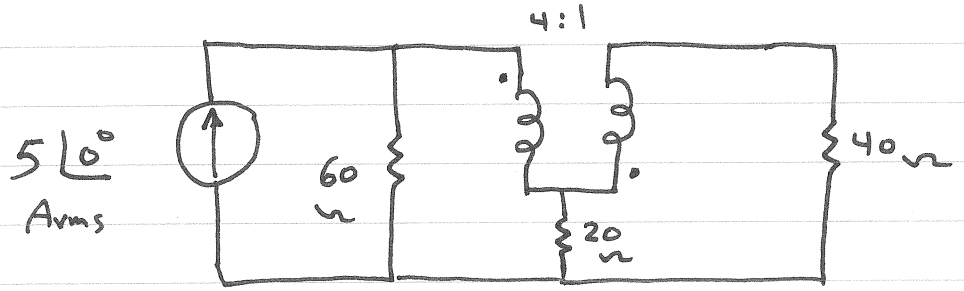
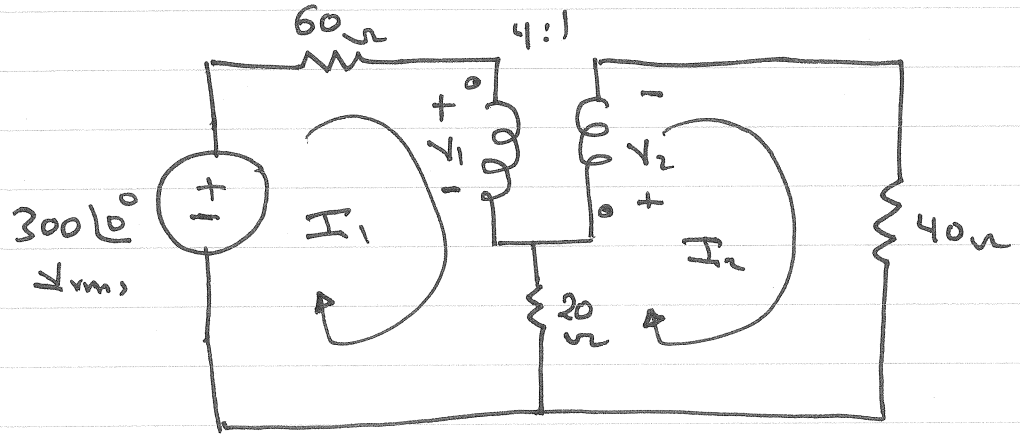
10.39





$$300\angle 0^\circ = 60\vec{I}_1 + \vec{V}_1 + 20(\vec{I}_1 - \vec{I}_2)$$

$$0 = 40\vec{I}_2 + 20(\vec{I}_2 - \vec{I}_1) + V_2$$

$$\vec{V}_2 = \frac{\vec{V}_1}{4} \quad ; \quad \vec{I}_2 = -4\vec{I}_1$$

Solving:

$$\vec{V}_1 = 260\angle 0^\circ \text{ V rms}$$

$$\vec{V}_2 = 65\angle 0^\circ \text{ V rms}$$

$$\vec{I}_1 = 0.25\angle 0^\circ \text{ A rms} \quad ; \quad I_2 = 1\angle 180^\circ \text{ A rms}$$

