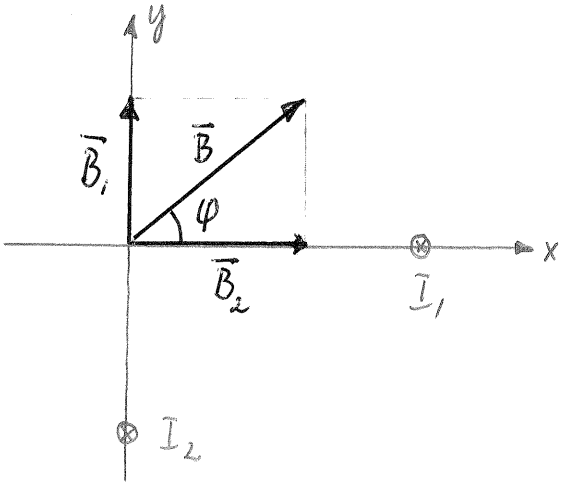
Oppgave 1

a) $B_1 = \frac{\mu_0 I_1}{2\pi a} = \frac{4\pi \cdot 10^{-7} \cdot 40}{2\pi \cdot 0.08}\,T = \underline{1.0 \cdot 10^{-4}\,T}$

$B_2 = \frac{\mu_0 I_2}{2\pi b} = \frac{4\pi \cdot 10^{-7} \cdot 30}{2\pi \cdot 0.05}\,T = \underline{1.2 \cdot 10^{-4}\,T}$

$B = \sqrt{B_1^2 + B_2^2} = 10^{-4}\sqrt{1.0^2 + 1.2^2}\,T = \underline{1.6 \cdot 10^{-4}\,T}$

$\tan\varphi = \frac{B_1}{B_2} = \frac{1.0}{1.2} = 0.8333 \Rightarrow \varphi = \underline{39.8^\circ}$



b) Induktiv reaktans $X_L = \omega L = 2\pi f L = 2\pi \cdot 50 \cdot 5 \cdot 10^{-2}\,\Omega = \underline{15.7\,\Omega}$

Kapasitiv reaktans $X_C = 1/\omega C = \frac{1}{2\pi f C} = \frac{1}{2\pi \cdot 50 \cdot 50 \cdot 10^{-6}}\,\Omega = \underline{63.7\,\Omega}$

Impedans $Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{100^2 + (15.7 - 63.7)^2}\,\Omega = \underline{110.9\,\Omega}$

i) $\cos\varphi = \frac{R}{Z} = \frac{100}{110.9} = \underline{0.90} \Rightarrow \varphi = \pm 25.6^\circ$

$X_C > X_L \Rightarrow$ Strømmen er faseforskjøvet foran spenningen φ er derfor negativ $\Rightarrow \varphi = \underline{-25.6^\circ}$

ii) $\langle P \rangle = I_{rms}^2 \cdot R = \frac{\mathcal{E}_{rms}^2}{Z^2} \cdot R = \frac{V_0^2}{Z^2} \cdot \frac{1}{2} \cdot R$

$= \frac{315^2}{110{,}9^2} \cdot \frac{1}{2} \cdot 100\,W \quad = \underline{403\,W}$

Alternativt:

Effekten som utvikles i R er lik effekten som tilføres kretsen:

$\langle P \rangle = \mathcal{E}_{rms} \cdot I_{rms} \cdot \cos\varphi = \frac{V_0}{\sqrt{2}} \cdot \frac{\frac{V_0}{\sqrt{2}}}{Z} \cdot \cos\varphi$

$= \frac{315^2}{2 \cdot 110{,}9} \cdot 0{,}90\,W \quad = \underline{403\,W}$

iii)

$X_C = X_L \Rightarrow \frac{1}{2\pi f C} = 2\pi f L$

$C = \frac{1}{4\pi^2 f^2 L} = \frac{1}{4\pi^2 \cdot 50^2 \cdot 5 \cdot 10^{-2}}\,F \quad = \underline{203\,\mu F}$