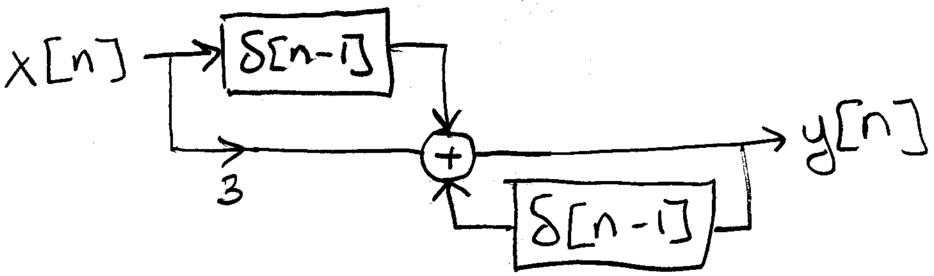
Find the frequency response $H(\omega)$ of the following system

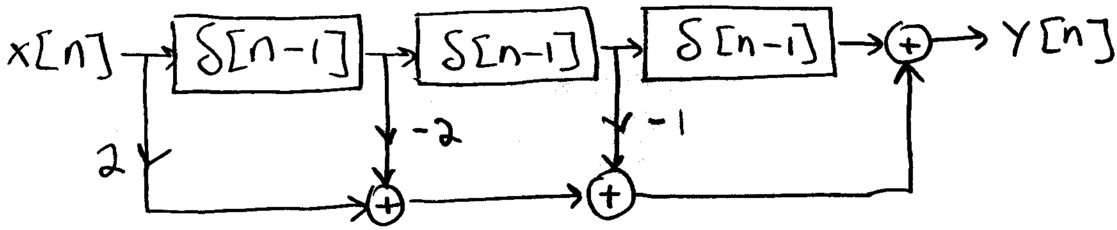


$$y[n] - y[n-1] = 3x[n] + x[n-1]$$

$$(1 - e^{-j\omega})\,Y(e^{j\omega}) = (3 + e^{-j\omega})\,X(e^{j\omega})$$

$$H(\omega) = \frac{3 + e^{-j\omega}}{1 - e^{-j\omega}}$$

Find the frequency response $H(\omega)$



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

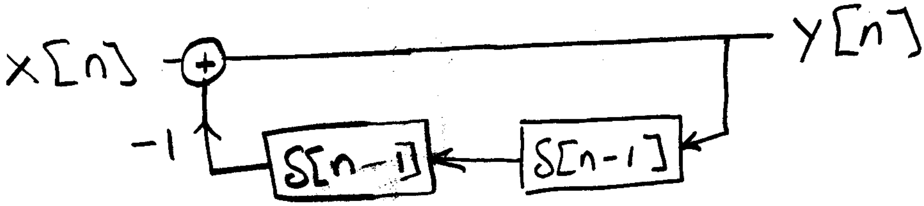
$$H(\omega) = 2 - 2e^{-j\omega} - e^{-2j\omega} + e^{-3j\omega}$$

FOR THE FOLLOWING SYSTEM, WHAT IS THE

(A) DIFFERENCE EQUATION?

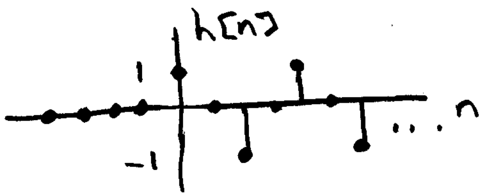
(B) IMPULSE RESPONSE? (A GRAPH OF $h[n]$ SUFFICIENT)

(C) DISCRETE TIME FOURIER TRANSFORM $H(e^{jw})$



(A) $y[n] + y[n-2] = x[n]$

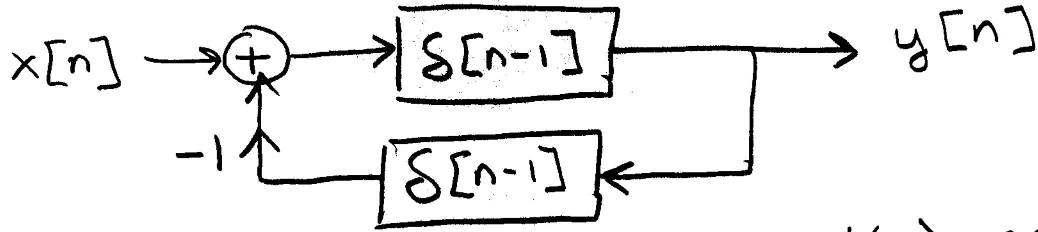
(B)



