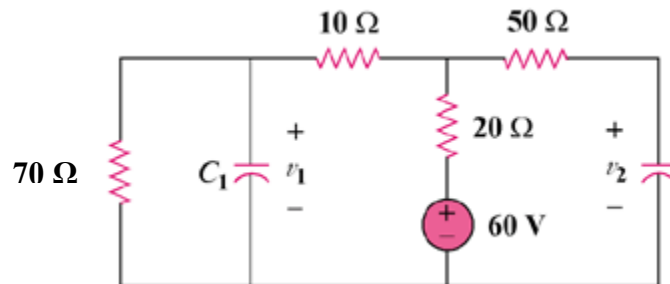


EE1002 Tutorial 8

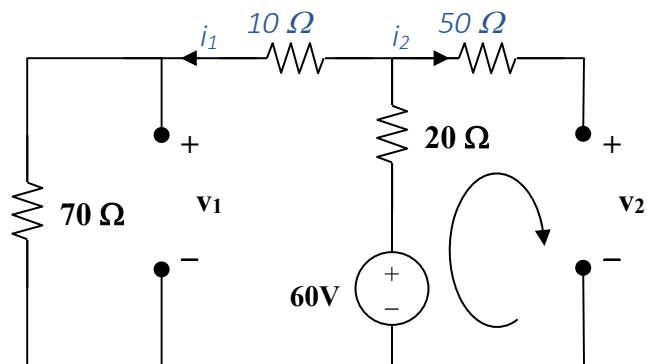
(Questions from Alexander & Sadiku, 7th edition, Problems 6.13, 6.48, & 6.61)

1. Find the voltage across the capacitors in the following circuit under dc conditions.



Solution

Under dc conditions, the circuit becomes that shown below:

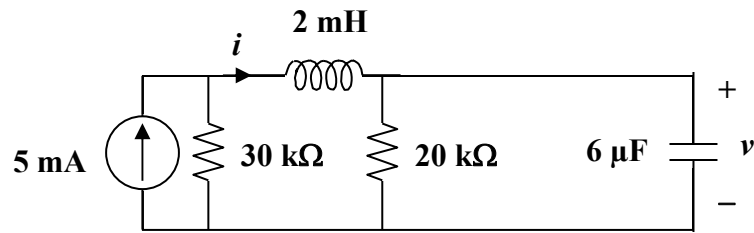


$$i_2 = 0, i_1 = 60 / (70 + 10 + 20) = 0.6 \text{ A}$$

$$v_1 = 70i_1 = 42 \text{ V}, v_2 = 60 - 20i_1 = 48 \text{ V}$$

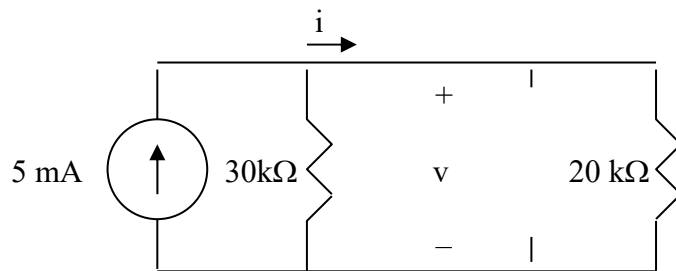
Thus, $v_1 = 42 \text{ V}$, $v_2 = 48 \text{ V}$.

2. Under steady-state dc conditions, find i and v in the following circuit.



Solution

Under steady-state, the inductor acts like a short-circuit, while the capacitor acts like an open circuit as shown below.

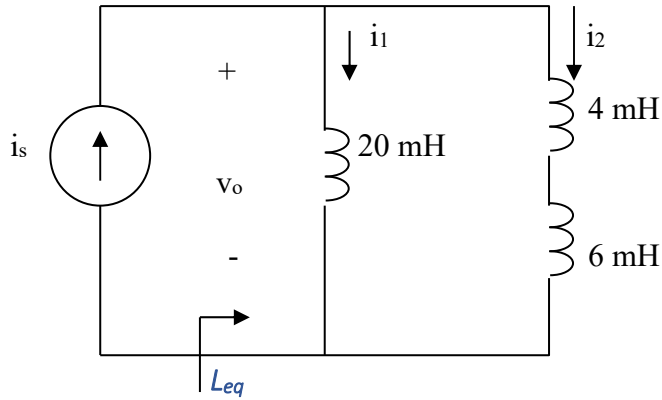


Using current division,

$$i = (30\text{k}/(30\text{k}+20\text{k}))(5\text{mA}) = \mathbf{3\text{ mA}}$$

$$v = 20\text{k}i = \mathbf{60\text{ V}}$$

3. Consider the following circuit. Find: (a) L_{eq} , $i_1(t)$ and $i_2(t)$ if $i_s = 3e^{-t}$ mA, (b) $v_o(t)$, (c) energy stored in the 20-mH inductor at $t=1$ s. [Hint: the energy stored in an inductor is given by $W = (1/2)Li^2$, where L and i are the inductance and inductor current, respectively.]



Solution

(a) $L_{eq} = 20 // (4 + 6) = 20 \times 10 / 30 = \underline{6.667 \text{ mH}}$

Using current division,

$$i_1(t) = \frac{10}{10 + 20} i_s = \underline{e^{-t} \text{ mA}}$$

$$i_2(t) = \underline{2e^{-t} \text{ mA}}$$

(b) $v_o = L_{eq} \frac{di_s}{dt} = \frac{20}{3} \times 10^{-3} (-3e^{-t} \times 10^{-3}) = \underline{-20e^{-t} \mu V}$

(c) $w = \frac{1}{2} Li_1^2 = \frac{1}{2} \times 20 \times 10^{-3} \times e^{-2} \times 10^{-6} = \underline{1.3534 \text{ nJ}}$