NTNU

Institutt for fysikk

# TFY4240

# Problem set 6 Autumn 2015

**Problem 1.**
Example 7.2, 7.4, 7.7, 7.9 and 7.13 from Griffiths.

**Problem 2.**
A closed square loop of wire of sides $a$ lies on a table. Its lower section is initially placed a distance $s_0 \ll a$ from an infinitely long straight wire, which carries a current $I$.
A coordinate system is defined so that the $\hat{\boldsymbol{z}}$-axis coincides with the infinite wire and the look is located in the $yz$-plane.

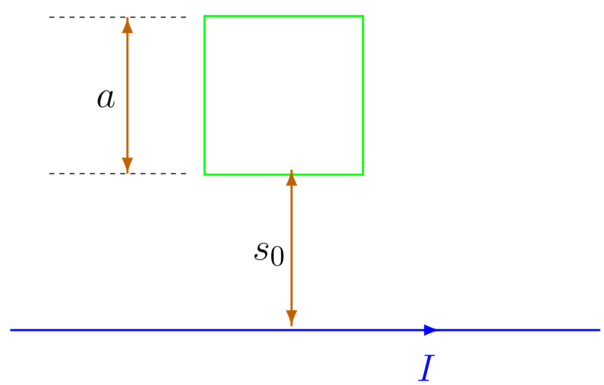


Figure 1: Schematics of the geometry

**a)** Write down an expression for the current density $\boldsymbol{J}(\boldsymbol{r})$ associated with the infinitely long wire. This expression should be valid for all spatial positions $\boldsymbol{r}$.

**b)** Use the expression for $\boldsymbol{J}(\boldsymbol{r})$ to obtain the magnetic field $\boldsymbol{B}(\boldsymbol{r})$ around the long wire.

**c)** Assume now that someone pulls the square loop directly away from the wire with a (constant) speed $\boldsymbol{v}_1 = v\hat{\boldsymbol{y}}$. What emf is generated? In what direction (clockwise or counterclockwise) does the induced current flow?

**d)** Make a plot of the induced emf *vs.* time $t$. Discuss in particular the small and large time limits.

**e)** What if the loop instead is pulled with the velocity $\boldsymbol{v}_2 = v\hat{\boldsymbol{z}}$. What is then the emf?