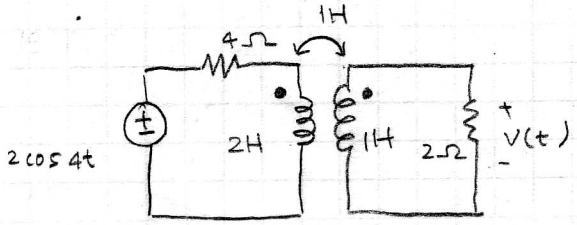
#13.8

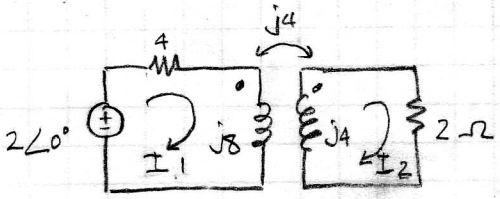
HW SET #13 SOLUTION



FIND $v(t)$

$\omega = 4$

REDRAW the ckt diagram:



Loop 1: $-2\angle 0^\circ + (4+j8)I_1 - j4I_2 = 0$

$(4+j8)I_1 - j4I_2 = 2\angle 0^\circ$ ——— ①

Loop 2: $-j4I_1 + (2+j4) = 0$ ——— ②

Solving for eqn ① & ②

$$\begin{bmatrix} 4+j8 & -j4 \\ -j4 & 2+j4 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 2\angle 0^\circ \\ 0 \end{bmatrix}$$

$I_1 = (0.206 - j0.176)\,A = 0.271\angle -40.6^\circ\,A$

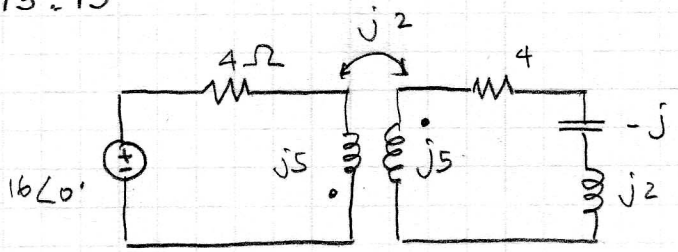
$I_2 = (0.235 - j0.0588)\,A = 0.243\angle -14.04^\circ\,A$

$V_{2\Omega} = 2I_2 = 0.471 - j0.118\,V$

$= 0.485\angle -14.04\,V$

$v(t) = 0.485\cos(4t - 14.04^\circ)$

#13.13



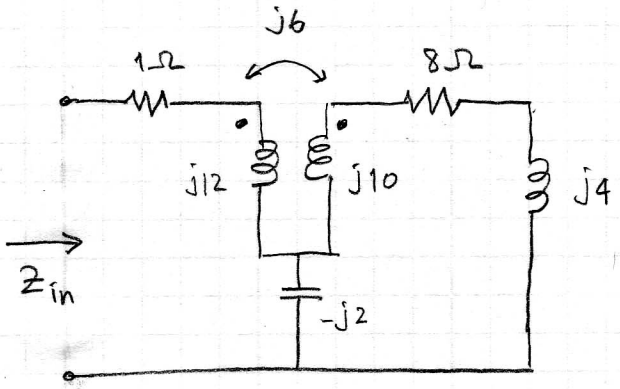
$$Z_{in} = Z_{\text{LEFT COIL}} + \frac{\omega^2}{Z_{\text{RIGHT COIL}}}$$

$$= 4 + j5 + \frac{2^2}{j5 + 4 - j + j2}$$

$$= 4 + j5 + \frac{4}{4 + j6}$$

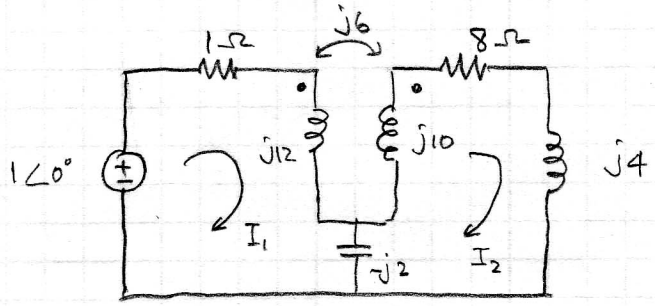
$$= (4.308 + j\,4.54)\ \Omega$$

13.34



FIND THE INPUT IMPEDANCE of the circuit.

Let INSERT 1V SOURCE at the input TERMINAL.



