multiple Choice -- TEST I



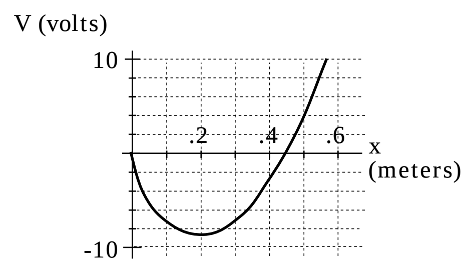
1.) The capacitors in the circuit are fully charged. At t = 0, the dielectric between the plates of C_1 is quickly removed and that capacitance is halved. As a consequence:

a.) After a long period of time, the charge on C_2 will increase.
b.) After a long period of time, the charge on C_2 will decrease.
c.) Just an instant after the dielectric is removed, the voltage across C_1 will go to $2V_o$.
d.) None of the above.



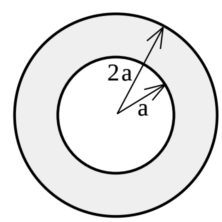
2.) The charges shown in the configuration form an equilateral triangle. Where will a negative charge most likely feel a net force in the -j direction?

a.) Point A.
b.) Point B.
c.) Point C.
d.) Both Points A and C.
e.) None of the labeled points.



3.) An electrical potential field along the x-axis is defined by the graph shown. The associated electric field is:

a.) Initially negative, then positive. Also, the field is zero at x = .45 meters.
b.) Initially positive, then negative. Also, the field is zero at x = .45 meters.
c.) Initially positive, then negative. Also, the field is zero at x = .2 meters.
d.) None of the above.



4.) A hollow sphere of inside radius a and outside radius 2a has a volume charge density shot through it of $\frac{k_3 e^{-k_4 r}}{r^2}$, where k_3 and k_4 are constants. The electric flux through a sphere whose radius is 2a will be:

a.) $\left(-\frac{4\pi k_3}{k_4 \varepsilon_o}\right)\left(e^{-k_4 r}\right)$, and that function would have been different if the inside radius of the hollow had been (1/2)a.

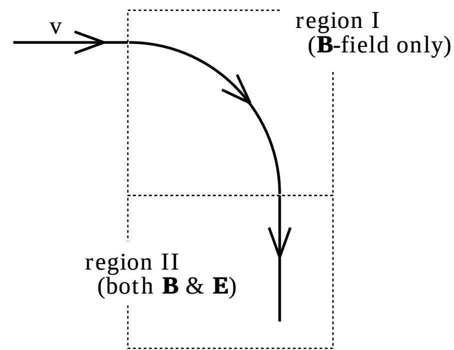
b.) $\left(-\frac{4\pi k_3}{k_4 \varepsilon_o}\right)\left(e^{-k_4 (2a)} - e^{-k_4 a}\right)$, and that function would have been different if the inside radius of the hollow had been (1/2)a.

c.) $\left(\frac{4\pi k_3}{k_4\varepsilon_o}\right)\left(e^{-k_4 r}\right)$, and that function would not have been different if the inside radius of the hollow had been (1/2)a.

d.) $\left(-\frac{4\pi k_3}{k_4\varepsilon_o}\right)\left(e^{-k_4(2a)} - e^{-k_4 a}\right)$, and that function would not have been different if the inside radius of the hollow had been (1/2)a.

e.) The integral involved in this problem is not standard, hence the problem cannot be solved without access to a table of integrals.

5.) A positive charge moves with known velocity v into region I in which exists an unknown B-field. It accelerates as shown in the sketch, then enters region II in which there exists not only B but also an unknown electric field E.



a.) The direction of the B-field is toward the bottom of the page, and there is no need for the presence of an electric field to keep the charge moving in the direction shown in region II, E = 0.

b.) The direction of the B-field is into the page, and the direction of the E-field is to the left.

