Name______________________________

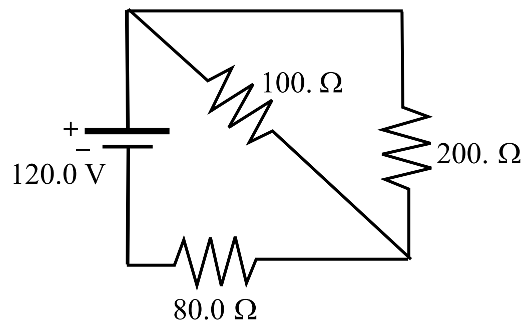
Mar. 17, 2008

Quiz #3 — Spring 2008

Phys 2020

1. For the circuit diagrammed at the right,

a) Find the current in the $80\,\Omega$ resistor.



In this circuit the $100\,\Omega$ and $200\,\Omega$ reisstors are in parallel, and *that* combination is in series with the $80\,\Omega$ resistor.

The equivalent resistance of the $100 - 200\,\Omega$ combination is

$$\frac{1}{R_{\rm eq}} = \frac{1}{100\,\Omega} + \frac{1}{200\,\Omega} \qquad \Longrightarrow \qquad R_{\rm eq} = 66.7\,\Omega$$

The equivalent resistance of the entire circuit is

$$R = 80\,\Omega + 66.7\,\Omega = 146.7\,\Omega$$

and Ohm's law gives the *total* current:

$$I = \frac{V}{R} = \frac{120\ \mathrm{V}}{146.7\,\Omega} = 0.818\ \mathrm{A}$$

and the total current is *the same* as the current in the $80\,\Omega$ resistor.

b) Find the current in the $200\,\Omega$ resistor.

The potential difference across the $80\,\Omega$ resistor is

$$V_{80} = IR = (0.818\ \mathrm{A})(80\,\Omega) = 65.5\ \mathrm{V}$$

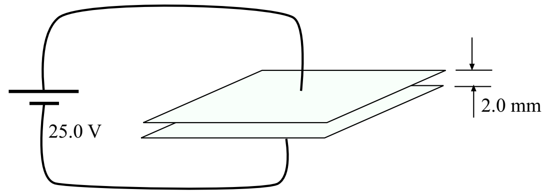
so, adding in this voltage drop, the potential difference across the parallel resistors is

$$V = 120\ \mathrm{V} - 65.5\ \mathrm{V} = 54.5\ \mathrm{V}$$

which is the same as the potential across the $200\,\Omega$ resistor. Then the *current* in the $200\,\Omega$ resistor is

$$I_{200} = \frac{V}{R} = \frac{54.5\ \mathrm{V}}{200\,\Omega} = 0.27\ \mathrm{A}$$

2. A capacitor is formed from two flat plates which are separated by a (small) distance of 2.0 mm. A potential difference of 25.0 V is applied to the plates and a charge of 5.00 nC collects on the plates.



a) What is the value of the capacitance?

Use $Q = CV$, then

$$C = \frac{Q}{V} = \frac{(5.00 \times 10^{-9}\ \mathrm{C})}{(25.0\ \mathrm{V})} = 2.0 \times 10^{-10}\ \mathrm{F}$$

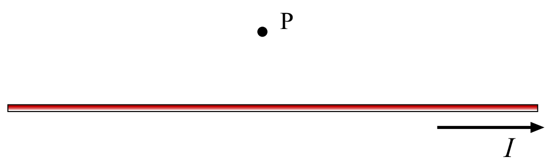
b) What is the magnitude of the electric field between the plates (when the voltage is applied)?

Use $|E_s| = \Delta V / \Delta s$ (this is valid because there is a uniform field between the plates), then

$$E = \frac{(25.0\ \mathrm{V})}{(2.00 \times 10^{-3}\ \mathrm{m})} = 1.25 \times 10^{4}\ \frac{\mathrm{V}}{\mathrm{m}}$$

3. A long wire carries a current I as shown at the right; the current is in the plane of the page, as is the point P.

What is direction of the magnetic field at point P? *Briefly* explain how you arrived at your answer.



Using the right-hand rule (thumb in dir of cirrent, fingers wrapping around wire) we find that the magnetic field at P is $\boxed{\text{out of the page}}$.

You must show all your work and include the right units with your answers!

$$e = 1.60 \times 10^{-19}\ \mathrm{C} \qquad K = 8.99 \times 10^{9}\ \frac{\mathrm{N{\cdot}m^2}}{\mathrm{C^2}} \qquad \epsilon_0 = 8.854 \times 10^{-12}\ \frac{\mathrm{C^2}}{\mathrm{N{\cdot}m^2}}$$

$$F = K\frac{|q_1 q_2|}{r^2} \qquad \mathbf{F} = q\mathbf{E} \qquad E_{\mathrm{pt-ch}} = K\frac{Q}{r^2} \qquad E_{\mathrm{par-pl}} = \frac{Q}{\epsilon_0 A}$$

$$\Delta U = Q\Delta V \qquad E_s = -\frac{\Delta V}{\Delta s} \qquad V_{\mathrm{pt-ch}} = K\frac{Q}{r} \qquad Q = C(\Delta V_C) \qquad C = \kappa\frac{\epsilon_0 A}{d}$$

$$I = \frac{Q}{\Delta t} \qquad V = IR \qquad P = VI = I^2 R \qquad R_{\mathrm{ser}} = R_1 + R_2 + \cdots \qquad \frac{1}{R_{\mathrm{par}}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$$