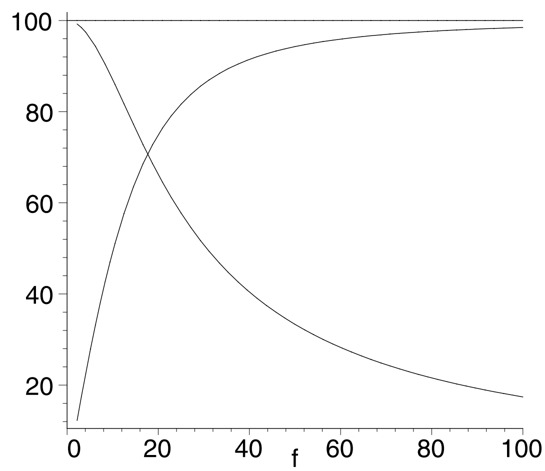
78. (a) The voltage amplitude for the source is $V_s = 100\,\text{V} = IZ = I\sqrt{R^2 + X_C^2}$, from which we can determine the current at each frequency (the explicit dependence of X_C on frequency is stated in the solution to part (a) of problem 77). This leads to the voltage amplitude across the resistor $V_R = IR$ and the voltage amplitude across the capacitor

$$V_C = IX_C = \left(\frac{V_s}{\sqrt{R^2 + X_C^2}}\right) X_C \quad \text{where} \quad X_C = \frac{1}{2\pi C f}$$

using the values $R = 200\,\Omega$ and $C = 45 \times 10^{-6}$ F given in problem 77. We show, below, the graphs of V_s, V_R and V_C over the range $0 < f < 100\,\text{Hz}$. The falling curve is V_C and the rising curve is V_R.



(b) The graph indicates that V_C and V_R are equal at roughly 18 Hz. More careful considerations lead to $f = 17.7$ Hz as the frequency for which $V_C = V_R$.