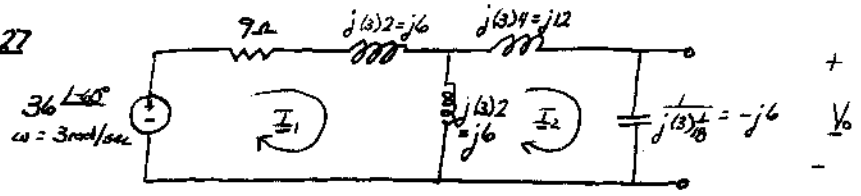
EE212 HW3 Soln

PR. 8.27, 8.29, 8.33, 8.34, 8.36, 8.44

PR 8.27



a) @ $\underline{I}_1$: $-36\angle -60^\circ + 9\underline{I}_1 + j6\underline{I}_1 + j6(\underline{I}_1 - \underline{I}_2) = 0$

$\Rightarrow (9 + j12)\underline{I}_1 - j6\underline{I}_2 = 36\angle -60^\circ$

@ $\underline{I}_2$: $j6(\underline{I}_2 - \underline{I}_1) + j12\underline{I}_2 - j6\underline{I}_2 = 0$

$\Rightarrow -j6\underline{I}_1 + j12\underline{I}_2 = 0$

$\Rightarrow j12\underline{I}_2 = j6\underline{I}_1$

$\Rightarrow 2\underline{I}_2 = \underline{I}_1$

$\Rightarrow (9+j12)2\underline{I}_2 - j6\underline{I}_2 = 36\angle -60^\circ$

$\Rightarrow (18 + j24 - j6)\underline{I}_2 = 36\angle -60^\circ$

$\Rightarrow (18 + j18)\underline{I}_2 = 36\angle -60^\circ$

$\Rightarrow 18\sqrt{2}\angle 45^\circ \underline{I}_2 = 36\angle -60^\circ$

$\Rightarrow \underline{I}_2 = \frac{36}{18\sqrt{2}}\angle -60-45^\circ$

$= \frac{2}{\sqrt{2}}\angle -105^\circ = \frac{2\sqrt{2}}{2}\angle -105^\circ$

$= \sqrt{2}\angle -105^\circ$

* $\underline{V}_o = -j6\underline{I}_2 = 6\angle -90^\circ (\sqrt{2}\angle -105^\circ) = 6\sqrt{2}\angle -195^\circ$

$\Rightarrow \boxed{v_o(t) = 6\sqrt{2}\cos(3t - 195^\circ) \text{ V} = 8.49\cos(3t + 165^\circ) \text{ V}}$

b) for $Z_{\text{seen by source}}$, can either reduce circuit to right of source to equivalent impedance or use $Z_{\text{seen by source}} = \frac{V_s}{I_1}$

$Z_{\text{seen by source}} = \frac{V_s}{I_1} = \frac{36\angle -60^\circ}{2\sqrt{2}\angle -105^\circ} = 9\sqrt{2}\angle 45^\circ = 9 + j9$

$\Rightarrow \boxed{Z_{\text{seen by source}} = 9\sqrt{2}\angle 45^\circ \Omega = 9 + j9\,\Omega}$

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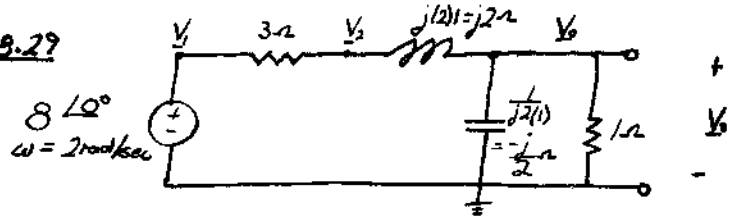
PR 8.29



a) @ V_1: $V_1 = 8\angle 0°$

@ V_2: $\frac{V_2 - V_1}{3} + \frac{V_2 - V_0}{j2} = 0$) $\times j6$

$\Rightarrow j2V_2 - j2V_1 + 3V_2 - 3V_0 = 0$

$\Rightarrow (3+j2)V_2 - j2V_1 - 3V_0 = 0$

@ V_0: $\frac{V_0 - V_2}{j2} + \frac{V_0 - 0}{-j\frac{1}{2}} + \frac{V_0 - 0}{1} = 0$) $\times j2$

