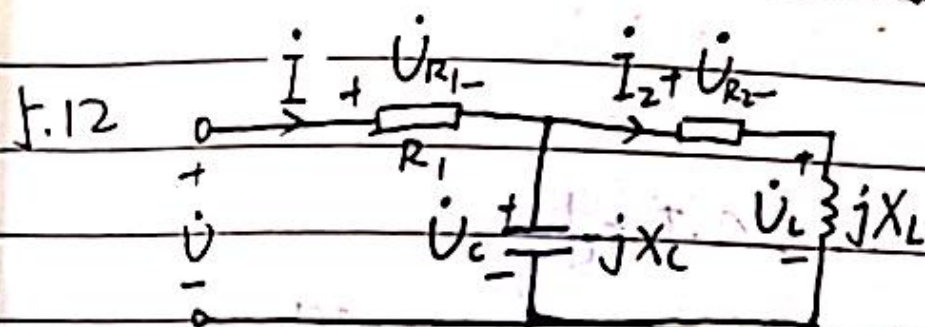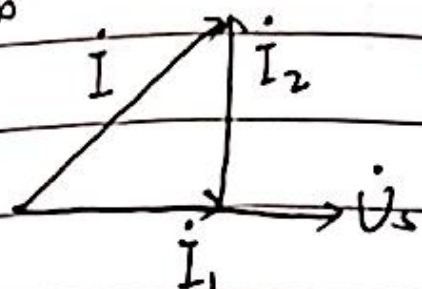**5.11**

$U_S = I_1 R = 100V$

以 $\dot{U}_S$ 为参考相量

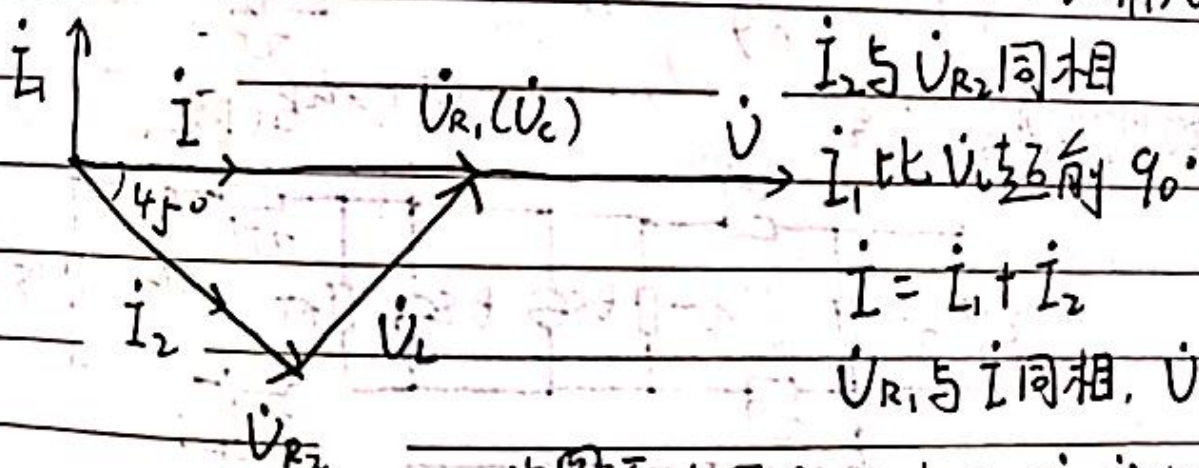$\dot{I}_1$ 与 $\dot{U}_S$ 同相

$\dot{I}_2$ 比 $\dot{U}_S$ 超前 $90°$

$\dot{I} = \dot{I}_1 + \dot{I}_2$

$I = 10\sqrt{2}A$

5.12

$\dot{U}_L$ 为参考相量 $\dot{U}_{R_2} + \dot{U}_L = \dot{U}_c$ 且 $U_{R_2} = U_L$, $\dot{U}_c$ 比 $\dot{U}_{R_2}$ 超前

