EXERCISE 7.7: Double-check the fact that the inputs $x_1[n]$, $x_2[n]$, and $x_3[n]$ determined in Example 7-10 produce outputs that are zero everywhere by substituting these signals into the difference equation $y[n] = x[n] - 2x[n-1] + 2x[n-2] - x[n-3]$ to show that the complex phasors cancel out for all values of n. Also show that since the filter is linear, it will also null out signals such as $2\cos(\pi n/3)$, which is the sum of $x_2[n]$ and $x_3[n]$.

McClellan, Schafer and Yoder, *Signal Processing First,* ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458.

SOLUTION

when $x[n] = x_1[n] = 1$

$$y[n] = 1 - 2 + 2 - 1 = 0$$

When $x[n] = x_2[n] = e^{j\pi n/3}$

$$y[n] = e^{j\pi n/3} - 2e^{j\pi(n-1)/3} + 2e^{j\pi(n-2)/3} - e^{j\pi(n-3)/3}$$

$$= e^{j\pi n/3}\left(1 - 2e^{-j\pi/3} + 2e^{-j2\pi/3} - e^{-j\pi}\right)$$

$$= e^{j\pi n/3}\left(1 - (1 - j\sqrt{3}) + (-1 - j\sqrt{3}) + 1\right) = 0$$

When $x[n] = e^{-j\pi n/3}$

$$y[n] = e^{-j\pi n/3} - 2e^{-j\pi(n-1)/3} + 2e^{-j\pi(n-2)/3} - e^{-j\pi(n-3)/3}$$

$$= e^{-j\pi n/3}\left(1 - 2e^{j\pi/3} + 2e^{j2\pi/3} - e^{j\pi}\right) = 0$$

This is just the conjugate of the previous case