

THIRD MIDTERM

Name (print) David DeTienne Name (signed) \_\_\_\_\_

Discussion Instructor (circle one): Davis DeTienne Hamed Molina Paul Zhang

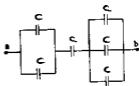
Discussion Section # \_\_\_\_\_

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

-1 UNITS  
 -1 SF

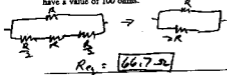
- (a) Calculate the equivalent capacitance between (a) and (b). All capacitors are 3.00 pF.

$$C_{eq} = \left( \frac{1}{2C} + \frac{1}{C} + \frac{1}{3C} \right)^{-1} = \frac{6C}{11} \text{ pF}$$



$$C_{eq} = \boxed{1.64 \text{ pF}}$$

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



$$R_{eq} = \frac{2R^2}{3R} = \frac{2R}{3}$$



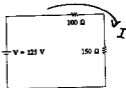
$$R_{eq} = \boxed{66.7 \Omega}$$

- (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  $5.00 \times 10^{28} \text{ m}^{-3}$ .

$$v_d = \frac{I}{nqA} = \boxed{2.12 \times 10^{-5} \text{ m/s}}$$

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

$$I = \frac{125V}{250\Omega} = 0.5 \text{ A}$$



$$P = I^2 R = (0.5 \text{ A})^2 (150 \Omega) = \boxed{37.5 \text{ W}}$$

- (e) Antimony has an atomic mass of 121.8 and a density of  $5.68 \text{ g/cm}^3$ . If antimony has  $3.00 \times 10^{18}$  charge carriers per  $\text{cm}^3$ , how many carriers per atom does it have?

$$\left( 3.00 \times 10^{18} \frac{e^-}{\text{cm}^3} \right) \left( \frac{3.302 \times 10^{22} \text{ atoms}}{\text{cm}^3} \right) = \boxed{9.09 \times 10^{-5} \frac{e^-}{\text{atom}}}$$

$$\frac{6.68 \frac{\text{g}}{\text{cm}^3}}{121.8 \frac{\text{g}}{\text{mole}}} = 5.484 \times 10^{-2} \frac{\text{mole}}{\text{cm}^3} \quad \left( 5.484 \times 10^{-2} \frac{\text{mole}}{\text{cm}^3} \right) \left( 3.02 \times 10^{23} \frac{\text{atoms}}{\text{mole}} \right) = 1.64 \times 10^{22} \frac{\text{atoms}}{\text{cm}^3}$$