一个锐角, $\dot{U}_{R_2}$ 与 $\dot{U}_L$ 正交

$\dot{I}_2$ 与 $\dot{U}_{R_2}$ 同相

$\dot{I}_1$ 比 $\dot{U}_c$ 超前 $90°$

$\dot{I} = \dot{I}_1 + \dot{I}_2$

$\dot{U}_{R_1}$ 与 $\dot{I}$ 同相, $\dot{U} = \dot{U}_{R_1} + \dot{U}_c$

由图 $I_2 = 10\sqrt{2}A$, $I_1 = 10A$, $<\dot{I}_2, \dot{I}> = 135°$, 故 $I = 10A$

$U_{R_1} = I \cdot R_1 = 100V$ $<\dot{U}, \dot{U}_{R}> = 0°$ $U_c = 100V$

故: $\dot{U}_c = 100\angle 0°V$ $\dot{U}_{R_1} = 100\angle 0°V$ $\dot{U} = 200\angle 0°V$

$\dot{I} = 10\angle 0°A$ $\dot{I}_1 = 10\angle 90°A$ $\dot{I}_2 = 10\sqrt{2}\angle -45°A$

$\dot{U}_{R_2} = 50\sqrt{2}\angle -45°V$ $\dot{U}_L = 50\sqrt{2}\angle 45°V$

5.14. 加0Ü的电压
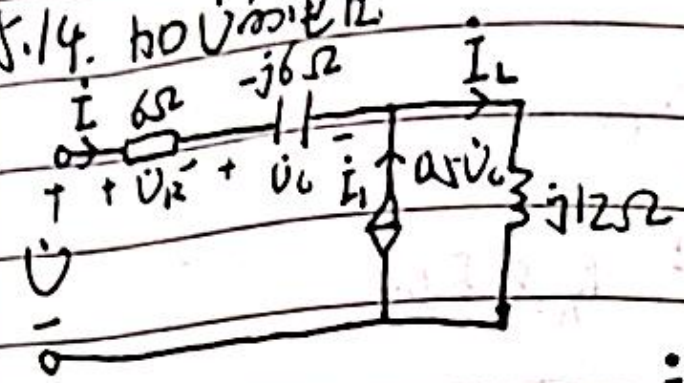
以 $\dot{I} = I\angle 0°$ 为参考相量
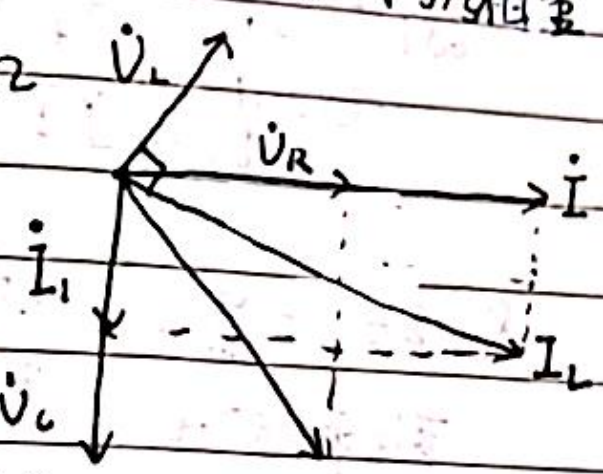
$\dot{U}_R = 6\dot{I} = 6I\angle 0°$

$\dot{U}_c = -6j\cdot\dot{I} = 6I\angle-90°$

$\dot{I}_L = 0.5\dot{U}_c + \dot{I} = 3I\angle-90° + I\angle 0°$
$\qquad = -3Ij + I$

$\dot{U}_L = \dot{I}_L \cdot 12j = 36I + 12Ij$

$\dot{U} = \dot{U}_R + \dot{U}_c + \dot{U}_L = 6I - 6Ij + 36I + 12Ij = 42I + 6Ij$

