Capacitor Quiz – 05-12-04 $Ch. 16$

$1/C_{eq} = 1/C_1 + 1/C_2 + 1/C_3$ $C_{eq} = C_1 + C_2 + C_3$ $Q = CV$ $C = k\varepsilon_o A/d$ $\varepsilon_o = 8.85 \times 10^{-12}\ C^2/Nm^2$

1. Three capacitors ($C_1 = 22\ \mu F$, $C_2 = 10\ \mu F$, and $C_3 = 15\ \mu F$) are in series with a 9 V battery. Draw diagram.
   (a) What is the equivalent capacitance? (b) What is the charge on C_1? (EC) What is the voltage across C_1?

$V = 9V$

$C_1 = 22\mu F$

$C_2 = 10\mu F$

$C_3 = 15\mu F$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

$$= \frac{1}{22\mu F} + \frac{1}{10\mu F} + \frac{1}{15\mu F}$$
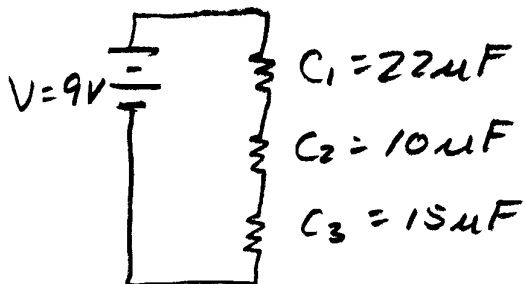
a) $\boxed{C_{eq} = 4.71\ \mu F}$

$Q_{eq} = C_{eq}V$

$= 4.71\mu F(9V)$

$Q_{eq} = 42.4\ \mu C$

b) $\boxed{Q_1 = 42.4\ \mu C}$

$Q_1 = C_1 V_1$

$V_1 = \dfrac{Q_1}{C_1}$

$= \dfrac{42.4\mu C}{22\mu F}$

EC) $\boxed{V_1 = 1.93\ V}$

2. You need to design a parallel plate capacitor to have $C = 22 \times 10^{-9}$ F. If you use polystyrene, which has a dielectric constant of 2.56, and the spacing is half a millimeter, what area of plate should you use?

$$C = \frac{k\varepsilon_o A}{d}$$

$$A = \frac{Cd}{k\varepsilon_o}$$

$$= \frac{22\times10^{-9}F(0.0005m)}{2.56(8.85\times10^{-12}\frac{C^2}{Nm^2})}$$

$\boxed{A = 0.486\ m^2}$