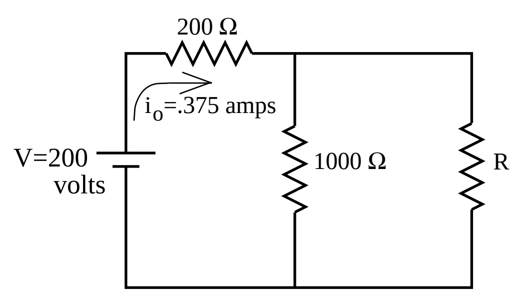
c.) The direction of the B-field is into the page, and the direction of the E-field is to the right.

d.) The direction of the B-field is out of the page, and the direction of the E-field is to the left.

e.) The direction of the B-field is out of the page, and the direction of the E-field is to the right.

f.) None of the above.

6.) Given the circuit information shown, how large must the resistor R be?



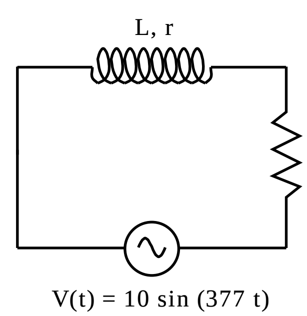
a.) 500 Ω.

b.) 1000 Ω.

c.) 2000 Ω.

d.) None of the above.

7.) The RMS voltage across the 10 kΩ resistor in the RL circuit shown is 2 volts. The approximate RMS voltage across the inductor is:



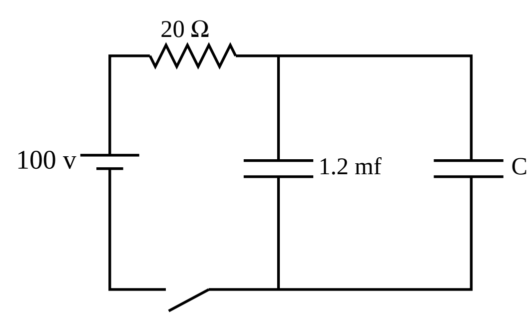
a.) 3 volts.

b.) 5 volts.

c.) 8 volts.

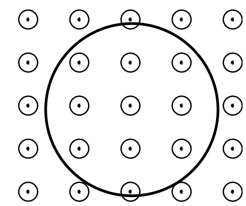
d.) None of the above.

8.) The capacitors in the circuit shown are initially uncharged. At t = 0, the switch is closed. At t = .2 seconds, it is observed that the current being drawn from the battery is approximately 2 amps. The capacitance of C is approximately:



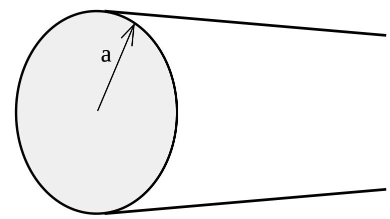
a.) 4.4 mf.
b.) 8.8 mf.
c.) 13.3 mf.
d.) None of the above.

9.) A coil of resistance R faces a uniform B-field coming out of the page that doubles at a constant rate every 10 seconds. At t = 0, the field strength is .5 teslas. As time progresses:



a.) The EMF generated in the coil will be constant, and the induced current in the coil will be clockwise.
b.) The EMF generated in the coil will increase, and the induced current in the coil will be counterclockwise.
c.) The EMF generated in the coil will decrease, and the induced current in the coil will be clockwise.
d.) The EMF generated in the coil will increase, and the induced current in the coil will be clockwise.
e.) There will be no EMF or induced current in the coil.

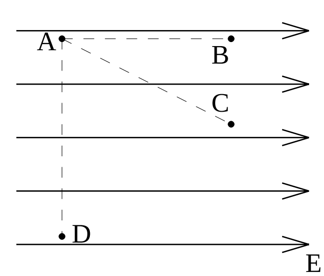
10.) A solid cylinder of radius a has a volume charge density shot through it of $\frac{k_3 e^{-k_4 r}}{r}$, where k_3 and k_4 are constants. The electric field function for r < a is:



a.) $\left(-\frac{k_3}{k_4 r \varepsilon_o}\right)e^{-k_4 r}$.
b.) $\left(-\frac{k_3}{k_4 r \varepsilon_o}\right)\left(e^{-k_4 r} - 1\right)$.
c.) $\left(\frac{-k_3}{k_4 \varepsilon_o r}\right)\left(e^{-k_4 r} - e^{-k_4 a}\right)$.
d.) None of the above.

