5.7 Find: current through $R_4$.

Since the voltages and currents do not vary with time, the capacitors act like open circuits and the inductors act like short circuits.

The circuit reduces to:

$$ I = \frac{V_0}{R_2 + R_4} = \frac{50}{6.5 \, \Omega} = 7.7 \, mA $$

6.4 Given: $f = 27 \sin(wt + 47^\circ)$; $w = 18$

Rewrite $f$ as $A \cos(wt + \phi)$

Find: $A$, $w$, $\phi$

$$ f = 27 \cos(18t + 47^\circ - 90^\circ) = 27 \cos(18t - 43^\circ) $$

$$ A = 27, \quad w = 18, \quad \phi = -43^\circ = 317^\circ $$

6.8 Rewrite $27 \cos(376t - 80^\circ)$ as

$$ V_1 \cos wt + V_2 \sin wt $$

$$ 27 \cos(376t - 80^\circ) = 27 (\cos 376t \cos(-80^\circ) - \sin 376t \sin(-80^\circ)) $$

$$ = 27 (0.174 \cos 376t + 0.985 \sin 376t) $$

$$ = 4.69 \cos wt + 26.59 \sin wt \quad ; \quad \omega = 376 $$. 
6.9  Given: \( z = 12 + 17j \)

Find:

(a) \( z^* \)

(b) \( \frac{z}{z} \) in exp form

(c) \( \frac{z^*}{z} \) " "

(d) \( |z| \)

a. \( z^* = 12 - 17j \)

b. \( z = A e^{j\phi} \); \( A = \sqrt{12^2 + 17^2} = 20.81 \)

\[ \phi = \tan^{-1}(17/12) = 54.8^\circ \]

\[ \Rightarrow z = 20.81 e^{j(54.8^\circ)} \]

c. \( \frac{z^*}{z} = \frac{12 - 17j}{20.81} \) \( \approx -0.5j \)

d. \( |z| = A = 20.81 \)

6.10  Given: \( z_1 = 0.6 e^{-0.8j} \), Find:

(a) \( z_1^* \)

(b) \( z_1 \) in rect. form

(c) \( \frac{z_1^*}{z_1} \) " "

(d) \( |z_1| \)

a. \( z_1^* = 0.6 e^{0.8j} \)

b. \( z_1 = 0.6 (\cos(-0.8) + j \sin(-0.8)) = 0.418 - 0.43j \)

c. \( \frac{z_1^*}{z_1} = 0.418 + 0.43j \)

d. \( |z_1| = 0.6 \)

6.12  Given: \( z_1 = 3 - 2j \), \( z_2 = \frac{1}{2} + \frac{6}{2}j \); Find: \( z_1 + z_2 \) and plot

\[ z_1 + z_2 = (3-1) + (-2+6)j \]

\[ = 2 + 4j \]
6.13 Given: $\overline{z}_1 = 2 + 3j$  $\overline{z}_2 = 4 - 2j$

Find: (a) $\overline{z}_1 \overline{z}_2$ is rec. form, (b) put in exp form, (c) convert $\overline{z}_1, \overline{z}_2$ to exp form, (d) find product.

a. $\overline{z}_1 \overline{z}_2 = (2 + 3j)(4 - 2j) = 8 - 4j + 12j - 6j^2 = 14 + 8j$

b. $14 + 8j = Ae^{\phi j}$

$A = \sqrt{14^2 + 8^2} = 16.12$  $\phi = \tan^{-1}\left(\frac{8}{14}\right) = 29.7^\circ$

