REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

(a) [5 pts.] Each resistor has a value of 3 ohms. Calculate the equivalent resistance between a and b.

\[ \frac{1}{R_{cd}} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} \Rightarrow R_{cd} = 1 \Omega \]

\[ \frac{1}{R_{ce}} = \frac{1}{1/3 + 1/3} = \frac{1}{1/2} \Rightarrow R_{ce} = \frac{12}{1} \Omega \]

\[ \frac{1}{R_{cb}} = \frac{1}{4/3} + \frac{1}{3} + \frac{1}{3} = \frac{18}{33} \Rightarrow R_{cb} = \frac{33}{18} = \frac{11}{6} \Omega \]

\[ R_{ab} = \frac{11}{6} + 3 = \frac{29}{6} \Omega \text{ or } 4.83 \Omega \]

(b) [5 pts.] Calculate the equivalent capacitance of three capacitors 3.0, 5.0 and 9.0 \( \mu F \) in series.

\[ \frac{1}{C_{eff}} = \frac{1}{3} + \frac{1}{5} + \frac{1}{9} = \frac{29}{45} \]

\[ \Rightarrow C_{eff} = \frac{45}{29} \mu F \text{ or } 1.55 \mu F \]

(c) [5 pts.] A copper wire has a diameter of 1.75 mm. It carries a current of 4.25 A. Calculate the current density.

\[ J = \frac{I}{A} = \frac{4.25 \text{ A}}{\pi \left( \frac{1.75 \text{ mm}}{2} \right)^2} = 1.77 \frac{\text{A}}{\text{mm}^2} \text{ or } 1.77 \times 10^6 \frac{\text{A}}{\text{m}^2} \]

(d) [5 pts.] Calculate the charging time constant if \( R = 17.5 \times 10^3 \Omega \) and \( C \) has the value of 12.8 pF.

\[ \tau = RC = 17.5 \times 10^3 \Omega \times 12.8 \times 10^{-12} \text{F} \]

\[ = 2.24 \times 10^{-7} \text{ s} \]

(e) [5 pts.] A capacitor of 4.75 \( \mu F \) is charged to 150 V. The battery is disconnected and then a dielectric is inserted. The dielectric is \( \kappa = 4.12 \). Calculate the potential in the capacitor after the dielectric has been inserted.

\[ Q = C_0 V_0 = C_1 V_1 = \kappa C_0 V_1 \]

\[ \Rightarrow C_1 = \frac{V_0}{V_1} = \frac{150 \text{ V}}{4.12} = 36.4 \text{ V} \]