ENGG104 Tutorial 6 Class Questions

Team Name: ____

Question 1 [typical exam question]

For the circuit in Fig. 94, composed of standard values:

a. Determine the time constant of the circuit.

b. Write the mathematical equation for the voltage v_C following the closing of the switch.

c. Determine the voltage v_C after one, three, and five time constants.

d. Write the equations for the current i_C and the voltage v_R.

e. Sketch the waveforms for v_C and i_C.

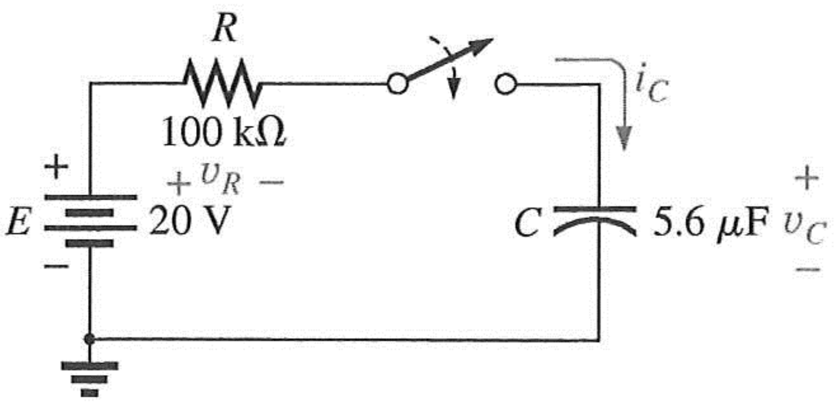


FIG. 94

a. $\tau = RC = (10^5\ \Omega)(5.6\ \mu F) = \mathbf{0.56\ s}$

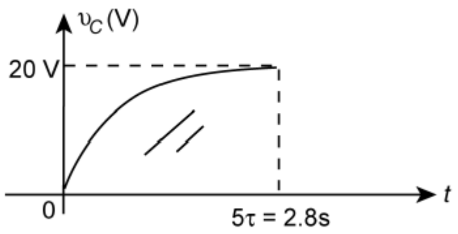
b. $v_C = E(1 - e^{-t/\tau}) = \mathbf{20\ V(1 - e^{-t/0.56\ s})}$

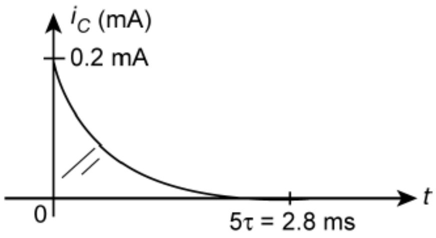
c. $1\tau = 0.632(20\text{ V}) = \mathbf{12.64\text{ V}}$, $3\tau = 0.95(20\text{ V}) = \mathbf{19\text{ V}}$
$5\tau = 0.993(20\text{ V}) = \mathbf{19.87\text{ V}}$

d. $i_C = \dfrac{20\text{ V}}{100\text{ k}\Omega}e^{-t/\tau} = \mathbf{0.2\text{ mA}e^{-t/0.56\text{ s}}}$

$\upsilon_R = Ee^{-t/\tau} = \mathbf{20\text{ V}e^{-t/0.56\text{ s}}}$

e.



