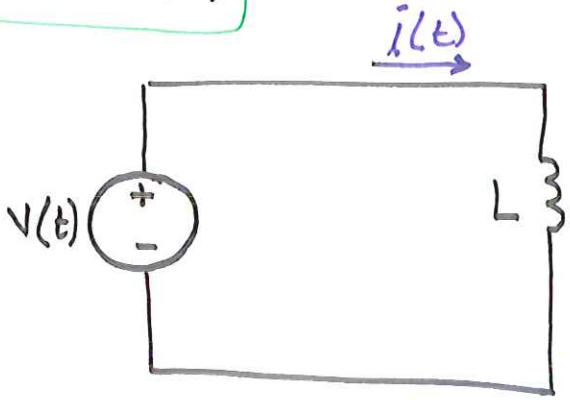
KAPITEL 8

8.1 Bestäm $i(t)$, $p(t)$ och $w(t)$

$$v(t)=\begin{cases}0 & , t\leq 0\\ V_0\sin(\omega t) & , t\geq 0\end{cases}$$



$$v=L\frac{di}{dt} \Leftrightarrow i=\frac{1}{L}\int v(t)\,dt$$

$$\Leftrightarrow i=\frac{1}{L}\left(-\cos(\omega t)\cdot\frac{V_0}{\omega}\right)\overset{+L}{=}-\frac{V_0}{\omega L}\cdot\cos(\omega t)+C$$

Vi vet att $i(0)=0 \Rightarrow C=\frac{V_0}{\omega L}$

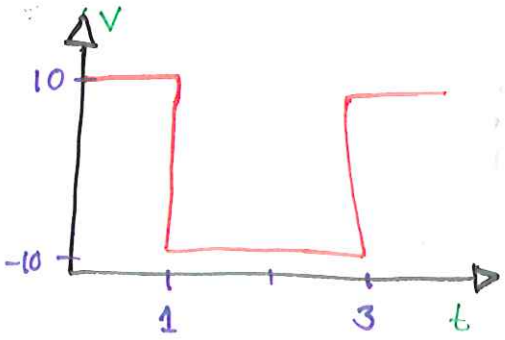
$$\Rightarrow \boxed{i(t)=\frac{V_0(1-\cos(\omega t))}{L\omega}}$$

$$p(t)=v(t)\cdot i(t)=\frac{V_0^2\sin(\omega t)(1-\cos(\omega t))}{L\omega}$$

$$w(t)=\frac{1}{2}L\cdot i(t)^2=\frac{V_0^2(1-\cos(\omega t))^2}{2L\omega^2}$$

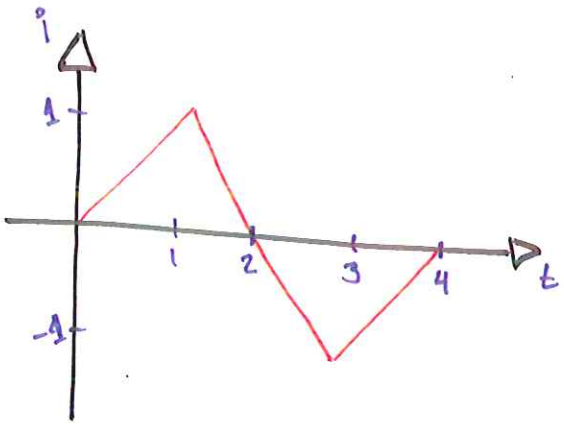
8.2 Skissa ström, effekt och energi i induktansen.