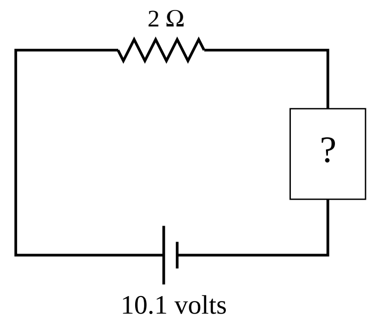
11.) A 1 amp fuse is placed in series with an RC circuit in which the AC voltage amplitude is 1500 volts. The net resistance is 140 Ω, and the capacitance is 20 mf. Approximately what is the largest frequency at which the power supply can operate without blowing the fuse?
a.) 350 Hz.
b.) 500 Hz.
c.) 5000 Hz.
d.) None of the above.

12.) An electric field is set up as shown.

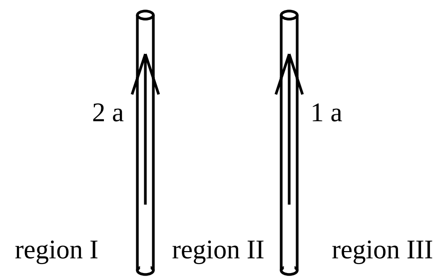


a.) The field will do more work when a positive charge goes from A to B than when the same charge goes from A to C.
b.) The field will do the same amount of work when a positive charge goes from A to B as when the same charge goes from A to C.

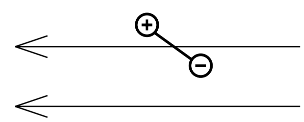
c.) The field will do more work when a positive charge goes from A to B than when the same charge goes from A to D because the distance between A and D is greater.
d.) None of the above.



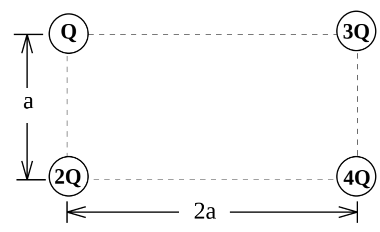
13.) Approximately 1 amp flows into the box. The circuit that exists inside the box will be:
a.) Four 2 Ω resistors in series.
b.) Four 32 Ω resistors in parallel.
c.) An 8 Ω resistor in parallel with a 10,000 Ω resistor.
d.) Both a and b.
e.) Responses a, b, and c.



14.) In what region is the net magnetic field equal to 2 teslas directed out of the page?
a.) In region I.
b.) In region II.
c.) In region III.
d.) Both in regions I and II.
e.) All of the above.



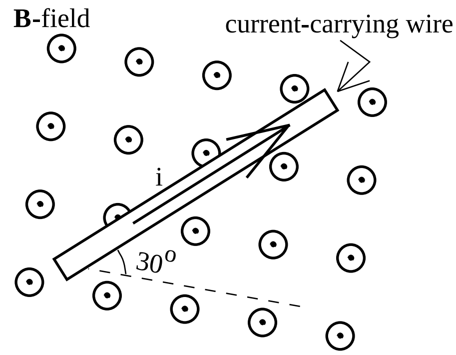
15.) A dipole is placed in an electric field as shown. Over time, the dipole will:
a.) Experience a constant acceleration of its center of mass toward the right and will experience a constant torque that motivates it to angularly accelerate in a clockwise direction.
b.) Experience no acceleration of its center of mass but will experience a varying torque that motivates it to angularly accelerate in a clockwise direction.
c.) Experience a varying acceleration of its center of mass toward the left and will experience a varying torque that motivates it to angularly accelerate in a clockwise direction.
d.) Experience no acceleration but will experience a varying torque that motivates it to angularly accelerate in a counterclockwise direction.
e.) None of the above.



16.) Charges are placed as shown at the corners of a rectangle.
a.) At the center of the rectangle, the x-component of the electric field will be positive (to the right) and the y-component will be negative (downward).
b.) At the center of the rectangle, the x-component of the electric field will be negative (to the left) and the y-component will be negative (downward).
c.) At the center of the rectangle, the x-component of the electric field will be positive (to the right) and the y-component will be positive (upward).
d.) At the center of the rectangle, the x-component of the electric field will be negative (to the left) and the y-component will be positive (upward).

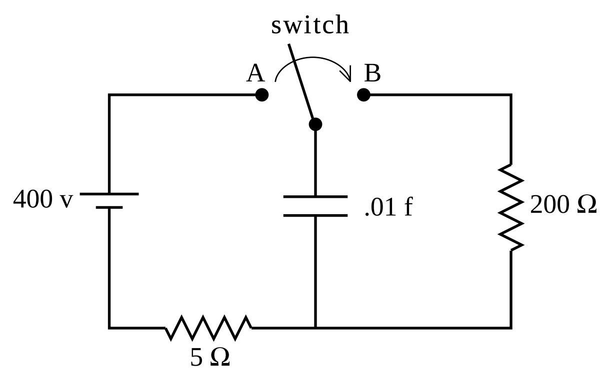
17.) A 2 meter long wire carries a .5 amp current as shown. If the wire is bathed in a 10^{-2} tesla magnetic field, the magnitude of the force on the wire is:

a.) Zero newtons.
b.) $.5 \times 10^{-2}$ newtons.
c.) 10^{-2} newtons.
d.) None of the above.



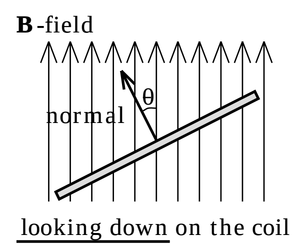
18.) In the system shown, the switch has been set on contact A for a long time. At t = 0, the switch flips from contact A to contact B. The power dissipated by the resistor during the discharge will be:

a.) 200 watts.
b.) 400 watts.
c.) 800 watts.
d.) None of the above.



19.) The magnetic flux through a square loop is found to be 10^{-4} webers when the loop's normal is oriented at an unknown angle θ relative to the direction of the B-field (see sketch). When the normal is parallel to the direction of the B-field, the magnetic flux through the loop is 10^{-3} webers. The angle θ is:

a.) 22^o.
b.) 47^o.
c.) 78^o.
d.) None of the above.

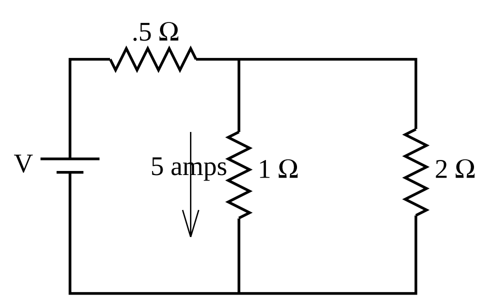


20.) An electric field is defined by $E = kr^2r$, where r is a unit vector in the radial direction.

a.) The units of k must be kilograms/(meter·second^2·coulomb).
b.) The units of k must be volt/meter^3.
c.) The units of k must be newtons/(meter^2·coulomb).
d.) All of the above.
e.) None of the above.

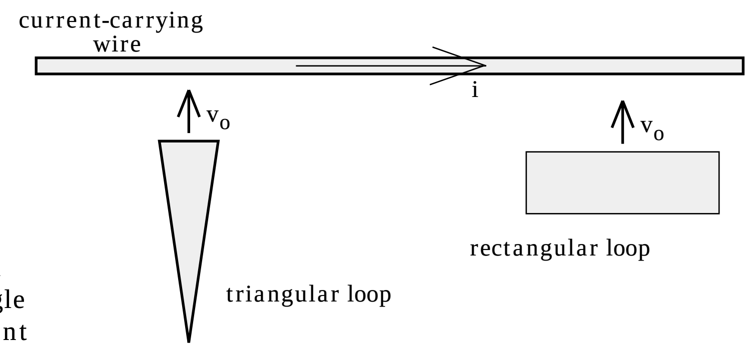
21.) The voltage across the .5 Ω resistor is:

a.) 12.5 volts.
b.) 7.5 volts.
c.) 5 volts.
d.) None of the above.



