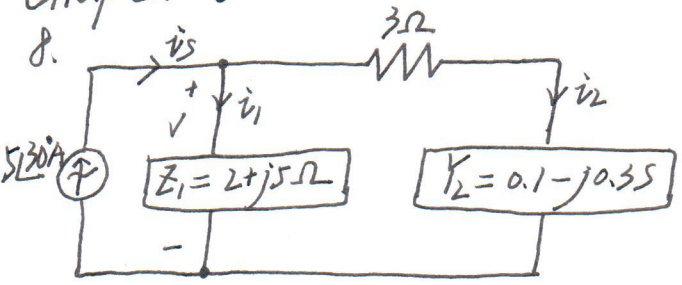
chapter 8

8.



(a) dissipated in the 3-Ω resistor

(b) generated by the source

$$Z_2 = \frac{1}{Y_2} = \frac{1}{0.1-j0.35} = 1+j3\,\Omega$$

$$\begin{cases} i_1 + i_2 = 5\angle 30^\circ = \frac{5\sqrt{3}}{2} + j\frac{5}{2} \\ i_1 \cdot Z_1 = i_2 \cdot (Z_2 + 3) \Rightarrow i_1(2+j5) = i_2(1+j3+3) \end{cases}$$

$$\therefore i_2 = 1.9 + j1.9\,A = 2.7\angle 45^\circ$$

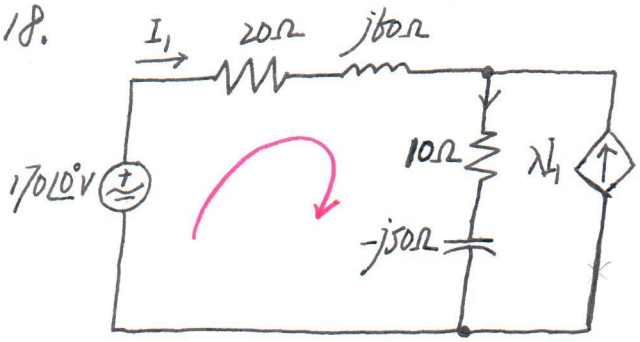
(a) $P_R = \frac{1}{2} I_m^2 R = \frac{1}{2} \cdot 2.7^2 \cdot 3 = 10.935\,W$

(b) $P = \frac{1}{2} V_m I_m \cos(\theta - \phi)$

$V = i_2 \cdot (3 + 1 + j3) = 2.7\angle 45^\circ \cdot 5\angle 36.9^\circ = 13.5\angle 81.9^\circ$

$$\therefore P = \frac{1}{2} \cdot 13.5 \cdot 5 \cos(81.9^\circ - 30^\circ) = 20.82\,W$$

18.



(a) $\lambda = 0$ open circuit

$Z_{all} = 20 + j60 + 10 - j50 = 30 + j10\,\Omega$

$$I_1 = \frac{170\angle 0^\circ}{30+j10} = 5.1 - j1.7 = 5.38\angle -18.43^\circ$$

$P_{20} = \frac{1}{2}(5.38)^2 \cdot 20 = 289.4\,W$

$P_{10} = \frac{1}{2}(5.38)^2 \cdot 10 = 144.7\,W$

(b) $\lambda = 1$

KVL:

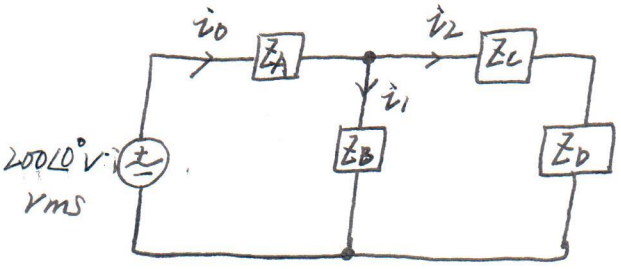
$170 = 20I_1 + j60I_1 + (10 - j50) \cdot 2I_1$

$$\therefore I_1 = \frac{170}{40 - j40} = 2.125 + j2.125 = 3\angle 45^\circ$$

$P_{20} = \frac{1}{2}(3)^2 \cdot 20 = 90\,W$

$P_{10} = \frac{1}{2}(3+3)^2 \cdot 10 = 180\,W$

33.