$Z = \dfrac{\dot{U}}{\dot{I}} = (42 + 6j)\Omega$

5.16.
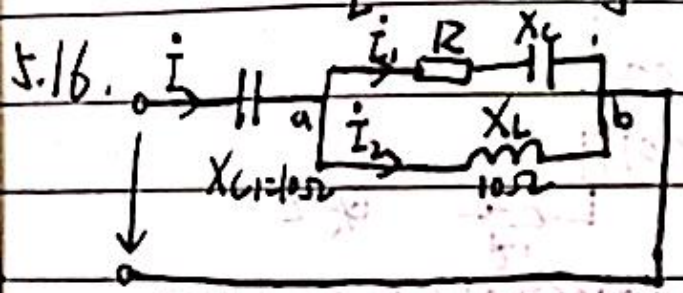
$\dot{I} = 5\angle 45°(A), \quad \dot{U} = 50\sqrt{2}\angle 0°(V)$

$U_{c1} = \dot{I}(-10j) = (25\sqrt{2} - 25\sqrt{2}j)V$

$U_{ab} = U - U_{c1} = (25\sqrt{2} + 25\sqrt{2}j)V$
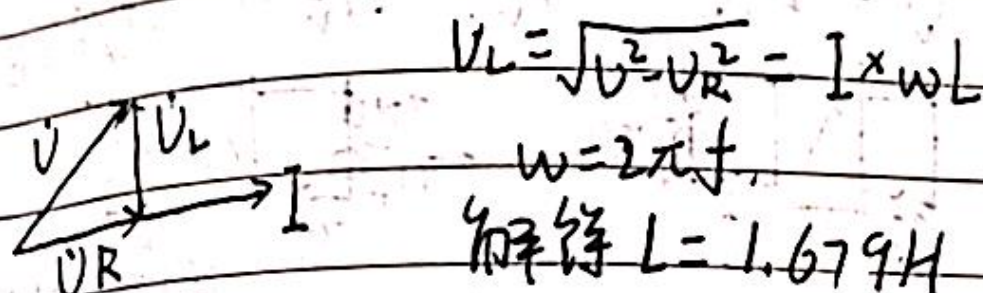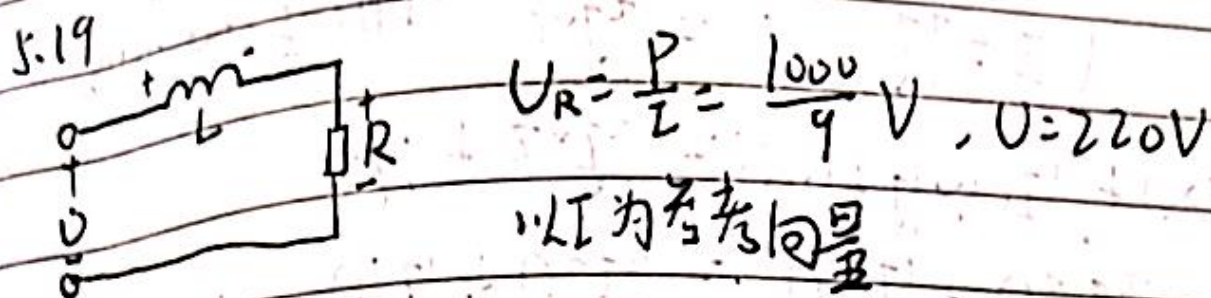
$\dot{I}_2 = \dfrac{U_{ab}}{10j} = \left(\dfrac{5\sqrt{2}}{2} - \dfrac{5\sqrt{2}}{2}j\right)V$

$\dot{I}_1 = \dot{I} - \dot{I}_2 = 5\sqrt{2}j \; V$

$U_{ab} = \dot{I}_1 R + \dot{I}_1(-X_c j) = 5\sqrt{2}Rj + 5\sqrt{2}X_c$
$\qquad\qquad = 25\sqrt{2} + 25\sqrt{2}j$

