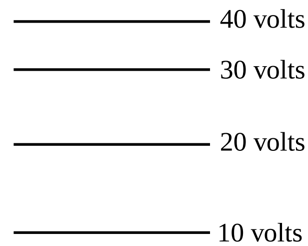
Multiple Choice--Test IV



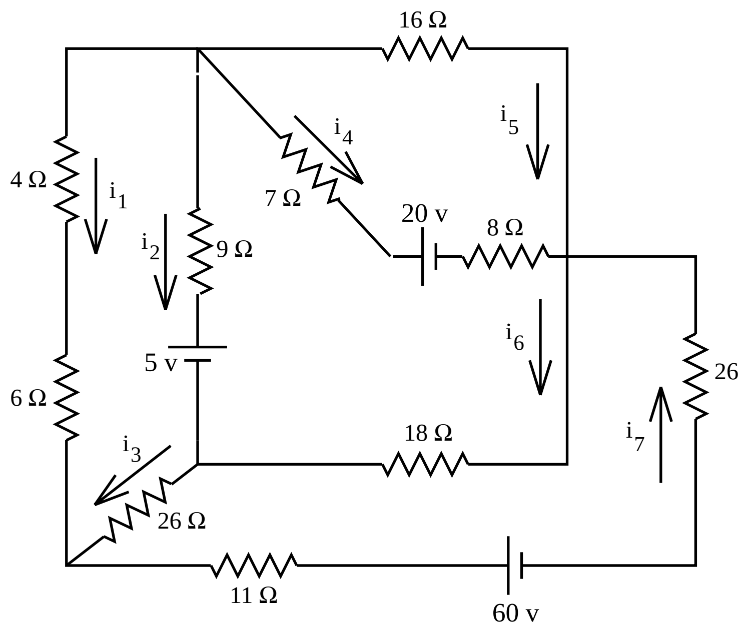
1.) In a 10 second period, a -2 coulomb charge is made to move with a constant velocity from the top to the bottom of the electrical potential field shown.

a.) The electric field direction will be downward and the power provided by the field will equal +6 watts, where the positive sign signifies the fact that the charge's potential energy has increased.

b.) The electric field direction will be upward and the power provided by the field will equal -6 watts, where the negative sign signifies the fact that the charge's potential energy has decreased.

c.) The electric field direction will be downward and the power provided by the field will equal -6 watts, where the negative sign signifies the fact that the charge's potential energy has decreased.

d.) None of the above.



2.) For the large circuit shown:

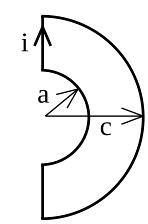
a.) $16i_5 - 15i_4 + 20 = 0$.

b.) $-15i_4 - 18i_6 + 9i_2 = 15$.

c.) $60 + 37i_7 + 10i_1 + 16i_5 = 0$.

d.) Both b and c.

e.) None of the above.



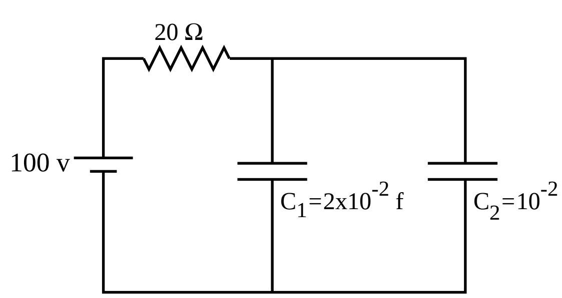
3.) What is the magnitude of the magnetic field at the center of the two connected arcs?

a.) There is not enough information to complete this problem.

b.) $-\frac{\mu_o i}{4c} + \frac{\mu_o i}{4a}$.

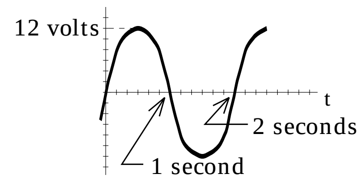
c.) $-\frac{\mu_o i}{4c} - \frac{\mu_o i}{4a}$.

d.) None of the above.



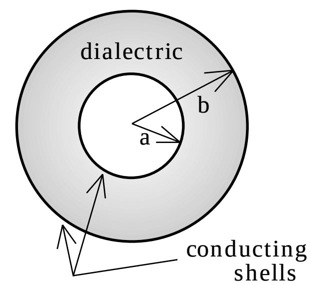
4.) The charge ratio between capacitors C_1 and C_2 is:

a.) 1:2.
b.) 2:1.
c.) 2:4.
d.) None of the above.



5.) The induced voltage across a .6 mH inductor is shown in the graph to the right. The rate of change of the current at t = .5 seconds will be:

a.) Zero.
b.) $2x10^{4}$ amps/second.
c.) $7.2x10^{-4}$ amps/second.
d.) None of the above.



6.) A spherical conducting shell of radius b bounds a dielectric-filled region (dielectric constant κ_d) centered on a second smaller conducting shell of radius a (see sketch). The capacitance of the system is:

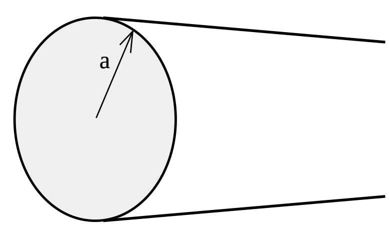
a.) $[4\pi\kappa_d\varepsilon_o(b-a)]/(ab)$.
b.) $(4\pi\kappa_d\varepsilon_o ab)/(b-a)$.
c.) $qab/[(4\pi\kappa_d\varepsilon_o)(b-a)]$.
d.) None of the above.

7.) A 10 amp fuse is placed in series with an RL circuit in which the AC voltage amplitude is 1500 volts, the net resistance is 140 Ω, and the inductance is 20 mH. Approximately what is the lowest frequency the power supply can operate at without blowing the fuse?

a.) $1.10x10^{4}$ Hz.
b.) $2.35x10^{4}$ Hz.
c.) $4.29x10^{3}$ Hz.
d.) None of the above.

8.) At a distance of 1R from a field-producing point charge, the coulomb force on a test charge is 1F. What is the slope of the force vs. position graph for that charge as evaluated at a distance 3R?

a.) -FR/3.
b.) -F/3R.
c.) -F/9R.
d.) -2F/27R.
e.) None of the above.



9.) A solid cylinder of radius a has a volume charge density shot through it of $-k_2/r$, where k_2 is a constant. The electric field function outside of a is:

a.) $\dfrac{-k_2 a}{\varepsilon_o r}$.

b.) $\dfrac{-k_2}{\varepsilon_o r}(r-a)$.

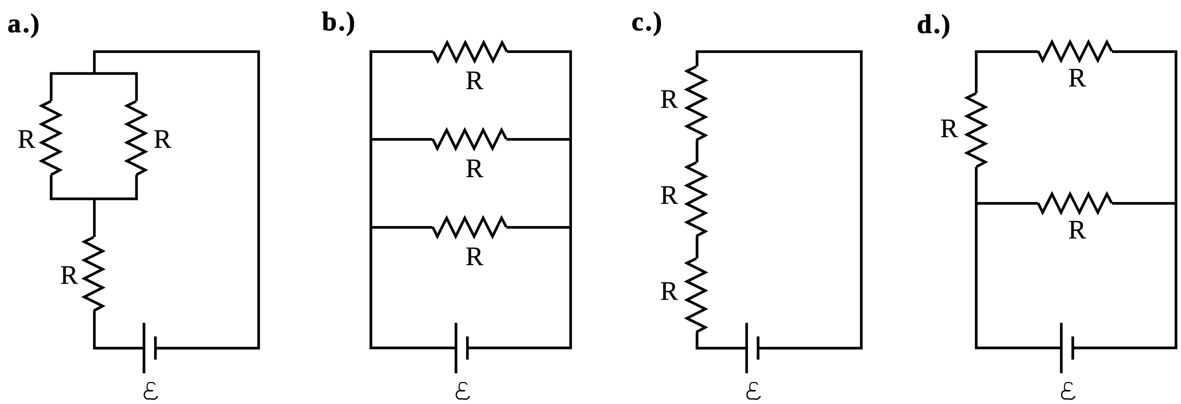
c.) $\dfrac{-k_2}{2\varepsilon_o r^2}(r^2-a^2)$.

d.) None of the above.

