For the inductor *L*, assume the current through it is

The voltage across the inductor is

We can write the voltage as

which transforms to the phasor

As

In the preceding section, we obtained the voltage-current relations for

the three passive elements as

**Z** is a frequency-dependent quantity known as *impedance*, measured in ohms.

Table 5.2

As a complex quantity, the impedence may be expressed in rectangular form as

Or

where

Find *v*(*t*) and *i*(*t*) in the circuit shown in Figure 5.2.

Figure 5.2

Solution:

From the voltage source,

$$\left. { 10\cos 4 t , \omega = 4 } \\ { V \_ { s } = 10 \angle 0 ^ { \circ } V } \right.$$

The impedance is

Hence the current

$$\left. { I = \frac { V \_ { s } } { Z } = \frac { 10 \angle 0 ^ { \circ } } { 5 - j 2.5 } = \frac { 10 ( 5 + j 2.5 ) } { 5 ^ { 2 } + 2.5 ^ { 2 } } }\\{ = 1.6 + j 0.8 = 1.789 \angle 26.57 ^ { \circ } A } \right.$$

The voltage across the capacitor is

$$\left. { V = I Z \_ { C } = \frac { I } { j \omega C } = \frac { 1.789 \angle 26.57 ^ { \circ } } { j 4 \times 0.1 } }\\{ = \frac { 1.789 \angle 26.57 ^ { \circ } } { 0.4 \angle 90 ^ { \circ } } = 4.47 \angle - 63.43 ^ { \circ } V } \right.$$

Converting **I** and **V** to the time domain, we get

$$\left. { i ( t ) = 1.789 \cos ( 4 t + 26.57 ^ { \circ } ) A } \\ { v ( t ) = 4.47 \cos ( 4 t - 63.43 ^ { \circ } ) V } \right.$$

Notice that *i*(*t*) leads *v*(*t*) by 90􏰉 as expected.