a) What is the coefficient of coupling?

b) Assume that the physical structure of these coupled coils is such that $P_1 = P_2$, (permeance $= \text{permeance 2}$). What is the turns ratio $N_2 / N_1$, if $N_1$ is the number of turns on the 4H coil?

c) Write a set of mesh-current equations that describe the circuit in terms of the currents $i_1$ and $i_2$ in the frequency domain, where the source current, $i_y$, is known and it has $\omega = 0.25$ rad/s. (Hint: first represent in the $j\omega$ domain)

\[
\begin{align*}
    a) \quad M &= N_1 N_2 \sqrt{L_1 L_2} \quad \Rightarrow \quad k = \frac{M}{\sqrt{L_1 L_2}} = \frac{8}{\sqrt{4 \times 16}} = 1 \\

    b) \quad L_1 &= N_1^2 P_1, \quad L_2 = N_2^2 P_2 \\
     \frac{L_1}{L_2} &= \frac{N_1^2 P_1}{N_2^2 P_2} \quad \Rightarrow \quad \frac{N_2}{N_1} = \sqrt{\frac{L_2}{L_1}} = \sqrt{\frac{16}{4}} = \sqrt{4} = 2 \\

    c) \quad J\omega L_1 &= J (0.25) (4) = J \\
     J\omega L_2 &= J (0.25) (16) = 4J \\
     J\omega M &= J (0.25) (2) = 2J \\

    \begin{align*}
    20 \left( i_1 - i_2 \right) + 5 \left( i_1 - i_2 \right) + 3J i_1 + 2J \left( i_y - i_2 \right) &= 0 \\
    60 i_2 + 4J \left( i_2 - i_2 \right) - 2J i_1 + 20 \left( i_2 - i_1 \right) &= 0 
    \end{align*}
\]

Good Luck.

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