$\Rightarrow V_0 - V_2 - 4V_0 + j2V_0 = 0$

$\Rightarrow (-3+j2)V_0 = V_2$

$(3+j2)(-3+j2)V_0 - j2(8\angle 0°) - 3V_0 = 0$

$\Rightarrow (-9+j6-j6-4-3)V_0 = 16\angle 90°$

$\Rightarrow -16V_0 = 16\angle 90°$

$\Rightarrow V_0 = \frac{16\angle 90°}{16\angle 180°} = 1\angle -90°$

$\Rightarrow$ **$v_0(t) = \cos(2t - 90°)\ V$**

$= \sin 2t\ V$

b) can find impedance seen by source by reducing circuit to right of source or use $\frac{V_s}{I_s}$

$$Z_{\text{seen by source}} = \frac{V_s}{I_s} = \frac{8\angle 0°}{\frac{V_s - V_2}{3}} = \frac{8\angle 0°}{\frac{8\angle 0° - (-3+j2)(1\angle -90°)}{3}} = \frac{24}{8 - (-3+j2)(-j)}$$

$$= \frac{24}{8 - j3 - 2} = \frac{24}{6 - j3}\frac{(6+j3)}{(6+j3)} = \frac{24(6+j3)}{36+9}$$

$$= \frac{24}{45}(6+j3) = 3.2 + j1.6$$

$Z_{\text{seen by source}} = 3.2 + j1.6\ \Omega$

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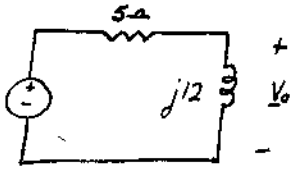
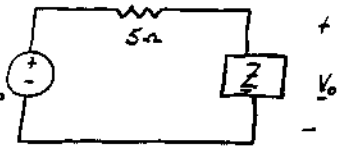
PR 8.33



$\underline{V_s} = 12\angle 0° + 5\angle -90°$
$= 12 - j5$
$= 13\angle -22.62°$
$\omega = 2 \frac{rad}{sec}$

a) $\underline{V_o} = \dfrac{(13\angle -22.62°)(j12)}{5+j12} = \dfrac{(12-j5)(j12)}{5+j12} = 12 \Rightarrow \boxed{v_o(t) = 12\cos 2t \ \ V}$

b) $\underline{V_s} = 12 - j5$
$= 13\angle -22.62°$

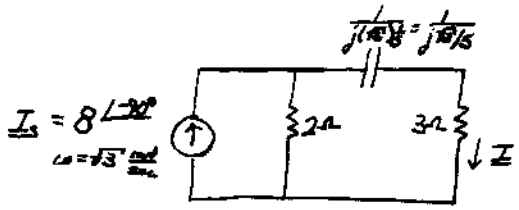


$\underline{Z} = \dfrac{5(j12)}{5+j12} = \dfrac{j60}{5+j12}$

$\underline{V_o} = \dfrac{\dfrac{(12-j5)(j60)}{5+j12}}{5 + \dfrac{j60}{5+j12}} = 6.25 - j1.2 = 6.36\angle -10.9°$

$\Rightarrow \boxed{v_o(t) = 6.36\cos(2t - 10.9°) \ V}$

PR 8.34

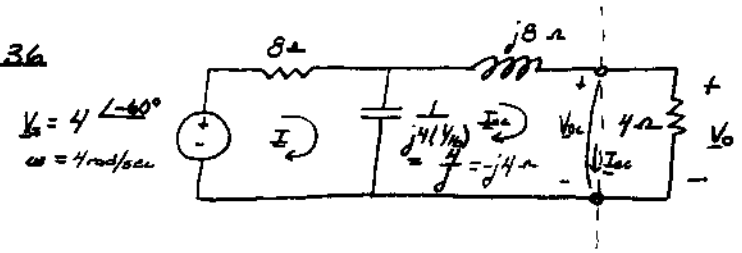


$\underline{I} = \dfrac{(8\angle 30°)(2)}{2 + (3 + 1/j\sqrt{3}/5)} = \dfrac{-j16}{5 - j5/\sqrt{3}} = 1.385 - j2.4$
$= 2.77\angle -60°$

$\Rightarrow \boxed{i(t) = 2.77\cos(\sqrt{3}t - 60°) \ A}$

EE212 HW3 Soln

PR8.36



* V_{oc} : $V_{oc} = \frac{(4\angle -60°)(-j4)}{8-j4} = \frac{4\angle -60° \; 4\angle -90°}{8.944\angle -26.57°} = 1.79\angle -123.4° = \frac{4}{\sqrt{5}}\angle -123.4°$

