8. Magnetic pulse ***(7 points)*** Since we can neglect the inductance of the coil, it performes as a voltage source, which outputs $U = NSB/\tau = 1\,\mathrm{V}$ during the time period between $t = 0\,\mathrm{ms}$ and $10\,\mathrm{ms}$, and $0\,\mathrm{V}$ otherwise. The characteristic time scales of the RC and LC cirquits are $\tau_1 = R_1C = 0.6\,\mathrm{s}$ and $\tau_2 = L/R_2 \approx 0.3\,\mathrm{s}$. So, for both cirquits, the processes are very fast, i.e. the capacitor is effectively short-circuited, and almost all the voltage falls on the inductance.

i) According to the considerations given above, $I_1 = U/R_1 \approx 0.33\,\mathrm{A}$. As for I_2, it starts growing from $0\,\mathrm{A}$ at $t = 0$ at a rate, given by $L\frac{dI}{dt} = U$, i.e. $I_2 = Ut_1/L = 5\,\mathrm{mA}$.

ii) When the voltage U is switched off (at $t = \tau = 10\,\mathrm{ms}$), the capacitor will (almost completely, because $t_2 - \tau \ll R_1C$) retain the charge it has accumulated, $Q = I_1\tau$. All the voltage of the capacitor (Q/C) will fall on the resistor R_1, so that $I_1' = Q/R_1C = U\tau/R_1^2C \approx 5.6\,\mathrm{mA}$. As for the inductance, it will retain (almost completely, because $t_2 - \tau \ll L/R_2$) the current it has acquired during the first $10\,\mathrm{ms}$, $I_2' = U\tau/L = 10\,\mathrm{mA}$.

iii) Since the current in R_2 will decay very slowly, as compared to its growth during the first $10\,\mathrm{ms}$, we can neglect the charge passing thorugh it during $t < \tau$. Then we can write the Kirhoff's law in the form $L\frac{dI}{dt} + R_2\frac{dq}{dt} = 0$, from where $LdI + R_2dq = 0$, and $L\Delta I = -R_2\Delta q$. Since $\Delta I = -I_2'$, we obtain $\Delta q = LI_2'/R_2 = 3.3\,\mathrm{mC}$.