1 Convolution

Consider three DT signals, $a[n]$, $b[n]$, and $c[n]$, shown below. Each of these signals is zero if $n < 0$ or $n > 15$.

Determine which of the following signals can be generated by convolving $a[n]$ or $b[n]$ or $c[n]$ with $a[n]$ or $b[n]$ or $c[n]$, and enter $a$ or $b$ or $c$ in the appropriate boxes. If no combination of $a[n]$, $b[n]$, and $c[n]$ can produce the signal, enter None in both boxes.

Note: the answers may not be unique. Only one correct answer is needed for full credit.

- $f_0[n] = a * b$
- $f_1[n] = \text{None} * \text{None}$
- $f_2[n] = a * a$
- $f_3[n] = c * c$
- $f_4[n] = b * c$
- $f_5[n] = \text{None} * \text{None}$
2 Inverse Fourier

Part 1.

The magnitude and angle of the DTFT of \( x[n] \) are shown below.

Enter a closed-form expression for \( x[n] \) in the box below:

\[
x[n] = -\frac{1}{2} (\delta[n - 2] + \delta[n + 2])
\]

Part 2.

Consider a signal \( x'[n] \), whose DTFT magnitudes are the same as those of \( x[n] \), but whose phase alternates between \( \pi/2 \) and \( -\pi/2 \) instead of \( \pi \) and \( 0 \).

Enter a closed-form expression for \( x'[n] \) in the box below:

\[
x'[n] = \frac{j}{2} (\delta[n - 2] + \delta[n + 2])
\]
Part 3.
The magnitude and angle of the DTFT of $y[n]$ are shown below.

\[ X(\Omega) = -j \sin(\Omega)e^{-j\Omega} \]

Firstly, consider the signal given by $Y(\Omega) = -j \sin(\Omega)$. In the time domain, this signal looks like $y[n] = \frac{1}{2}\delta[n-1] - \frac{1}{2}\delta[n+1]$.

By the time shift property, because $X(\Omega) = Y(\Omega)e^{-j\Omega}$, we know that $x[n] = y[n-1]$.

Therefore, we have:

\[ x[n] = \frac{1}{2}\delta[n-2] - \frac{1}{2}\delta[n] \]