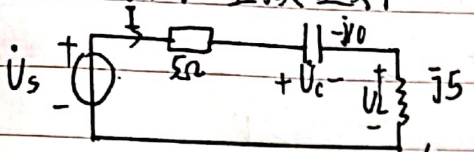
第十章作业

CU=Q

[10-13] 原电路相量模型如下:



(1) KVL: $u_S = 5i + 100\int i\,dt + 0.5\frac{di}{dt}$

(2) $\dot U_S = (5 - j10 + j5)\dot I = 20\angle 45^\circ\ V$

∴ $\dot I = \frac{20\angle45^\circ}{5\sqrt2\angle -45^\circ} A = 2.83\angle 90^\circ A$

∴ $i = 2.83\cos(10t+90^\circ) A$

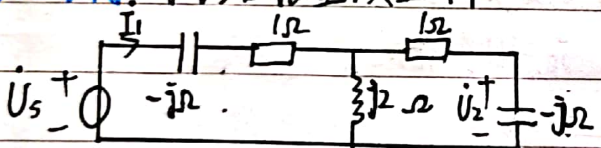
(3) $\dot U_L = j5\dot I = 14.15\angle180^\circ V$

$\dot U_C = -j10\dot I = 28.3\angle 0^\circ V$

∴ $u_L = 14.15\cos(10t+180^\circ)V$

$u_C = 28.3\cos(10t) V$

[10-34] 原电路相量模型如下:



$Z_{eq} = 1-j + \frac{j2\times(1-j)}{j2+1-j} = 3-j$ 取 $\dot U_S = 10\sqrt2\angle0^\circ$

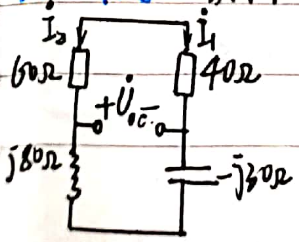
$\dot I_1 = \frac{\dot U_S}{Z_{eq}} = \frac{10\sqrt2\angle0^\circ}{\sqrt{10}\angle-18.4^\circ} = 4.47\angle18.43^\circ A$

$\dot U_2 = \frac{-j}{1-j}\times\frac{\frac{j2\times(1-j)}{j2+1-j}}{Z_{eq}}\times\dot U_S = 6.32\angle-26.57^\circ V$

∴ $i_1 = 4.47\cos(100t+18.43^\circ)A = 3.16\sqrt2\cos(100t+18.43^\circ)A$

$u_2 = 6.32\cos(100t-26.57^\circ)V = 4.47\sqrt2\cos(100t-26.57^\circ)V$

[10-41] ①戴维南定理:

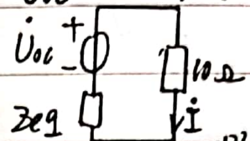


$Z_{eq} = (60\Omega+40\Omega)//(j80\Omega - j30\Omega) = \frac{100\times j50}{100+j50} = 20(1+j2)\Omega$

$\dot I_1 = \frac{60+j80}{60+j80+40+(-j30)}\times 3\angle60^\circ$

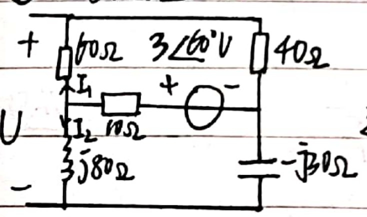
$\dot I_2 = \frac{40-j30}{60+j80+40-j30}\times3\angle60^\circ$

$\dot U_{oc} = 40\dot I_1 - 60\dot I_2 = 60\sqrt5\angle123.43^\circ = 134.2\angle123.43^\circ V$



$\dot I = \frac{\dot U_{oc}}{10+Z_{eq}} = \frac{134.2\angle123.43^\circ}{30+j40} = \frac{134.2\angle123.43^\circ}{50\angle53.13^\circ} = 2.68\angle70.3^\circ A$

②互易定理:



$\dot U = j80\dot I_2 - 60\dot I_1$

$Z_{eq} = (10+\frac{100\times j50}{100+j50})\Omega = (30+j40)\Omega$

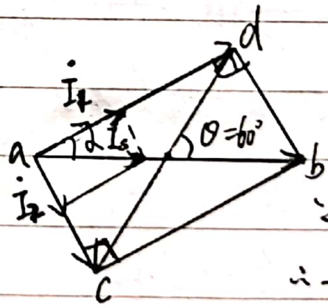
$\dot I_1 = \frac{j50}{100+j50}\times\frac{3\angle60^\circ}{Z_{eq}}$, $\dot I_2 = \frac{100}{100+j50}\times\frac{3\angle60^\circ}{Z_{eq}}$

