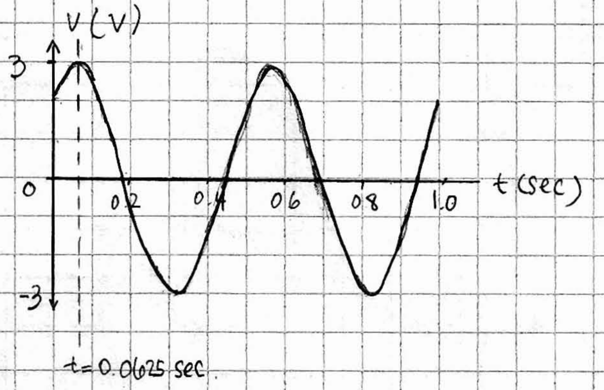
ECE 301

HW 9 Solution

#5.26



Write the sinusoid in the form $V_m \cos(\omega t + \theta)$
Determine the phasor & RMS value of v(t)

ANS

$V_m = 3$

$T = 0.5\,s \rightarrow f = \frac{1}{T} = 2\,Hz$

$\rightarrow \omega = 2\pi f = 4\pi$ rad/sec

$\theta = (-360°)\frac{t_{max}}{T} = (-360°)\frac{0.0625}{0.5}$

$= -45°$

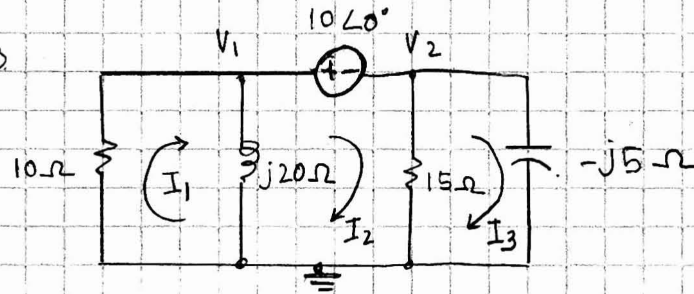
$\therefore \; v(t) = 3 \cos(4\pi t - 45°)$

Phasor:

$V = 3 \angle -45°$

$V_{RMS} = \frac{3}{\sqrt{2}} = 2.121\,V$

5.53



Use nodal Analysis.

At Supernode : $\frac{V_1}{10} + \frac{V_1}{j20} + \frac{V_2}{15} + \frac{V_2}{-j5} = 0$

$V_1\left(\frac{1}{10} + \frac{1}{j20}\right) + V_2\left(\frac{1}{15} + \frac{1}{-j5}\right) = 0.$ —— ①

Constraint : $V_1 - V_2 = 10\angle 0^\circ$ —— ②

Solving eqns ① & ② we have

$V_1 = 9.402\angle 29.58^\circ\ V$
$V_2 = 4.986\angle 111.45^\circ V$

5.59 Same problem as in P 5.53 , but using nodal analysis

Mesh 1 : $10 I_1 + j20(I_1 - I_2) = 0$

$(10 + j20) I_1 - j20 I_2 = 0$ —— ①

Mesh 2 $j20(I_2 - I_1) + 15(I_2 - I_3) + 10 = 0$

$-j20 I_1 + (15 + j20) I_2 - 15 I_3 = -10$ —— ②

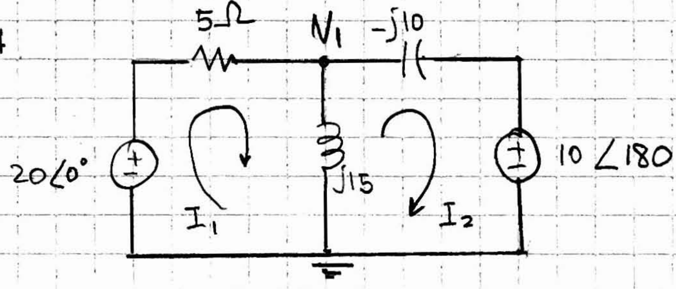
Mesh 3 : $15(I_3 - I_2) - j15 I_3 = 0$

$-15 I_2 + (15 - j5) I_3 = 0$ —— ③

Solve eqn ① & ② & ③ we have.