$Z_A = 5+j2\,\Omega$ $Z_B = 20-j10\,\Omega$ $Z_C = 10\angle 30°\,\Omega$

$Z_D = 10\angle -60°\,\Omega$

(a) apparent power delivered to each load

(b) apparent power generated by the source

$$Z_{CD} = Z_C + Z_D = 10\angle 30° + 10\angle -60° = 10\cdot\cos 30° + j10\sin 30° + 10\cdot\cos(-60°) + j10\sin(-60°)$$
$$= 10\cdot\frac{\sqrt{3}}{2} + j5 + 5 - j\cdot 10\frac{\sqrt{3}}{2}$$
$$= (5\sqrt{3}+5) + j(5-5\sqrt{3})$$

$$Z_{BCD} = Z_B \,//\, Z_{CD} = \frac{[(5+5\sqrt{3})+j(5-5\sqrt{3})](20-j10)}{[(5+5\sqrt{3})+j(5-5\sqrt{3})]+(20-j10)} \approx 8.21-j2.90$$

$$\therefore Z_{ABCD} = Z_A + Z_{BCD} = 5+j2+8.21-j2.9 = 13.21-j0.9 = 13.24\angle -3.90°$$

$$\therefore i_0 = \frac{200\angle 0°}{Z_{ABCD}} = \frac{200\angle 0°}{13.24\angle -3.9°} = 15.11\angle 3.9°$$

$$i_1 = i_0\frac{(Z_C+Z_D)}{(Z_C+Z_B+Z_D)} = \frac{(5+5\sqrt{3})+j(5-5\sqrt{3})}{(5+5\sqrt{3})+j(5-5\sqrt{3})+(20-j10)}\times 15.11\angle 3.9° = 5.77+j1.12 = 5.88\angle 10.98°$$

$$i_2 = i_0\frac{Z_B}{(Z_C+Z_D+Z_B)} = \frac{20-j10}{(5+5\sqrt{3})+j(5-5\sqrt{3})+(20-j10)}\times 15.11\angle 3.9° = 9.3-j0.09 = 9.3\angle -0.55$$

✓ $P_S = 200\times 15.11 = 3022\,VA$

$U_{ZA} = i_0\cdot Z_A = 15.11\angle 3.9°\cdot(5+j2) = 81.4\angle 25.7°$

✓ $P_{ZA} = 81.4\times 15.11 = 1230\,VA$

$U_{ZB} = i_1\cdot Z_B = (5.77+j1.12)\cdot(20-j10) = 131.4\angle -15.6°$

✓ $P_{ZB} = 131.4\times 5.88 = 772\,VA$

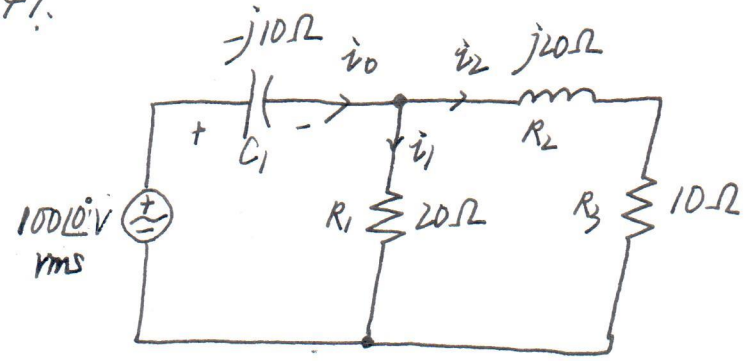
$U_{ZC} = i_2\cdot Z_C = (9.3-j0.09)\cdot 10\angle 30° = 93\angle 29.4°$

✓ $P_{ZC} = 93\times 9.3 = 865\,VA$

$U_{ZD} = i_2\cdot Z_D = (9.3-j0.09)\cdot 10\angle -60° = 93\angle -60.6°$

✓ $P_{ZD} = 93\times 9.3 = 865\,VA$

4).



$$Z_{并} = \frac{20\cdot(10+j20)}{20+(10+j20)} = 10.77 + j6.15\ \Omega$$

$$Z_{all} = Z_{并} - j10 = 10.77 + j6.15 - j10 = 10.77 - j3.85\ \Omega = 11.44\angle -19.67^\circ$$

$$\therefore i_0 = \frac{100\angle 0^\circ}{Z_{all}} = \frac{100\angle 0^\circ}{11.44\angle -19.67^\circ} = 8.23 + j2.94 = 8.74\angle 19.66^\circ$$

$$i_1 = \frac{(10+j20)}{20+(10+j20)}\cdot i_0 = 3.53 + j4.12 = 5.43\angle 49.4^\circ$$

$$i_2 = \frac{20}{20+(10+j20)}\cdot i_0 = 4.7 - j1.17 = 4.84\angle -14^\circ$$

$$P_S = 100\angle 0^\circ \cdot 8.74\angle 19.66^\circ = 874\angle 19.66^\circ = 823 - j294\ VA$$

$$P_{C1} = -j10\cdot i_0^2 = 483.9 - j590.9\ VA$$

$$P_{R1} = 20\cdot i_1^2 = -90.3 + j581.7\ VA$$

$$P_{R2} = j20\cdot i_2^2 = 219.96 + j414.4\ VA$$

$$P_{R3} = 10\cdot i_2^2 = 207.2 - j109.98\ VA$$