10.) A .5 kg mass has a 10 coulomb charge on it. It is placed at x = 3 meters in an electric field equal to (kx)i, where k = 1 nt/(coulomb·meter). The voltage at x = 3 meters is -4.5 volts. Released from rest, the mass is allowed to accelerate freely to a point whose voltage is -18 volts. At that point:

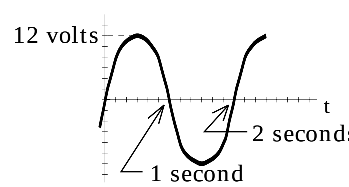
a.) The mass's coordinate is x = 13.5 meters.
b.) The mass's coordinate is x = 12 meters.
c.) The mass's coordinate is x = 6 meters.
d.) None of the above.

11.) In the circuit below, each of the resistors characterized by R is the same size. As far as equivalent resistance goes, which of the combinations comes closest to a single resistor R?



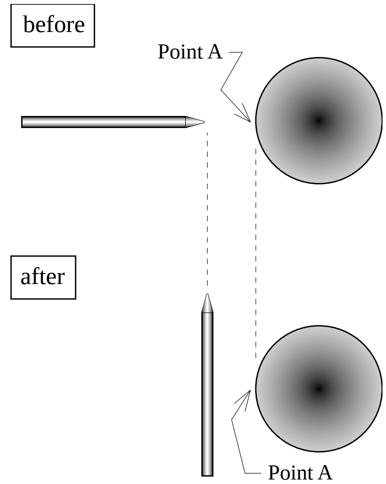
a.) Circuit a.
b.) Circuit b.
c.) Circuit c.
d.) Circuit d.

12.) A graph of the voltage across an AC power supply is shown. The voltage can be characterized as:



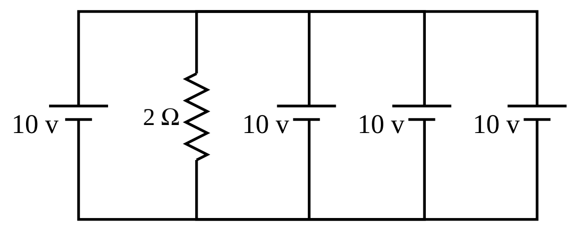
a.) 12 sin (πt) volts.
b.) 12 sin (2t) volts.
c.) 12 sin (2πt) volts.
d.) None of the above.

13.) A positively charged conducting rod is brought in close to an uncharged conducting ball, as shown in the "before" sketch. The rod is then rotated to the position shown in the "after" sketch. Point A is very, very close to the ball.



- a.) The net electric field at Point A will have the same magnitude in the two scenarios, and the direction of the net electric field at Point A will also be the same in both scenarios.
- b.) The net electric field at Point A will have the same magnitude in the two scenarios, but the direction of the net electric field at Point A in the after situation will have a component toward the bottom of the page.
- c.) The net electric field at Point A will not have the same magnitude in the two scenarios, and the direction of the net electric field at Point A in the after situation will have a component toward the bottom of the page.
- d.) The net electric field at Point A will not have the same magnitude in the two scenarios, and the direction of the net electric field at Point A in the after situation will have a component toward the top of the page.
- e.) None of the above.

14.) Consider the circuit shown. If four more 10 volt batteries were added in parallel to the power supplies already there:



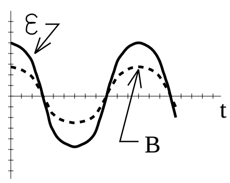
- a.) Both the power and current provided by each battery will remain the same.
- b.) Both the power and current provided by each battery will decrease by 1/2.
- c.) Both the power and current provided by each battery will decrease by 1/4.
- d.) None of the above.