$I_1 = 0.940\angle -150.4^\circ$ A
$I_2 = 1.051\angle -177^\circ$ A
$I_3 = 0.997\angle -158.55^\circ$ A

5.54



Solve the node voltage using nodal analysis

At node V_1 :

$$\frac{V_1 - 20\angle 0^\circ}{5\,\Omega} + \frac{V_1}{j15} + \frac{V_1 - 10\angle 180^\circ}{-j10} = 0$$

$$V_1\left(\frac{1}{5} + \frac{1}{j15} - \frac{1}{j10}\right) = \frac{20\angle 0^\circ}{5} - \frac{10\angle 180^\circ}{j10}$$

$$V_1 = 20.33\angle -23.5^\circ \text{ V}$$

5.57 Same problem as # 5.54 using mesh analysis to find currents

Mesh 1 :

$$-20\angle 0^\circ + 5I_1 + j15\,(I_1 - I_2) = 0$$

$$(5+j15)\,I_1 - j15\,I_2 = 20\angle 0^\circ \quad \text{—— (1)}$$

Mesh 2 :

$$j15\,(I_2 - I_1) - j10\,I_2 + 10\angle 180 = 0$$

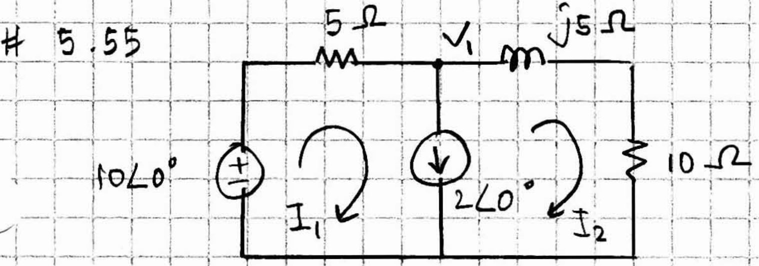
$$-j15\,I_1 + j5\,I_2 = -10\angle 180^\circ \quad \text{—— (2)}$$

Solving (1) & (2) , we have

$$I_1 = 1.64\angle 80.54^\circ \text{ A}$$

$$I_2 = 2.977\angle 74.2^\circ \text{ A}$$

5.55



Solve V_1 using nodal analysis

$$\frac{V_1 - 10}{5} + 2\angle 0^\circ + \frac{V_1}{10 + j5} = 0$$

$$V_1\left(\frac{1}{5} + \frac{1}{10 + j5}\right) = -2\angle 0^\circ + 2$$
$$= 0$$

$$\underline{\underline{V_1 = 0\,V}}$$

5.58 Solve the mesh current for problem 5.55

Mesh 1 & 2: $-10\angle 0^\circ + 5I_1 + (10 + j5)I_2 = 0$

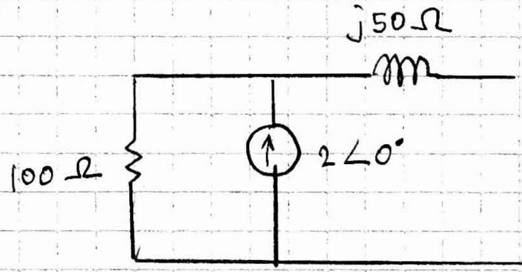
$$5I_1 + (10 + j5)I_2 = 10\angle 0^\circ \quad \text{— (1)}$$

Constraint : $I_1 - I_2 = 2\angle 0^\circ$ — (2)

Solving eqn (1) & (2) we have

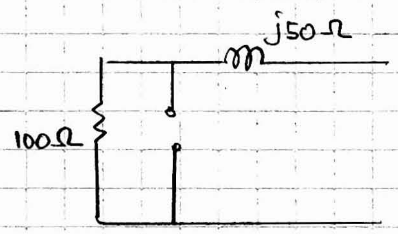
$$I_1 = 2\angle 0^\circ A$$
$$I_2 = 0\,A$$

5.89



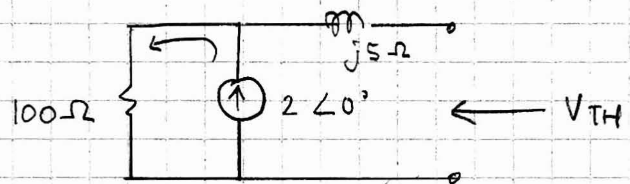
(a) Find thevenin & norton equivalent ckt

To find thevenin impedance, we remove the current source.



$Z_{TH} = (100 + j50)\ \Omega$
$= 111.8 \angle 26.6°$

To find thevenin voltage, we put the current source back



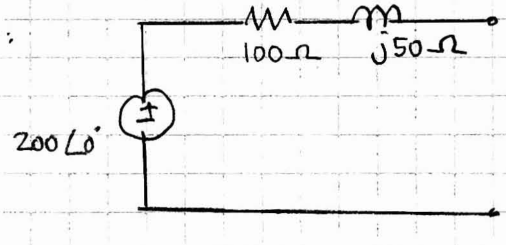
but there is no current flows through j5 Ω due to open ckt, and there is zero voltage across j5 Ω. Current from the current source only flows to 100 Ω.

The Thevenin voltage $V_{TH} = V_{oc} = V_{100} = (2\angle 0°)(100)$

$= 200\angle 0°\ V$

Norton current $I_N = \dfrac{V_{TH}}{Z_{TH}} = \dfrac{200\angle 0°}{(100 + j50)} = 1.789 \angle -26.57°$

Thevenin Eqn ckt:



Norton eqn ckt: