task_0j7accfimmemytq9_with_calculation

Student Group

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Exercise E1 Cylindrical Coil
(written test, approx. 6 % of a 120-minute written test, SS2021)

a) the magnetic flux density (2 points)

Result

Path

The proportion of the magnetic voltage outside the coil can be neglected. Determine the following for the inside of the coil:

a) the magnetic field strength (2 points)

Path

Given is a cylindrical coil with the following information is given:

- Length $ = 30 {~\rm cm}$,
- Winding diameter $ = 390 {~\rm mm}$,
- Number of windings $ = 240$,
- Current through the conductor $ = 500 {~\rm mA}$,
- Material inside: Air
- $\mu_0 = 4\pi\cdot 10^{-7} {{\rm Vs}\over{\rm Am}}$

The magnetic field strength is $B = \mu_0 \mu_{\rm r} \cdot H$:

\begin{align*} B &= \mu_0 \cdot {{\rm Vs}\over{\rm Am}} \cdot {{\rm A}\over{\rm m}} \end{align*}

Putting in the numbers: \begin{align*} B &= 4\pi\cdot 10^{-7} {{\rm Vs}\over{\rm Am}} \cdot 400 ~\rm {{A}\over{m}} \\ &= 0.0005026... {{\rm Vs}\over{\rm m^2}} \end{align*}

\begin{align*} A = \pi r^2 = \pi \left({{d}\over{2}} \right)^2 \end{align*}

Therefore: \begin{align*} \Phi &= B \cdot \pi \left({{d}\over{2}} \right)^2 \end{align*}

Putting in the numbers: \begin{align*} \Phi &= 0.0005026... {{\rm Vs}\over{\rm m^2}} \cdot \pi \left({{0.39{\rm m}}\over{2}} \right)^2 \\ &= 0.00006004... {\rm Vs} \end{align*}

\begin{align*} H &= {{n \cdot I}\over{l}} = {{w \cdot I}\over{l}} \end{align*}

Putting in the numbers: \begin{align*} H &= {{240 \cdot 0.5 {~\rm A}}\over{0.3 {~\rm m}}} \end{align*}