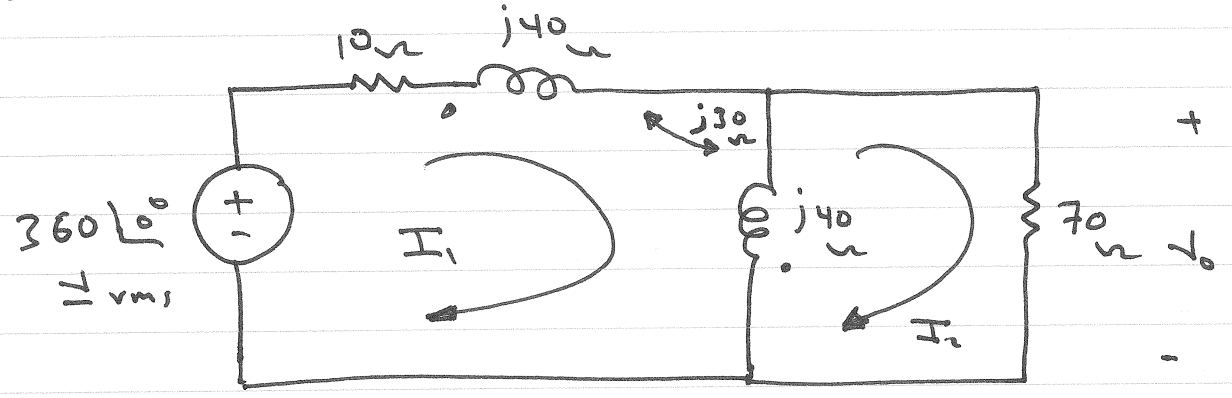
$$\vec{V}_{5\angle 0^\circ\,\text{A}} = \vec{V}_1 + 20(\vec{I}_1 - \vec{I}_2) = 285\angle 0^\circ \text{ V rms}$$

$$P_{5\angle 0^\circ\,\text{A}} = (5)(285) = 1425 \text{ W}$$

$$\vec{I}_{20\Omega} = \vec{I}_1 - \vec{I}_2 = 1.25\angle 0^\circ \text{ A rms}$$

$$P_{20\Omega} = (1.25)^2 \cdot 20 = 31.25 \text{ W}$$

10.44



$$360\angle 0^\circ = 10\vec{I}_1 + j40\vec{I}_1 - j30(\vec{I}_1 - \vec{I}_2) + j40(\vec{I}_1 - I_2) - j30\vec{I}_1$$

$$360\angle 0^\circ = (10 + j20)\vec{I}_1 - j10\vec{I}_2$$

$$0 = 70\vec{I}_2 + j40(\vec{I}_2 - \vec{I}_1) + j30\vec{I}_1$$

$$0 = -j10\vec{I}_1 + (70 + j40)\vec{I}_2$$

solving:

$$\vec{I}_1 = 16.1245\angle -60.25^\circ \text{ A rms}$$

$$\vec{I}_2 = 2\angle 0^\circ \text{ A rms}$$

$$\vec{V}_o = 140\angle 0^\circ \text{ V rms}$$

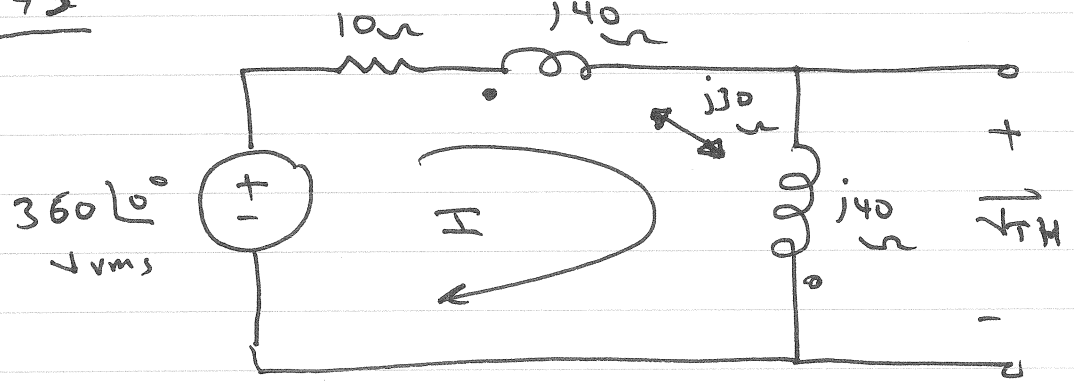
b) $P_{70\Omega} = (I_2)^2 \cdot 70 = 280 \text{ W}$

c) $P_{360\angle 0^\circ} = VI\cos\theta = (360)(16.1245)\cos(0 + 60.25^\circ)$

$P_{360\angle 0^\circ} = 2880 \text{ W}$

$\%$ delivered $= \frac{280}{2880} \times 100\% = 9.72\%$

10.45



$$360\angle 0^\circ = 10\vec{I} + j40\vec{I} - j30\vec{I} + j40\vec{I} - j30\vec{I}$$