15.) Four equal, uncharged series capacitors are connected in series with a switch and a fixed-voltage power source (call this circuit 1). When the switch connecting the power supply to the capacitors is closed, Q's worth of charge is drawn from the power supply during the time it takes for the capacitors to fully charge. A nearly identical second circuit (call this circuit 2) has five uncharged series capacitors instead of four. The power supply is exactly the same, and when its switch is closed, the circuit's capacitors are given enough time to charge fully. For this situation:

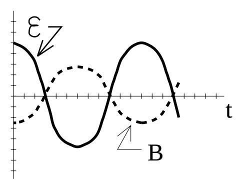
- a.) The net capacitance of circuit 2 will be greater than that of circuit 1. Also, the total charge drawn from the power supply in circuit 2 will be greater than that drawn in circuit 1.
- b.) The net capacitance of circuit 2 will be greater than that of circuit 1. Also, the total charge drawn from the power supply in circuit 2 will be less than that drawn in circuit 1.
- c.) The net capacitance of circuit 2 will be less than that of circuit 1. Also, the total charge drawn from the power supply in circuit 2 will be less than that of circuit 1.
- d.) None of the above.

16.) A coil is placed in a changing magnetic field. A graph of the induced EMF in the coil is shown on each of the grids below. Which graph depicts the appropriate B-field function, given the EMF function?

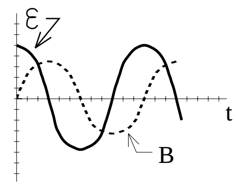
a.)



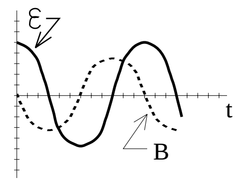
b.)



c.)

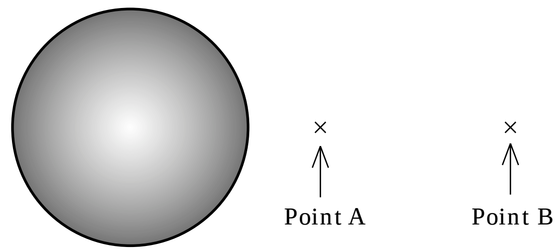


d.)



e.) None of these.

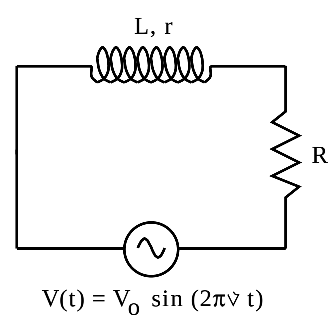
17.) Charge Q is uniformly distributed through a solid sphere. The voltage at Point A is known to be 10 volts. Point B is twice as far from the sphere's center as is Point A.



a.) The voltage at Point B is 20 volts.
b.) The voltage at Point B is 10 volts.
c.) The voltage at Point B is 5 volts.
d.) The voltage at Point B is 2.5 volts.
e.) None of the above.

18.) A spherical shell has an inside radius of a and outside radius of b. The charge density within the shell is k/r, where k is a constant with appropriate units.

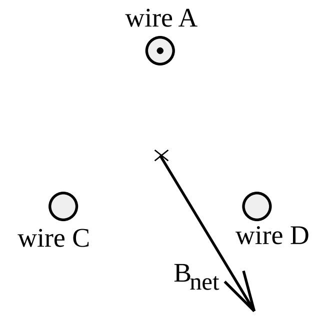
a.) The shell is a conductor whose charge density decreases as r increases, and whose electric field inside the shell increases as r increases.
b.) The shell is a conductor whose charge density decreases as r increases, and whose electric field inside the shell decreases as r increases.
c.) The shell is an insulator whose charge density decreases as r increases, and whose electric field inside the shell increases as r increases.
d.) The shell is an insulator whose charge density decreases as r increases, and whose electric field inside the shell decreases as r increases.
e.) None of the above.



19.) The inductance of the inductor in the circuit shown is 10 mH and its resistor-like resistance is 100 Ω. The load resistor is R = 1000 Ω. The frequency of the source is 20,000 cycles/second. The impedance of the circuit is:

a.) 1107Ω.
b.) 1255 Ω.
c.) 1670 Ω.
d.) None of the above.

