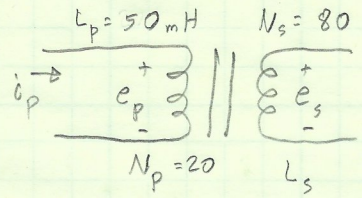
① For the transformer:



$k = 0.8$

a) Find L_s if $M = 200\,mH$

$$M = k\sqrt{L_p L_s} \rightarrow L_s = \left(\frac{M}{k}\right)^2 \cdot \frac{1}{L_p} = \frac{(200\,mH)^2}{(0.8)^2} \cdot \frac{1}{50\,mH} = \boxed{1.25\,H}$$

b) Find e_p and e_s if the flux linking the coils changes at a rate of $0.08\ \frac{Wb}{s}$

$$e_p = N_p \frac{d\Phi_p}{dt} = (20)\left(0.08\ \tfrac{Wb}{s}\right) = \boxed{1.6\,V}$$

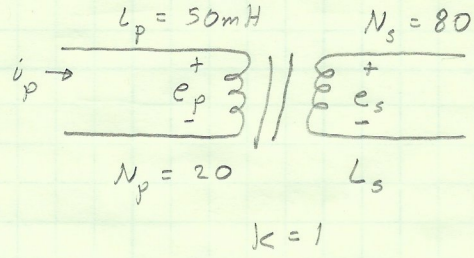
$$e_s = k N_s \frac{d\Phi_p}{dt} = (0.8)(80)\left(0.08\ \tfrac{Wb}{s}\right) = \boxed{5.12\,V}$$

c) Find e_p and e_s if i_p changes at a rate of $0.3\ \frac{A}{ms}$

$$e_p = L_p \frac{di_p}{dt} = (50\,mH)\left(300\ \tfrac{A}{s}\right) = \boxed{15\,V}$$

$$e_s = M \frac{di_p}{dt} = (200\,mH)\left(300\ \tfrac{A}{s}\right) = \boxed{60\,V}$$

(2) Repeat problem 1 if $k = 1$



a) Find L_s if $M = 200\,mH$

$$M = k\sqrt{L_p L_s} \rightarrow L_s = \left(\frac{M}{k}\right)^2 \cdot \frac{1}{L_p} = \frac{M^2}{L_p} = \frac{(200\,mH)^2}{50\,mH}$$

$$= \boxed{800\,mH}$$

b) Find e_p and e_s if the flux linking the coils changes at a rate of $0.08\ \frac{Wb}{s}$

$$e_p = N_p \frac{d\Phi_p}{dt} = (20)\left(0.08\ \tfrac{Wb}{s}\right) = \boxed{1.6\,V}$$

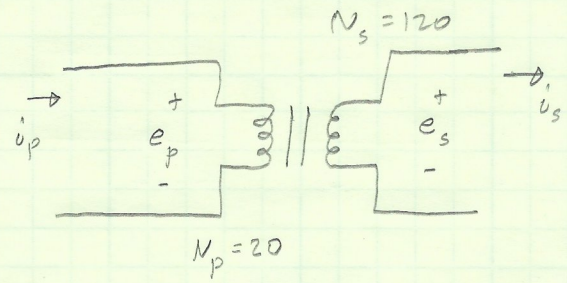
$$e_s = k N_s \frac{d\Phi_p}{dt} = (1)(80)\left(0.08\ \tfrac{Wb}{s}\right) = \boxed{6.4\,V}$$

c) Find e_p and e_s if i_p changes at a rate of $0.3\ \frac{A}{ms}$

$$e_p = L_p \frac{di_p}{dt} = (50\,mH)\left(300\ \tfrac{A}{s}\right) = \boxed{15\,V}$$

$$e_s = M \frac{di_p}{dt} = (200\,mH)\left(300\ \tfrac{A}{s}\right) = \boxed{60\,V}$$

④ For the transformer:



$e_p = 40V$, 60 Hz $\qquad k = 1$

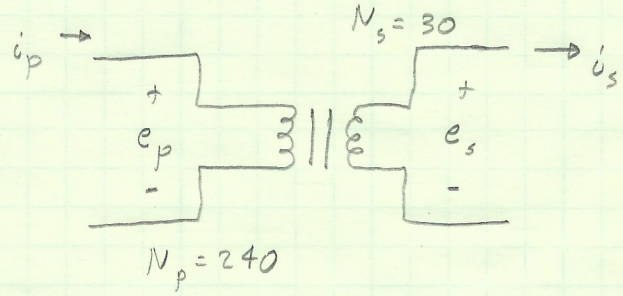
a) Find e_s

$$e_s = \frac{N_s}{N_p} e_p = \frac{120}{20}(40V) = \boxed{240V}$$

b) Find the maximum flux Φ_m

$$\Phi_m = \frac{e_p}{4.4 \cdot f \cdot N_p} = \frac{40V}{(4.4)(60Hz)(20)} = \boxed{7.58\,mWb}$$

