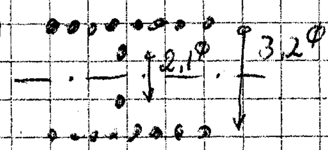
SIF 4020

Kontinuasjonseksamen 1999

Oppgave 1.

a)



$$B = \mu_0 I n = 4\pi \cdot 10^{-7} \cdot 1{,}5 \cdot 220 \cdot 100 \, T \qquad = \underline{4{,}15 \cdot 10^{-2} T}$$

(cm/m)

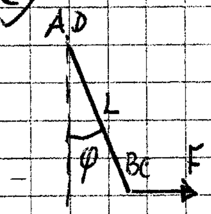
b) $A = \pi \left(\frac{d_2}{2}\right)^2 = \pi \left(\frac{2{,}1}{2}\right)^2 cm^2 = 3{,}46 \cdot 10^{-4} m^2$

$\Phi_B = BA = 4{,}15 \cdot 10^{-2} \cdot 3{,}46 \cdot 10^{-4} \, Wb = 14{,}4 \cdot 10^{-6} \, Wb$

$\Delta\Phi_B = -2 \cdot \Phi_B$

$$\mathcal{E} = -N \frac{\Delta\Phi_B}{\Delta t} = -130 \cdot \frac{2 \cdot (-14{,}4 \cdot 10^{-6})}{50 \cdot 10^{-3}} V \qquad = \underline{75 \, mV}$$

c)



Magnetisk kraft har netto virkning bare på den horisontale delen av rammen

$\vec{F} = I \vec{L} \times \vec{B} \qquad F = ILB$

Moment om AD: $T_{magn} = ILB \cdot L\cos\varphi = IL^2B\cos\varphi$

Moment pga gravitasjon: $T_{grav} = -\lambda Lg \cdot L\sin\varphi - 2\lambda Lg \cdot \frac{L}{2}\sin\varphi$
$= -2\lambda L^2 g \sin\varphi$

$T_{magn} + T_{grav} = 0$

$IL^2B\cos\varphi + (-2\lambda L^2 g \sin\varphi) = 0$

$\tan\varphi = \frac{IB}{2\lambda g} = \frac{10 \cdot 10 \cdot 10^{-3}}{2 \cdot 0{,}1 \cdot 9{,}81} = 0{,}0510 \quad \Rightarrow \varphi = \underline{3^\circ}$

d) Impedansen $Z = \sqrt{R^2 + \left(2\pi f L - \frac{1}{2\pi f C}\right)^2} = \sqrt{R^2 + (X_L - X_C)^2}$

$X_L = 2\pi \cdot 6 \cdot 10^3 \cdot 4 \cdot 10^{-3} \, \Omega = 151 \, \Omega$

$X_C = (2 \cdot \pi \cdot 6 \cdot 10^3 \cdot 4 \cdot 10^{-7})^{-1} \, \Omega = 66{,}4 \, \Omega \qquad R = 160 \, \Omega$

$Z = \sqrt{160^2 + (151 - 66{,}4)^2} \, \Omega \qquad = \underline{181 \, \Omega}$

d) forts.

$$\tan\varphi = \frac{X_L - X_C}{R} = \frac{151 - 66,4}{160} = 0.529 \Rightarrow \varphi = \underline{27,9°}$$

e) φ uttrykker at spenningen ligger 27,9° foran strømmen i fase.

$$I_0 = \frac{V_0}{Z} = \frac{10\,V}{181\,\Omega} = \underline{0,055\,A}$$