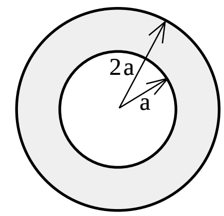
20.) Three current-carrying wires oriented perpendicular to the page are positioned at the corners of a triangle as shown on the next page. Wire A's current is out of the page.



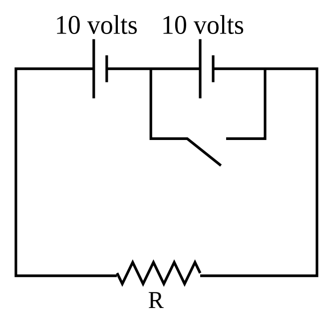
Assuming the current magnitudes are the same for all of the wires, the net magnetic field at the center of the triangle will be as shown if:

a.) Currents C and D are both out of the page.
b.) Currents C and D are both into the page.
c.) Current C is into the page and current D is out of the page.
d.) None of the above.

21.) A hollow sphere of inside radius a and outside radius 2a has a volume charge density shot through it of k_2/r, where k_2 is a constant. The electric field function for the region between a and 2a is:



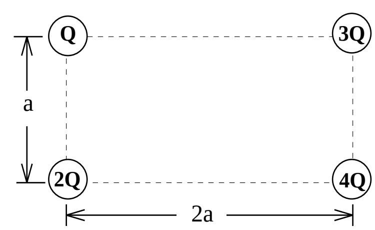
a.) $\frac{k_2}{2\varepsilon_o}$, and that function would have been different if the outside radius had been 3a.
b.) $\left(\frac{k_2}{2\varepsilon_o r^2}\right)(r^2 - a^2)$, and that function would have been different if the outside radius had been 3a.
c.) $\frac{k_2}{2\varepsilon_o}$, and that function would not have been different if the outside radius had been 3a.
d.) $\left(\frac{k_2}{2\varepsilon_o r^2}\right)(r^2 - a^2)$, and that function would not have been different if the outside radius had been 3a.
e.) None of the above.



22.) When the switch is closed in the circuit to the right:

a.) The power dissipated by R increases.
b.) The power drawn from the power supply complex increases.
c.) The current in the circuit increases.
d.) The equivalent resistance of the circuit increases.
e.) None of the above.

23.) Charges are placed as shown at the corners of a rectangle.

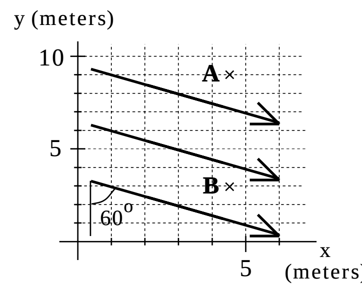


a.) Along the line between Q and 2Q, the x-component of the net electric field setup by the four charges will be toward the right side of the page, and the y-component will be toward the top of the page.
b.) Along the line between Q and 2Q, the x-component of the net electric field setup by the four charges will be toward the left side of the page, and the y-component will be toward the top of the page.
c.) Along the line between Q and 2Q, the x-component of the net electric field setup by the four charges will be toward the right side of the page, and the y-component will be toward the bottom of the page.
d.) Along the line between Q and 2Q, the x-component of the net electric field setup by the four charges will be toward the left side of the page, and the y-component will be toward the bottom of the page.
e.) None of the above.

24.) For a given primary voltage, doubling the winds in the secondary of a transformer will:

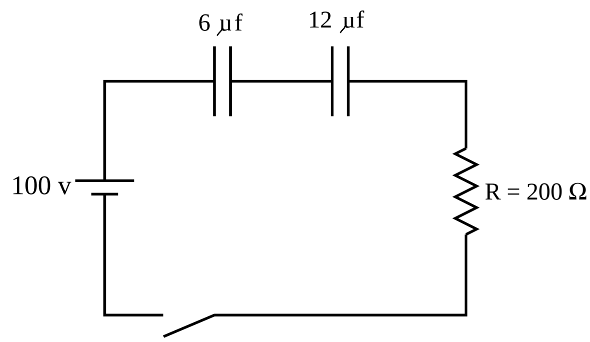
a.) Double both the secondary voltage and the secondary current.
b.) Halve the secondary voltage and double the secondary current.
c.) Double the secondary voltage and halve the secondary current.
d.) None of the above.

