Chapter 13, Solution 5.

(a) If the coils are connected in series,

$$L = L_1 + L_2 + 2M = 50 + 120 + 2(0.5)\sqrt{50x120} = \mathbf{247.4\ mH}$$

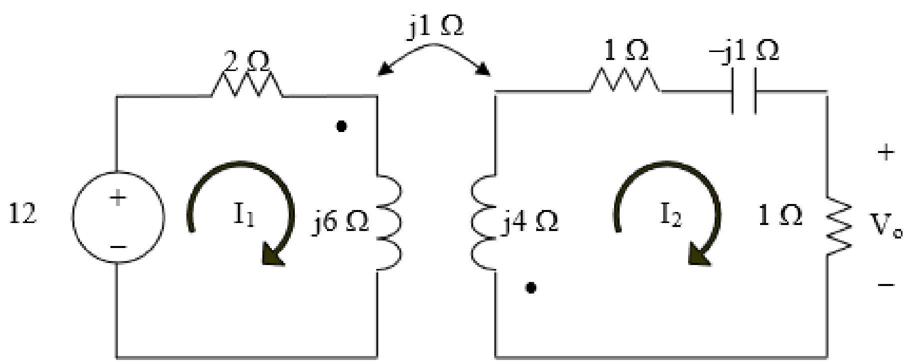
(b) If they are connected in parallel,

$$L = \frac{L_1L_2 - M^2}{L_1 + L_2 - 2M} = \frac{50x120 - 38.72^2}{50 + 120 - 2x38.72}\,\text{mH} = \mathbf{48.62\ mH}$$

(a) 247.4 mH, (b) 48.62 mH

Chapter 13, Solution 7.

We apply mesh analysis to the circuit as shown below.



For mesh 1,

$(2+j6)I_1 + jI_2 = 24$

For mesh 2,

$jI_1 + (2–j+j4)I_2 = jI_1 + (2+j3)I_2 = 0$ or $I_1 = (–3+j2)I_2$

Substituting into the first equation results in $I_2 = (–0.8762+j0.6328)$ A.

$$V_o = I_2x1 = \mathbf{1.081\angle 144.16^\circ\ V}.$$

Chapter 13, Solution 24.

(a) $k = M/\sqrt{L_1L_2} = 1/\sqrt{4x2} = \mathbf{0.3535}$

(b) $\omega = 4$

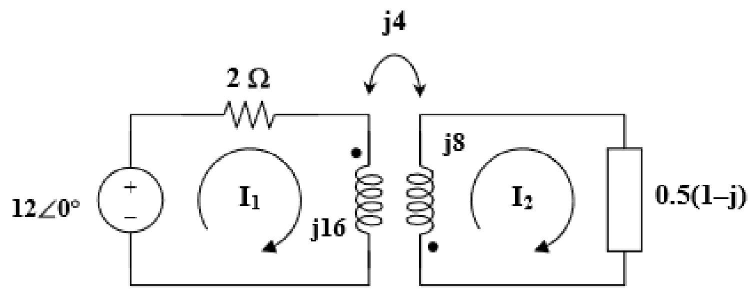
$1/4$ F leads to $1/(j\omega C) = -j/(4x0.25) = -j$

$1||(-j) = -j/(1-j) = 0.5(1-j)$

1 H produces $j\omega M = j4$

4 H produces $j16$

2 H becomes $j8$



$$12 = (2 + j16)I_1 + j4I_2$$

or $\quad 6 = (1 + j8)I_1 + j2I_2 \qquad (1)$

$$0 = (j8 + 0.5 - j0.5)I_2 + j4I_1 \text{ or } I_1 = (0.5 + j7.5)I_2/(-j4) \qquad (2)$$

Substituting (2) into (1),

$$24 = (-11.5 - j51.5)I_2 \text{ or } I_2 = -24/(11.5 + j51.5) = -0.455\angle{-77.41°}$$

$$V_o = I_2(0.5)(1 - j) = 0.3217\angle 57.59°$$

$$v_o = \mathbf{321.7\cos(4t + 57.6°)\ mV}$$

(c) From (2), $I_1 = (0.5 + j7.5)I_2/(-j4) = 0.855\angle{-81.21°}$

$$i_1 = 0.885\cos(4t - 81.21°) \text{ A}, \; i_2 = -0.455\cos(4t - 77.41°) \text{ A}$$

At t = 2s,

$$4t = 8 \text{ rad} = 98.37°$$

$$i_1 = 0.885\cos(98.37° - 81.21°) = 0.8169$$

$$i_2 = -0.455\cos(98.37° - 77.41°) = -0.4249$$

$$w = 0.5L_1 i_1^{\,2} + 0.5L_2 i_2^{\,2} + Mi_1 i_2$$

$$= 0.5(4)(0.8169)^2 + 0.5(2)(-.4249)^2 + (1)(0.1869)(-0.4249) = \mathbf{1.168\ J}$$

Chapter 13, Solution 41.

