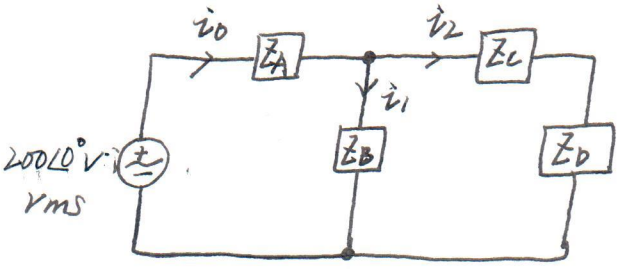
33.



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

$Z_D = 10\angle -60°\,\Omega$

(a) apparent power delivered to each load

(b) apparent power generated by the source

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

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

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

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

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

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

✓ $P_S = 200\times 15.11 = 3022\,VA$

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

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

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

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

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

✓ $P_{ZC} = 93\times 9.3 = 865\,VA$

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

✓ $P_{ZD} = 93\times 9.3 = 865\,VA$