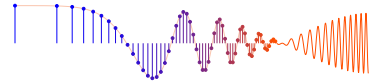

PROBLEM:

A linear time-invariant discrete-time system is described by the difference equation

$$y[n] = x[n] - 2x[n-1] + 3x[n-2] - 4x[n-3] + 2x[n-4].$$

(a) Draw a block diagram that represents this system in terms of unit-delay elements, coefficient multipliers, and adders as in Figure 5.13 in the *SP First*.

(b) Determine the impulse response $h[n]$ for this system.

(c) Use convolution to determine the output due to the input

$$x[n] = \delta[n] - \delta[n-1] + \delta[n-2] = \begin{cases} 1 & n = 0, 1, 2 \\ 0 & \text{otherwise} \end{cases}$$

Plot the output sequence $y[n]$ for $-3 \leq n \leq 10$.

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
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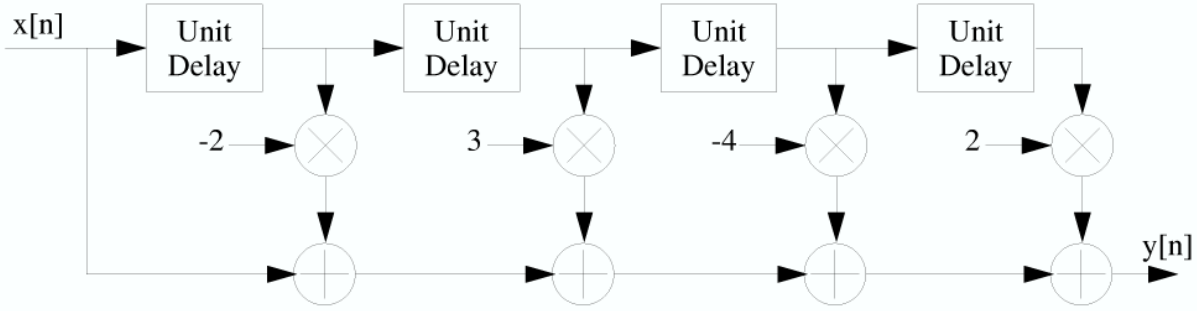
SOLUTION

$$y[n] = x[n] - 2x[n-1] + 3x[n-2] - 4x[n-3] + 2x[n-4]$$

a) The block diagram for $y[n]$ is as follows.



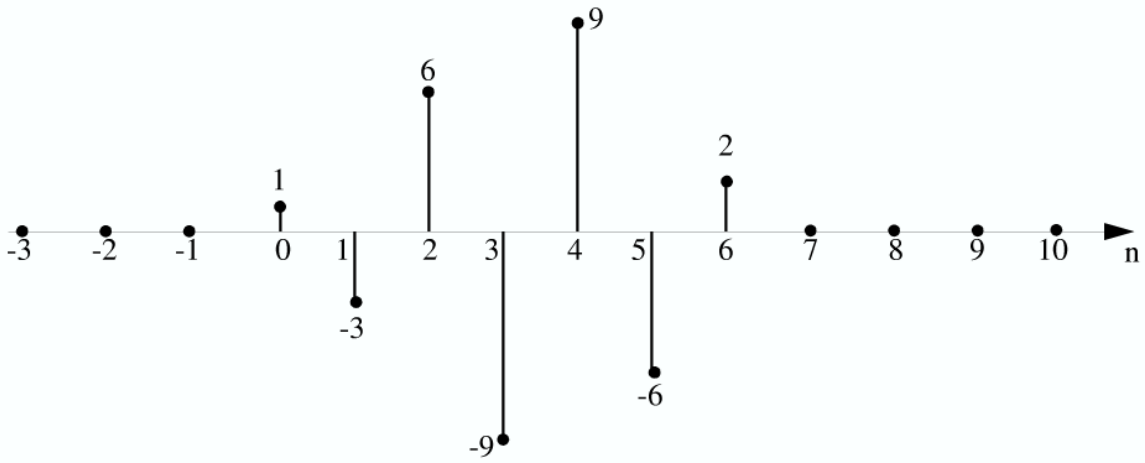
b) The impulse response for $y[n]$ can be found by using $x[n] = \delta[n]$ which results in

$$y[n] = h[n] = \delta[n] - 2\delta[n-1] + 3\delta[n-2] - 4\delta[n-3] + 2\delta[n-4]$$

c) $y[n]$ can be tabulated as follows.

n	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10
$h[n]$				1	-2	3	-4	2						
$x[n]$				1	-1	1								
				1	-2	3	-4	2						
					-1	2	-3	4	-2					
						1	-2	3	-4	2				
$y[n]$				1	-3	6	-9	9	-6	2				

Plotting $y[n]$ gives



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