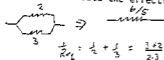


Spring Quarter 1981

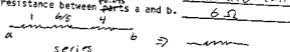
May 15, 1981

Average ≈ 16.3 Name: Grader: SawyerDiscussion Instructor: Battelino Bruno DeSisto Gehrke Izatt
Roshko Sawyer ShastryPROBLEM 1B

- (a) Given a simple circuit consisting of a resistance of 25Ω (boxed) and a capacitance of $15,000 \text{ pf}$, find the time constant. 2.7×10^5 (boxed) $4.0 \times 10^{-3} \text{ s}$
- (b) Given an RC circuit. The capacitor is discharged at $t = 0$. The capacitor is charged through the resistance R from a battery of 100 V . If the capacitance is 3000 pf , what is the charge on the capacitor at $t = 1.5 \text{ RC}$? $2.3 \times 10^{-7} \text{ C}$
- (c) A current of 15 amperes passes through a resistance. The potential across the resistance is 110 volts . What is the power dissipated in the resistance? $1.6 \times 10^3 \text{ W}$ and a density of 6.68 g/cm^3
- (d) Antimony has an atomic mass of 121.8 . If antimony has 3.0×10^{18} charge carriers per cm^3 , how many carriers per atom does it have? $9.1 \times 10^5 \text{ carriers/atom}$
- (e) Calculate the effective resistance between parts a and b. 6Ω



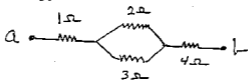
parallel



$$R_{\text{eff}} = 1 + \frac{6}{5} + 4 = \frac{31}{5}$$

$$R = 6 \Omega$$

$$1 \text{ s.f.}$$



$$\tau = RC = 2.7 \times 10^5 \Omega \times 1.5 \times 10^4 \times 10^{-12} \text{ f} = 4.05 \times 10^{-3} \text{ s} \Rightarrow 4.0 \times 10^{-3} \text{ s}$$

$$Q = Q_0 (1 - e^{-t/RC}) = CV (1 - e^{-t/RC}) = 3 \times 10^3 \times 10^{-12} \text{ f} \times 10^2 \text{ V} (1 - e^{-1.5})$$

$$Q = 2.33 \times 10^{-7} \text{ C} \Rightarrow 2.3 \times 10^{-7} \text{ C}$$

$$P = IV = 15 \text{ A} \times 110 \text{ V} = 1.65 \times 10^3 \text{ W} \Rightarrow 1.6 \times 10^3 \text{ W}$$

$$3.0 \times 10^{18} \frac{\text{carriers}}{\text{cm}^3} \times \frac{1 \text{ cm}^3}{6.69 \text{ gm}} \times \frac{121.8 \text{ gm}}{\text{mole}} \times \frac{1 \text{ mole}}{6.022 \times 10^{23} \text{ atoms}} = 9.08 \times 10^5$$

carriers/atom

$$\Rightarrow 9.1 \times 10^5 \frac{\text{carriers}}{\text{atom}}$$