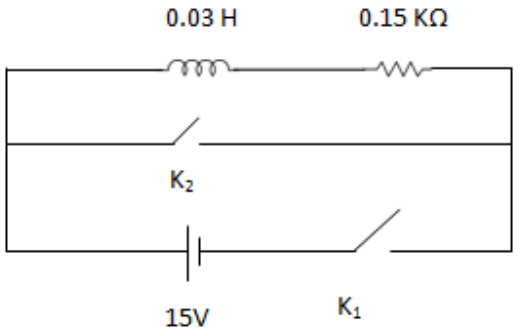
22. An inductor (L = 0.03H) and a resistor (R = 0.15 kΩ) are connected in series to a battery of 15V EMF in a circuit shown below. The key K_1 has been kept closed for a long time. Then at t = 0, K_1 is opened and key K_2 is closed simultaneously. At t = 1ms, the current in the circuit will be : ($e^5 \cong 150$)



(1) 100 mA (2) 67 mA (3) 6.7 mA (4) 0.67 mA

Answer:

When K1 is closed for sufficiently long time current in the circuit grows to maximum when K1 opened and K2 closed this current starts falling, during the fall the current is varying and this varying current flowing through the inductance produces an induced emf which opposes the cause that is decay of current, hence decay is delayed (Note: Please refer selfstudy.in → Advanced Physics →L-R Circuit for more detail)

We know that current at any instant t in L-R circuit during decay is given by

$$i = I_0 e^{-\frac{R}{L}t} \rightarrow (1)$$

$$also\ I_0 = \frac{E}{R} = \frac{15}{0.150 \times 1000} = 0.1$$

$$therefore\ at\ t = 1ms = 0.001$$

$$i = 0.1e^{-\frac{0.15\times1000\times0.001}{0.03}}$$

$$i = 0.1e^{-5} = \frac{0.1}{e^5}$$

$$= \frac{0.1}{150} = 6.666 \times 10^{-3} \approx 0.67mA$$

Correct option (4) 0.67 mA.