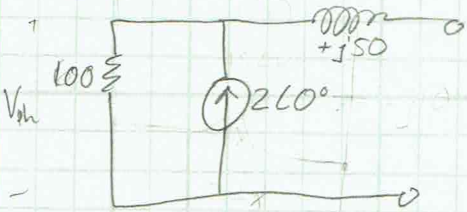
Ross Fischer | Circuits HW13 | ch.5 | 83, 85, 87, 90, 91, 92, 98

10

7/7

(83) Find thev. + Norton eq.

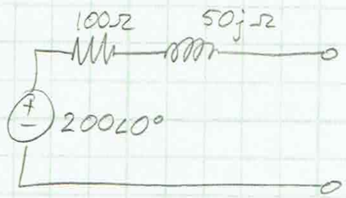


$Z_{th} = 100 + j50\ \Omega$

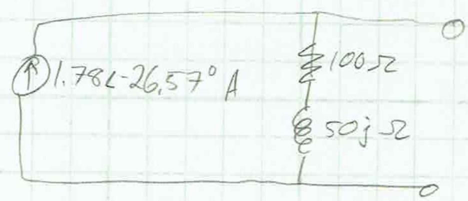
$V_{th} = I_R R = 2 \cdot 100 = 200\angle 0°$

$I_{th} = \frac{V_{th}}{R_{th}} = \frac{200 + 0j}{100 + 50j} = 1.78\angle -26.57°$

Thevenin



Norton



b) Find max P circuit can deliver to load if load can have complex z

$Z_L = Z_t^* = 100 + 50j$

$I = \frac{200\angle 0}{100 + 50j + 100 - 50j} = 1 \qquad I_{rms} = \frac{1}{\sqrt{2}}$

$P_{max} = I_{rms}^2 R_L = \left(\frac{1}{\sqrt{2}}\right)^2 (100) = \boxed{50\ W}$

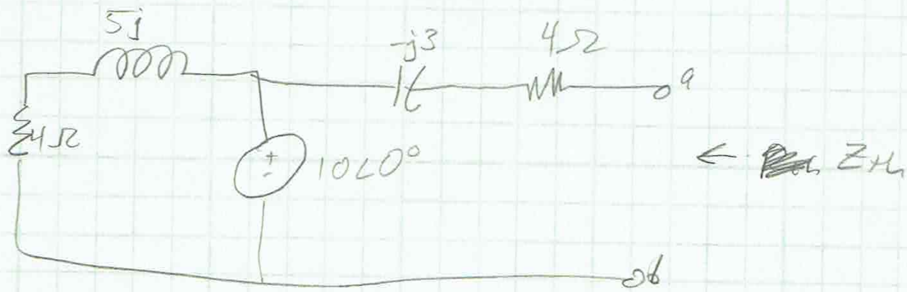
c) Max P for purely resistive load

$R_L = |Z_t| = \sqrt{100^2 + 50^2} = 111.8\ \Omega$

$I = \frac{200}{100 + 50j + 111.8} = .919\angle -13.2°$

$P_{max} = I_{rms}^2 R_L = \left(\frac{.919}{\sqrt{2}}\right)^2 \cdot 111.8 = \boxed{47.21\ W}$

85



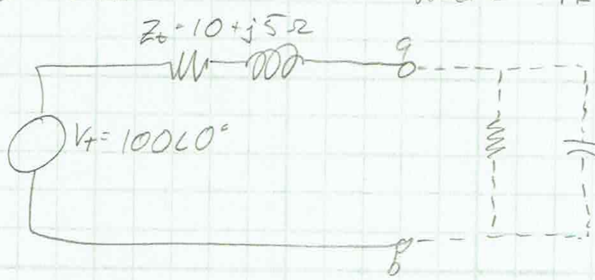
$Z_{th} = 4 - 3j$

$V_{th} = 10\ V$

$I_{th} = \frac{V_t}{Z_t} = \frac{10\angle 0^\circ}{4-3j} =$

$\boxed{\begin{array}{c} 4-3j = Z_{th} \\ 10\ V = V_{th} \\ 2\angle 36.9^\circ = I_{th} \end{array}}$

87 Find R + C where P_R is maximized $F = 60Hz$



$X_c = \frac{1}{+j\omega C}$

R+C equivalent Z must ⇒ $10 - 5j = \frac{R\ X_c}{R + X_c}$

$10 - 5j = \frac{\frac{R}{j\omega C}}{\frac{j\omega C}{j\omega C}R + \frac{1}{j\omega C}} = \frac{\frac{R}{\cancel{j\omega C}}}{\frac{1 + Rj\omega C}{j\omega C}} \cdot \frac{\cancel{j\omega C}}{1 + Rj\omega C} = \frac{R}{1 + Rj\omega C}$

$10 - 5j = \frac{R}{1 + Rj\omega C} \cdot \frac{1 - Rj\omega C}{1 - Rj\omega C}$

$10 - 5j = \frac{R + R^2 j\omega C}{(1 - (Rj\omega C))^2} = \frac{R}{(1 - (Rj\omega C))^2} - j\left(\frac{R^2 j\omega C}{(1 + (Rj\omega C))^2}\right)$