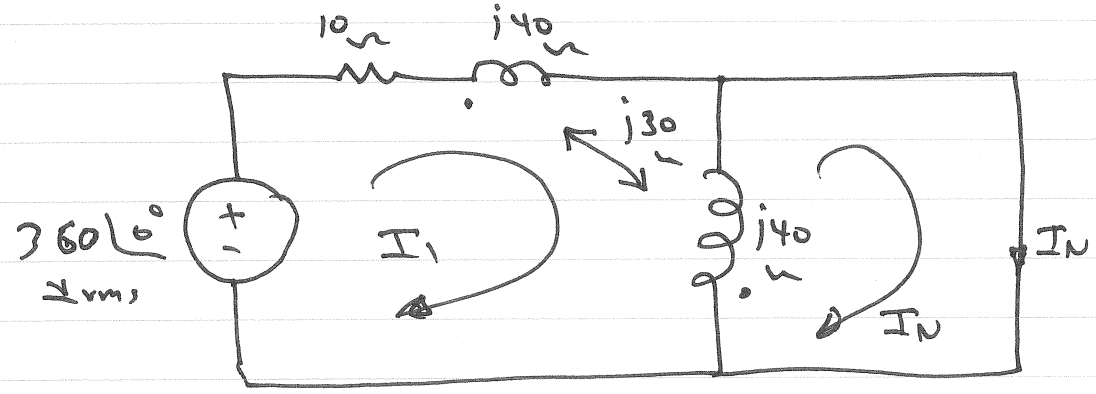
$$360\angle 0^\circ = (10 + j20)\vec{I}$$

