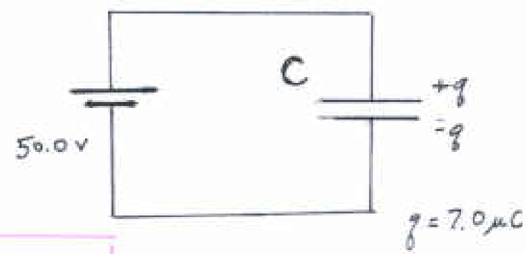
Name________________ Units? Units?

Phys 2020
Quiz #2 — Fall 2002

1. When a potential difference of 50.0 V is applied to the plates of a capacitor, it is found that a charge of 7.0 μC is stored.



a) What is the value of the capacitance?

Use $q = CV$, then:

$$C = \frac{q}{V} = \frac{(7.0 \times 10^{-6}\,\mathrm{C})}{50.0\,\mathrm{V}} = \boxed{1.4 \times 10^{-7}\,\mathrm{F} = 0.14\,\mu\mathrm{F}}$$

b) How much energy is stored in the capacitor under these conditions?

Use $(\text{Energy}) = \frac{1}{2} C V^2$, then:

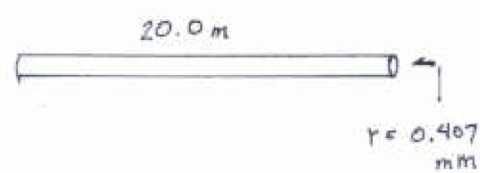
$$\text{Energy} = \tfrac{1}{2}(1.4 \times 10^{-7}\,\mathrm{F})(50.0\,\mathrm{V})^2 = \boxed{1.75 \times 10^{-4}\,\mathrm{J}}$$

c) If all of this energy is delivered to a strobe lamp in 0.350 ms, what is the (average) power delivered to the lamp?

Use $\text{Power} = \frac{\text{Energy del'd}}{\Delta t}$, then

$$P = \frac{1.75 \times 10^{-4}\,\mathrm{J}}{(0.350 \times 10^{-3}\,\mathrm{s})} = \boxed{0.50\,\mathrm{W}}$$

2. A copper wire is 20.0 m long; it has a circular cross-section with radius $r = 0.407$ mm. [Copper has a resistivity of $1.72 \times 10^{-8}\,\Omega \cdot \mathrm{m}$.]



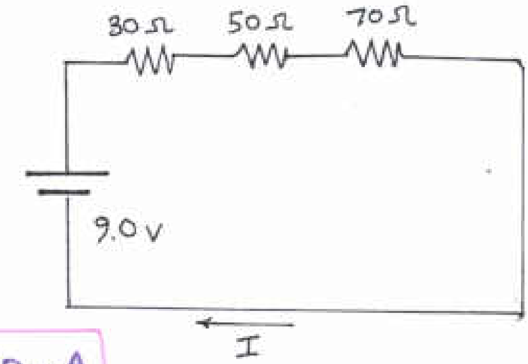
What is the resistance of the wire?

Using $A = \pi r^2$, cross-sectional area is

$$A = \pi (0.407 \times 10^{-3}\,\mathrm{m})^2 = 5.2 \times 10^{-7}\,\mathrm{m}^2$$

Using $R = \rho \frac{L}{A}$, resistance is

$$R = (1.72 \times 10^{-8}\,\Omega\cdot\mathrm{m}) \frac{(20.0\,\mathrm{m})}{(5.2 \times 10^{-7}\,\mathrm{m}^2)} = \boxed{0.66\,\Omega}$$



3. A circuit consists of a 9.0 V battery connected to a set of resistors, with values 30 Ω, 50 Ω and 70 Ω, as shown in the figure.

a) What is the current in the circuit?

With $R_{eq} = R_{series} = 30\,\Omega + 50\,\Omega + 70\,\Omega = 150\,\Omega$

then from $V = IR_{eq}$,

$I = V/R_{eq} = (9.0\,V)/(150\,\Omega) = \boxed{6.0\times 10^{-2}\,A = 60\,mA}$

b) What is the potential difference (voltage drop) across the 50.0 Ω resistor?

Voltage is given by Ohm's law for that resistor, $V = IR$, so

$V = (6.0\times10^{-2}\,A)(50\,\Omega) = \boxed{3.0\,V}$

c) How much energy is dissipated in the 50.0 Ω resistor in one minute?

Use $P = I^2R$, then power dissipation is

$P = (6.0\times10^{-2}\,A)^2(50\,\Omega) = 0.18\,W$

and in $1\,min = 60\,s$, energy dissipated is

$E = P\cdot t = (0.18\,W)(60\,s) = \boxed{10.8\,J}$

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

$$k = \frac{1}{4\pi\epsilon_0} = 8.99\times10^9\,\frac{\mathrm{N\cdot m^2}}{\mathrm{C^2}} \qquad \epsilon_0 = 8.85\times10^{-12}\,\frac{\mathrm{C^2}}{\mathrm{N\cdot m^2}} \qquad F = k\frac{|q_1q_2|}{r^2} = \frac{1}{4\pi\epsilon_0}\frac{|q_1q_2|}{r^2}$$

$$\mathbf{F} = m\mathbf{a} \qquad g = 9.80\,\tfrac{\mathrm{m}}{\mathrm{s}^2} \qquad m_{\mathrm{elec}} = 9.1094\times10^{-31}\,\mathrm{kg} \qquad e = 1.602\times10^{-19}\,\mathrm{C}$$

$$A_{\mathrm{circle}} = \pi r^2 \qquad \mathrm{Energy} = Pt \qquad |E_x| = \left|\frac{\Delta V}{\Delta x}\right| \qquad q = CV \qquad C = \frac{\epsilon_0 A}{d} \qquad \mathrm{Energy} = \tfrac{1}{2}CV^2$$

$$V = IR \qquad R = \rho\frac{L}{A} \qquad R_{\mathrm{ser}} = R_1 + R_2 + \ldots \qquad \frac{1}{R_{\mathrm{par}}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$$

$$P = VI = I^2R = \frac{V^2}{R}$$