**Ex:** Given $\omega = 10k \text{ rad/s}$, for each of the following impedances, determine which of the following the impedance is from: a capacitor, an inductor, or a resistor. Also, find the value of that capacitor, inductor, or resistor.

a) $1 \text{ k}\Omega$

b) $-j50 \text{ \Omega}$

c) $j400 \text{ \Omega}$

d) $-j2 \text{ k}\Omega$

e) $j8 \text{ k}\Omega$

**Sol’N:**

a) A real value of impedance originates from a resistance, and the value of the impedance in the frequency-domain is the same as the resistance in the time-domain.

$$R = 1 \text{ k}\Omega$$

b) A purely imaginary and negative value of impedance originates from a capacitance, and the value of the impedance in the frequency-domain is inversely proportional to the capacitance in the time-domain.

$$z_C = \frac{1}{j\omega C}$$

or

$$-j50 \text{ \Omega} = \frac{1}{j10k \text{ r/s} \cdot C}$$

or

$$C = \frac{1}{j10k \text{ r/s} \cdot -j50 \text{ \Omega}} = \frac{1}{500k} \text{ F} = 2 \mu\text{F}$$

c) A purely imaginary and positive value of impedance originates from an inductor, and the value of the impedance in the frequency-domain is proportional to the inductor in the time-domain.

$$z_L = j\omega L$$
or
\[ j400 \, \Omega = j\omega L \]
or
\[ L = \frac{j400 \, \Omega}{j10 \, \text{k} \, \text{r/s}} = 40 \, \text{mH} \]

d) This impedance is 40 times as high as that in part (b). This requires a capacitance that is 40 times smaller.
\[ C = 50 \, \text{nF} \]


e) This impedance is 20 times as high as that in part (b). This requires an inductance that is 20 times larger.
\[ L = 800 \, \text{mH} = 0.8 \, \text{H} \]