$\dot U = \frac{100j}{2+j}\times\frac{3\angle60^\circ}{30+j40} V = 2.68\angle70.3^\circ V$

由互易定理, $\frac{\dot U}{3\angle60^\circ V} = \frac{\dot I}{3\angle60^\circ A}$

∴ $\dot I = 2.68\angle70.3^\circ A$

[10-51]



选 $\dot U_{ab}$ 作为参考向量

∵ $R_1=R_2$

∴ $\frac{I_2}{I_1} = \frac{U_{ac}}{U_{ad}} = \frac{I_2R_1}{I_1R_2}$

由题意, ∠θ=60°, ∠acb=∠adb=90°

∵ $\dot U_{ab}=\dot U_{cd}$ ∴ a,b,c,d四点共圆

∴ α=30°

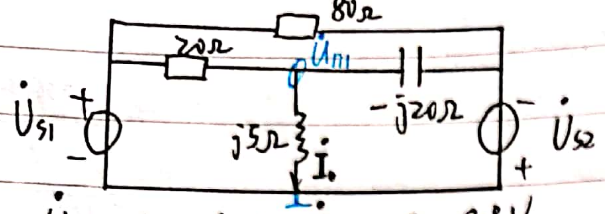
$\dot I_1 = I_S\cos\alpha = 5\sqrt3 A$, $\dot I_2 = I_S\sin\alpha = 5A$

$\dot U_{ab} = \frac{U_{cb}}{\cos\alpha} = 10V$, $\dot U_{ad} = \dot U_{ab}\cos\alpha = 5\sqrt3 V$

∴ $R_1=R_2=\frac{U_{ac}}{I_2} = \frac{U_{ad}}{I_1} = 1\Omega$

$X_L = \frac{U_{cb}}{I_2} = \sqrt3\Omega$ $X_C = \frac{U_{db}}{I_1} = \frac{\sqrt3}{3}\Omega$

[10-53] (1) 电路的相量模型图如下:



$\dot U_{S1}=60\angle 0° V$, $\dot U_{S2}=90\angle 90° V$

(取有效值相量)

(2) 用KCL方程, 对结点!

$(\frac{1}{j5}+\frac{1}{20}+\frac{1}{-j20})\dot U_{n1}-\frac{\dot U_{S1}}{20}+\frac{\dot U_{S2}}{-j20}=0$

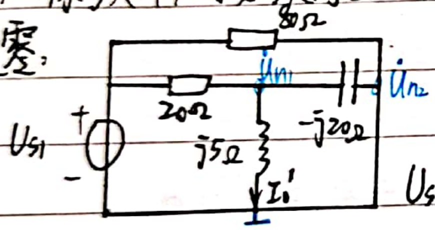
∴ $\dot U_{n1}=\frac{15\angle 0°}{1-3j}=\frac{15\angle 0°}{\sqrt{10}\angle -71.56°}=1.5\sqrt{10}\angle 71.56° V$

$\dot I_0=\frac{\dot U_{n1}}{j5}=9.5\angle -18.44° A$

∴ $i_0=9.5\sqrt2\cos(4\times10^4 t-18.44°)A$

(3) 改变电压源频率,则必须用叠加定理

① 将U_{S2}置零:



(取有效值) $U_{S1}=60\angle 0° V$

KCL-1: $(\frac{1}{20}+\frac{1}{j5}+\frac{1}{-j20})\dot U_{n1}-\frac{1}{20}\dot U_{S1}-\frac{1}{-j20}\dot U_{n2}=0$

KCL-2: $(-\frac{1}{j20}+\frac{1}{80})\dot U_{n2}-\frac{1}{-j20}\dot U_{n1}=0$ ∴ $\dot U_{n2}=0$

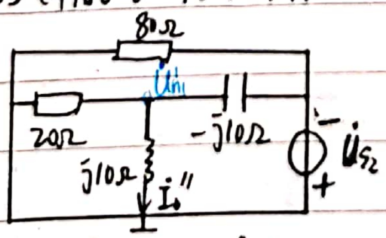
∴ $\dot U_{n1}=6\sqrt{10}\angle 71.56° V$

$\dot I_0'=\frac{\dot U_{n1}}{j5}=3.8\angle -18.44° A$

$i_0'=3.8\sqrt2\cos(4\times10^4t-18.44°)A$

② 将U_{S1}置零.