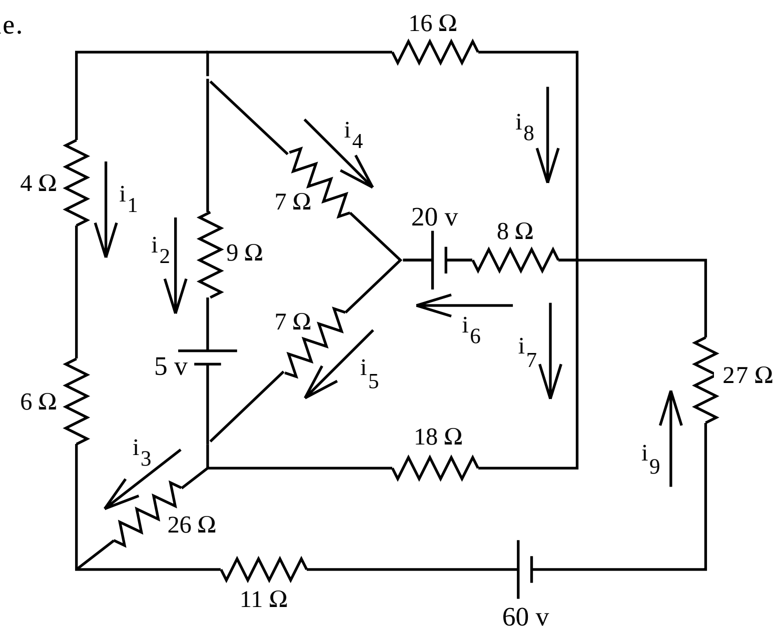
22.) A .5 kg mass has a 10 coulomb charge on it. It is placed in an electrical potential field at x = 2 meters where the voltage is 2 volts. Released from rest, the mass is allowed to accelerate freely. At x = 3 meters, its velocity is 12 m/s.

a.) The voltage at x = 3 meters is 1.6 volts.
b.) The voltage at x = 3 meters is -1.6 volts.
c.) The voltage at x = 3 meters is -1.7 volts.
d.) None of the above.



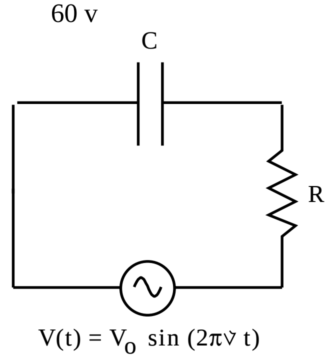
23.) A triangular loop and a rectangular loop each have the same area. Each is forced to approach a current-carrying wire with the same constant velocity (see sketch and ignore gravity).

a.) The direction of the induced current in both is clockwise, and the induced current in the triangle is greater than the induced current in the rectangle.
b.) The direction of the induced current in both is counterclockwise, and the induced current in the triangle is greater than the induced current in the rectangle.
c.) The direction of the induced current in both is clockwise, and the induced current in the rectangle is greater than the induced current in the triangle.
d.) The direction of the induced current in both is counter-clockwise, and the induced current in the rectangle is greater than the induced current in the triangle.
e.) The induced currents are in opposite directions.



24.) For the large circuit shown:

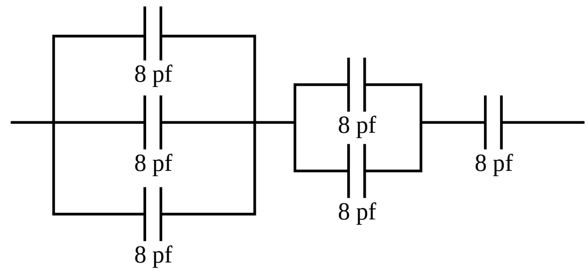
a.) $-38i_9 - 18i_7 - 26i_3 = 60$.
b.) $16i_8 - 7i_4 + 8i_6 = -20$.
c.) $7i_4 - 9i_2 + 7i_5 = 5$.
d.) There are at least two correct loop equations above.
e.) None of the above.



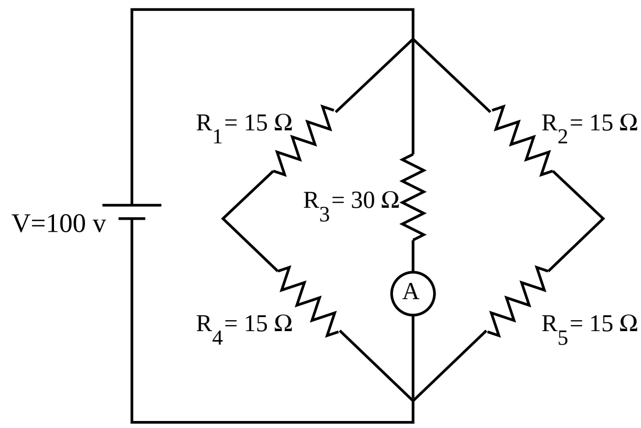
25.) The capacitance of the capacitor in the circuit is 10 nf and the resistance is R = 1000 Ω. At 200 cycles per second, the approximate capacitive reactance of the circuit is:

a.) 1.25×10^{-4} Ω.