$$\vec{I} = 7.2 - j14.4 \text{ A rms}$$

$$\therefore \vec{V}_{TH} = j40\vec{I} - j30\vec{I} = j10\vec{I}$$

$$\vec{V}_{TH} = 144 + j72 = 161\angle 26.56^\circ \text{ V rms}$$

To find I_N



$$360\angle 0^\circ = (10 + j20)\vec{I}_1 - j10\vec{I}_N$$

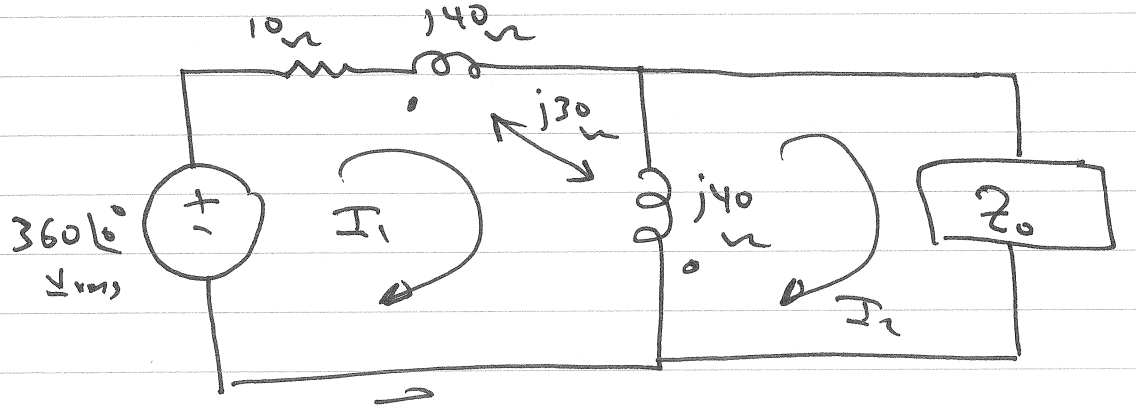
$$0 = -j10\vec{I}_1 + j40\vec{I}_N$$

$$\therefore \vec{I}_N = 2.215 - j7.877 \text{ A rms}$$

$$Z_{TH} = \frac{\vec{V}_{TH}}{\vec{I}_N} = 2 + j36\ \Omega$$

$$\therefore Z_o = Z_{TH}^* = 2 - j36\ \Omega$$

$$P_{L,max} = \frac{|V_{TH}|^2}{4R_{TH}} = 3240\ W$$



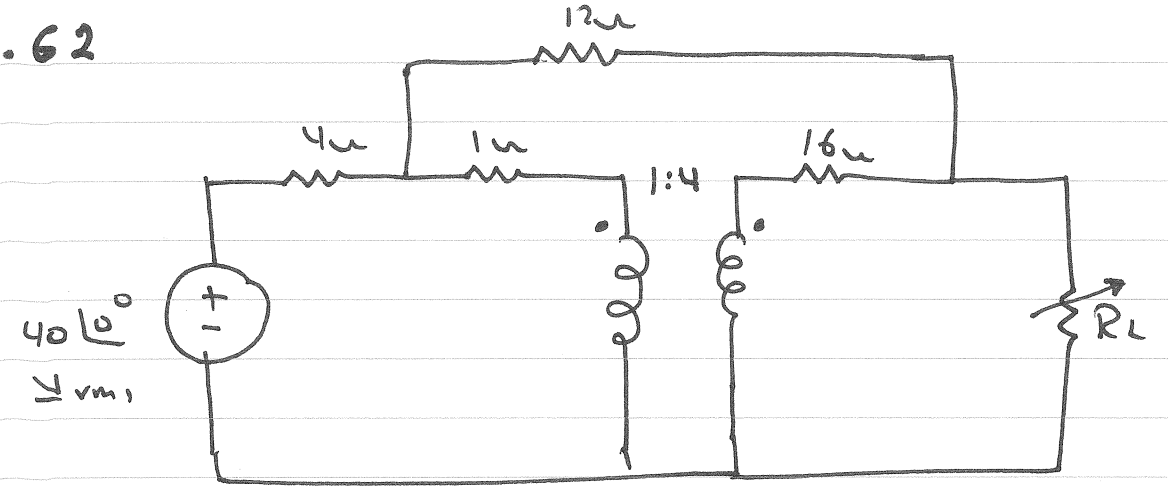
$$\vec{I}_2 = \frac{\vec{V}_{TH}}{4} = 36 + j18 \quad A_{rms}$$

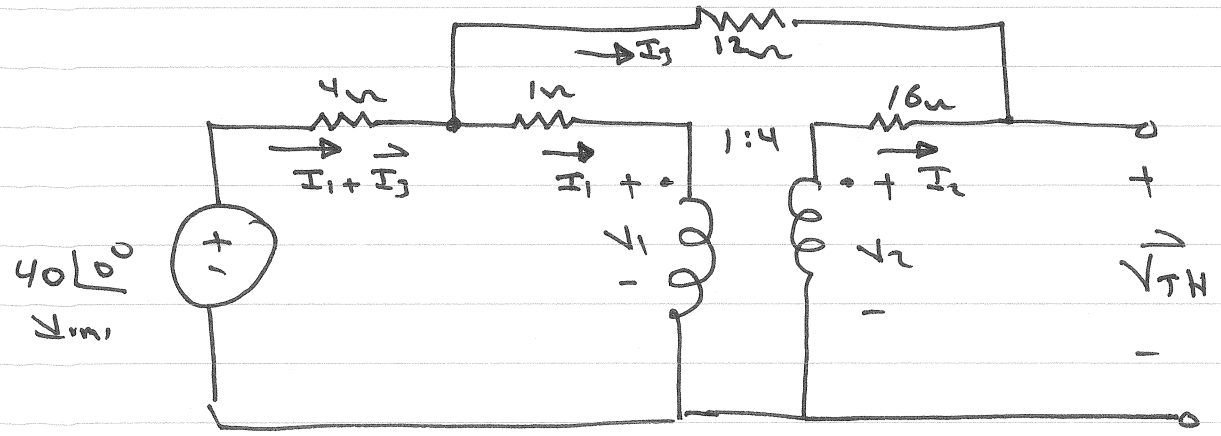
$$360\angle 0^\circ = (10 + j20)\vec{I}_1 - j10\vec{I}_2$$

