Circuits II

Ch09 Additional Problems Solution

P 9.1 **[a]** $\omega = 2\pi f = 800\,\text{rad/s}, \qquad f = \dfrac{\omega}{2\pi} = 127.32\,\text{Hz}$

[b] $T = 1/f = 7.85\,\text{ms}$

[c] $I_m = 125\,\text{mA}$

[d] $i(0) = 125\cos(36.87^\circ) = 100\,\text{mA}$

[e] $\phi = 36.87^\circ; \qquad \phi = \dfrac{36.87^\circ(2\pi)}{360^\circ} = 0.6435\ \text{rad}$

[f] $i = 0$ when $800t + 36.87^\circ = 90^\circ$. Now resolve the units:

$$(800\ \text{rad/s})t = \frac{53.13^\circ}{57.3^\circ/\text{rad}} = 0.927\,\text{rad}, \qquad t = 1.16\,\text{ms}$$

[g] $(di/dt) = (-0.125)800\sin(800t + 36.87^\circ)$

$(di/dt) = 0 \quad \text{when} \quad 800t + 36.87^\circ = 180^\circ$

$$\text{or} \qquad 800t = \frac{143.13^\circ}{57.3^\circ/\text{rad}} = 2.498\,\text{rad}$$

Therefore $t = 3.12\,\text{ms}$

AP 9.1 **[a]** $\mathbf{V} = 170\underline{/-40^\circ}\,\text{V}$

[b] $10\sin(1000t + 20^\circ) = 10\cos(1000t - 70^\circ)$

$\therefore \qquad \mathbf{I} = 10\underline{/-70^\circ}\,\text{A}$

[c] $\mathbf{I} = 5\underline{/36.87^\circ} + 10\underline{/-53.13^\circ}$

$= 4 + j3 + 6 - j8 = 10 - j5 = 11.18\underline{/-26.57^\circ}\,\text{A}$

[d] $\sin(20{,}000\pi t + 30^\circ) = \cos(20{,}000\pi t - 60^\circ)$

Thus,

$\mathbf{V} = 300\underline{/45^\circ} - 100\underline{/-60^\circ} = 212.13 + j212.13 - (50 - j86.60)$

$= 162.13 + j298.73 = 339.90\underline{/61.51^\circ}\,\text{mV}$

AP 9.2 **[a]** $v = 18.6\cos(\omega t - 54^\circ)\,\text{V}$

[b] $\mathbf{I} = 20\underline{/45^\circ} - 50\underline{/-30^\circ} = 14.14 + j14.14 - 43.3 + j25$

$= -29.16 + j39.14 = 48.81\underline{/126.68^\circ}$

Therefore $\quad i = 48.81\cos(\omega t + 126.68^\circ)\,\text{mA}$

[c] $\mathbf{V} = 20 + j80 - 30\underline{/15^\circ} = 20 + j80 - 28.98 - j7.76$

$= -8.98 + j72.24 = 72.79\underline{/97.08^\circ}$

$v = 72.79\cos(\omega t + 97.08^\circ)\,\text{V}$

AP 9.3 **[a]** $\omega L = (10^4)(20 \times 10^{-3}) = 200\,\Omega$

[b] $Z_L = j\omega L = j200\,\Omega$

[c] $\mathbf{V}_L = \mathbf{I}Z_L = (10\underline{/30^\circ})(200\underline{/90^\circ}) \times 10^{-3} = 2\underline{/120^\circ}\,\text{V}$

[d] $v_L = 2\cos(10{,}000t + 120^\circ)\,\text{V}$

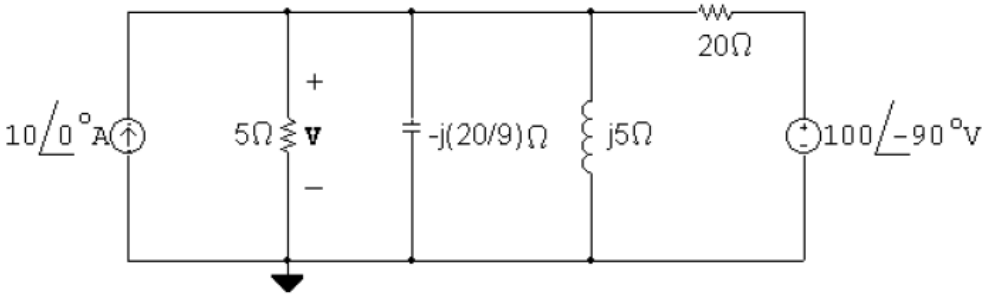
AP 9.4 **[a]** $X_C = \dfrac{-1}{\omega C} = \dfrac{-1}{4000(5 \times 10^{-6})} = -50\,\Omega$

[b] $Z_C = jX_C = -j50\,\Omega$

[c] $\mathbf{I} = \dfrac{\mathbf{V}}{Z_C} = \dfrac{30\underline{/25^\circ}}{50\underline{/-90^\circ}} = 0.6\underline{/115^\circ}\,\text{A}$

[d] $i = 0.6\cos(4000t + 115^\circ)\,\text{A}$

AP 9.12 The phasor domain circuit is as shown in the following diagram:



The node voltage equation is

$$-10 + \frac{\mathbf{V}}{5} + \frac{\mathbf{V}}{-j(20/9)} + \frac{\mathbf{V}}{j5} + \frac{\mathbf{V} - 100\underline{/-90^\circ}}{20} = 0$$

Therefore $\mathbf{V} = 10 - j30 = 31.62\underline{/-71.57^\circ}$

Therefore $v = 31.62\cos(50{,}000t - 71.57^\circ)\,\text{V}$