

Pre-Lab Exercises

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Lab Section:

Hand this in at the beginning of the lab period. The grade for these exercises will be included in your lab grade this week. Show all work.

1. How will you determine the spacing between the parallel plates of your capacitor?

measuring the thickness of multiple pages with a digital caliper and dividing by the number of pages then counting the # of pages

2. The plates of a parallel plate capacitor measure 14.1 cm square and are separated by 0.8 mm. The measurement error in all values is 0.1 mm.
 - a. What is the capacitance of this configuration?

$$\begin{aligned}
 C &= \frac{\epsilon_0 A}{d} \\
 &= \frac{(8.854 \times 10^{-12})(14.1 \times \frac{1m}{100cm})^2}{0.8 \times \frac{1m}{1000mm}} \\
 &= (2.20 \times 10^{-10} \pm 0.125 * 2.20 \times 10^{-10}) F \\
 &= (220 \pm 28) pF
 \end{aligned}$$

$$\begin{aligned}
 \frac{\delta C}{C} &= \sqrt{2 \left(\frac{0.1mm}{141mm} \right)^2 + \left(\frac{0.1mm}{0.8mm} \right)^2} \\
 &= 0.125 \quad (\text{inherently unitless})
 \end{aligned}$$

- b. Some material is placed such that it completely fills the gap between the plates. The capacitance measured is now 420 pF. What is the dielectric constant of that material?

$$\begin{aligned}
 C &= \frac{K \epsilon_0 A}{d} \\
 &= K C_{parallel plates}
 \end{aligned}$$

$$\begin{aligned}
 K &= \frac{C}{C_{\parallel}} \\
 &= \frac{420 pF}{220 pF} = (1.91 \pm 0.24)
 \end{aligned}$$

$$\frac{\delta K}{K} = \sqrt{\left(\frac{28 pF}{220 pF} \right)^2} = 0.125$$

$$\delta K = 0.125 \times 1.91 = 0.24$$

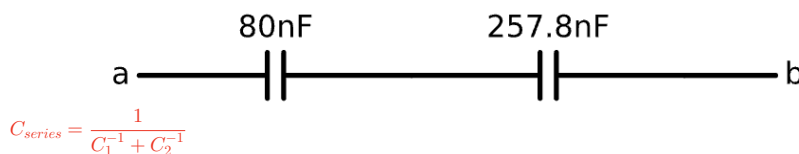
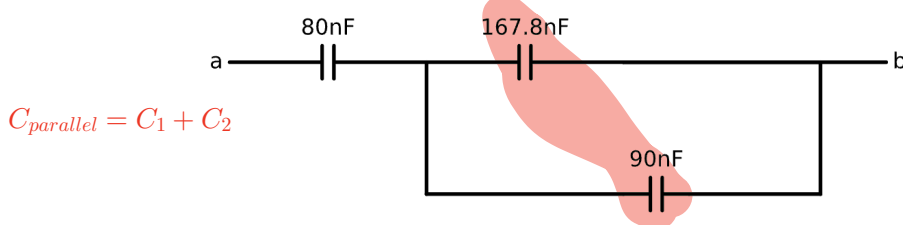
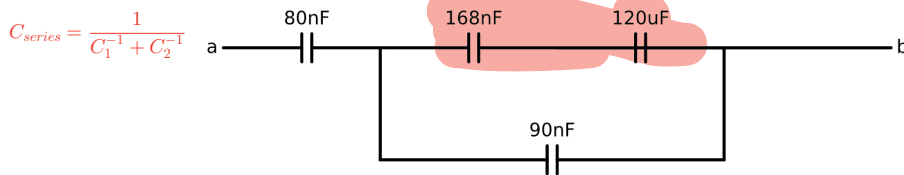
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- C. How much charge is on each plate when a potential difference of 16.0V is applied to the plates with the dielectric material is inserted?

$$\begin{aligned}
 Q &= V \cdot C \\
 &= (16.0 \text{ V}) \times (4.20 \times 10^{-10} \text{ F}) \\
 &= 6.72 \text{ nC}
 \end{aligned}$$

error can't be computed since the 420pF was not given with an error.

3. Determine the equivalent capacitance between points A and B of the configuration of capacitors given in figure to the right.



which gives a final answer of

