Mean: 19.1
SD: 6.3

THIRD MIDTERM

Name (print) David DeTienne Name (signed) Paul Zhang

Discussion Instructor (circle one): Davis DeTienne Hamed Molina

Discussion Section #

REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!

Use the conversion constants and data given on the front page.

(a) Calculate the equivalent capacitance between (a) and (b). All capacitors are 3.00 pF.

\[ C_{eq} = \left( \frac{1}{2C} + \frac{1}{C} + \frac{1}{3C} \right)^{-1} = \frac{C}{\frac{1}{2} + \frac{1}{3}} \]

\[ C_{eq} = \left[ \frac{1}{6} \right] \text{ pF} \]

(b) Calculate the effective resistance between (a) and (b). All resistors have a value of 100 ohms.

\[ R_{eq} = \frac{3R_1}{\frac{1}{2} + \frac{1}{3}} = \frac{2 \times 10^2}{3} \Omega = 66.7 \Omega \]

(c) Calculate the drift velocity for a current of 12.0 A in a circular cross section copper wire of radius 1.50 mm. Take the charge carrier density as $5.00 \times 10^{29}$ m$^{-3}$.

\[ V_d = \frac{I}{nqA} = \frac{12.0}{2.12 \times 10^{-5} \times \pi \times 0.75^2} \]

(d) Calculate the power being dissipated in the 150 ohm resistor.

\[ I = \frac{125V}{250\Omega} = 0.5 A \]

\[ P = I^2 R = (0.5 A)^2 (150 \Omega) = 37.5 W \]

(e) Antimony has an atomic mass of 121.8 and a density of 6.68 g/cm$^3$. If antimony has $2.00 \times 10^{15}$ charge carriers per cm$^3$, how many carriers per atom does it have?

\[ \frac{2.00 \times 10^{15} \text{ e}^-}{(3.30 \times 10^{-22} \text{ cm}^3 \times 6.02 \times 10^{23} \text{ mol}^{-1})} = \frac{9.09 \times 10^{-5} \text{ e}^-}{\text{ atom}} \]

\[ \frac{6.68 \text{ gcm}^{-3}}{\text{atom}} = \frac{5.484 \times 10^{-22} \text{ mole}}{\text{ m}^{-3}} \]

\[ \frac{(5.484 \times 10^{-22} \text{ mole})}{(6.02 \times 10^{23} \text{ atom}^{-1})} = \frac{2.31 \times 10^{18} \text{ atom}}{\text{cm}^3} \]