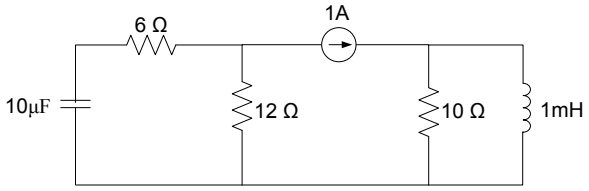
TOPIC

Electricity and Magnetism – Section XI – Question 13

QUESTION

The circuit below has been in the state for a long period. The energy stored in μJoules on the capacitor and inductor, respectively most nearly is



(A) 0, 0
(B) 5, 500
(C) 720, 500
(D) -720, 500

HINT

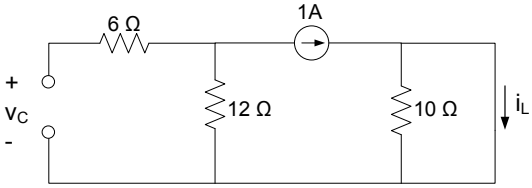
$E_L = \frac{1}{2} L . {i_L}^2$ (The current through the inductor is required)

$E_C = \frac{1}{2} C {V_C}^2$ (The voltage drop across the capacitor is required)

For DC Signals: A capacitor is open circuit and an inductor is a short circuit.

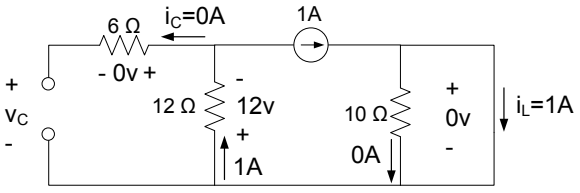
SOLUTION

The current source is DC. The capacitor is open circuit (i_C=0A) and the inductor is a short circuit (v_L=0v).Therefore, the circuit is as follows:



Analysis:

The 10Ω resistor is in parallel to the inductor. So they have the same voltage drop. But the inductor is short circuit and v_L=0 which means that v_{10}=0. So the current through the 10 Ω is 0/10=0A.



So on the top right node, 1A is entering and 0A goes through the resistor which means that 1A goes through the inductor. Or KCL top node:

$-1 + 0 + i_L = 0$

$i_L = 1A.$

The current through the 6Ω resistor is the same with the capacitor current which is 0A. So, the voltage drop across the 6Ω resistor is 0v.

KVL left loop:

$-v_C - 0 - 12 = 0$

$v_C = -12V.$

$$E_L = \frac{1}{2}(1m)(1)^2$$
$$= 0.5mJ$$
$$= 500\mu J$$
$$E_C = \frac{1}{2}(10\mu)(-12)^2$$
$$= 720\mu J$$

ANSWER

(C)

CONTRIBUTOR

Stelios Ioannou