George Williams

THIRD MIDTERM

Name (print) Mike Hansen Name (signed) _____

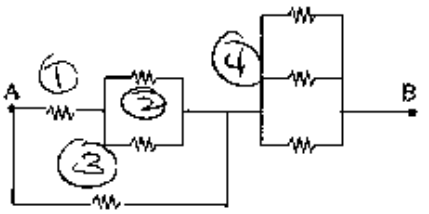
Discussion Instructor (circle): Gramada Hansen Li Zhukov

Discussion Section # _____

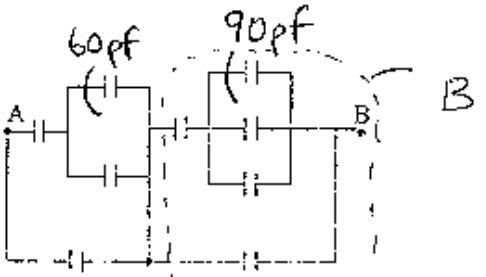
REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

(a) Calculate the effective resistance between A and B if all resistors have the value of 3.00 ohms

$R_{eq} = \frac{14}{5}\ \Omega$



(b) Calculate the effective value of the capacitance between A and B if all capacitors have the value 30.0 pF.

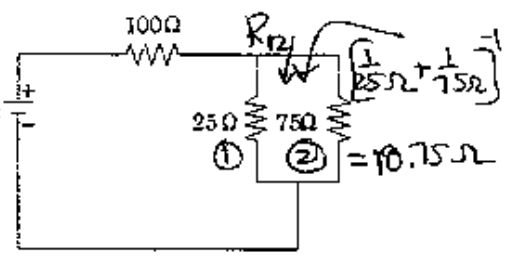


B: $\left[\frac{1}{90\,pf} + \frac{1}{30\,pf}\right]^{-1} \Rightarrow \frac{90}{4}\,pf + 30\,pf = 52.5\,pf$

A: $\left[\frac{1}{60\,pf} + \frac{1}{30\,pf}\right]^{-1} + 30\,pf = 50\,pf$

$C_{eq} = \left[\frac{1}{50\,pf} + \frac{1}{52.5\,pf}\right]^{-1} = 25.6\,pf$

(c) If ε = 75.0 V, what is the power being dissipated in the 25 Ω resistor?



$R_{eq} = 100\,\Omega + 18.75\,\Omega = 118.75\,\Omega$

$V_{Total} = I_{total} R_{eq} \Rightarrow I_{Total} = \frac{V_{Tot}}{R_{eq}} = \frac{75V}{118.75\Omega} = .632\,A$

$I_1 + I_2 = I_{Total} \quad V_1 = V_2 \rightarrow V_1 = I_1 R_1 = I_2 R_2$

$V_1 = V_2 = I_{total} R_{12}$

$= I_{total} R_2 - I_1 R_2 \Rightarrow I_1 = \frac{I_{Total} R_2}{(R_1 + R_2)}$

$= .474\,A$

$P_1 = V_{12} I_1 = (11.85V)(.474A) = 5.62\,W$

(d) Calculate the drift velocity (in m/s) in a silver wire with current = 4.20 A that has a circular cross section with r = 1.20×10^{-3} m. Silver has 5.90×10^{22} electrons/cm^{-3} that are mobile.

$5.9\cdot10^{22}\ e^-/cm^3 \cdot \frac{10^6\,(cm^3/m^3)}{} = 5.9\cdot10^{28}\ e^-/m^3$

$I = nq v_d A \Rightarrow v_d = \frac{I}{nqA} = \frac{4.20\,A}{5.9\cdot10^{28}\frac{e}{m^3} \times 1.609\cdot10^{-19}C \times \pi \times (1.20\cdot10^{-3}m)^2} = 9.82\cdot10^{-5}\,m/s$

(e) A parallel plate capacitor is constricted using a material whose dielectric constant is 4.27. If it is necessary to have the plate separator at 1.27 mm, what is the area needed to give C = 17.0 pF?

$f = \frac{C^2}{J}$

$C = K\varepsilon_0 \frac{A}{d} \Rightarrow A = \frac{Cd}{K\varepsilon_0} = \frac{17.0\,pF \cdot 1.27\cdot10^{-3}m}{(4.27)(8.85\cdot10^{12}\frac{C^2}{N\,m^2})} = 5.71\cdot10^{-4}\,m^2$