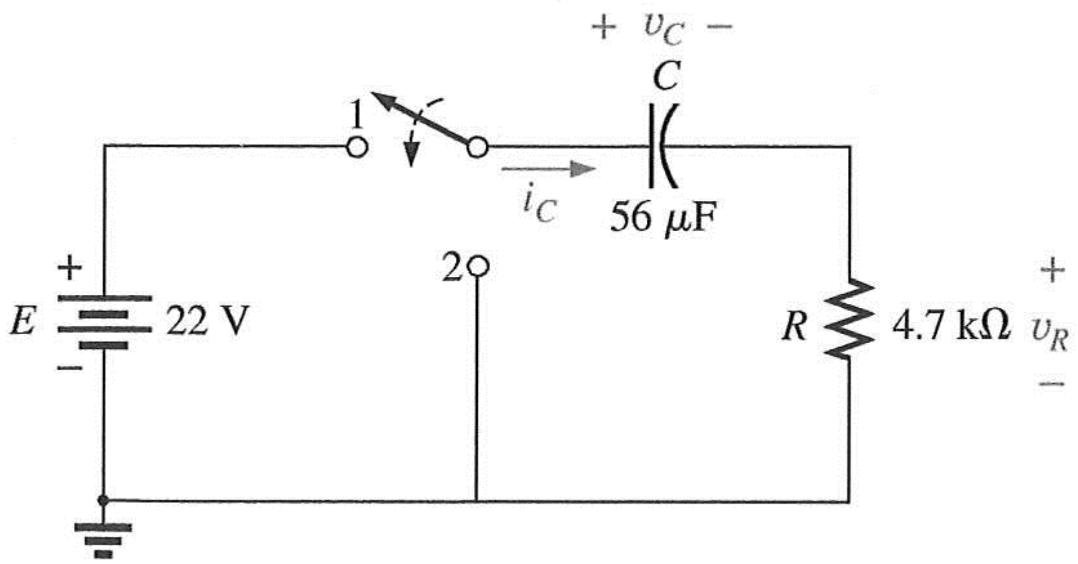


Question 2 [typical exam question]

For the *R*-*C* circuit in Fig. 97, composed of standard values:

a. Determine the time constant of the circuit when the switch is thrown into position 1.

b. Find the mathematical expression for the voltage across the capacitor and the current after the switch is thrown into position 1.



c. Determine the magnitude of the voltage υ_C and the current i_C the instant the switch is thrown into position 2 at $t = 1$ s.

d. Determine the mathematical expression for the voltage υ_C and the current i_C for the discharge phase.

e. Plot the waveforms of υ_C and i_C for a period of time extending from 0 to 2 s from when the switch was thrown into position 1.

a. $\tau = RC = (4.7\text{ k}\Omega)(56\ \mu\text{F}) = \mathbf{263.2\ ms}$

b. $\upsilon_C = E(1 - e^{-t/\tau}) = \mathbf{22\ V(1 - e^{-t/263.2ms})}$

$$i_C = \frac{E}{R}e^{-t/\tau} = \frac{22\text{ V}}{4.7\text{ k}\Omega}e^{-t/263.2\text{ms}} = \mathbf{4.68\ mA}e^{-t/263.2\text{ms}}$$

c. $\upsilon_C(1\text{ s}) = 22\text{ V}(1 - e^{-1\text{s}/263.2\text{ms}}) = 22\text{ V}(1 - e^{-3.8})$

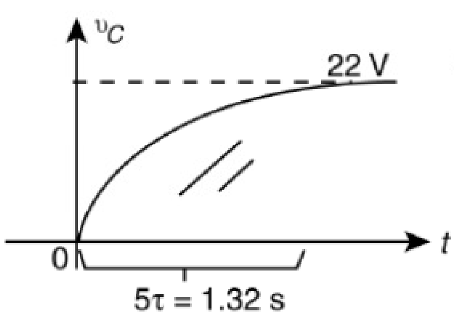
$= 22\text{ V}(1 - 22.37 \times 10^{-3}) = \mathbf{21.51\ V}$

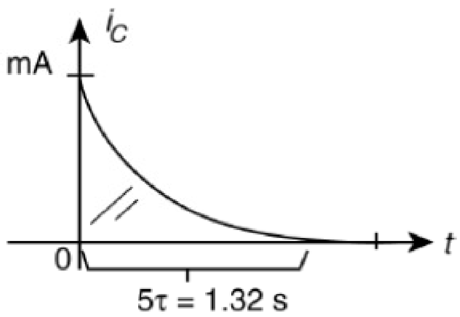
$i_C(1\text{ s}) = 4.68\text{ mA}e^{-1\text{s}/263.2\text{ms}} = 4.68\text{ mA}(22.37 \times 10^{-3}) = \mathbf{0.105\ mA}$

d. $\upsilon_C = \mathbf{21.51\ V}e^{-t/263.2\text{ms}}$

$$i_C = \frac{21.51\text{ V}}{4.7\text{ k}\Omega}e^{-t/263.2\text{ms}} = \mathbf{4.58\ mA}e^{-t/263.2\text{ms}}$$

e.