We reflect the 2-ohm resistor to the primary side.

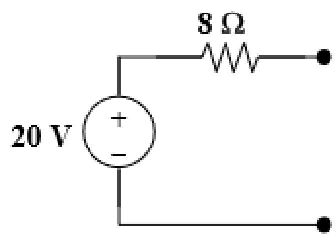
$\mathbf{Z_{in}} = 10 + 2/n^2, \quad n = -1/3$

Since both $\mathbf{I_1}$ and $\mathbf{I_2}$ enter the dotted terminals, $\mathbf{Z_{in}} = 10 + 18 = 28$ ohms

$\mathbf{I_1} = 14\angle 0°/28 = \mathbf{500\ mA}$ and $\mathbf{I_2} = \mathbf{I_1}/n = 0.5/(-1/3) = \mathbf{-1.5\ A}$

Chapter 13, Solution 53.

(a) The Thevenin equivalent to the left of the transformer is shown below.



The reflected load impedance is $Z_L' = Z_L/n^2 = 200/n^2$.

For maximum power transfer, $8 = 200/n^2$ produces $n = \mathbf{5}$.

(b) If $n = 10$, $Z_L' = 200/10 = 2$ and $I = 20/(8 + 2) = 2$

$p = I^2 Z_L' = (2)^2(2) = \mathbf{8\ watts}$.

Chapter 13, Solution 71.

$$Z_{in} = V_1/I_1$$

But $V_1 I_1 = V_2 I_2$, or $V_2 = I_2 Z_L$ and $I_1/I_2 = N_2/(N_1 + N_2)$

Hence $V_1 = V_2 I_2/I_1 = Z_L(I_2/I_1)I_2 = Z_L(I_2/I_1)^2 I_1$

$$V_1/I_1 = Z_L[(N_1 + N_2)/N_2]^2$$

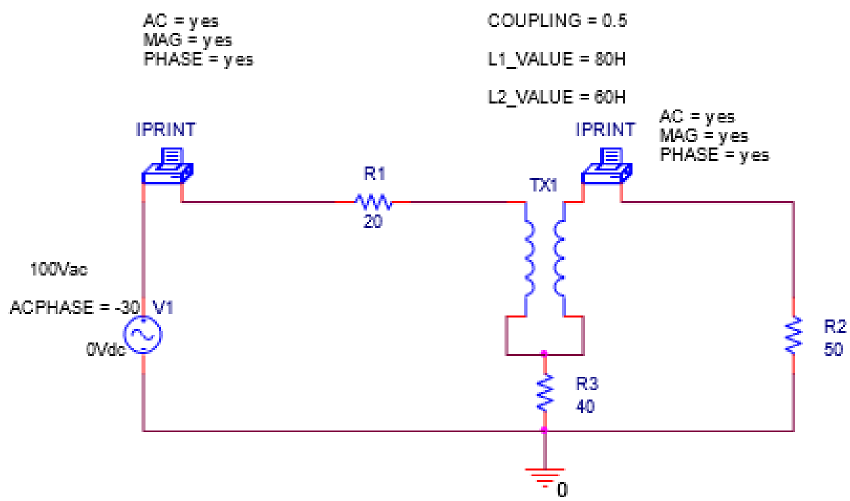
$$\mathbf{Z_{in} = [1 + (N_1/N_2)]^2 Z_L}$$

Chapter 13, Solution 78.

We convert the reactances to their inductive values.

$$X = \omega L \quad \longrightarrow \quad L = \frac{X}{\omega}$$

The schematic is as shown below.



FREQ IM(V_PRINT1)IP(V_PRINT1)

1.592E-01 1.347E+00 -8.489E+01

FREQ IM(V_PRINT2)IP(V_PRINT2)

1.592E-01 6.588E-01 -7.769E+01

Thus,

$$\mathbf{I_1 = 1.347\angle{-84.89^\circ}\ amps\ and\ I_2 = 658.8\angle{-77.69^\circ}\ mA}$$

Chapter 13, Solution 90.

(a) $n = V_2/V_1 = 240/2400 = \mathbf{0.1}$

(b) $n = N_2/N_1$ or $N_2 = nN_1 = 0.1(250) = \mathbf{25\ turns}$

(c) $S = I_1V_1$ or $I_1 = S/V_1 = 4x10^3/2400 = \mathbf{1.6667\ A}$

$S = I_2V_2$ or $I_2 = S/V_2 = 4x10^4/240 = \mathbf{16.667\ A}$