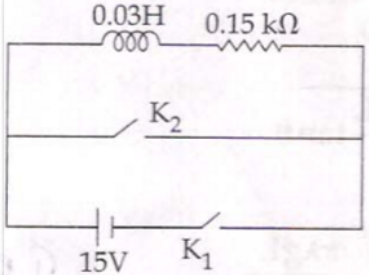
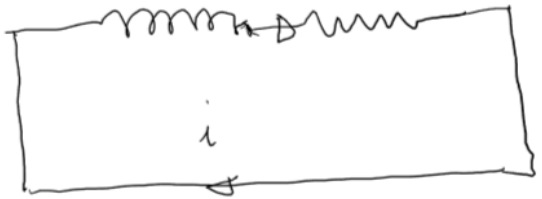
10. An inductor (L = 0.03H) and a resistor (R = 0.15 kΩ) are connected in series to a battery of 15V EMF in a circuit shown below. The key K_1 has been kept closed for a long time. Then at t = 0, K_1 is opened and key K_2 is closed simultaneously. At t = 1ms, the current in the circuit will be : ($e^5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



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

After $t = 0$, circuit is an LI circuit.

$L = 0.03H$ $R = 0.15\,k\Omega$



$$L\frac{di}{dt} + Ri = 0$$

$$\int_{i_0}^{i} \frac{di}{i} = \int_{t=0}^{t} -\frac{R}{L}\,dt$$

At $t = 0$, $i = i_0$

$$\Rightarrow \ln\frac{i}{i_0} = -\frac{R}{L}t \Rightarrow \boxed{i = i_0 e^{-(R/L)t}}$$

Given $t = 1ms$, $i = ?$ $\quad i_0 = \dfrac{15\,V}{0.15\,k\Omega} = 0.1\,A$

$$\Rightarrow i = 0.1 \times e^{-\left(\frac{150}{0.03}\right)\times 10^{-3}}$$

$$i = 0.1\,e^{-5} \simeq \frac{0.1}{150} \simeq 0.67\,mA$$