(C) $Y(e^{jw})(1 + e^{-2jw}) = X(e^{jw})$

$$H(e^{jw}) = \frac{Y(e^{jw})}{X(e^{jw})} = \frac{1}{1 + e^{-2jw}}$$

What is the Fourier Transform $H(\omega)$ of the following system



At what frequency ω is $H(\omega) = \infty$?
(we assume a sampling freq. $\omega_s = 2\pi$)
Explain in terms of the system drawing above.

$$y[n] = x[n-1] - y[n-2]$$

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

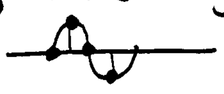
since $x[n-n_0] \xleftrightarrow{F} e^{-jn_0\omega} X(\omega)$

$$\left[1 + e^{-j2\omega}\right] Y(\omega) = e^{-j\omega} X(\omega)$$

$$H(\omega) = \frac{Y(\omega)}{X(\omega)} = \frac{e^{-j\omega}}{1+e^{-j2\omega}}$$

$H(\omega) = \infty$ when $e^{-j2\omega} = -1$, or $\omega = \pm\frac{\pi}{2}$

The delay around the loop is 2 samples, so at $\omega = \frac{\pi}{2}$ and $\omega_s = 2\pi$, the signal regenerates itself.



out of phase
times -1

Draw a systems diagram $x[n] \rightarrow \square \rightarrow y[n]$

for $H(\omega) = j\sin(\omega)$

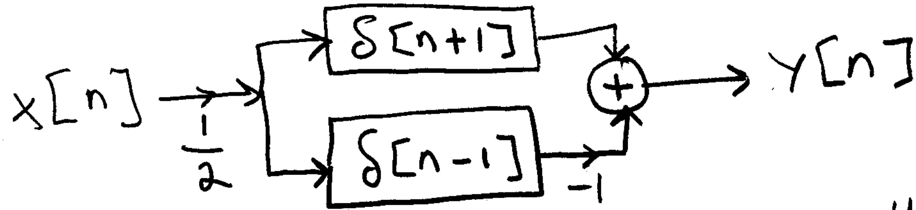
at what frequency, ω, is $H(\omega) = 0$?

(we assume a sampling freq. $\omega_s = 2\pi$)

Explain in terms of the systems diagram.

$$H(\omega) = j\left[\frac{e^{j\omega} - e^{-j\omega}}{2}\right] = \frac{e^{j\omega}}{2} - \frac{e^{-j\omega}}{2}$$

$$y[n] = \frac{1}{2}\left(x[n+1] - x[n-1]\right)$$



$H(\omega) = 0$ where $\omega = \pm\pi$, or $\frac{\omega_s}{2}$

at $\omega = \pm\pi$ the signal is split and each half shifted 180° so that the diffence between them is zero

What is the Fourier Transform $H(\omega)$ of the following system

$$y[n] = x[n] - x[n-8] \ ?$$

give one frequency ω, not $\omega = 0$, where $H(\omega) = 0$ (assume sampling frequency $\omega_s = 2\pi$) and explain why the system does not transmit that frequency.

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since $x[n-n_0] \overset{F}{\longleftrightarrow} e^{-jn_0\omega} X(\omega)$

$$Y(\omega) = 1 - e^{-j8\omega} X(\omega)$$

$$H(\omega) = \frac{Y(\omega)}{X(\omega)} = 1 - e^{-j8\omega}$$

$$H(\omega) = 0 \text{ when } e^{-j8\omega} = 1$$

$$\omega = \frac{2\pi}{8} = \frac{1}{4}\pi = \frac{\omega_s}{8}$$

at $\omega = \frac{\omega_s}{8}$, $x[n]$ is in phase with $x[n-8]$, so they cancel