

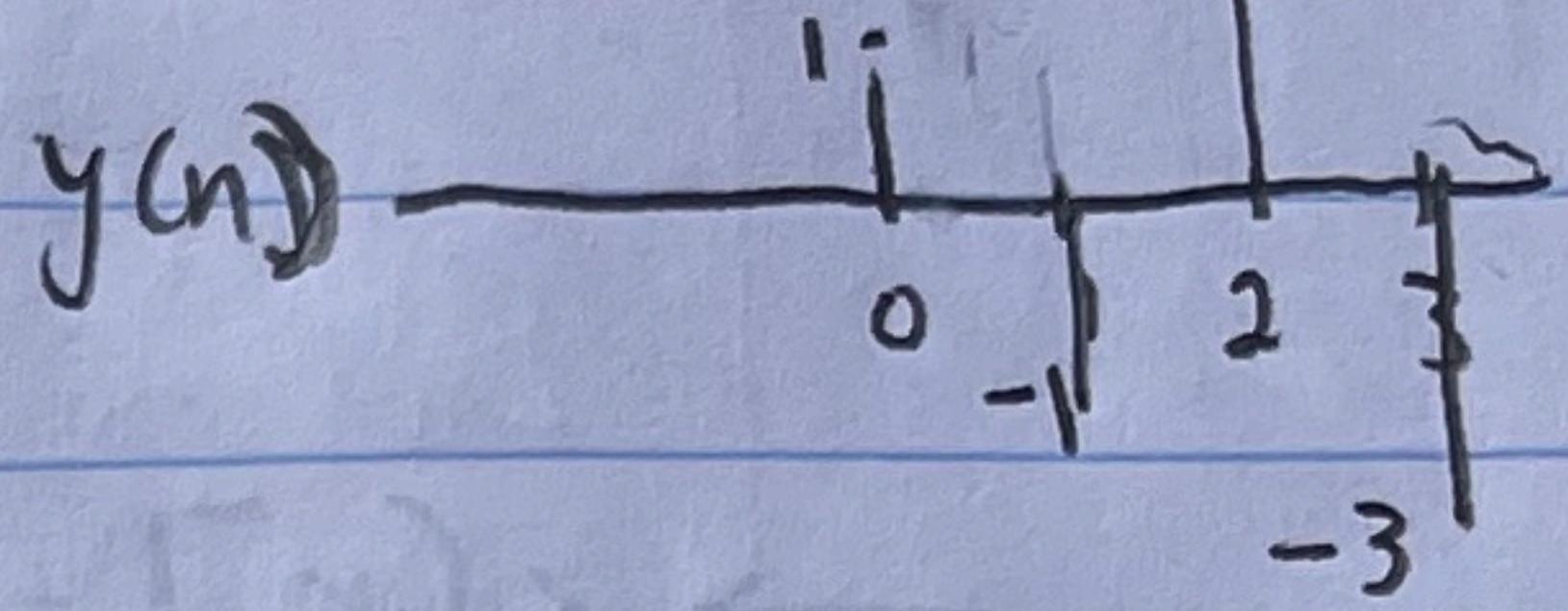
## Algebraic Props of Convolution

1.  $x[n] * y[n] = y[n] * x[n]$  Commutative
2.  $x[n] * (y[n] * z[n]) = (x[n] * y[n]) * z[n]$  Associative
3.  $x[n] * (ay[n] + bz[n]) = ax[n] * y[n] + bx[n] * z[n]$  Distributive
4.  $x[n] * z[n-n_0] = x[n-n_0]$  Identity