$10 = \frac{R}{(1 + (Rj\omega C))^2}$

$10 = \frac{R}{1 + (R\omega C)^2} \cdot \frac{1 + (R\omega C)^2}{\omega R^2 C}$

$\frac{10}{5} = \frac{\frac{R}{1 + (R\omega C)^2}}{\frac{\omega R^2 C}{1 + (R\omega C)^2}} \Rightarrow \frac{10}{5} = \frac{1}{\omega RC}$

$\omega RC = .5$

$10 = \frac{R}{1 - (.5)^2}$

$\boxed{R = 12.5\ \Omega}$

$\omega RC = .5$

$2\pi(6)(12.5)C = .5$

$\boxed{C = 106.1\ \mu F}$

(90) $V_{an}(t) = 150\cos(400\pi t + 15^\circ)$

a) Find F $\quad \omega = 400\pi = 2\pi F$

$\boxed{F = 200\ Hz}$

b) Give expressions for

$$\boxed{\begin{aligned} V_{bn}(t) &= 150\cos(400\pi t - 105^\circ) \\ V_{cn}(t) &= 150\cos(400\pi t + 135^\circ) \end{aligned}}$$

c) Repeat for neg-seq. source

$$\boxed{\begin{aligned} V_{bn}(t) &= 150\cos(400\pi t + 135^\circ) \\ V_{cn}(t) &= 150\cos(400\pi t - 105^\circ) \end{aligned}}$$

(91) 50Ω R parallel w/ 100μF cap $\quad \omega = 2\pi 60 = 120\pi$

F = 60

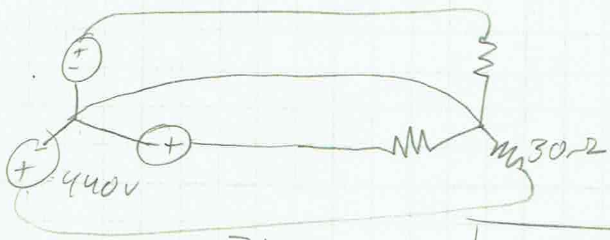
$X_c = \frac{1}{j\omega C} = 26.53$

$Z_c = 26.53\angle -90^\circ \quad Z_{eq} = \frac{1}{1/50 + 1/26.53j} = 23.44\angle -62$

$\boxed{3 \cdot Z_{eq} = 70.31\angle -62.1\,\Omega}$

92 line to neutral $V = 440$

Find rms line to line voltage mag.



$\rightarrow i_{arm} = \dfrac{440}{30} = \boxed{14.\overline{6}\ A = i}$

line to line voltage

$$V_{L-L} = \sqrt{3}\ \text{line-neutral}$$

$$= \sqrt{3}\ 440 = \boxed{762.1\ \text{rms}V = V_{L-L}}$$

total power $\rightarrow 3P = 3(i \cdot V)$

$$3P = 3(14.\overline{6} \cdot 440) =$$

$$\boxed{P_{max} = 19.36\ KW}$$

3-0235 — 50 SHEETS — 5 SQUARES
3-0236 — 100 SHEETS — 5 SQUARES
3-0237 — 200 SHEETS — 5 SQUARES
3-0137 — 200 SHEETS — FILLER

COMET

(98) 60Hz $V_L = 208\ V_{rms} = \sqrt{3}\, V_Y$ $V_Y = 120\ V_{rms}$

$Z_L = 30 + 40j$ $V_Y = 120\sqrt{2}$

Find line to neutral voltage phasors

$$\boxed{\begin{aligned} V_{an} &= 120\sqrt{2}\angle 0^\circ \ V \\ V_{bn} &= 120\sqrt{2}\angle -120^\circ \ V \\ V_{cn} &= 120\sqrt{2}\angle 120^\circ \ V \end{aligned}}$$

Line-to-line

$$\boxed{\begin{aligned} V_{ab} &= 294\angle 30^\circ \ V \\ V_{bc} &= 294\angle -90^\circ \ V \\ V_{ca} &= 294\angle 150^\circ \ V \end{aligned}}$$

$V_{ab} = V_{an} - V_{bn} = 120\sqrt{2}\angle 0 - 120\sqrt{2}\angle -120$
$= 294\angle 30^\circ$

Line current phasors

$i_{Aa} = \frac{V_{AN}}{30+40i} = \frac{120\sqrt{2}\angle 0^\circ}{30+40i} = 2.4\sqrt{2}\angle -53.13$

$$\boxed{\begin{aligned} i_{aA} &= 2.4\sqrt{2}\angle -53.13^\circ \ A \\ i_{bB} &= 2.4\sqrt{2}\angle -173.13^\circ \ A \\ i_{cC} &= 2.4\sqrt{2}\angle 66.87^\circ \ A \end{aligned}}$$

The Power

$P(t) = 3\frac{V_Y I_L}{2}\cos\theta = \frac{3}{2}(120\sqrt{2})(2.4\sqrt{2})\cos(53.13) = \boxed{518.4\ W = P}$ delivered

Reactive

$Q = 3\frac{V_Y I_L}{2}\sin\theta = \frac{3}{2}\, 120\sqrt{2}\ 2.4\sqrt{2}\ \sin(53.13) = \boxed{691.2\ VAR = Q}$ delivered