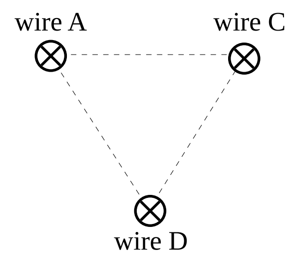
b.) 2000 Ω.
c.) 80000 Ω.
d.) None of the above.



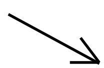
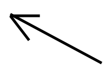
26.) The equivalent capacitance for the capacitor combination shown is:
a.) 11/48 picofarads.
b.) 48/11 picofarads.
c.) 14.67 picofarads.
d.) None of the above.



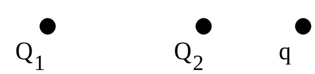
27.) In the circuit shown to the right, what will the ammeter read?
a.) Zero amps.
b.) 3.3 amps.
c.) 10 amps.
d.) None of the above.



28.) Three current-carrying wires oriented perpendicular to the page are positioned at the corners of a triangle as shown. Assume the current magnitudes are the same for all of the wires. Wires C and D will produce a magnetic force on wire A. In what direction will that force be?

a.)  **b.)**  **c.)**  **d.)**  **e.)** None of these.

29.) The net impedance in an RL circuit is 2000 Ω. The resistor-like resistance in that circuit is 1000 Ω. The inductor is removed and placed in a second circuit whose voltage amplitude is twice that of the original circuit and whose frequency is the same. The resistor-like resistance in that circuit is 500 Ω. The approximate impedance in that circuit will be:
a.) 1000 Ω.
b.) 1800Ω.
c.) 4000 Ω.
d.) None of the above.



30.) Charges Q_1 and Q_2 are placed as shown. We don't know whether they are positive or negative. It is known that charge q is positive and that, as placed, it feels no electric force.
a.) Charge Q_1 must be positive and larger in magnitude than Q_2, which must be negative.
b.) Charge Q_1 must be negative and larger in magnitude than Q_2, which must be positive.
c.) Charge Q_1 must be negative and smaller in magnitude than Q_2, which must be positive.

d.) If q's charge had been negative, it would have been necessary to place it on the other side of Q_1 to find a point where it would feel no force.

e.) None of the above.

31.) Two large parallel plates are oppositely charged, then disconnected from the battery source that charged them up. The distance between the plates is then doubled.

a.) The electric field will halve as will the electrical potential difference between the plates.

b.) The electric field will halve but the electrical potential difference between the plates will stay the same.

c.) The electric field will stay the same and the electrical potential difference between the plates will stay the same.

d.) The electric field will stay the same but the electrical potential difference between the plates will double.

e.) None of the above.

32.) A variable power supply produces an AC voltage equal to 5 sin ($4\pi t$) volts. What is the frequency of the source?

a.) 2 hertz.

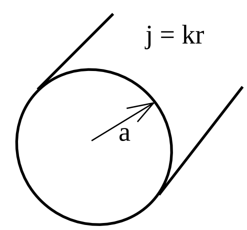
b.) 2 cycles/second.

c.) 79 hertz.

d.) Both a and b.

e.) None of the above.

33.) A wire of radius a is made of an odd mixture of metals that effectively allows for a current that varies from point to point across the cross section of the wire. In fact, the current along the central axis is zero with the current magnitude getting larger as one moves out from there. The current density function (i.e., the current per unit area) is j = kc, where c is a distance from the wire's central axis to the point of interest. What is the magnitude of the magnetic field a distance r units from the central axis, where r < a?