* I_{sc} : mesh currents @ I : $-4\angle -60° + 8I - j4(I - I_{sc}) = 0$

$\Rightarrow (8-j4)I + j4I_{sc} = 4\angle -60°$

@ I_{sc} : $-j4(I_{sc} - I) + j8I_{sc} = 0$

$\Rightarrow j4I + j4I_{sc} = 0$

$\Rightarrow -I_{sc} = I$

$\Rightarrow (8-j4)(-I_{sc}) + j4I_{sc} = 4\angle -60°$

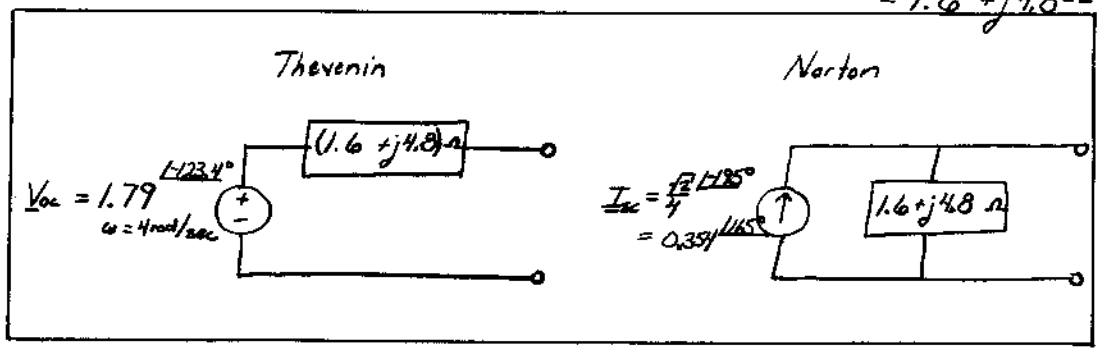
$\Rightarrow (8+j8)I_{sc} = 4\angle -60°$

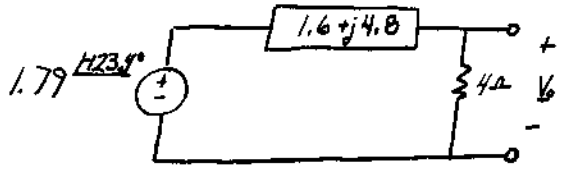
$\Rightarrow I_{sc} = \frac{4\angle -60°}{8\sqrt{2}\angle 135°} = \frac{\sqrt{2}}{4}\angle -195°$

* Z_{TH} can be found by turning off source or $Z_{TH} = \frac{V_{oc}}{I_{sc}} = \frac{1.79\angle -123.4°}{\frac{\sqrt{2}}{4}\angle -195°}$

$= 5.06\angle 71.56°$

$= 1.6 + j4.8\,\Omega$





$V_o = \frac{(1.79\angle -123.4°)(4)}{4 + 1.6 + j4.8}$

$= -0.933 - j0.267$

$= 0.97\angle -164°$

$\Rightarrow \boxed{v_o(t) = 0.97\cos(4t - 164°)\ V}$

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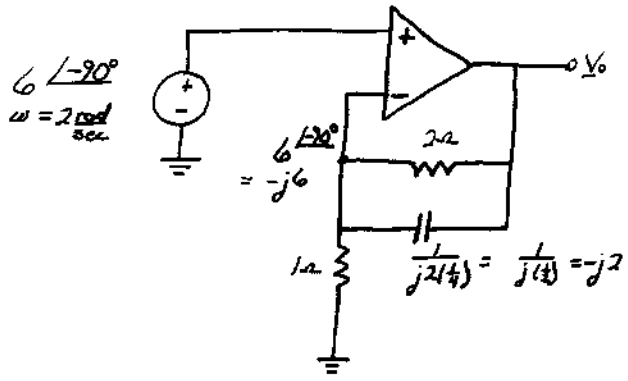
PR 8.44



@ '-': $\frac{(-j6 - V_o)}{2} + \frac{(-j6 - V_o)}{-j2} + \frac{-j6 - 0}{1} = 0$) x -j2

$\Rightarrow -6 + jV_o - j6 - V_o - 12 = 0$

$\Rightarrow V_o(-1 + j) = 18 + j6$

$\Rightarrow V_o = \frac{18 + j6}{-1 + j} = 13.42 \angle -116.6°$

$\Rightarrow \boxed{v_o(t) = \underbrace{13.42}_{6\sqrt{5}} \cos(2t - 116.6°) \ V}$