$i(0) = 0$

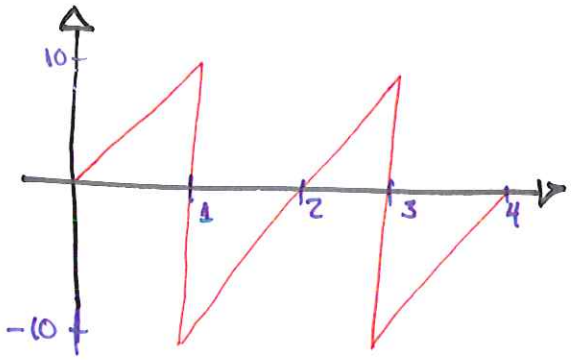


$$i = \frac{1}{L}\int v(t)\,dt$$

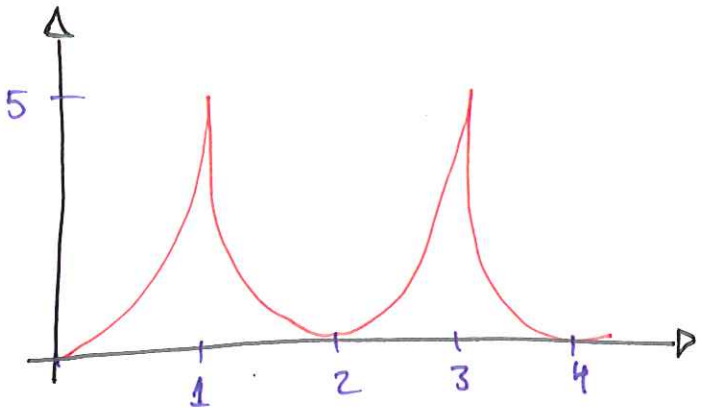
Ström



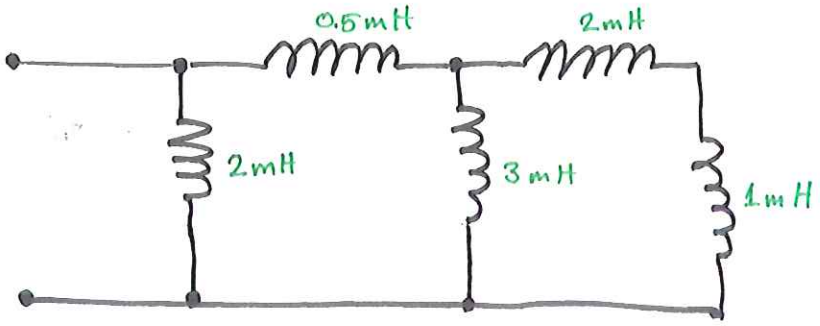
Effekt $\left(p(t) = i(t) \cdot v(t)\right)$



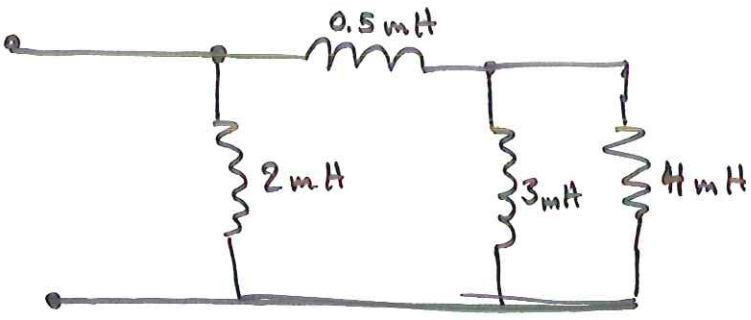
Energi $\left(w(t) = \frac{1}{2} L\, i(t)^2\right)$



8.3 Beräkna den ekvivalenta induktansen.

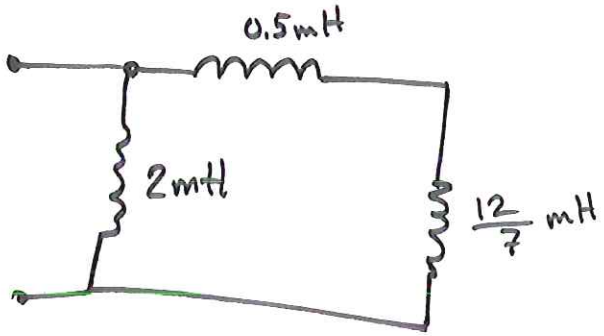


- $2\,mH + 1mH = \underline{3mH}$



- $\frac{1}{L} = \frac{1}{3} + \frac{1}{4}$

$\Rightarrow L = \underline{\frac{12}{7}}$



$L = \frac{1}{2} + \frac{1}{0.5 + \frac{12}{7}}$

$\Rightarrow L = \underline{1\,mH}$

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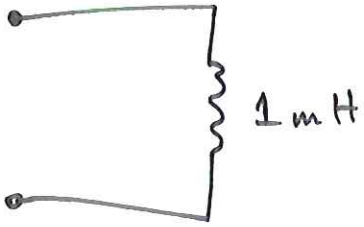
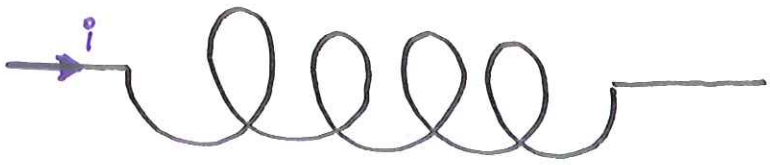


8.4 Beräkna induktansen i en rak spole.



8.5 Beräkna induktansen (per längdenhet) i koaxialkabeln.

Vi vet från 7.7 att $\overline{B} = \frac{\mu_0 i}{2\pi r}\overline{e_\phi}$

Vi har energirelationen:

$$\frac{1}{2}Li^2 = \frac{1}{2}\int \overline{B}\cdot\overline{H}\,dV$$

Enligt fs: $\overline{H} = \frac{1}{\mu_0}\overline{B}$

$$\Rightarrow \frac{1}{2}Li^2 = \frac{1}{2}\int_{r=a}^{b} \frac{1}{\mu_0}\cdot\overline{B}\cdot\overline{B}\cdot dV = \frac{1}{2}\int_a^b \frac{1}{\mu_0}\cdot\frac{\mu_0^2 i^2}{4\pi^2 r^2}\underbrace{l\,2\pi r\,dr}_{dV} =$$

$$= \frac{l\mu_0 i^2}{4\pi}\int_a^b \frac{1}{r}\,dr = \frac{l\mu_0 i^2}{4\pi}\ln\left(\frac{b}{a}\right)$$

$$\Rightarrow L = \frac{l\mu_0}{2\pi}\ln\left(\frac{b}{a}\right)$$

svar

$$\Rightarrow \frac{L}{l} = \frac{\mu_0}{2\pi}\ln\left(\frac{b}{a}\right)$$ (induktans per längdenhet)