25.) The constant electric field shown in the sketch has a magnitude of 100 volts/meter. The voltage at B is 200 volts. The voltage at A is:



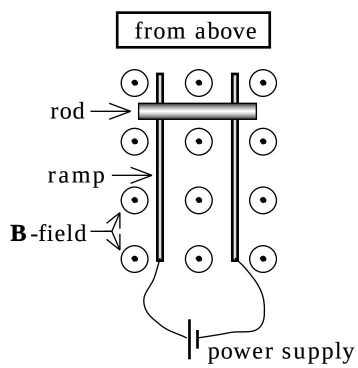
a.) -100 volts.
b.) +100 volts.
c.) +500 volts.
d.) None of the above.

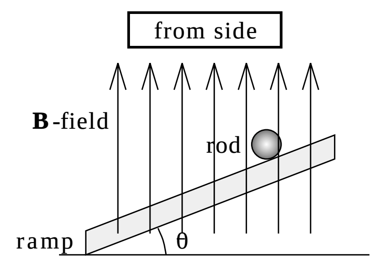
26.) The capacitors in the circuit shown are initially uncharged. If the switch is closed at t = 0, what is the maximum charge the 12 μf capacitor will hold?



a.) $2\text{x}10^{-4}$ coulombs.
b.) $4\text{x}10^{-4}$ coulombs.
c.) $6\text{x}10^{-4}$ coulombs.
d.) None of the above.

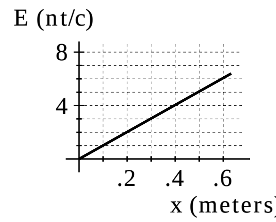
27.) An aluminum ramp tilted at an angle θ is connected to a large voltage source as shown in the sketch. The assembly is bathed in a large B-field (for the field's orientation, see the sketch). A very light aluminum cylinder is placed across the ramp and released. Assuming the battery's voltage is large, but not so large that the current generated in the aluminum cylinder spot-welds the cylinder to the ramp:





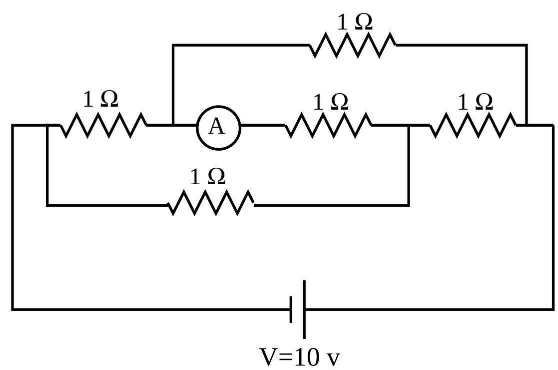
a.) The cylinder will roll down the incline but will do so more slowly than if the B-field was not present.
b.) The cylinder will roll down the incline but will do so faster than if the B-field was not present.
c.) The cylinder will roll down the incline as though there was no B-field present because aluminum is not a magnetic substance and, hence, will not be affected by the B-field.
d.) The cylinder will roll up the incline.
e.) The cylinder will not roll at all but will remain stationary.

28.) An electric field along the x-axis is defined by the graph shown. The electrical potential function that goes with this electric field is:



- a.) A constant.
- b.) Linear along the x-axis.
- c.) Quadratic along the x-axis.
- d.) None of the above.

29.) In the circuit shown, what will the ammeter read?



- a.) 2 amps.
- b.) 1 amp.
- c.) Zero amps.
- d.) None of the above.