Loop 1: $(1+j12)\,I_1 - j2\,(I_1 - I_2) - j6\,I_2 = 1\angle 0°$

$$(1+j10)\,I_1 - j4\,I_2 = 1\angle 0° \quad \text{——} \ (1)$$

Loop 2: $-j6\,I_1 - j2\,(I_2 - I_1) + (8+j4+j10)\,I_2 = 0$

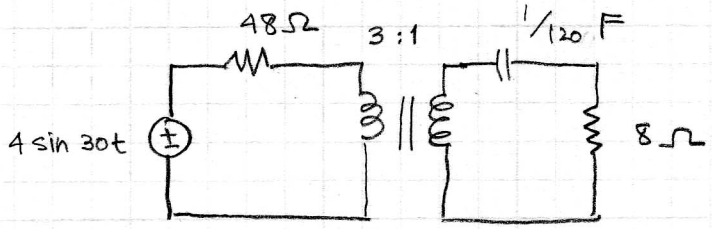
$$-j4\,I_1 + (8+j12)\,I_2 = 0 \quad \text{——} \ (2)$$

Solving EQUATIONS (1) & (2), WE GET:

$$I_1 = 0.019 - j\,0.107 = 0.108\angle -79.9° \text{ A}$$
$$I_2 = 0.021 - j\,0.022 = 0.03\angle -46.22° \text{ A}$$

$$\therefore Z_{in} = \frac{V}{I_1} = \frac{1\angle 0°}{0.108\angle -79.9°} = \underline{\underline{9.22\angle 79.9°}}$$

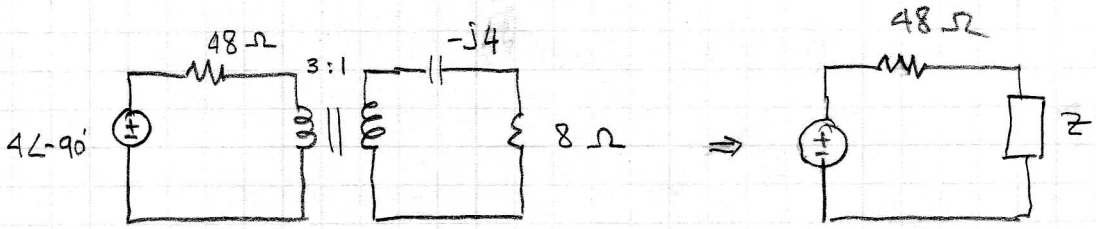
13.45



FIND THE AVERAGE POWER ABSORBED BY 8Ω

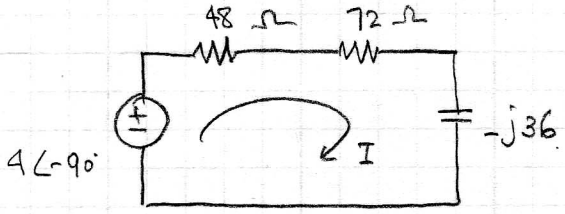
REDRAW THE CIRCUIT IN FREQUENCY DOMAIN.

