Winter Quarter 1994
February 18, 1994
George Williams

16.1 / 25

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THIRD MIDTERM

Name (print) C. Gundlach Name (signed) _____

Discussion Instructor (circle): Basko Chakhbazian DiCarlo Gundlach Romer Wei

Discussion Section # _____

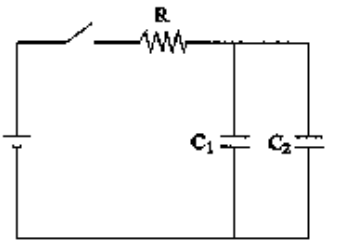
-1 UNITS
-1 SF

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

(a) For the circuit shown, calculate the time constant.

$R = 1.45 \times 10^3\ \Omega$
$C_1 = 25.0$ pF
$C_2 = 40.0$ pF

C/A or Ω F was not counted as a correct unit



$t = R(C_1 + C_2) = 9.43 \cdot 10^{-8}\ s = 94.3\ ns$

(b) Calculate the capacitance of a parallel plate capacitor if the plates are square, with sides of 0.250 m, a separation of 0.220 mm, and a dielectric of $\kappa = 4.50$ filling the space between the plates.

$C = \kappa A \varepsilon_0 / d = \kappa \ell^2 \varepsilon_0 / d = 1.131 \cdot 10^{-8}\ F = 11.31\ nF$

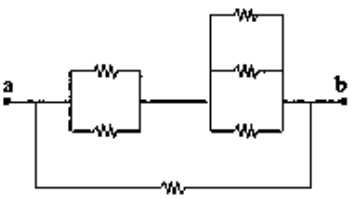
(c) A copper wire has a diameter of 2.30 mm. If it carries a current of 17.2 A, calculate the magnitude of the current density in A/m^2.

$j = I/A = I/(\pi r^2) =$ [illegible] $4.14 \cdot 10^6\ A/m^2$

(d) Antimony (a semimetal) has atomic mass of 121.8 and a density of 6.68 g/cm^3. If we assume it has 1.25×10^{-4} charge carriers per atom, what is the density of charge carries per m^3?

$(1.25 \cdot 10^{-4})(6.68 \cdot 10^6\ g/m^3)(121.8\ g/mol)^{-1}(6.02 \cdot 10^{23}/mol) = 4.13 \cdot 10^{24}\ /m^3$

(e) All resistances in the network have a resistance R. Calculate the effective resistance between a and b.



$R_{eff} = \left\{ \left[(3R^{-1})^{-1} + (2R^{-1})^{-1} \right]^{-1} + R^{-1} \right\}^{-1}$

$= \left\{ \left[\frac{1}{3} + \frac{1}{2} \right]^{-1} + 1 \right\} R^{-1} = \frac{5}{11} R = 0.455\ R$