$c. \overline{z}_1 = \sqrt{14 + 8j} \exp\left(j \tan^{-1}\left(\frac{8}{14}\right)\right) = 3.61 e^{j56.3^\circ}$
$c. \overline{z}_2 = \sqrt{16 + 4j} \exp\left(j \tan^{-1}\left(-\frac{2}{4}\right)\right) = 4.47 e^{-j26.57^\circ}$

d. $\overline{z}_1 \overline{z}_2 = (3.61)(4.47) e^{j(53.6 - 26.57)}$

$= 16.13 e^{j29.7^\circ}$

6.15 Find: $|\frac{\overline{z}_1}{\overline{z}_2}|$ where $\overline{z}_1 = a + bj$  $\overline{z}_2 = c + dj$

$\frac{\overline{z}_1}{\overline{z}_2} = \frac{a + bj}{c + dj} \times \left(\frac{c - dj}{c - dj}\right) = \frac{(ac + bd) + (bc - ad)j}{c^2 + d^2}$

$|\frac{\overline{z}_1}{\overline{z}_2}| = \frac{1}{c^2 + d^2} \times \left[\frac{(ac + bd)^2 + (bc - ad)^2}{c^2 + d^2}\right]^{1/2}$

$= \frac{a^2c^2 + b^2d^2 + 2abcd + b^2c^2 + a^2d^2 - 2abcd}{c^2 + d^2}$

$= \frac{\left[a^2c^2 + b^2d^2 + b^2c^2 + a^2d^2\right]^{1/2}}{c^2 + d^2}$  $a$ factor out $(c^2 + d^2)^{1/2}$

$= \frac{\sqrt{(a^2 + b^2)(c^2 + d^2)}}{c^2 + d^2}$  $= \left|\frac{\overline{z}_1}{\overline{z}_2}\right|$
G.18 Rewrite sinusoids as phasors in exp. form.

a. \( V_1 = \cos(\omega t + 10^\circ) \, \text{V} = e^{j10^\circ} \, \text{V} \)

b. \( 27.6 \sin(\omega t - 54^\circ) \, \text{V} = 27.6 \cos(\omega t - 54^\circ - 90^\circ) \)

\( = 27.6 e^{-j144^\circ} \, \text{V} \)

c. \( i_1(t) = 3.4 \cos(\omega t - 0.42 \text{ rad}) \, \text{mA} = 3.4 e^{-j(0.42 \text{ rad})} \, \text{mA} \)

G.19 Rewrite Phasors as \( A \cos(\omega t + \phi) \)

a. \( V_1 = 12 e^{j(34^\circ)} = 12 \cos(\omega t + 34^\circ) \, \text{V} \)

b. \( V_2 = 7 + 9j \, \text{V} \)

\[ A = \sqrt{7^2 + 9^2} = 11.4 \]

\[ \phi = \tan^{-1}(\frac{9}{7}) = 52.12^\circ \]

\[ V_2 = 11.4 e^{j52.12^\circ} \, \text{V} \]

\[ V_2 = 11.4 \cos(\omega t + 52.12^\circ) \, \text{V} \]

c. \( i_1 = 6 - 2j \)

\[ A = \sqrt{6^2 + 4} = 6.32 \]

\[ \phi = \tan^{-1}(\frac{-2}{6}) = -18.43^\circ \]

\[ i_1 = 6.32 \cos(\omega t - 18.43^\circ) \, \text{mA} \]

G.20 Find: \( A \) and \( \phi \)

a. \( 3 + 2j \)

\[ A = \sqrt{3^2 + 2^2} = 3.61 \]

\[ \phi = \tan^{-1}(\frac{2}{3}) \]

b. \( 15 e^{-j24^\circ} \)

\[ A = 15 \]

\[ \phi = -24^\circ \]
\[ \frac{1.3 - 2.1j}{0.3 - 0.8j} \times \frac{0.3 + 0.8j}{0.3 + 0.8j} = \frac{2.04 + 0.41j}{0.39 + 0.64} = 2.84 + 0.56j \]

\[ A = \sqrt{2.84^2 + 0.56^2} = 2.9 \]
\[ \phi = \tan^{-1}\left(\frac{0.56}{2.84}\right) = 11.2^\circ - \phi \]