$$\therefore \vec{I}_1 = 18\angle 0^\circ \quad A_{rms}$$

$$P_{360\angle 0^\circ} = (360)(18) = 6480\ W$$

10.62





$$40\angle 0^\circ = 4\left(\vec{I}_1 + \vec{I}_3\right) + 12\vec{I}_3 + \vec{V}_{TH}$$

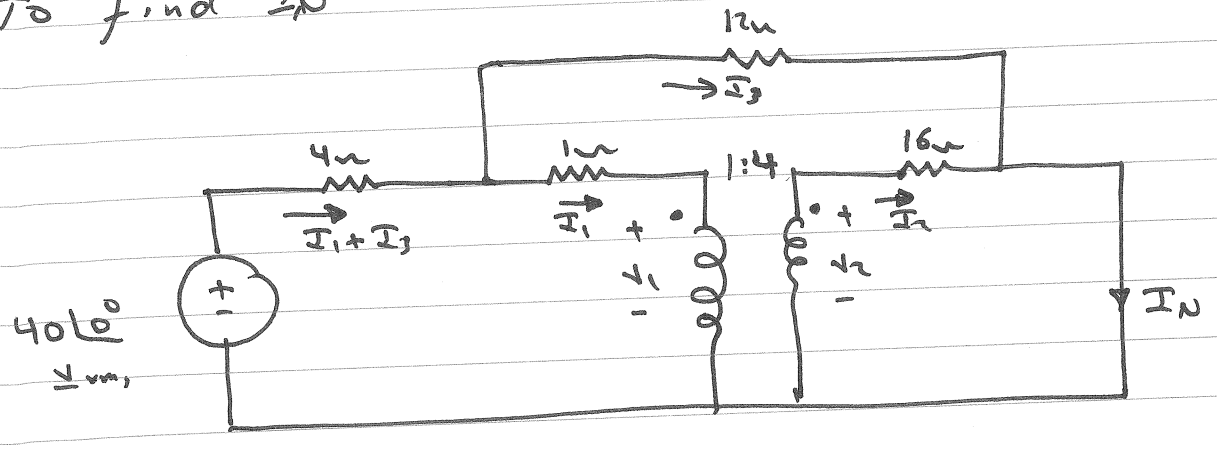
$$\vec{I}_3 = -\vec{I}_2 = -\frac{\vec{I}_1}{4}$$

$$\therefore \vec{I}_3 = -\frac{\vec{I}_1}{4}$$

Solving:

$$\vec{V}_{TH} = 40\angle 0^\circ \text{ V rms}$$

To find $\vec{I}_N$



$$40\angle 0° = 4(\vec{I}_1 + \vec{I}_3) + \vec{I}_1 + \vec{V}_1$$

$$\vec{V}_2 = 16\vec{I}_2$$

$$-\vec{V}_1 - \vec{I}_1 + 12\vec{I}_3 - 16\vec{I}_2 + \vec{V}_2 = 0$$

$$\vec{V}_1 = \frac{\vec{V}_2}{4}$$

$$\vec{I}_1 = 4\vec{I}_2$$

Solving: $\vec{I}_1 = 6\angle 0°$ A rms, $\vec{I}_2 = 1.5\angle 0°$ A rms

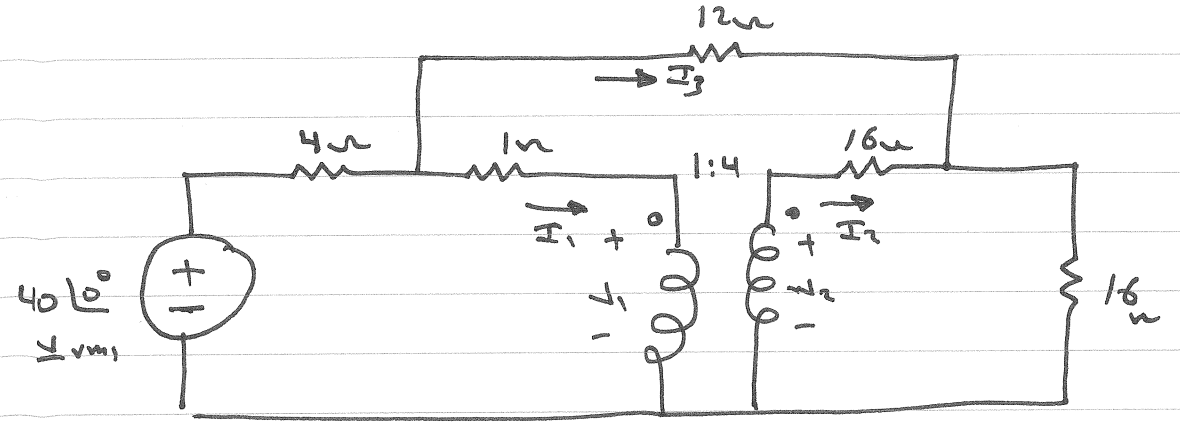
$\vec{I}_3 = 1\angle 0°$ A rms

$$\vec{I}_N = \vec{I}_2 + \vec{I}_3 = 2.5\angle 0° \text{ A rms}$$

$$\therefore R_{TH} = \frac{\vec{V}_{TH}}{\vec{I}_N} = 16\,\Omega$$

$$\therefore R_L = R_{TH} = 16\,\Omega$$

$$P_{L,max} = \frac{|V_{TH}|^2}{4R_L} = 25\text{ W}$$



$$40\angle 0° = 4(\vec{I}_1+\vec{I}_2) + \vec{I}_1 + \vec{V}_1$$

$$\vec{V}_2 = 16\vec{I}_2 + 16(\vec{I}_2+\vec{I}_3)$$

$$-\vec{V}_1 - \vec{I}_1 + 12\vec{I}_3 - 16\vec{I}_2 + \vec{V}_2 = 0$$

