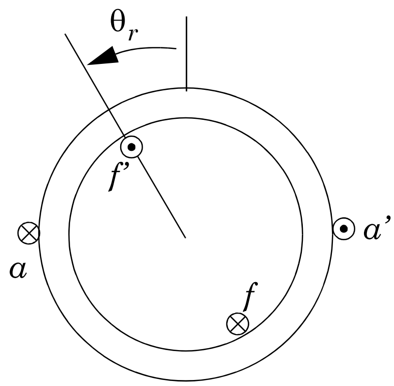
Work on separate sheets of paper. Must be turned in at beginning of class. First page blank with only your name and should be stapled. Homework will be collected promptly at 2:30. If not submitted in time, it will not be graded.

1.



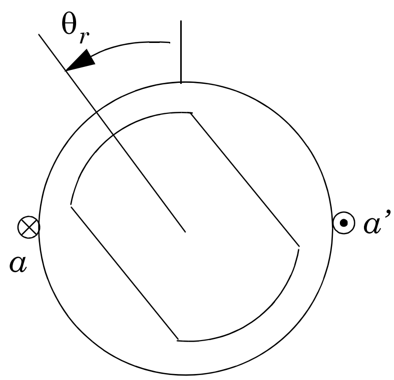
Winding a has 100 turns and winding f has 50 turns. $\Re_m = 2000\ \mathrm{H}^{-1}$. Neglect leakage inductances and assume variations are sinusoidal.

(a) $L_{aa}(\theta_r) =$ ___ + ___ $\cos(?)$ H

(b) $L_{af}(\theta_r) =$ ___ + ___ $\cos(?)$ H

(c) $L_{ff}(\theta_r) =$ ___ + ___ $\cos(?)$ H

2.



Winding a has 100 turns. $\Re_{m,\max} = 1000\ \mathrm{H}^{-1}$, $\Re_{m,\min} = 500\ \mathrm{H}^{-1}$. Neglect leakage inductance.

(a) $L_{aa}(\theta_r) =$ ___ + ___ $\cos(?)$ H

(b) If $i_a = 2\cos\omega_e t$ and $\theta_r = \omega_r t$. Express v_a. Neglect resistance. For what combinations of ω_e and ω_r will $p_a = v_a i_a$ have a nonzero average value.

3. Suppose for a 2-winding device, $L_{11} = 2\ \mathrm{mH}$, $L_{22} = 1\ \mathrm{mH}$, and $L_{12} = 0.5\sin\theta_r\ \mathrm{mH}$. Let $i_2 = 1\ \mathrm{A}$, $i_1 = 3\cos\omega_e t\ \mathrm{A}$, and $\theta_r = 50t$. At what value or values of ω_e is the steady-state v_1 a sinusoidal function of time with the same frequency as the current i_1? For this (these) value(s) of ω_e, express $V_1(t)$ (steady-state $v_1(t)$). Neglect resistances.