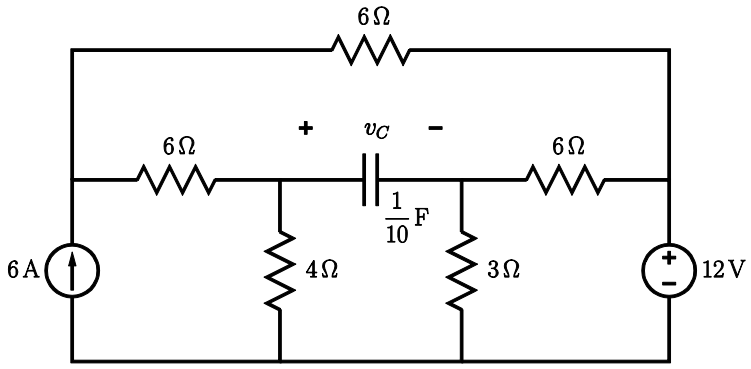
METU/EEED
EE 201

HOMEWORK VII

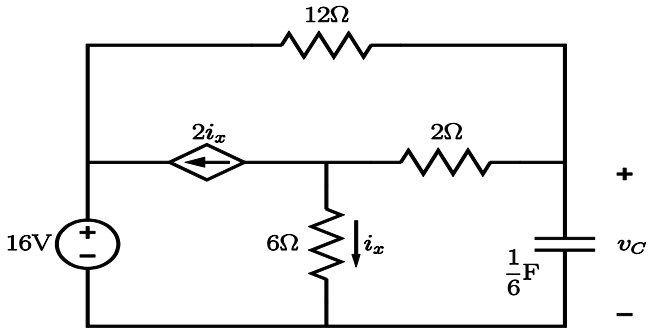
Question 1 In the circuit below, find (as a function of time) the instantaneous power, p(t), supplied by the current source for $t \geq 0$.



$v_C(0) = 2$ V.

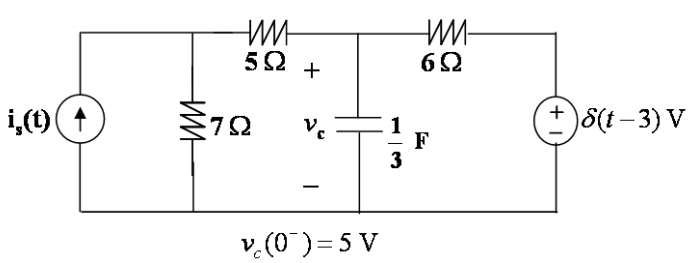
Answer $p(t) = 180 - 10.8e^{-2t}$ W, $t \geq 0$.

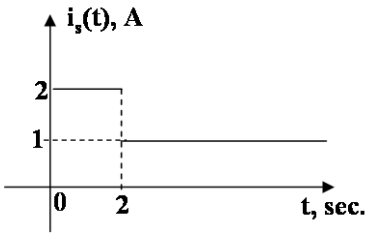
Question 2 Consider the circuit below. The initial voltage on the capacitor is $v_C(0) = 6$ V. Find $i_x(t)$ for $t \geq 0$.



Answer $i_x(t) = (1/3) + (1/6)e^{-2t}$ A, $t \geq 0$.

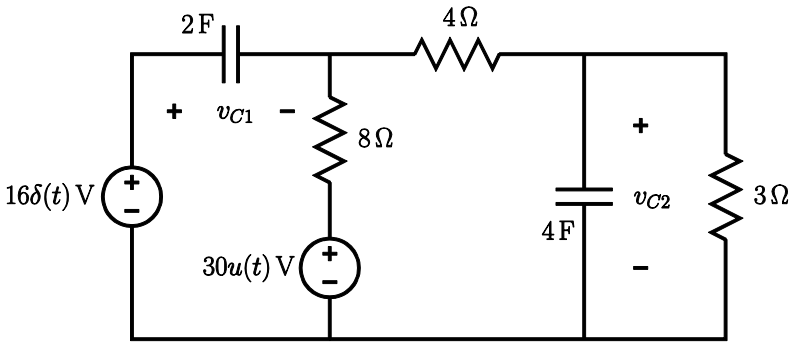
Question 3 Find $v_c(t)$ for $t \geq 0$.





Answer $\tau = 4/3$ sec, $v_c(3^+) - v_c(3^-) = 0.5$ V, $v_c(\infty) = 7/3$ V.

Question 4 Find $v_{C1}(0^+)$, $v_{C2}(0^+)$, $v_{C1}(\infty)$, $v_{C2}(\infty)$.

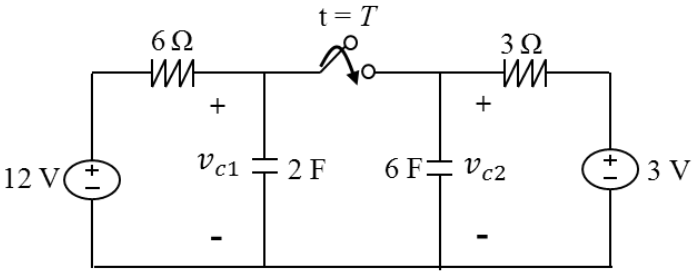


$v_{C1}(0^-) = -1$ V,

$v_{C2}(0^-) = 4$ V.

