Problem 1: (20 pts.) A capacitor is built with two parallel plates of area $0.2000\,\mathrm{m}^2$ separated by a distance of $0.001\,50\,\mathrm{m}$ in air. The plates are charged so that the electric field between the plates is $7500\,\mathrm{N/C}$. Throughout this problem, watch out for roundoff errors. Some of the numbers are quite small, so you may need to use scientific notation to see more than one significant digit in the answer on your calculator.

a. (5 pts.) What is the capacitance of the capacitor?

b. (5 pts.) What is the magnitude of the voltage difference between the two plates?

c. (5 pts.) What is the magnitude of the charge stored on each plate?

d. (5 pts.) How much energy is stored in the capacitor?

Problem 1: (20 pts.) A capacitor is built with two parallel plates of area $0.2000\,\mathrm{m}^2$ separated by a distance of $0.001\,50\,\mathrm{m}$ in air. The plates are charged so that the electric field between the plates is $7500\,\mathrm{N/C}$. Throughout this problem, watch out for roundoff errors. Some of the numbers are quite small, so you may need to use scientific notation to see more than one significant digit in the answer on your calculator.

a. (5 pts.) What is the capacitance of the capacitor?

$$C = \frac{\epsilon_0 A}{d} = \frac{(8.85 \times 10^{-12}\,\mathrm{C^2/Nm^2}) \times (0.2000\,\mathrm{m^2})}{0.001\,50\,\mathrm{m}} = \boxed{1.18 \times 10^{-9}\,\mathrm{F} = 1.18\,\mathrm{nF}}$$

b. (5 pts.) What is the magnitude of the voltage difference between the two plates?

$$V = Ed = (7500\,\mathrm{N/C}) \times (0.001\,50\,\mathrm{m}) = \boxed{11.25\,\mathrm{V}}$$

c. (5 pts.) What is the magnitude of the charge stored on each plate?

$$Q = CV = (1.180 \times 10^{-9}\,\mathrm{F}) \times (11.25\,\mathrm{V}) = \boxed{1.328 \times 10^{-8}\,\mathrm{C}}$$

d. (5 pts.) How much energy is stored in the capacitor?

$$U = \frac{1}{2}QV = \frac{1}{2}\,(1.328 \times 10^{-8}\,\mathrm{C}) \times (11.25\,\mathrm{V}) = \boxed{7.467 \times 10^{-8}\,\mathrm{J}}$$