$$\vec{V}_2 = 4\vec{V}_1$$

$$\vec{I}_1 = 4\vec{I}_2$$

Solving: $\vec{I}_1 = 6\angle 0°$ A rms

$\vec{I}_3 = -0.25\angle 0°$ A rms

$\vec{I}_1+\vec{I}_3 = 5.75\angle 0°$ A rms

$$P_{\underline{V}\,40\angle 0°} = (40)(5.75) = 230\text{ W}$$

$$\%\,\text{deliv} = \frac{25}{230}\times 100\% = 10.87\%$$

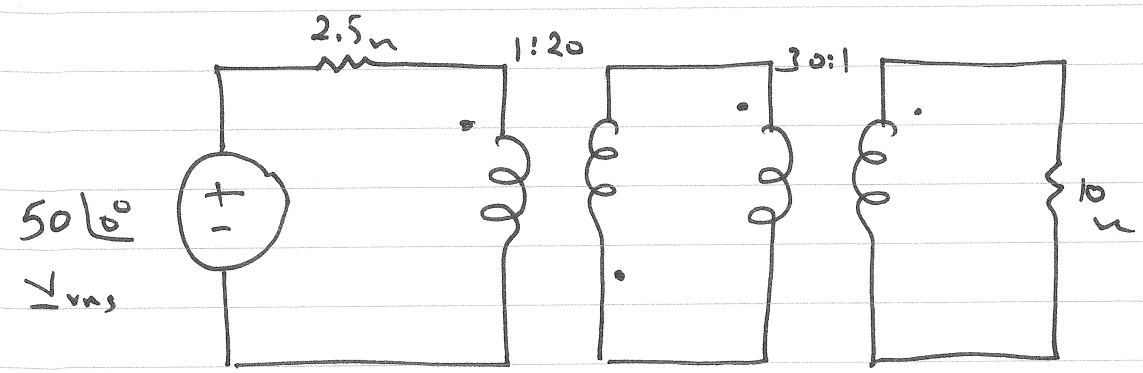
$$P_{4\Omega} = |\vec{I}_1+\vec{I}_2|^2 \cdot 4 = 132.25\text{ W}$$

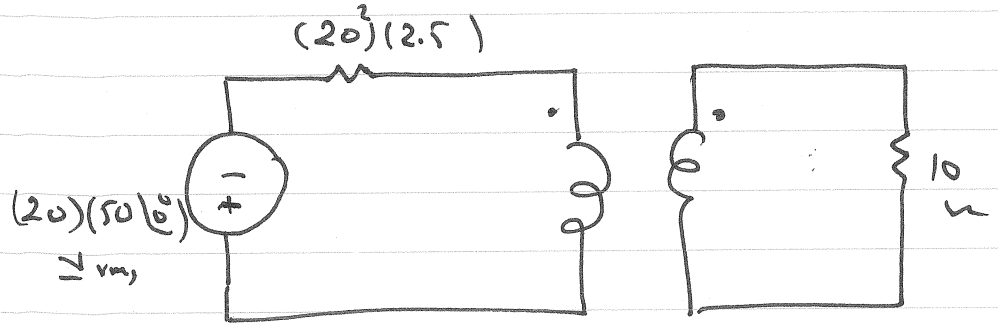
$$P_{1\Omega} = |\vec{I}_1|^2 \cdot 1 = 36\text{ W}$$

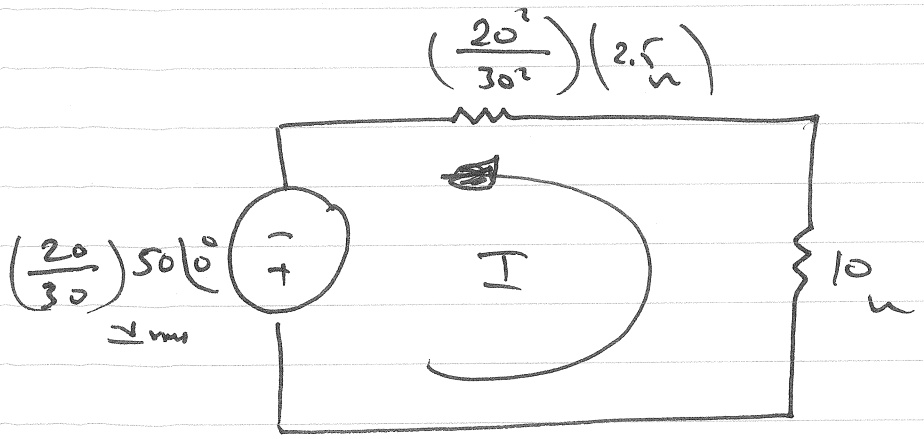
$$P_{16\Omega} = |\vec{I}_2|^2 \cdot 16 = 36\text{ W} \quad ; \quad P_{12\Omega} = |\vec{I}_3|^2 \cdot 12 = 0.75\text{ W}$$

$$\Sigma \text{absor} = 230\text{ W}$$

10.64







$$I = 3\angle 0^\circ \text{ A rms}$$

$$P_{10\Omega} = (3)^2 \cdot 10 = 90 \text{ W}$$