Answer $v_{C1}(0^+) = 2$ V, $v_{C2}(0^+) = 5$ V, $v_{C1}(\infty) = -14$ V, $v_{C2}(\infty) = 6$ V.

Question 5 Consider the circuit below.



$v_{c1}(0) = -4$ V, $v_{c2}(0) = -1$ V; $T = 36\ln(2)$ sec.

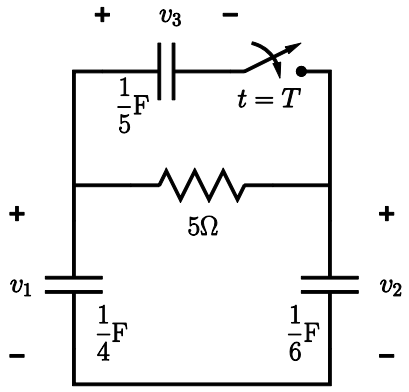
a) Find and sketch $v_{c1}(t)$ for $t \geq 0$.

b) Find the energy dissipated on the 3 Ω resistor and the energy supplied by the 3 V source on the time interval $\left[0, \frac{T}{2}\right]$.
Find the stored energy in the 6 F capacitor at t = 0 and t = T/2.

Answer *a)* $v_{c1}(T^-) = 10$ V, $v_{c2}(T^-) = 2$ V, $v_{c1}(T^+) = 4$ V; $v_{c1}(t) = 6 - 2e^{-(t-T)/16}$ V, $t > T$.

b) $W_{3\Omega} = 36$ J, $W_{3V} = 36$ J, $e_{6F}(0) = e_{6F}(T/2) = 3$ J.

Question 6 Consider the circuit below.



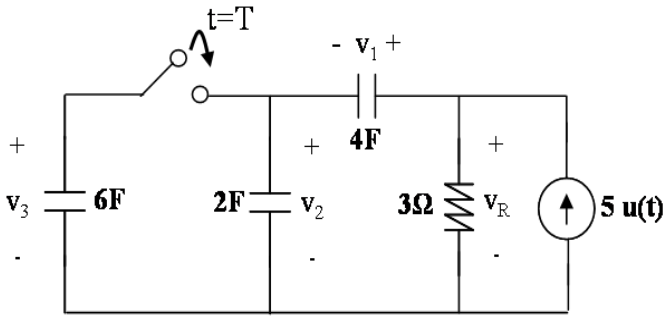
$v_1(0) = -3$ V, $v_2(0) = 7$ V, $v_3(0) = 3.5$ V; $v_1(T^-) = 0$.

a) Find and sketch $v_1(t)$ for $t \geq 0$.
b) Find the energy delivered to the resistor on the interval $0 \leq t < T$ and the stored energies in the capacitors at $t = 0$ and $t = T^-$. Verify that the energy is conserved.

Answer *a)* $v_2(T^-) = 2.5$ V, $v_3(T^+) = 1.5$ V; $v_1(t) = 1 + 0.6e^{-2(t-T)/3}$ V, $t > T$.

b) $W_R = 75/16$ J.

Question 7 In the circuit below, the switch is closed at $t = T$. Find $v_R(t)$ and $v_2(t)$ for $t > 0$.

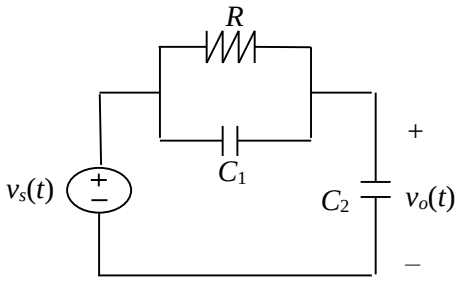


$v_1(0^-) = -6$ V, $v_2(0^-) = 3$ V, $v_3(0^-) = -1$ V; $T = 4\ln(3)$ sec.

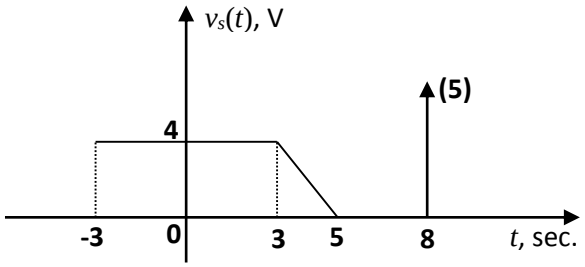
Answer $v_R(t) = 15 - 18e^{-t/4}$ V, $v_2(t) = 15 - 12e^{-t/4}$ V, $0 \leq t < T$;

$v_R(t) = 15 - 15e^{-(t-T)/8}$ V, $v_2(t) = 7 - 5e^{-(t-T)/8}$ V, $t > T$.

Question 8 The unit step response for $v_o(t)$ for the following circuit is $h_u(t) = (1 - \frac{1}{3}e^{-2t})u(t)$ V.



a) Find the zero-state response for $v_o(t)$ for the input given below.



b) Find suitable R, C_1, and C_2 values to realize the given step response.

Answer *a) The impulse response:* $h(t) = (2/3)e^{-2t}u(t) + (2/3)\delta(t)$ *V,*

The ramp response: $h_r(t) = [t + (1/6)e^{-2t} - (1/6)]u(t)$ *V.*

b) $C_1 = 2C_2$, $RC_2 = 1/6$.