

Name:

I.D. Number:

KEY

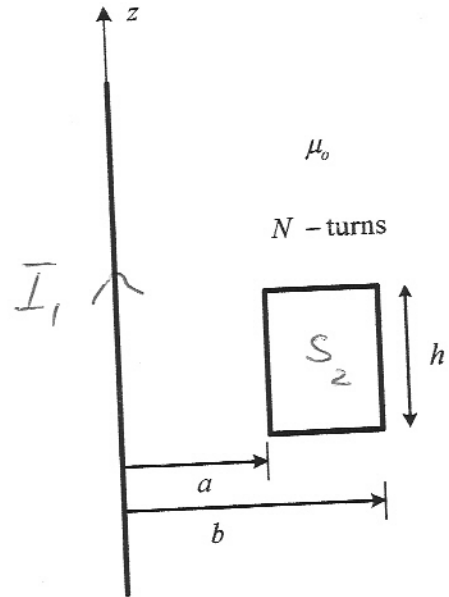
Derive an expression for the mutual inductance between the infinitely-long filamentary wire and the coplanar N -turn rectangular conducting loop.

$$\vec{B}_1 = \frac{\mu_0 I_1}{2\pi\rho} \vec{a}_\phi$$

$$\psi_{21} = \int_{S_2} \vec{B}_1 \cdot d\vec{s}$$

$$= \int_0^h \int_a^b \frac{\mu_0 I_1}{2\pi\rho} d\rho dz$$

$$= \frac{\mu_0 I_1 h}{2\pi} \ln \frac{b}{a}$$



$$\Lambda_{21} = N_2 \psi_{21} = \frac{\mu_0 I_1 h N}{2\pi} \ln \frac{b}{a}$$

$$M_{21} = \frac{\Lambda_{21}}{I_1} = \frac{\mu_0 h N}{2\pi} \ln \frac{b}{a}$$