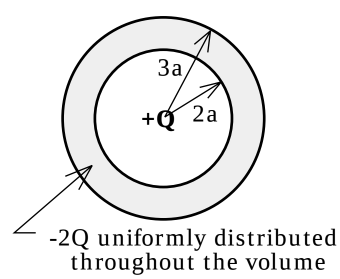
a.) $k\mu_o c^2/(2r)$.

b.) $k\mu_o c^3/(3r)$.

c.) $k\mu_o c^4/(4r)$.

d.) None of the above.

34.) A charge +Q is suspended at the center of a hollow sphere that is, itself, charged uniformly to -2Q. The sphere's inside radius is 2a and its outside radius is 3a.



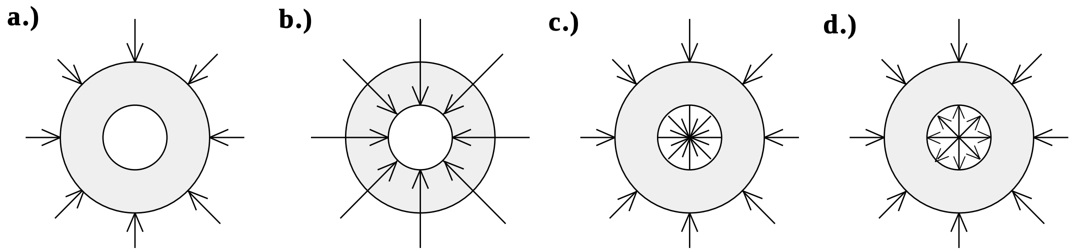
a.) The electric field lines outside the sphere will be oriented radially outward, and there will be a place between 2a and 3a at which the electric field is zero.

b.) The electric field lines outside the sphere will be oriented radially inward, and there will be a place between 2a and 3a at which the electric field is zero.

c.) The electric field will be continuous across the boundary defined by the inside radius (i.e., at 2a).
d.) Both b and c.
e.) None of the above.

35.) A 10 mf capacitor is charged by a 100 volt battery, then isolated (i.e., removed from the circuit). It is then connected in parallel with an uncharged capacitor C. After the charge on the 10 mf capacitor redistributes itself, the voltage across C is measured at 80 volts. The capacitance C is:
a.) 12 mf.
b.) 8 mf.
c.) 2.5 mf.
d.) None of the above.

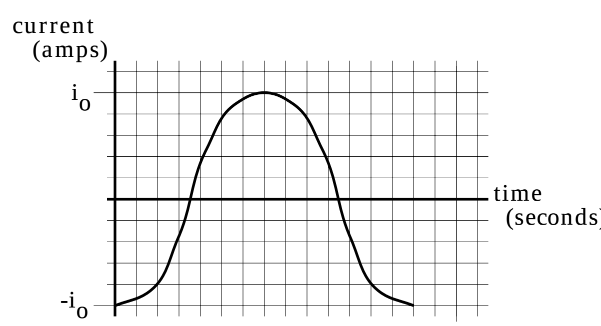
36.) If you place a charge -Q on a hollow conducting sphere, the electric field lines for the situation will look like:



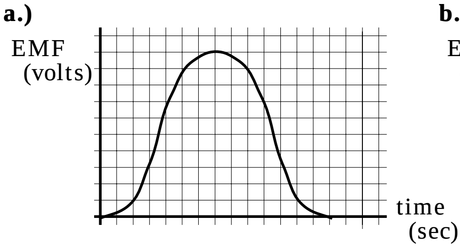
e.) None of these.

37.) A .5 kg mass has a 10 coulomb charge on it. It is placed at point A in an electric field and released from rest, freely accelerating to point B. The electrical potential of B is 40 volts.
a.) If the field does 200 joules of work in the process, the velocity of the mass when at B is $(200)^{1/2}$ m/s.
b.) If the field does 200 joules of work in the process, the velocity of the mass when at B is $(800)^{1/2}$ m/s.
c.) If the field does 200 joules of work in the process, there isn't enough information to determine the velocity at A because we don't have enough information to calculate the voltage at A.
d.) None of the above.