由实部相等 虚部相等

$R = 5\Omega \quad X_c = 5\Omega$

5.19

$$U_R = \frac{P}{I} = \frac{1000}{9} V, \quad U = 220V$$

以 $\dot{I}$ 为参考向量

$$U_L = \sqrt{U^2 - U_R^2} = I \times \omega L$$

$$\omega = 2\pi f,$$

解得 $L = 1.679H$

5.18 复数功率 $\tilde{S} = \dot{U}\bar{I} = 30\angle 45° \times 10\angle -15°$

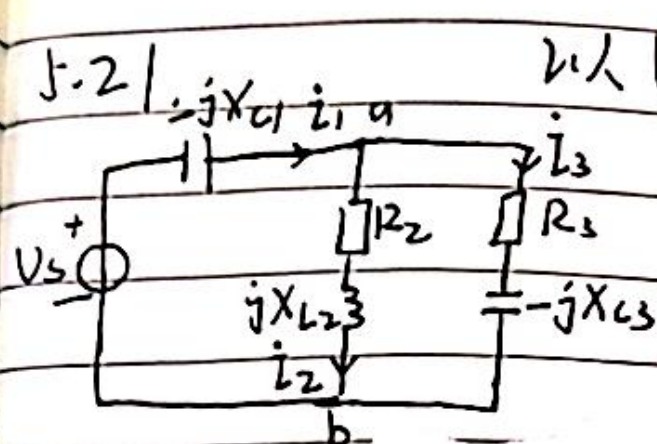$$= 300\angle 30° = 150j + 150\sqrt{3} \ VA$$

有功 $P = 150\sqrt{3} \ W$

无功 $Q = 150 \ VAR$

视功 $S = \sqrt{P^2 + Q^2} = 300 \ VA$

5.21

以 $\dot{U}_S$ 为参相量 $\dot{U}_S = 20\angle 0° V$

$$\dot{I}_1 = \frac{\dot{U}_S}{-jX_{c1} + (R_2+jX_{L2})//(R_3-jX_{c3})}$$

$$= 3.0 + 1.98j$$

$$\tilde{S}_{c1} = \dot{I}_1 \cdot \overline{\dot{I}}_1(-j) = -12.92j \ VA$$

$$\dot{I}_2 = \dot{I}_1 \times \frac{R_3 - jX_{c3}}{R_2+jX_{L2}+R_3-jX_{c3}}$$

$$= 1.3 - 1.25j \ A$$

$$\tilde{S}_{c2} = \dot{I}_2 \cdot \overline{\dot{I}}_2(6+8j)$$

$$= 19.52 + 26.02j \ VA$$

$$\dot{I}_3 = \dot{I}_1 - \dot{I}_2 = 1.7 + 3.23j \ A$$

$$\tilde{S}_{c3} = \dot{I}_3 \times \overline{\dot{I}}_3(3-4j)$$

$$= 40.0 - 53.3j \ VA$$

电源: $\tilde{S} = \dot{U}_S \overline{\dot{I}}_1 = 60.0 - 39.6j \ VA$

负载上:

$\tilde{S}_{c1} = -12.92j \ VA$

$\tilde{S}_{c2} = 20.0 + 26.02j \ VA$

$\tilde{S}_{c3} = 40.0 - 53.3j \ VA$

电源:

$\tilde{S} = 60.0 - 39.6j \ VA$

5.22(1)
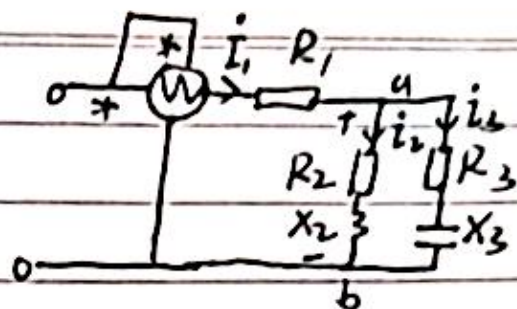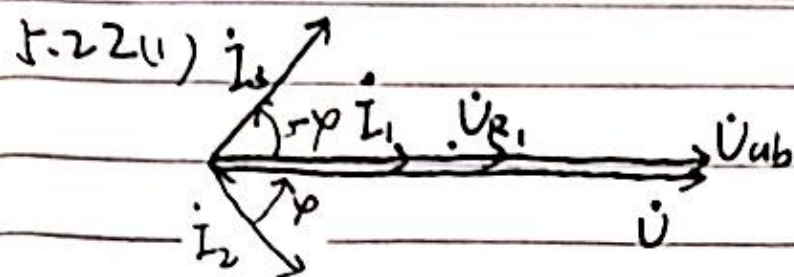
(2) $P = UI_1 \cos 0°$ $\quad I_1 = 1A \quad I_1 = I_2 = I_3 = 1A$

