6. Loop (6 points) — *Lasse Franti.* A wire loop is hovering in outer space (weightless vacuum) with its plane parallel to the xy-plane. In $x < 0$ there is a homogeneous magnetic field parallel to the z-axis. The rigid rectangular loop is $l = 10\,\text{cm}$ wide and $h = 30\,\text{cm}$ long. The loop is made of copper wire with a circular cross section (radius $r = 1.0\,\text{mm}$). At $t = 0\,\text{s}$ the external magnetic field starts to decrease at a rate of $0.025\,\text{T/s}$.

i) *(3 points)* Find the acceleration of the loop right after $t = 0\,\text{s}$. The magnetic flux density is initially $B = 2.0\,\text{T}$ and the loop is immersed $d = 12\,\text{cm}$ into the external field with its shorter side parallel to the y-axis.

ii) *(3 points)* We can try to increase the acceleration in many ways. How does the result in i) change if

a) the loop is made with twice thicker copper wire ($r = 2.0\,\text{mm}$)?

b) the original wire is wound three times instead of one (giving a short-circuited coil with three windings, the dimensions of the rectangle stay the same)?

c) the mass of the coil is kept constant by using a wire with half the cross section which is then wound two times (the dimensions of the rectangle stay the same)?

d) the loop is made of a different metal? Which of the metals given in the table gives the best result?

Metal	Resistivity $10^{-8}\,\text{m}$	Density $10^3\,\text{kg/m}^3$
Iron	9.71	7.87
Copper	1.67	8.96
Aluminum	2.65	2.70
Lithium	8.55	0.53

e) What if we use the thicker copper wire to make a twice bigger loop ($r = 2.0\,\text{mm}$, $l = 20\,\text{cm}$, $h = 60\,\text{cm}$) and immerse it $24\,\text{cm}$ into the external field?