$\omega = 30$



$$n = \frac{1}{3} \qquad Z = \frac{(8 - j4)}{(1/3)^2} = 9(8 - j4)$$

$$= 72 - j36$$

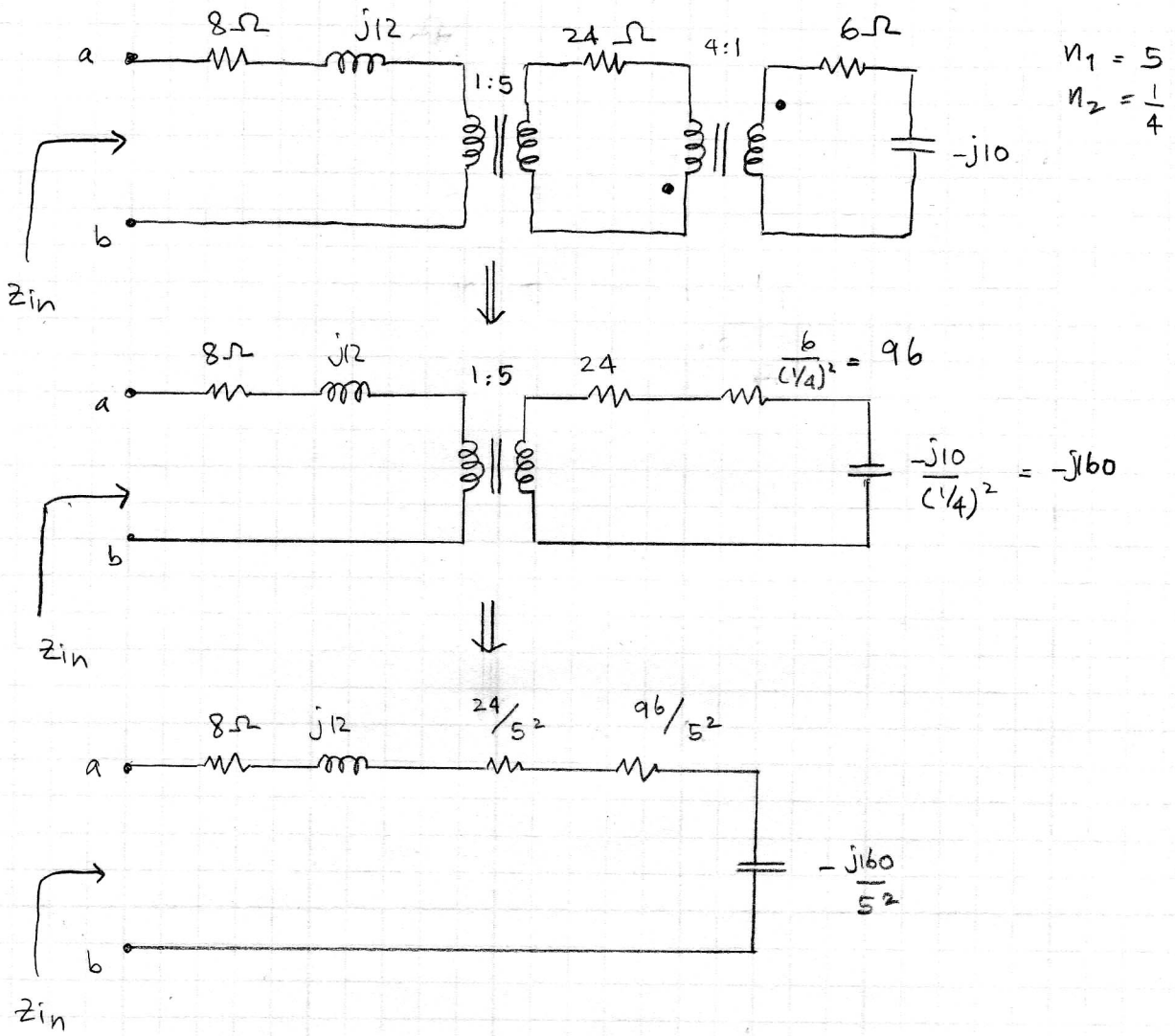


$$I = \frac{4\angle -90^\circ}{48 + 72 - j36} = \frac{4\angle -90^\circ}{120 - j36} = 0.03193\angle -73.3^\circ$$

$$\therefore P_{8\Omega} = \left| \frac{I^2}{2} \right| (72) = 0.0367 \text{ W}$$

$$= 36.7 \text{ mW}$$

13.50

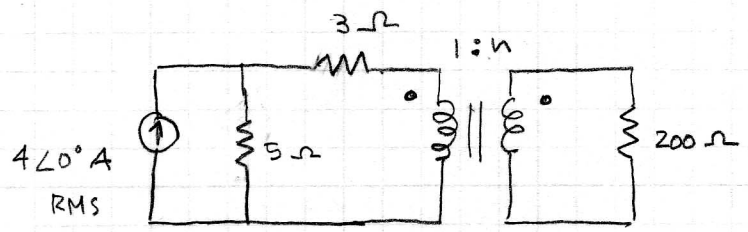


$$\therefore \quad z_{in} = 8 + \frac{24}{25} + \frac{96}{25} + j12 - \frac{j160}{25}$$

$$= \frac{320}{25} + j\,\frac{140}{25}$$

$$= (12.8 + j\,5.6)\ \Omega$$

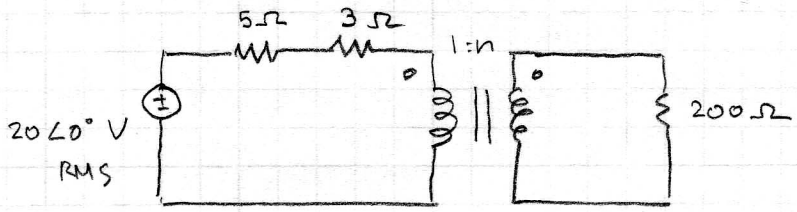
13.53



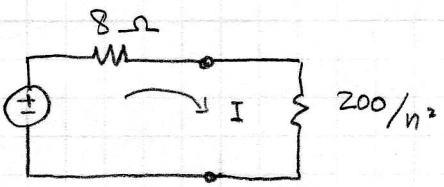
(a) Find n for maximum power supplied to 200 Ω load.

(b) Determine the power in 200-Ω load if $n = 10$.

(a) Redraw the circuit:



The Thevenin equivalent ckt to the left of the transformer.



For max power tranfer: $8 = 200/n^2$

$\therefore n = 5$

(b) If $n = 10$: $Z_L = \frac{200}{10^2} = 2\ \Omega$

$\therefore I = 20/8+2 = 2$

$P = I^2 Z_L = (2)^2(2) = \underline{8\ W}$