Problem 1A

(a) Calculate the capacitance of the series combination of a 4.0pf capacitor and a 2.0pf capacitor. \( 1.3 \text{ pF} \)

(b) Calculate the capacitance of the parallel combination of a 3.0pf capacitor and a 1.5pf capacitor. \( 4.5 \text{ pF} \)

(c) An electron is subjected to an electric field of 370 V/m. Find its acceleration. \( 6.5 \times 10^{-13} \text{ m/s}^2 \)

(d) A 1.5 volt battery is connected across a 100pf capacitor. Find the charge on the capacitor. \( 1.5 \times 10^{-10} \text{ C} \)

(e) The electric potential in a region of space is given by \( V = C x^2 \). Find the electric field. \( E = -2C \)

\[
a) \quad \frac{1}{C_{\text{eff}}} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{C_1 + C_2}{C_1 C_2} \quad C_{\text{eff}} = \frac{C_1 C_2}{C_1 + C_2} = \frac{8}{6} \text{ pF} = \frac{4}{3} \text{ pF} \\
b) \quad C_{\text{eff}} = C_1 + C_2 = 4.5 \text{ pF} \\
c) \quad a = \frac{E}{m} = \frac{q E}{m} = \frac{1.6 \times 10^{-19} \text{ C} \times 370 \text{ NC}}{9.1 \times 10^{-3} \text{ kg}} = 6.5 \times 10^{-13} \text{ m/s}^2 \\
d) \quad C = \frac{Q}{V} \quad Q = CV = 100 \times 10^{-12} \text{ F} \times 1.5 \text{ V} = 1.5 \times 10^{-10} \text{ C} \\
e) \quad E = -\frac{dV}{dx} = -\frac{d(Cx^2)}{dx} \quad E = -2Cx \\
\]