Physics 2220
Spring 2006
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THIRD MIDTERM

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Name:_____ Student ID #:_____

Discussion Instructor (circle): Barcikowski El-Gendy Johnson Rodriguez

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

(a) Calculate the cyclotron frequency for electron in a magnetic field of 367 gauss (in Hz).

$\rightarrow 0.0367\ T$

$$f = \frac{qB}{2\pi m} = \frac{1.60\times10^{-19}\times 3.67\times10^{-2}}{2\pi\times 9.11\times10^{-31}} = 1.026\times10^{9}\ Hz \simeq \boxed{1.03\times10^{9}\ Hz}$$

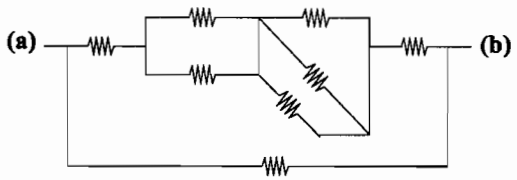
(b) Calculate the drift velocity in a semiconductor with a carrier density of 3.46×10^{17} carriers/cm^3. The current is 3.27 A in a wire with circular cross section and diameter 2.75 mm.

$\rightarrow 3.46\times10^{23}$ carriers/m^3

$\rightarrow 2.75\times10^{-3}$ m

$$V_D = \frac{I}{nqA} = \frac{3.27}{3.46\times10^{23}\times1.60\times10^{-19}\times\pi\times\left(\frac{2.75}{2}\times10^{-3}\right)^2} = 9.945\ m/s \simeq \boxed{9.95\ m/s}$$

(c) All resistors have the same values, R = 100 Ω. Calculate the effective resistance between (a) and (b). Numerical answer.



$$R+\frac{R}{2}+\frac{R}{3}+R=\frac{17}{6}R$$

$$\frac{6}{17}R+\frac{1}{R}=\frac{23}{17}R \Rightarrow \frac{17}{23}R = \frac{17}{23}\times100\Omega = 73.91\Omega \simeq \boxed{73.9\ \Omega}$$

(d) A 12.3 volt battery has an internal resistance of 0.75 ohm. What power will it deliver to an external load of 1.25 ohms?

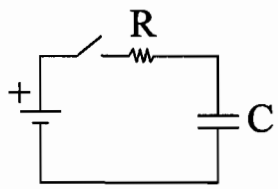
r_i

r_e

$$I=\frac{\mathcal{E}}{r_i+r_e},\quad P=I^2r_e=\frac{\mathcal{E}^2 r_e}{(r_i+r_e)^2}=\frac{12.3^2\times1.25}{(0.75+1.25)^2}=47.28\ w \simeq \boxed{47.3\ w}$$

(e) Calculate the time constant for charging the capacitor if the resistor R = 17.500 Ω and the capacitance is 6.25 μF.

$\rightarrow 6.25\times10^{-6}$ F



$$\tau = RC = 17.5\times6.25\times10^{-6} = 1.094\times10^{-4}\ s \simeq \boxed{1.09\times10^{-4}\ s}$$