Answers

RC circuits extended

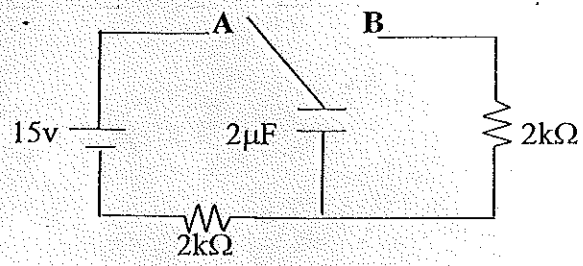
1. When the switch is in position A, the circuit reaches steady state conditions. It is then thrown to position B.
   a. Is the capacitor charging or discharging?
   b. What is the time constant?
   c. Find the capacitor voltage as a function of time.
   d. Find the resistor voltage as a function of time.
   e. Find the current as a function of time.
   f. At, 0.25 ms, what is the voltage and current across the resistor and the voltage across the capacitor?

RC = a second

V = IR → (Volt/Amp)(Coulomb/Volt)

Q = CV

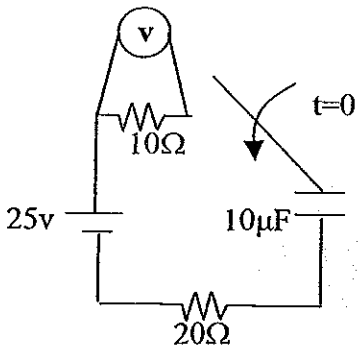
I = dq/dt → Coulomb/Amp = Sec



2. The circuit is in steady state at t = 0- (switch is originally open).
   a. What is the voltmeter reading at this point?

   Just as the switch is closed:
   b. Determine the voltmeter reading.
   c. Determine the current as a function of time.
   d. Find the voltmeter reading at 0.5 ms.

   After the circuit again reaches steady state:
   e. Determine the voltmeter reading.
   f. Write a differential equation using variables (use Kirchhoff's voltage loop rule).



AP Exam Review Unit 12 (1)

1. a) Discharging

b) $\tau = RC = (2k)(2mF) = .004s = 4ms$ (45-3 ✓)

c)

$V_C = 15e^{-250t}$

d) $V_R = -15e^{-250t}$ 1004

e) $I(t) = -.0075e^{-250t}$

f) $V_C = V_R = 14.09\ V$ $I_R = .007A_{ps}$

2. a) $V = 0$

b) $\frac{25}{30} = .83A \Rightarrow V = IR =$ F 3 ✓

$25 = 30I$ $V_C(5^-) = V_C(0^+)$

c) $I = .83e^{-t/3E-4}$

$I = .83e^{-3333.3t}$

$R_1 = 3k\Omega$

$C = 10mF$

$\tau = RC = 3E-4$

d) $V = (.83)(10)e^{-3333.3(1.5E-3)}$

$V = 1.57$ volts

e) $V = 0$

f) $-25 + 10I_1 + V_C + 2I_1 = 0$

$30I + \frac{q}{C} = 25$

$30\frac{dq}{dt} + \frac{q}{C} = 25$

AP Exam Answers Night 12

3. a)

$R_{eq} = 20\Omega$

a) $\therefore I = \frac{25}{20} = 1.25A$

b) $(10)(1.25) = 12.5V$

b) $V_c = 25 - 12.5V = 12.5V$

c) $V_c = 12.5e^{-t/RC}$ $R_2 = 10\Omega$

$\tau : RC = (4.7)(10) = 47s$

$V_c = 12.5e^{-t/47}$

$\therefore V = \frac{1}{2}$ of V_c because of 2-5V resistors

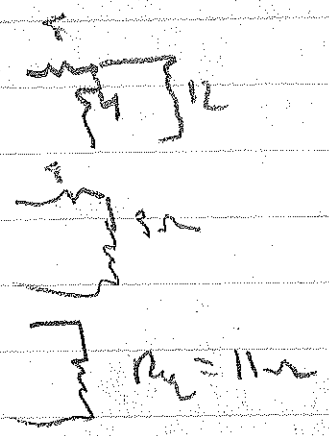
$V = 6.25e^{-t/47}$ Volts

d) $V = 6.25e^{-2/47}$

$V = 5.99$ Volts

Answers without R2 RC

4. a)



$\frac{3}{12}(4) = \frac{4}{12} = 3\Omega$

$\frac{20V}{11\Omega} = 1.82$ Amps

$\therefore V_{9\Omega} = (1.82)(9) = 14.5V$

$\therefore V_C = 20 - 14.5 = \underline{5.5V}$ (across)

b)

$V_1 = V_C = 5.5Ve^{-t/RC}$ $\quad \tau = RC = (3)(3) = 9$

$V_1 = 5.5e^{-t/9}$ V

$V_2 = \left(\frac{10}{10+2}\right)(5.5e^{-t/9})$ $\quad V_3 = \left(\frac{2}{10+2}\right)(5.5e^{-t/9})$

$\underline{V_2 = 4.58e^{-t/9}}$ V $\quad \underline{V_3 = .92e^{-t/9}}$ V