Question 3

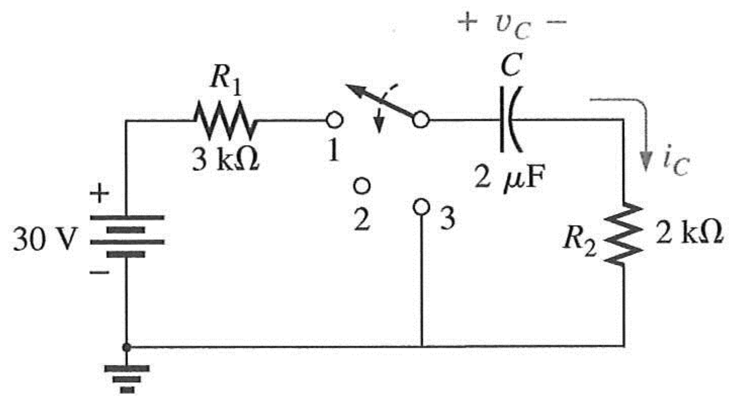
26. For the network in Fig. 98, composed of standard values:

a. Write the mathematical expressions for the voltages v_C, and v_{R_1} and the current i_C after the switch is thrown into position 1.

b. Find the values of v_C, v_{R_1}, and i_C when the switch is moved to position 2 at $t = 100$ ms.

c. Write the mathematical expressions for the voltages v_C and v_{R_2} and the current i_C if the switch is moved to position 3 at $t = 200$ ms.

d. Plot the waveforms of v_C, v_{R_2}, and i_C for the time period extending from 0 to 300 ms.



a. $\tau = RC = (3\text{ k}\Omega + 2\text{ k}\Omega)(2\ \mu\text{F}) = 10\text{ ms}$

$\upsilon_C = \mathbf{30\ V(1 - e^{-t/10ms})}$

$i_C = \dfrac{30\text{ V}}{5\text{ k}\Omega} e^{-t/10\text{ms}} = \mathbf{6\ mA^{-t/10ms}}$

$\upsilon_{R_1} = i_C R_1 = (6\text{ mA})(3\text{ k}\Omega)e^{-t/10\text{ms}} = \mathbf{18\ Ve^{-t/10ms}}$

b. 100ms: $e^{-10} = 45.4 \times 10^{-6}$

$\upsilon_C = 30\text{ V}(1 - 45.4 \times 10^{-6}) = \mathbf{30\ V}$

$i_C = 6\text{ mA}(45.4 \times 10^{-6}) = \mathbf{0.27\ \mu A}$

$\upsilon_{R_1} = 18\text{ V}(45.4 \times 10^{-6}) = \mathbf{0.82\ mV}$

c. 200 ms: $\tau' = R_2C = (2\text{ k}\Omega)(2\ \mu\text{F}) = 4\text{ ms}$

$\upsilon_C = \mathbf{30\ Ve^{-t/4ms}}$

$i_C = -\dfrac{30\text{ V}}{2\text{ k}\Omega} e^{-t/4\text{ms}} = \mathbf{-15\ mAe^{-t/4ms}}$

At $t = 0$: $\upsilon_{R_2} = i_C R_2 = (6\text{ mA})(2\text{ k}\Omega)e^{-t/10\text{ ms}}$

$= \mathbf{12\ Ve^{-t/10\ ms}}$

At $t = 200$ ms: $\upsilon_{R_2} = -(15\text{ mA})(2\text{ k}\Omega)e^{-t/4\text{ ms}}$

$= \mathbf{-30\ Ve^{-t/4\ ms}}$

d.