$\dot U_{S2}=90\angle 90°$ (取有效值)



KCL: $(\frac{1}{20}+\frac{1}{j10}+\frac{1}{-j10})\dot U_{n1}-\frac{1}{-j10}(-\dot U_{S2})=0$

∴ $\dot U_{n1}=180°\angle 0° V$

$\dot I_0''=\frac{\dot U_{n1}}{j10}=18\angle -90° A$

$i_0''=18\sqrt2\cos(8\times10^4t-90°)A$

∴ $i_0=i_0'+i_0''=[3.8\sqrt2\cos(4\times10^4t-18.44°)+18\sqrt2\cos(8\times10^4t-90°)]A$

其他题

[10-14] (1) $\dot I_S=\frac{\dot U}{10}+\frac{\dot U}{j4}+\frac{\dot U}{-j2.5}=2\angle -30° A$

∴ $\dot U=\frac{40\angle -30°}{2+3j}=\frac{40\angle -30°}{\sqrt{13}\angle 56.3°}=11.1\angle -86.3°$

∴ $u=11.09\sin(4t-86.3°)V$

$\dot I_L=\frac{\dot U}{j4}=2.77\angle -176.3° A$　∴ $i_L=\cdots$

$\dot I_C=\frac{\dot U}{-j2.5}=4.44\angle 3.7° A$　$i_C=\cdots$

[10-16] i的初相: $\frac{\pi}{6}+\frac{\pi}{2}=\frac{2\pi}{3}$

u_L初相超前i $\frac{\pi}{2}$, $\varphi_{uL}=\frac{2\pi}{3}+\frac{\pi}{2}=\frac{7}{6}\pi$

$2\pi-\frac{7}{6}\pi=-\frac{5}{6}\pi$

−i的初相=u_R初相: $\frac{2\pi}{3}$

i初相: ~~不变~~ $\frac{2\pi}{3}-\pi=-\frac{\pi}{3}$

[10-17] u超前i_L 90° ∴ u初相: 60°

i_R与u初相同 $\varphi_{iL}=60°$

$-i_C$超前u 90° ∴ $\varphi_{-iC}=150°$

$\varphi_{iC}=-30°$

[10-18] (1) $X=-20\angle -90°=20\angle 90°=20j$

→ $200L=20$　$L=0.1H$

(2) $X=-100\angle 90°=\frac{100}{j}=\frac{1}{j\omega C}$

∴ $500C=\frac{1}{100}$　∴ $C=20\mu F$

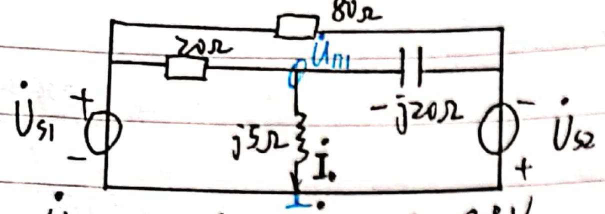
(3) ~~$X=100\angle -90° = \frac{100}{j} = \frac{1}{j1000C}$~~

统一sin、cos

$i=0.5\cos(1000t-30°)A$

$X=\frac{U}{I}=100\angle 0°$　∴ $R=100\Omega$

[10-53] (1) 电路的相量模型图如下：



$\dot{U}_{S1} = 60\angle 0^\circ\ V$，$\dot{U}_{S2} = 90\angle 90^\circ\ V$

(取有效值相量)

(2) 用KCL方程，对结点！

$(\frac{1}{j5}+\frac{1}{20}+\frac{1}{-j20})\dot{U}_{n1} - \frac{\dot{U}_{S1}}{20} + \frac{\dot{U}_{S2}}{-j20} = 0$

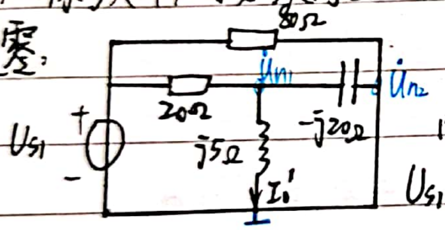
$\therefore \dot{U}_{n1} = \frac{150\angle 0^\circ}{1-3j} = \frac{150\angle 0^\circ}{\sqrt{10}\angle -71.56^\circ} = 15\sqrt{10}\angle 71.56^\circ\ V$

$\dot{I}_0 = \frac{\dot{U}_{n1}}{j5} = 9.5\angle -18.44^\circ A$

$\therefore i_0 = 9.5\sqrt{2}\cos(4\times10^4 t - 18.44^\circ) A$

(3) 改变电压源频率，则必须用叠加定理

① 将 U_{S2} 置零：



(取有效值)

