# Tutorial #7
## Solutions

P5.7 a) in DC, the impedance of the inductor is 0 and the impedance of the capacitor is infinite, so circuit is simply equivalent to resistor $R = 3\,k\Omega$

b) here $\omega = 5000$ rad/s

so $Z_L = j\,5000 \times 1 = j\,5000\,\Omega$

$$Z_c = -\frac{j}{5000 \times 2{,}5\times10^{-7}} = -j\,800\,\Omega$$

and $$Z = \frac{Z_c\,(R + Z_L)}{R + Z_L + Z_c} = \frac{-j\,800 \times (3000 + j\,5000)}{3000 + j\,4200}$$

$$= 904\,\angle{-85{,}5^\circ}$$ (erreur dans le livre)

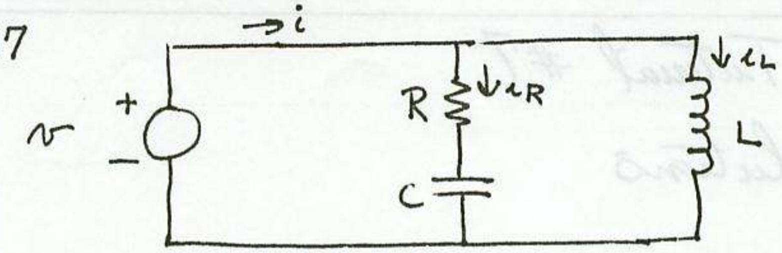
P5.11- a) $3 + j4 = 5\,\angle 53^\circ$

so $i(t) = 5\sqrt{2}\cos(\omega t + 53^\circ)$

b) $v(t) = 3\sqrt{2}\cos(\omega t - \pi/4)$

c) $i(t) = 4\sqrt{2}\cos(\omega t - 90^\circ)$

P5.17



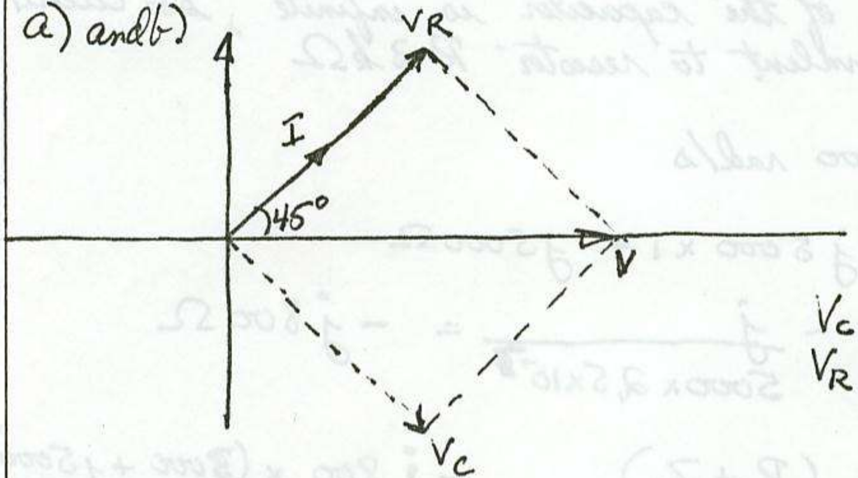

$R = 2\Omega$

$L = 0{,}3\,H$

$i_R = 10\sqrt{2}\cos(10t + 45°)$

$Z_L = j\,10 \times 0{,}3 = j3\,\Omega$

a) and b)




$V_c$ has a magnitude equal to $V_R$ and a phase of $-45°$.

c) from the phasor diagram

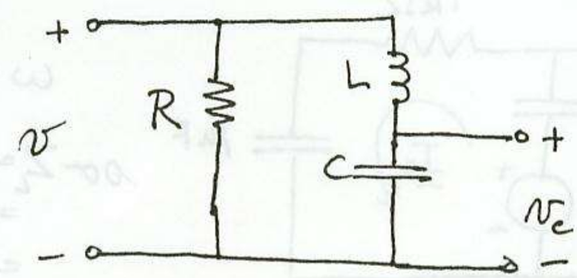
$$\underline{V} = \underline{V}_R + \underline{V}_c = 2\Omega \times 10\angle 45° + \underline{V}_c$$

