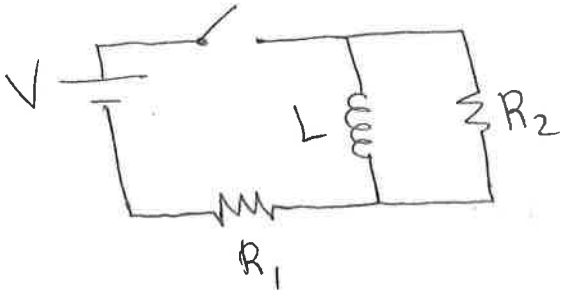
Example (Exam 3, 2011, Q3)




When switch is closed for long time, no current flows through $R_2$ since inductor provides no pushback $\left(-L\frac{di}{dt}\right)$ to current flow.

Current through $R_1$:

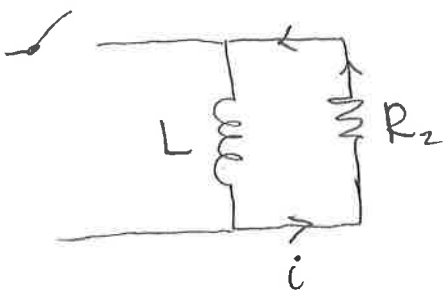
$$V - L\frac{di}{dt} - iR_1 = 0$$

($\frac{di}{dt} = 0$)

$$i = \frac{V}{R_1}$$

Now open switch. Current $i$ cannot change discontinuously through inductor $\Rightarrow i(0) = \frac{V}{R_1}$.

New Kirchhoff loop rule




$$-L\frac{di}{dt} - iR_2 = 0$$

$$L\frac{di}{dt} = -iR_2$$

$$\frac{di}{i} = -\frac{R_2}{L}dt$$

$$\int_{i(0)}^{i(t)} \frac{di}{i} = -\frac{R_2}{L} \int_0^t dt$$

$$\left[ \ln i \right]_{i(0)=V/R_1}^{i(t)} = -\frac{R_2}{L} t$$

$$\ln\left(i(t)\right) - \ln\left(V/R_1\right) = -\frac{R_2}{L} t$$

$$\ln\left(\frac{R_1}{V} i(t)\right) = -\frac{R_2}{L} t$$

$$\frac{R_1}{V} i(t) = e^{-\frac{R_2}{L} t}$$

$$i(t) = \frac{V}{R_1} e^{-\frac{R_2}{L} t}$$