(5) Repeat problem 4 if $N_p = 240$ and $N_s = 30$



$e_p = 40V$, 60 Hz $k = 1$

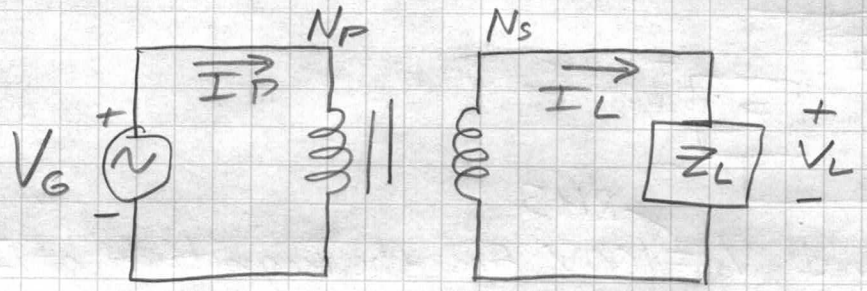
a) Find e_s

$$e_s = \frac{N_s}{N_p} e_p = \frac{30}{240} \cdot 40V = \boxed{5\ V}$$

b) Find the maximum flux Φ_m

$$\Phi_m = \frac{e_p}{4.4 \cdot f \cdot N_p} = \frac{40V}{(4.4)(60\ Hz)(240)} = \boxed{631\ \mu Wb}$$

23-8 For the iron-core transformer:



a) Find I_L and V_L if $a = 1/5$, $I_P = 2A$, and $Z_L = 2\Omega$ resisto

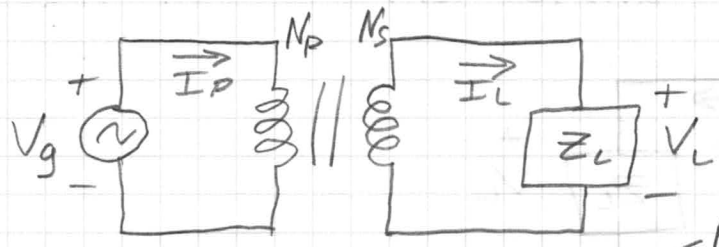
$\frac{I_S}{I_P} = a \Rightarrow I_S = I_P a = 2A \cdot 1/5 = \boxed{400mA}$

$V_L = I_L \cdot R_L = 400mA \cdot 2\Omega = \boxed{800mV}$

b) Find the input resistance

$Z_{in} = a^2 \cdot Z_L = (1/5)^2 \cdot 2\Omega = \boxed{.08\Omega}$

23-12



RMS

a) If $N_P = 400$, $N_S = 1200$, and $V_g = 100V$, find the magnitude of I_P for $Z_L = 12\Omega + j12\Omega$

$$\frac{V_P}{V} = \frac{N_P}{N_S} \Rightarrow V_L = \frac{V_P N_S}{N_P} = \frac{100V \cdot 1200}{400} = 300\,V$$

$$I_L = \frac{V_S}{R_L} = \frac{300\,V}{12\Omega + j12\Omega} = 17.678\,A_{RMS}$$

$$\frac{I_P}{I_L} = \frac{N_S}{N_P} \Rightarrow I_P = \frac{I_L N_S}{N_P} = \frac{17.678A_{RMS} \cdot 1200}{400}$$

$$= 53.033\,A_{RMS}$$

OR $Z_i = a^2 Z_L = \left(\frac{400}{1200}\right)^2 (12\Omega + j12\Omega) = 1.886\angle 45$

$$I_P = \frac{V_G}{Z_i} = \frac{100\,V_{RMS}}{1.886\,\Omega} = \boxed{53.022\,A_{RMS}}$$

b) Find the magnitudes of V_L and I_L

$$I_L = a I_P = \left(\frac{400}{1200}\right) 53.022A = \boxed{17.67\,A_{RMS}}$$

$$V_L = I_L \cdot R_L = 17.67\,A \cdot (12 + j12) = \boxed{300\,V_{RMS}}$$

Problem 23-13.

(a) For the circuit in Fig. 23.60, find the transformation ratio required to deliver maximum power to the speaker.

$$Z_p = a^2 \cdot Z_L$$

$$a = \sqrt{\frac{Z_p}{Z_L}} = \sqrt{\frac{36}{4}}$$
$$= 3$$

(b) Find the maximum power delivered to the speaker.

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{1}{3}$$

$$V_s = \frac{1}{3} V_p$$

where

$$Z_p t = 36\,\Omega + a^2 \cdot Z_L$$
$$= 36\,\Omega + 3^2 \cdot 4$$
$$= 36\,\Omega + 36\,\Omega$$

Using voltage divider rule, the primary voltage is

$$V_p = \frac{20 \cdot 36}{36 + 36}$$
$$= 10\,\text{V}$$

Therefore,

$$V_s = \frac{1}{3} \cdot 10 = 3.333\,\text{V}$$

The maximum power delivered to the speaker is

$$P = \frac{{V_s}^2}{Z_s} = \frac{3.333^2}{4} = \boxed{2.78\,\text{W}}$$

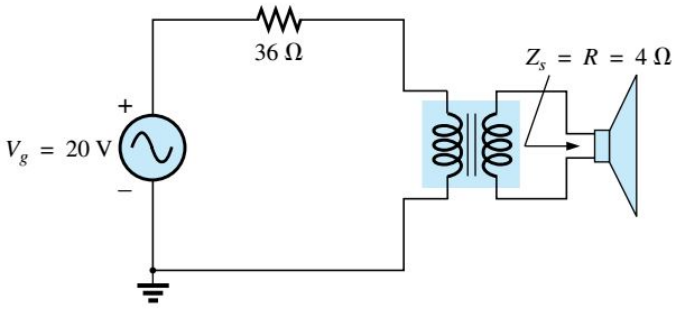


FIG. 23.60
Problem 13.