$U_{S1} = 60\angle 0^\circ V$

KCL-1：$(\frac{1}{20}+\frac{1}{j5}+\frac{1}{-j20})\dot{U}_{n1} - \frac{1}{20}\dot{U}_{S1} - \frac{1}{-j20}\dot{U}_{n2} = 0$

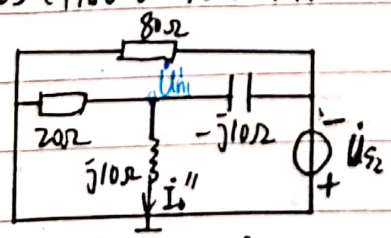
KCL-2：$(-\frac{1}{j20}+\frac{1}{80})\dot{U}_{n2} - \frac{1}{-j20}\dot{U}_{n1} = 0$　& $\dot{U}_{n2} = 0$

$\therefore \dot{U}_{n1} = 6\sqrt{10}\angle 71.56^\circ V$

$\dot{I}_0' = \frac{\dot{U}_{n1}}{j5} = 3.8\angle -18.44^\circ A$

$i_0' = 3.8\sqrt{2}\cos(4\times10^4 t - 18.44^\circ) A$

② 将 U_{S1} 置零.



$\dot{U}_{S2} = 90\angle 90^\circ$

(取有效值)

KCL：$(\frac{1}{20}+\frac{1}{j10}+\frac{1}{-j10})\dot{U}_{n1} - \frac{1}{-j10}(-\dot{U}_{S2}) = 0$

$\therefore \dot{U}_{n1} = 180^\circ\angle 0^\circ V$

$\dot{I}_0'' = \frac{\dot{U}_{n1}}{j10} = 18\angle -90^\circ A$

$i_0'' = 18\sqrt{2}\cos(8\times10^4 t - 90^\circ) A$

$\therefore i_0 = i_0' + i_0'' = [3.8\sqrt{2}\cos(4\times10^4 t - 18.44^\circ) + 18\sqrt{2}\cos(8\times10^4 t - 90^\circ)] A$

其他题

[10-14] (1) $\dot{I}_S = \frac{\dot{U}}{10} + \frac{\dot{U}}{j4} + \frac{\dot{U}}{-j2.5} = 2\angle -30^\circ A$

$\therefore \dot{U} = \frac{40\angle -30^\circ}{2+3j} = \frac{40\angle -30^\circ}{\sqrt{13}\angle 56.3^\circ} = 11.1\angle -86.3^\circ$

$\therefore u = 11.09\sin(4t - 86.3^\circ) V$

$\dot{I}_L = \frac{\dot{U}}{j4} = 2.77\angle -176.3^\circ A$　$\therefore i_L = \dots$

$\dot{I}_C = \frac{\dot{U}}{-j2.5} = 4.44\angle 3.7^\circ A$　$i_C = \text{—}$

[10-16] i 的初相：$\frac{\pi}{6} + \frac{\pi}{2} = \frac{2\pi}{3}$

u_L 初相超前 i $\frac{\pi}{2}$，$\varphi_{u_L} = \frac{2\pi}{3} + \frac{\pi}{2} = \frac{7}{6}\pi$

$2\pi - \frac{7}{6}\pi = -\frac{5}{6}\pi$

i 的初相 = u_R 初相：$\frac{2\pi}{3}$

i 初相：~~不太会写~~ $\frac{2\pi}{3} - \pi = -\frac{\pi}{3}$

[10-17] u 超前 i_L 90°　$\therefore u$ 初相：60°

i_R 与 u 初相同 $\varphi_{i_L} = 60^\circ$

i_C 超前 u 90°　$\therefore \varphi_{i_C} = 150^\circ$

$\varphi_{i_C} = -30^\circ$

[10-18] (1) $X = -20\angle -90^\circ = 20\angle 90^\circ = 20j$

$\rightarrow 200L = 20$　$L = 0.1H$

(2) $X = -100\angle 90^\circ = \frac{100}{j} = \frac{1}{j\omega C}$

$\therefore 500C = \frac{1}{100}$　$\therefore C = 20\mu F$

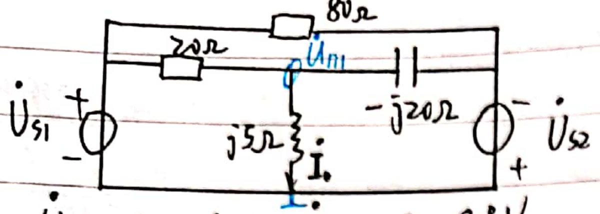
(3) $\cancel{X = 100\angle -90^\circ = \frac{100}{j} = \frac{1}{j1000C}}$

统一 sin、cos

$i = 0.5\cos(1000t - 38^\circ) A$

$X = \frac{u}{i} = 100\angle 0^\circ$　$\therefore R = 100\Omega$

[10-53] (1) 电路的相量模型图如下:



$\dot U_{S1}=60\angle 0^\circ V$, $\dot U_{S2}=90\angle 90^\circ V$

(取有效值相量)

(2) 用KCL方程，对结点!