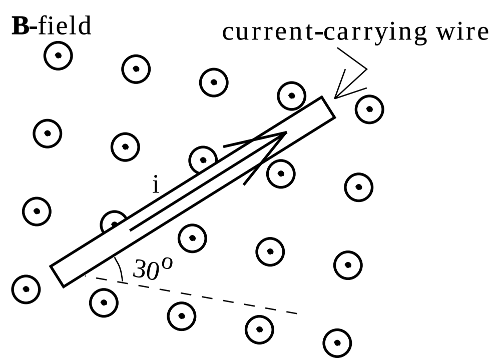
30.) Two charges q_a and q_b repulse one another with force F. If q_a's charge doubles while the distance between the two charges halves, the new force will be:

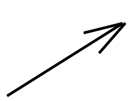
- a.) F/4.
- b.) F/2.
- c.) 2F.
- d.) 4F.
- e.) 8F.

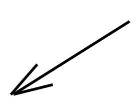
31.) A uniformly charged sphere of radius a has a Gaussian surface (a sphere) placed about it. The radius of the Gaussian surface is a (that is, the Gaussian surface is placed directly on top of the sphere). For that situation, the net flux through the Gaussian surface is ϕ. The radius of the Gaussian sphere is then halved to r/2 with everything else held constant. For this new situation, the net flux through the surface will be:

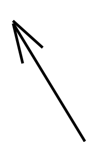
- a.) $\phi/2$.
- b.) $\phi/4$.
- c.) $\phi/8$.
- d.) None of the above.

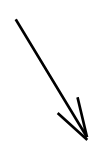
32.) A wire with current directed as shown feels a magnetic force in which direction?



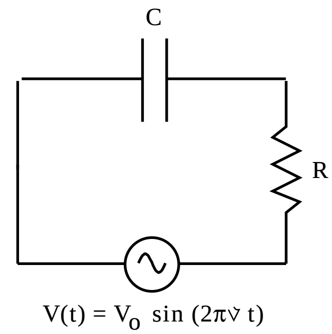
a.) 

b.) 

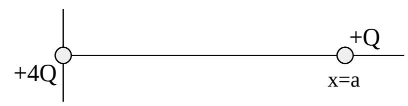
c.) 

d.) 

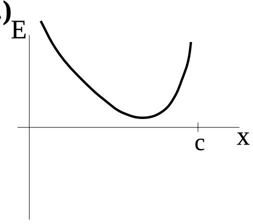
e.) None of these.

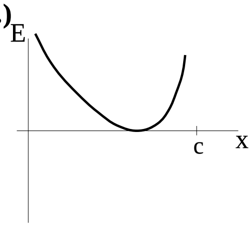


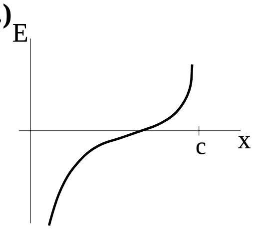
33.) If the frequency is doubled in this circuit:
- a.) The resistive nature of the capacitor will double and the current will halve.
- b.) The resistive nature of the capacitor will halve and the current will double.
- c.) The resistive nature of the capacitor will double and the current will double.
- d.) The resistive nature of the capacitor will halve and the current will halve.
- e.) None of the above.

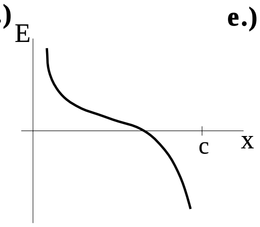


34.) Two charges are placed along the x axis as shown. A graph of the electric field E versus position x between the charges looks like:

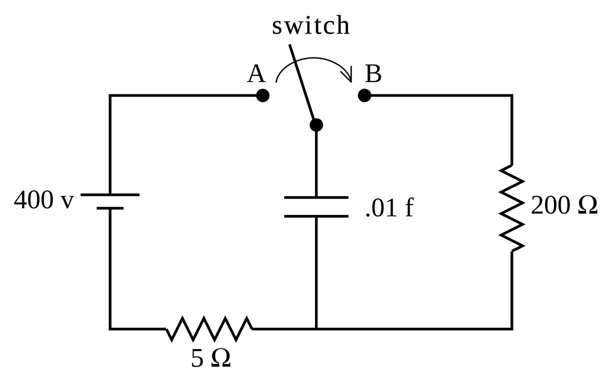
a.)


b.)