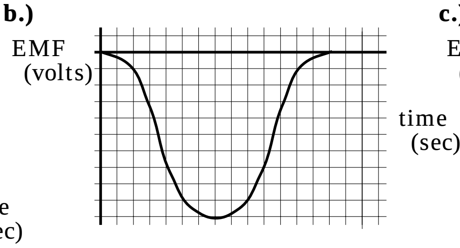
38.) A graph of the current through the primary coil of a transformer looks like the sketch shown (note that at t = 0, the current is negative). A graph of the EMF set up in the secondary will look like:



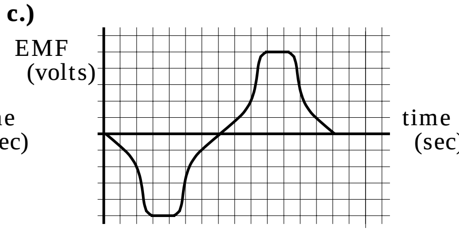
a.)



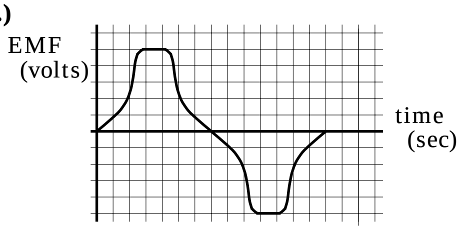
b.)



c.)



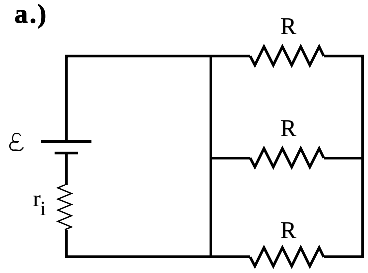
d.)



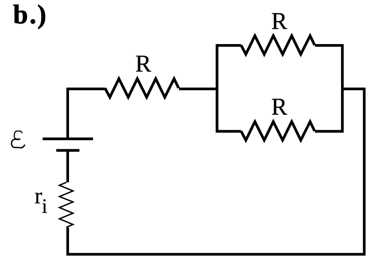
e.) None of the above.

39.) In the circuit below, each of the resistors characterized by R is the same size. Assuming the power supply's EMF is $\mathcal{E}$ while its very small internal resistance is r_i, which circuit will increase the temperature of water the fastest, assuming that all three heating resistors are immersed?

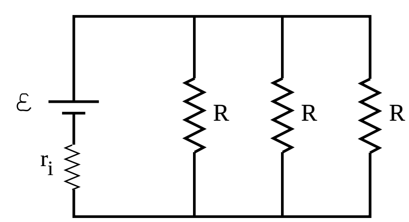
a.)



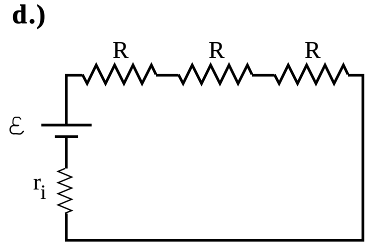
b.)



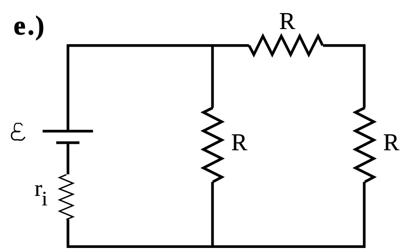
c.)



d.)



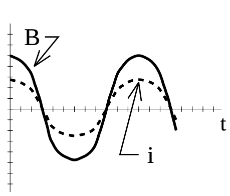
e.)



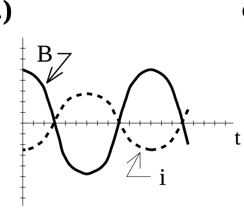
f.) To a good approximation, there are at least two circuits that will provide the maximum heating power to the circuit.

40.) A coil is placed in a changing magnetic field. A graph of the B-field is shown on each of the grids below. Due to the changing B-field, an induced current is generated in the coil. Which graph depicts the appropriate current function, given the B-field function?

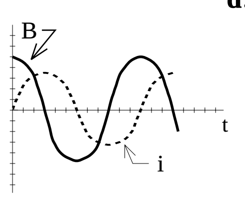
a.)



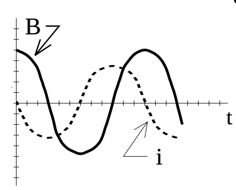
b.)



c.)



d.)



e.) None of these.