## Problem 7.2

**a)**

$$\mathbf{I_1} = \frac{V_0}{\frac{1}{j\omega C}} = V_0 j\omega C$$

$$|\mathbf{I_1}| = V_0\omega C$$

$$\phi = \arctan\frac{\omega C}{0} = \frac{\pi}{2}$$

$$I_1(t) = V_0\omega C\sin\left(\omega t + \frac{\pi}{2}\right)$$

**b)**

$$\mathbf{I_2} = \frac{V_0}{R + j\omega L} = V_0\frac{R - j\omega L}{R^2 + \omega^2 L^2}$$

$$I_2 = |\mathbf{I_2}| = \frac{V_0}{R^2 + \omega^2 L^2}\sqrt{R^2 + \omega^2 L^2} = \frac{V_0}{\sqrt{R^2 + \omega^2 L^2}}$$

$$\phi = \arctan\frac{-\omega L}{R} = -\arctan\frac{\omega L}{R}$$

$$\cos\phi = \frac{1}{\sqrt{1 + \left(\frac{\omega L}{R}\right)^2}} = \frac{R}{\sqrt{R^2 + \omega^2 L^2}}$$

$$\sin\phi = \frac{\frac{-\omega L}{R}}{\sqrt{1 + \left(\frac{\omega L}{R}\right)^2}} = \frac{-\omega L}{\sqrt{R^2 + \omega^2 L^2}}$$

**c)**

$$\begin{aligned}\mathbf{I_0} = \mathbf{I_1} + \mathbf{I_2} &= V_0 j\omega C + V_0\frac{R - j\omega L}{R^2 + \omega^2 L^2} \\ &= V_0\frac{j\omega C(R^2 + \omega^2 L^2) + R - j\omega L}{R^2 + \omega^2 L^2} \\ &= V_0\frac{R + j\omega(CR^2 + \omega^2 CL^2 - L)}{R^2 + \omega^2 L^2}\end{aligned}$$

$$|\mathbf{I_0}| = \frac{V_0}{R^2 + \omega^2 L^2}\sqrt{R^2 + \omega^2(CR^2 + \omega^2 CL^2 - L)^2}$$

$$\phi = \arctan\left(\frac{\omega(CR^2 + \omega^2 CL^2 - L)}{R}\right)$$

**d)**

$$\cos\phi = \frac{1}{\sqrt{1+\left(\frac{\omega(CR^2+\omega^2CL^2-L)}{R}\right)^2}} = \frac{R}{\sqrt{R^2+\omega^2(CR^2+\omega^2CL^2-L)^2}}$$