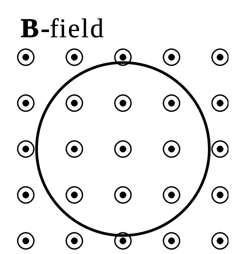
c.)


d.)


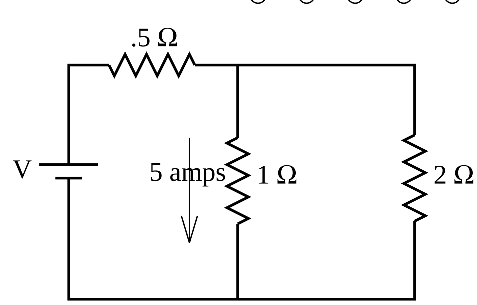
e.) None of these.



35.) 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 current in the circuit just after t = 0 will be:
- a.) .02 amps.
- b.) 1 amp.
- c.) 2 amps.
- d.) None of the above.

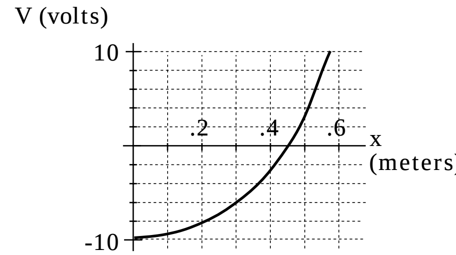


36.) A 50 turn coil of radius r = .2 meters and resistance R = 12 Ω faces a uniform B-field coming out of the page that doubles at a constant rate every 10 seconds. At t = 0, the magnetic field intensity is .25 teslas. The magnitude of the electric field setup in the coil will be:
- a.) .1 newton/coulomb.
- b.) .125 newtons/coulomb.
- c.) .15 newtons/coulomb.
- d.) None of the above.

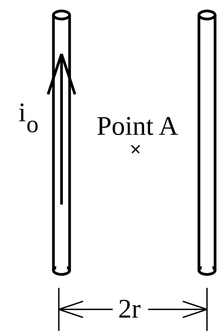


37.) The voltage across the 2 Ω resistor is:
- a.) 12.5 volts.
- b.) 7.5 volts.

c.) 5 volts.
d.) None of the above.



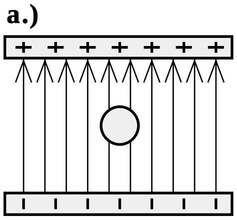
38.) An electrical potential field along the x-axis is defined by the graph shown. Its associated electric field is:
a.) Always positive and approximately zero at x = .45 meters.
b.) Positive up to approximately x = .45 meters and negative after that point. Also, the function will be zero at approximately x = .45 meters.
c.) Always negative and approximately zero around x = 0.
d.) None of the above.



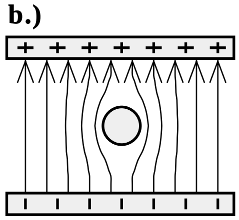
39.) Two wires separated by a distance 2r carry the same current i_o. The direction of one of the currents is shown in the sketch. The magnetic field halfway between the two wires (call this Point A) is found to be B, where B is not equal to zero. If the distance between the wires is changed to 6r:
a.) The direction of the second current is upward and the NEW magnetic field halfway between the wires is B/6.
b.) The direction of the second current is upward and the NEW magnetic field halfway between the wires is B/3.
c.) The direction of the second current is downward and the NEW magnetic field halfway between the wires is B/6.
d.) The direction of the second current is downward and the NEW magnetic field halfway between the wires is B/3.

40.) An uncharged sphere made of a conducting substance is placed between oppositely charged plates (see sketch). The electric field lines between the plates will look like:

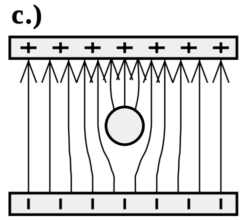
a.)



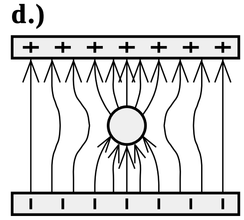
b.)



c.)



d.)



e.) None of these.