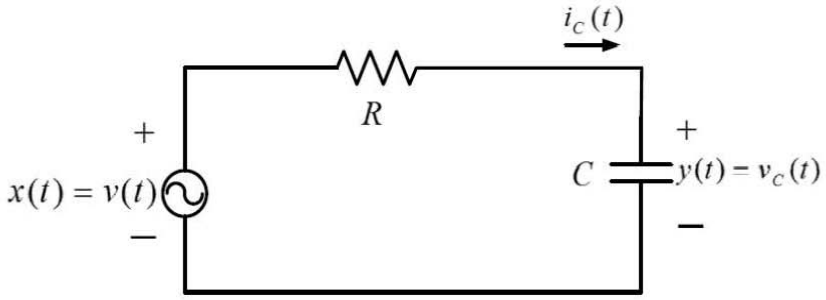
1. For the circuit shown below, find $y(t)$ for $x(t) = 10\cos(100\,t)$, $R = 1\ (k\Omega)$, and $C = 1\ (\mu F)$. [15 points]



For this circuit when the output is the voltage across the capacitor

$$H(\omega) = \frac{1/RC}{j\omega + 1/RC} = \frac{1000}{j\omega + 1000}$$

$$y(t) = 10\,|H(\omega)|\cos(100t + \angle H(\omega))$$

$$|H(\omega)| = \frac{1000}{\sqrt{\omega^2 + 10^6}}, \quad \angle H(\omega) = -\tan^{-1}\left(\frac{\omega}{1000}\right)$$

$$|H(100)| = \frac{1000}{\sqrt{(100)^2 + 10^6}} = 0.995 \qquad \angle H(100) = -5.71^\circ$$

$$\therefore\ y(t) = 9.95\cos(100t - 5.71^\circ)$$