$$= 20\angle 45° + 20\angle{-45}°$$

$$= \cancel{20\angle 0} \; 20\sqrt{2}\;\angle 0°$$

so $v(t) = 40\cos 10t$

P5.24




$v = 5\sqrt{2}\ \cos 5t$

$R = 2\Omega$

$L = 1H$ , $Z_L = j5 \times 1 = j5\Omega$

$C = 0{,}06F$ , $Z_C = \dfrac{-j}{5 \times 0{,}06} = -j3{,}33$

a) admittance of branch made of R : $\frac{1}{R} = \frac{1}{2}\ \mho$

admittance of branch made of L and Z

Z for that branch is : $Z_{L\text{-}C} = j5 - j3{,}33 = j1{,}66\,\Omega$

so Y is $\qquad Y_{L\text{-}C} = \dfrac{1}{j1{,}66} = -j\dfrac{3}{5}\ \mho$

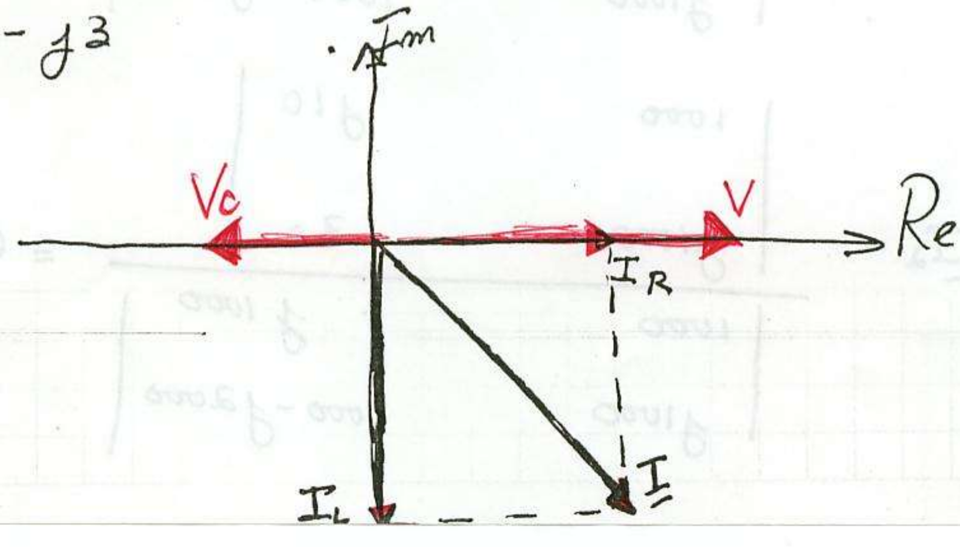
and admittance of total system is

$$Y = (0{,}5 - j\,0{,}6)\ \mho$$

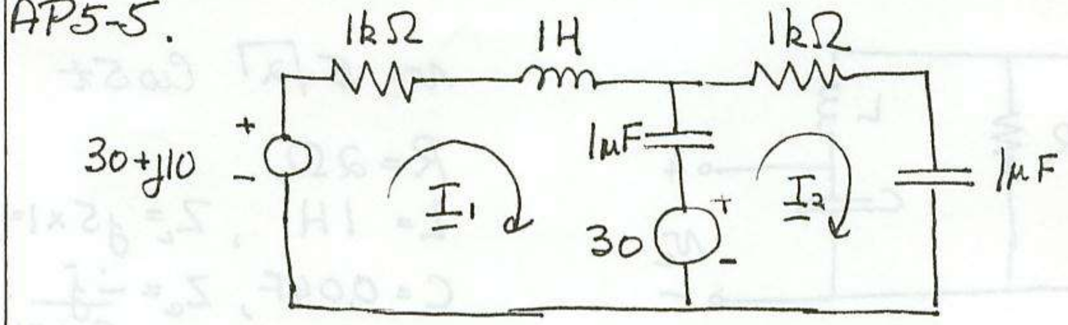
b) $\underline{I}_R = \dfrac{\underline{V}}{2\Omega} = 2{,}5\ \angle 0^\circ$

$\underline{I}_L = \underline{Y}_{L\text{-}C}\,\underline{V} = -j0{,}6 \times 5\ \angle 0^\circ = 3\ \angle -90^\circ$

$\underline{I} = 2{,}5 - j3$



AP5-5.




