Physics 2220
Spring 2003
George A. Williams

FINAL EXAM

2

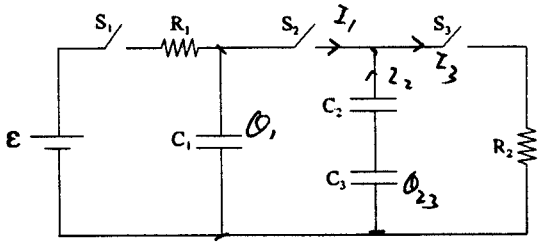
Name: Qiulin Tang

Discussion Instructor (circle): Billeter Blake Herring Young

Discussion Section # _____ Student ID #: _____

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

For the circuit given, all switches are initially open. S_1 is closed for a long time, and then opened. With S_1 and S_3 open, S_2 is closed.



(a) *[10 pts.]* Calculate the potential across C_1.
(b) *[10 pts.]* Find the potential across C_3.

With S_2 still closed and S_1 open, close S_3 at t = 0.

(c) *[10 pts.]* Calculate the charge on C_1 3.00 s after S_3 is closed.

$C_1 = 1.00\ \mu F$ $R_1 = 100\ \Omega$
$C_2 = 2.00\ \mu F$ $R_2 = 1.75 \times 10^6\ \Omega$
$C_3 = 3.00\ \mu F$ $\varepsilon = 165\ V$

a). $Q = C_1 \cdot \varepsilon = 165 \times 1.00\mu F = 1.65 \times 10^{-4} C$

$C_T = C_1 + \frac{1}{\frac{1}{C_2} + \frac{1}{C_3}} = \frac{11}{5}\ \mu F$

then $V_1 = \frac{Q}{C_T} = \frac{1.65 \times 10^{-4} C}{\frac{11}{5}\mu F} = 75V$

b). $Q_{23} = CV = 75 \times \frac{6}{5}\mu F$, then $V_3 = \frac{Q_{23}}{C_3} = \frac{75 \times \frac{6}{5}}{3} = 30V$

c). $\frac{dQ_1}{dt} + \frac{dQ_2}{dt} + I_3 = 0$

$\frac{Q_1}{C_1} = I_3 R_2$ $\Rightarrow$ $Q = Q_0 e^{-\frac{t}{\tau}}$

$\frac{Q_2}{C_{23}} = I_3 R_2$

$Q_0 = V_1 C_1 = 75V \times 1.00\mu F = 7.5 \times 10^{-5} C$

$\tau = R_2 C_2 = \frac{11}{5} \times 10^{-6} \times 1.75 \times 10^6 = 3.85 s$

So $Q = 7.5 \times 10^{-5} C \cdot e^{-\frac{3}{3.85}}$

$= 3.44 \times 10^{-5} C$