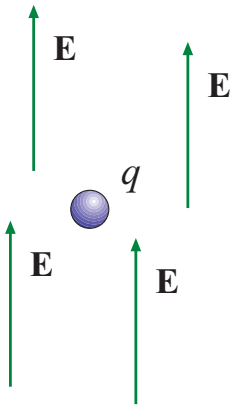
Name_____

Feb. 15, 2006

Phys 2020, NSCC – Spring 2006
Quiz #1

1. A $-6.0\,\mu$C charge is acted on by an electric field which has a magnitude of $5.5 \times 10^3\ \frac{\text{N}}{\text{C}}$ and is directed *upward*.

Find the magnitude and direction of the electric force on the charge.

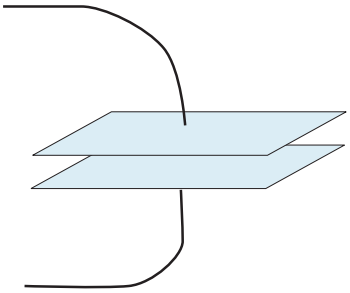


The magnitude of the force is

$$F = |qE_z| = (6.0 \times 10^{-6}\ \text{C})(5.5 \times 10^3\ \tfrac{\text{N}}{\text{C}}) = 3.3 \times 10^{-2}\ \text{N}$$

Since the charge is negative, the direction of the force is *opposite* that of the electric field, so the force on the charge is downward.

2. A 35 pF parallel-plate air-filled capacitor has plates of area 50.0 cm^2.



a) Find the separation of the plates.

Use

$$C = \epsilon_0 \frac{A}{d} \qquad \Longrightarrow \qquad d = \frac{\epsilon_0 A}{C}$$

Plug in the numbers:

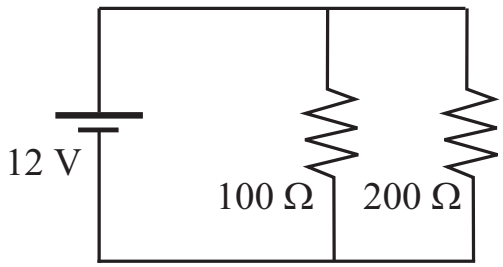
$$d = \frac{(8.85 \times 10^{-12}\ \frac{\text{C}^2}{\text{N}\cdot\text{m}^2})(50.0 \times 10^{-4}\ \text{m}^2)}{(35 \times 10^{-12}\ \text{F})} = 1.26 \times 10^{-3}\ \text{m} = 1.26\ \text{mm}$$

The separation is 1.26 mm.

b) If a potential difference of 15.0 V is put across the plates, how much charge is stored in the capacitor?

$$q = CV = (35 \times 10^{-12}\ \text{F})(15.0\ \text{V}) = 5.25 \times 10^{-10}\ \text{C}$$

3. A $100\,\Omega$ resistor and a $200\,\Omega$ resistor are connected as shown with a 12.0 V battery.



a) Find the equivalent resistance of this resistor combination.

Use

$$\frac{1}{R_{\text{ser}}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{100\,\Omega} + \frac{1}{200\,\Omega} = 1.5 \times 10^{-2}\,\Omega^{-1}$$

Then

$$R_{\text{eq}} = R_{\text{ser}} = 66.7\,\Omega$$

b) Find the total current I that flows in the circuit.

Use $V = IR_{\text{eq}}$, so

$$I = \frac{V}{R_{\text{eq}}} = \frac{(12.0\text{ V})}{(66.7\,\Omega)} = 0.18\text{ A}$$

c) What is the current in the $100\,\Omega$ resistor?

The potential difference across the $100\,\Omega$ resistor is 12.0 V so Ohm's law gives

$$I = \frac{V}{R} = \frac{(12.0\text{ V})}{(100\,\Omega)} = 0.12\text{ A}$$

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

$$F = k\frac{|q_1 q_2|}{r^2} \qquad k = \frac{1}{4\pi\epsilon_0} \qquad \mathbf{F} = q\mathbf{E} \qquad E = k\frac{q}{r^2} \qquad E_{\text{plates}} = \frac{\sigma}{\epsilon_0}$$

$$V = -\frac{\Delta E_s}{\Delta s} \qquad V = k\frac{q}{r} \qquad q = CV \qquad C = \epsilon_0\frac{A}{d} \qquad \text{Energy} = \tfrac{1}{2}CV^2 \qquad C_{\text{diel}} = \kappa C_{\text{vac}}$$

$$V = IR \qquad P = IR = I^2R \qquad R_{\text{ser}} = R_1 + R_2 \ldots \qquad \frac{1}{R_{\text{par}}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$$

$$k = 8.99 \times 10^9\ \tfrac{\text{N}\cdot\text{m}^2}{\text{C}^2} \qquad \epsilon_0 = 8.85 \times 10^{-12}\ \tfrac{\text{C}^2}{\text{N}\cdot\text{m}^2}$$