$P = I_1^2 R_1 + I_2^2 R_2 + I_3^2 Z_3$

$R_1 = R_2 = R_3 = 1\,\Omega \qquad U_{ab} = U - I_1 R_1 = 2V$

由图 $X_3 = -\dfrac{U_{ab}}{I_3} \cos -60° = \sqrt{3}\,\Omega$

$X_2 = \dfrac{U_{ab}}{I_2} \cos 60° = \sqrt{3}\,\Omega$

5.23. 以 U_2 为参考相量 $I = \dfrac{P_2}{U_2 \cos P_2} = 50.51A$

$I = 45.45 - 22.02j\ A$

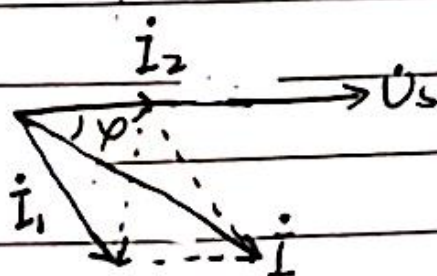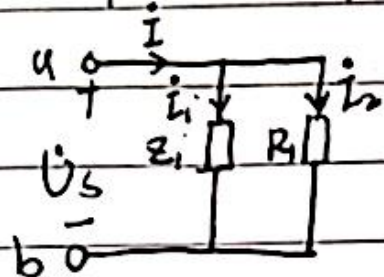$\dot{U}_1 = Z_1 \times \dot{I} + \dot{U}_2$

$= 226.74 + 2.34j$

$U_1 = 226.75\,V \qquad \cos u_1 = \dfrac{226.74}{226.75} \quad \sin u_1 = \dfrac{2.34}{226.75}$

$\cos Q_1 = \cos(u_1 + P_2) = 0.895$

$P_1 = U_1 I \cos Q_1 \qquad \eta = \dfrac{P_2}{P_1} = 0.476$

$\cos Q_1 = 0.895 \qquad U_1 = 226.75V$

5.24

$$\dot{I}_2 = \frac{\dot{U}_S}{R} = 5\angle0°A \qquad \dot{I}_1 = 5 - 5\sqrt{3}j\ A$$

$$\dot{I} = \dot{I}_1 + \dot{I}_2 = 10 - 5\sqrt{3}j\ A \qquad I = 5\sqrt{7}A = 13.23A$$

$$\varphi = \psi_u - \psi_i = -\varphi_i$$

$$P = U_S I\cos\varphi = 1000W \qquad \cos\varphi = \frac{10}{5\sqrt{7}} = 0.756$$

并联一个电容　$\dot{I}_C = I_C\angle90°$

$$\dot{I}' = \dot{I}_1 + \dot{I}_2 + \dot{I}_C = 10 + (-5\sqrt{3} + I_C)j$$

$$\sqrt{10^2 + (I_C - 5\sqrt{3})^2} = 11 \qquad I_C = (\pm\sqrt{21} + 5\sqrt{3})A$$

$$I_C = \omega C \cdot U_S$$

由于 $5\sqrt{3} + \sqrt{21} > 5\sqrt{3} - \sqrt{21}$　故送 $5\sqrt{3} - \sqrt{21}$ 电容要小

此时代入　$C = \frac{I_C}{2\pi f \cdot U_S} = 129.8\mu F$

$$\cos\alpha' = \frac{10}{11} = 0.909$$