76. For $t < 0$, no current goes through $L_2$, so $i_2 = 0$ and $i_1 = \mathcal{E}/R$. As the switch is opened there will be a very brief sparking across the gap. $i_1$ drops while $i_2$ increases, both very quickly. The loop rule can be written as

$$\mathcal{E} - i_1 R - L_1 \frac{di_1}{dt} - i_2 R - L_2 \frac{di_2}{dt} = 0 ,$$

where the initial value of $i_1$ at $t = 0$ is given by $\mathcal{E}/R$ and that of $i_2$ at $t = 0$ is 0. We consider the situation shortly after $t = 0$. Since the sparking is very brief, we can reasonably assume that both $i_1$ and $i_2$ get equalized quickly, before they can change appreciably from their respective initial values. Here, the loop rule requires that $L_1(di_1/dt)$, which is large and negative, must roughly cancel $L_2(di_2/dt)$, which is large and positive:

$$L_1 \frac{di_1}{dt} \approx -L_2 \frac{di_2}{dt} .$$

Let the common value reached by $i_1$ and $i_2$ be $i$, then

$$\frac{di_1}{dt} \approx \frac{\Delta i_1}{\Delta t} = \frac{i - \mathcal{E}/R}{\Delta t}$$

and

$$\frac{di_2}{dt} \approx \frac{\Delta i_2}{\Delta t} = \frac{i - 0}{\Delta t} .$$

The equations above yield

$$L_1 \left( i - \frac{\mathcal{E}}{R} \right) = -L_2(i - 0) \implies i = \frac{\mathcal{E} L_1}{L_2 R_1 + L_1 R_2} = \frac{L_1}{L_1 + L_2} \frac{\mathcal{E}}{R} .$$