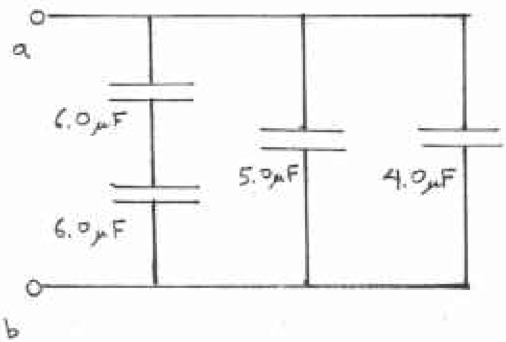
Units?, Units?

Name________________________

Phys 2120, Section 3
Quiz #3 — Spring 2003

1. a) For the circuit of capacitors shown at the right, find the equivalent capacitance.



Two 6.0μF cap's in series become:

$\frac{1}{R_{eq}} = \frac{1}{6.0\mu F} + \frac{1}{6.0\mu F} = 0.333\,\mu F^{-1}$ $R_{eq} = 3.0\mu F$

With this (equiv) capacitor in parallel with the 5.0μF and 4.0μF, get:

$R_{eq} = 3.0\mu F + 5.0\mu F + 4.0\mu F = \boxed{12.0\mu F}$

b) When a potential difference of 9.00 V is applied across the leads ab, find the charge on the 5.00 μF capacitor.

Then the pot'l diff. across the 5.0μF cap is also 9.0 v so the charge stored is

$q = CV = (5.0 \times 10^{-6} F)(9.0 v) = \boxed{4.5 \times 10^{-5} C}$

c) Again, with $V_{ab} = 9.0$ V, find the charge on either one of the 6.00 μF capacitors.

As found in (a), the series comb. of the 6.0μF cap's has an equiv. cap. of 3.0μF. With 9.0 v across the pair, the charge stored is

$q = C_{equ} V = (3.0 \times 10^{-6} F)(9.0 v) = 2.7 \times 10^{-5} C$

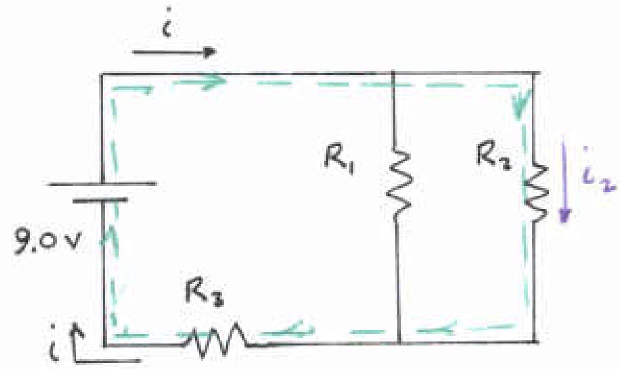
This is equal to the charge stored on any one of the series capacitors. So the charge on either 6.00μF cap. is

$\boxed{2.7 \times 10^{-5} C}$

2. A certain type of copper wire has a circular cross-section of diameter 1.30 mm. What length of this wire has a resistance of $0.500\,\Omega$?

With x-sec area $A = \pi r^2 = \pi d^2/4$, use $R = \rho \frac{L}{A}$ and solve for L:

$$L = \frac{RA}{\rho} = \frac{(0.500\,\Omega)\,\pi\,(1.30\times10^{-3}\,\text{m})^2/4}{(1.69\times10^{-8}\,\Omega\cdot\text{m})} = \boxed{39.3\,\text{m}}$$



$R_1 = 4.00\,\text{k}\Omega$
$R_2 = 6.00\,\text{k}\Omega$
$R_3 = 3.00\,\text{k}\Omega$

3. a) For the circuit shown, find the total current i.

Equiv. resistance of set of three resistors:

R_1 & R_2: $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{4.00\,\text{k}\Omega} + \frac{1}{6.00\,\text{k}\Omega}$

$R_{eq} = 2.4\,\text{k}\Omega$

R_{eq} & R_3: $R'_{eq} = 2.4\,\text{k}\Omega + 3.00\,\text{k}\Omega = 5.4\,\text{k}\Omega$

$$i = \frac{V}{R'_{eq}} = \frac{(9.00\,\text{V})}{(5.4\,\text{k}\Omega)} = \boxed{1.67\times10^{-3}\,\text{A}}$$

b) Find the current in R_2. (The Kirchhoff loop rule may be of help.)

Using the big loop shown (with i_2 as the current thru R_2) get:

$$+9.0\,\text{V} - i_2 R_2 - i R_3 = 0$$

Solve for i_2:

$$i_2 R_2 = 9.0\,\text{V} - i R_3 = 9.0\,\text{V} - (1.67\times10^{-3}\,\text{A})(3.00\times10^{3}\,\Omega) = 4.00\,\text{V}$$

$$i_2 = \frac{4.00\,\text{V}}{6.00\times10^{3}\,\Omega} = \boxed{6.67\times10^{-4}\,\text{A}}$$

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

$$q = CV \qquad C = \epsilon_0 \frac{A}{d} \qquad C = \kappa C_{\text{air}} \qquad C_{\text{par}} = C_1 + C_2 + \dots \qquad \frac{1}{C_{\text{series}}} = \frac{1}{C_1} + \frac{1}{C_2} + \dots$$

$$i = \frac{dq}{dt} \qquad J = i/A \qquad V = iR \qquad R = \rho\frac{L}{A} \qquad R_{\text{series}} = R_1 + R_2 + \dots \qquad \frac{1}{R_{\text{par}}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$$

$$\rho_{\text{Cu}} = 1.69\times10^{-8}\,\Omega\cdot\text{m} \qquad \alpha_{\text{Cu}} = 4.3\times10^{-3}\,\text{K}^{-1}$$

$$\tau = RC \qquad q(t) = C\mathcal{E}e^{-t/\tau} \qquad i(t) = \frac{\mathcal{E}}{R}e^{-t/\tau}$$