Given \( \omega = 10\text{k rad/s} \), 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. Recall that \( z_R = R \), \( z_L = j\omega L \), and \( z_C = \frac{1}{j\omega C} \).

a) 1 k\( \Omega \)
b) \(-j50\ \Omega\)
c) \(j400\ \Omega\)
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

\[ -j50\ \Omega = \frac{1}{j10\text{k}\ \text{r/s} \cdot C} \]

or

\[ C = \frac{1}{j10\text{k}\ \text{r/s} \cdot -j50\ \Omega} = \frac{1}{500\text{k}} \text{F} = 2 \mu\text{F} \]

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.
\[ L = 800 \, \text{mH} = 0.8 \, \text{H} \]