$\omega = 1000$ rad/s

so $Z_L = j\omega L$
$= j1000 \times 1$
$= j1000\ \Omega$

and $Z_C = \dfrac{-j}{\omega C} = -\dfrac{j}{1000 \times 10^{-6}}$
$= -j1000$

a) so loop equations will be

$$\begin{bmatrix} 1000 & j1000 \\ j1000 & 1000 - j2000 \end{bmatrix} \begin{bmatrix} \underline{I}_1 \\ \underline{I}_2 \end{bmatrix} = \begin{bmatrix} j10 \\ 30 \end{bmatrix}$$

so $$\underline{I}_1 = \frac{\begin{vmatrix} j10 & j1000 \\ 30 & 1000 - j2000 \end{vmatrix}}{\begin{vmatrix} 1000 & j1000 \\ j1000 & 1000 - j2000 \end{vmatrix}} = 0{,}01 \angle 0^\circ$$

and

$$\underline{I}_2 = \frac{\begin{vmatrix} 1000 & j10 \\ j1000 & 30 \end{vmatrix}}{\begin{vmatrix} 1000 & j1000 \\ j1000 & 1000 - j2000 \end{vmatrix}} = 0{,}01\sqrt{2} \angle 45^\circ$$

b) Node equation will be (There is a single node)

$$\frac{V_b - (30 + j10)}{1000 + j1000} + \frac{V_b - 30}{-j1000} + \frac{V_b}{1000 - j1000} = 0$$

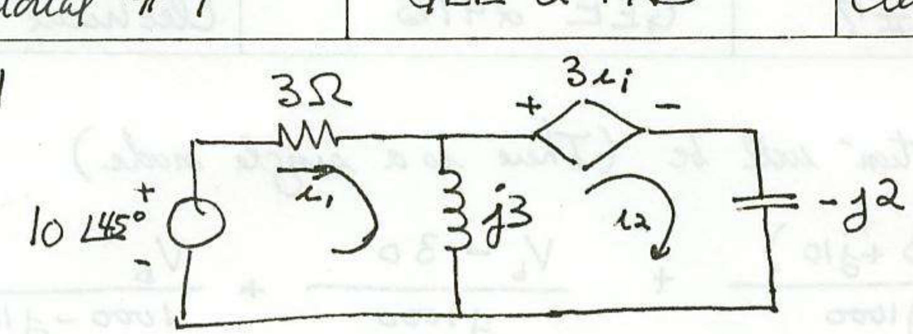
so $$V_b \left( \frac{1}{1000 + j1000} + \frac{j}{1000} + \frac{1}{1000 - j1000} \right) = \frac{30 + j10}{1000 + j1000} + \frac{30j}{1000}$$

$$\frac{V_b}{1000} \left( \frac{1 - j}{2} + j + \frac{1 + j}{2} \right) = \left\{ \frac{(30 + j10)(1 - j)}{2} + 30j \right\} \times \frac{1}{1000}$$

$$V_b (1 + j) = 20 + 20j = 20 (1 + j)$$

$$V_b = 20 \angle 0^\circ$$

APS.11




Reactive component impedances have been calculated using $\omega = 100\,s^{-1}$

We use mesh method with the 2 currents shown

$$10\angle 45^\circ - 3\underline{I}_1 - j3(\underline{I}_1 - \underline{I}_2) = 0 \qquad \text{mesh 1}$$

$$-j3(\underline{I}_2 - \underline{I}_1) - 3\underline{I}_1 + j2\,\underline{I}_2 = 0 \qquad \text{mesh 2}$$

so

$$(3 + j3)\,\underline{I}_1 - j3\,\underline{I}_2 = 10\angle 45^\circ$$

$$(3 - j3)\,\underline{I}_1 + j\,\underline{I}_2 = 0$$

or in matrix form:

$$\begin{bmatrix} 3+j3 & -j3 \\ 3-j3 & j \end{bmatrix} \begin{bmatrix} \underline{I}_1 \\ \underline{I}_2 \end{bmatrix} = \begin{bmatrix} 10\angle 45^\circ \\ 0 \end{bmatrix}$$

Then:

$$\underline{I}_1 = \frac{\begin{vmatrix} 10\angle 45^\circ & -j3 \\ 0 & j \end{vmatrix}}{\begin{vmatrix} 3+j3 & -j3 \\ 3-j3 & j \end{vmatrix}} = \frac{10j\angle 45^\circ}{j(3+j3) + j3(3-j3)}$$

$$= \frac{10\angle 135^\circ}{6 + j12} = 0{,}75\angle 71{,}6^\circ$$

and $i_1(t) = 0{,}75\sqrt{2}\cos(100\,t + 71{,}6^\circ)$ ~~V~~ A