$(\frac{1}{j5}+\frac{1}{20}+\frac{1}{-j20})\dot U_{n1}-\frac{\dot U_{S1}}{20}+\frac{\dot U_{S2}}{-j20}=0$

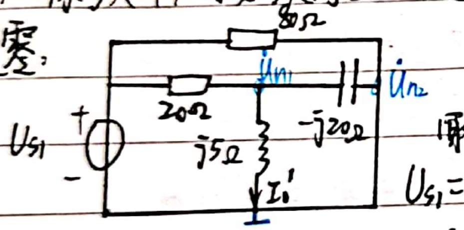
$\therefore \dot U_{n1}=\frac{150\angle 0^\circ}{1-3j}=\frac{150\angle 0^\circ}{\sqrt{10}\angle -71.56^\circ}=15\sqrt{10}\angle 71.56^\circ V$

$\dot I_0=\frac{\dot U_{n1}}{j5}=9.5\angle -18.44^\circ A$

$\therefore i_0=9.5\sqrt{2}\cos(4\times10^4 t-18.44^\circ)A$

(3) 改变电压源频率,则必须用叠加定理

① 将U_{S2}置零.



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KCL-1: $(\frac{1}{20}+\frac{1}{j5}+\frac{1}{-j20})\dot U_{n1}-\frac{1}{20}\dot U_{S1}-\frac{1}{-j20}\dot U_{n2}=0$

KCL-2: $(-\frac{1}{j20}+\frac{1}{80})\dot U_{n2}-\frac{1}{-j20}\dot U_{n1}=0$ & $\dot U_{n2}=0$

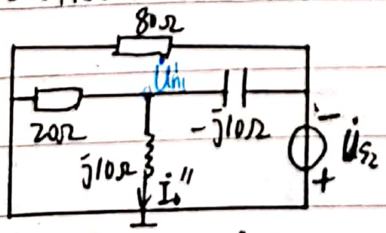
$\therefore \dot U_{n1}=6\sqrt{10}\angle 71.56^\circ V$

$\dot I_0'=\frac{\dot U_{n1}}{j5}=3.8\angle -18.44^\circ A$

$i_0'=3.8\sqrt{2}\cos(4\times10^4 t-18.44^\circ)A$

② 将U_{S1}置零.

$\dot U_{S2}=90\angle 90^\circ$ (取有效值)



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$\therefore \dot U_{n1}=180^\circ\angle 0^\circ V$

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$i_0''=18\sqrt{2}\cos(8\times10^4 t-90^\circ)A$

$\therefore i_0=i_0'+i_0''=[3.8\sqrt{2}\cos(4\times10^4 t-18.44^\circ)+18\sqrt{2}\cos(8\times10^4 t-90^\circ)]A$

其他题

[10-14] (1) $\dot I_S=\frac{\dot U}{10}+\frac{\dot U}{j4}+\frac{\dot U}{-j2.5}=2\angle -30^\circ A$

$\therefore \dot U=\frac{40\angle -30^\circ}{2+3j}=\frac{40\angle -30^\circ}{\sqrt{13}\angle 56.3^\circ}=11.1\angle -86.3^\circ$

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$2\pi-\frac{7}{6}\pi=-\frac{5}{6}\pi$

$-i$的初相$=u_R$初相: $\frac{2\pi}{3}$

i初相: $\frac{2\pi}{3}-\pi=-\frac{\pi}{3}$

[10-17] u超前i_L 90° $\therefore u$初相 60°

i_R与u初相同 $\varphi_{iL}=60^\circ$

i_C超前u 90° $\therefore \varphi_{iC}=150^\circ$

$\varphi_{iC}=-30^\circ$

[10-18] (1) $X=-20\angle -90^\circ=20\angle 90^\circ=20j$

$\rightarrow 200L=20$ $L=0.1H$

(2) $X=-100\angle 90^\circ=\frac{100}{j}=\frac{1}{j\omega C}$

$\therefore 500C=\frac{1}{100}$ $\therefore C=20\mu F$

(3) 统一sin、cos

$i=0.5\cos(1000t-30^\circ)A$

$X=\frac{u}{i}=100\angle 0^\circ$ $\therefore R=100\Omega$