KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

ELECTRICAL ENGINEERING DEPARTMENT

EE-201 ELECTRIC CIRCUITS

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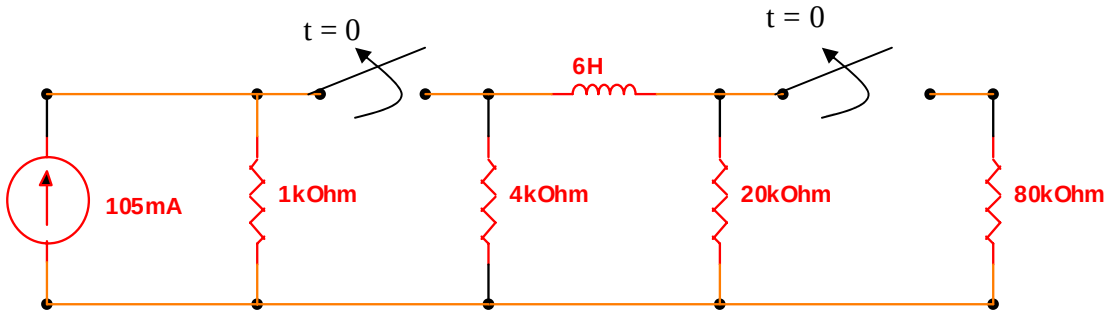
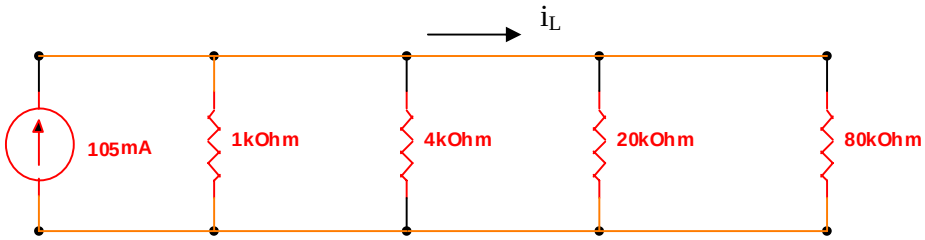
Solution

Sec: 8 Quiz # 6 Ser. # Name: I.D.#

The two switches in the circuit below are opened at t = 0 . How much time does it take for the energy dissipated in the 4 K-Ohm resistor to 10% of the initial energy stored in the 6 H inductor.



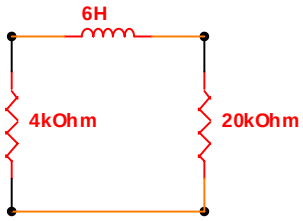
For t < 0



1 // 4 = 0.8 K-Ohm & 20 // 80 = 16 K-Ohm

$$i_L(t) = \frac{0.8}{0.8+16}(105) = 5 \text{ mA}$$

For t ≥ 0



$$i_L(t) = 5e^{-4000t} \text{ mA}$$

The energy stored in the inductor at t = 0

$$w(0) = \frac{1}{2}(6)(5 \text{ x } 10^{-3})^2 = 75 \ \mu \text{ J}$$

The power dissipated across the 4 K-Ohm resistor at time t

$$p(t) = (4000)(5e^{-4000t})^2 = 0.1e^{-8000t} \text{ W}$$

The energy dissipated across the 4 K-Ohm resistor at time t

$$w(t) = \int_0^t 0.1e^{-8000t}\,dt = 12.5(1 - e^{-8000t}) \ \mu \text{ J}$$

10% of the initial energy stored in the 6 H inductor = 7.5 μ J

Therefore, at this time

$$12.5(1 - e^{-8000t}) = 7.5$$

t = 114.5 μ s