a)  $y[n] = (\delta[n] + 3\delta[n-2]) * (2\delta[n] - \delta[n-1])$

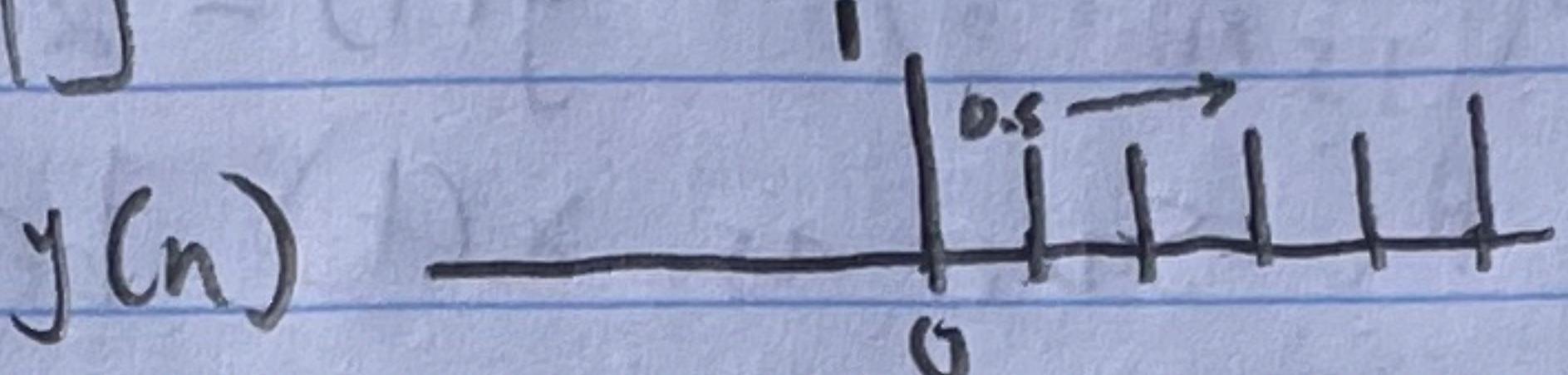
$$= \delta[n] * 2\delta[n] - \delta[n] * \delta[n-1] + 3\delta[n-2] * 2\delta[n] - 3\delta[n-2] * \delta[n-1]$$

$$= \delta[n] - \delta[n-1] + 6\delta[n-2] - 3\delta[n-3]$$



b)  $y[n] = v[n] * (\delta[n] - 0.5\delta[n-1])$

$$= v[n] - 0.5v[n-1]$$



5.6)  $y[n] = \sum_{k=0}^M b_k x[n-k]$

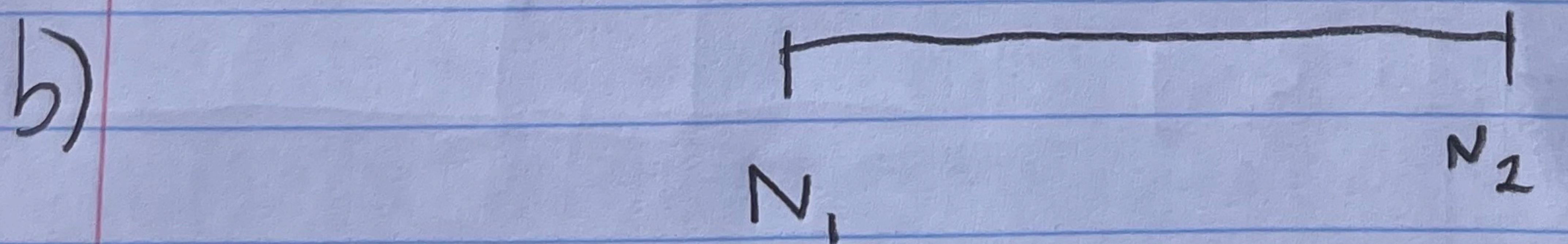
The diagram shows the convolution sum  $y[n] = \sum b_k x[n-k]$ . A horizontal line represents the output  $y[n]$ . Above it, a bracket labeled  $x[N-1]$  spans from  $n=M+1$  to  $n=N-1$ . Below the output line, a bracket labeled  $M+1$  spans from  $n=-M$  to  $n=0$ . The index  $n$  is marked with tick marks at  $-M, 0, N-1, M+1, \dots, n, \dots, N-1$ . The term  $x[0]$  is highlighted under the first summand  $b_0 x[n-k]$ .

$$(P-1) - (N-1) + 1 = M+1$$

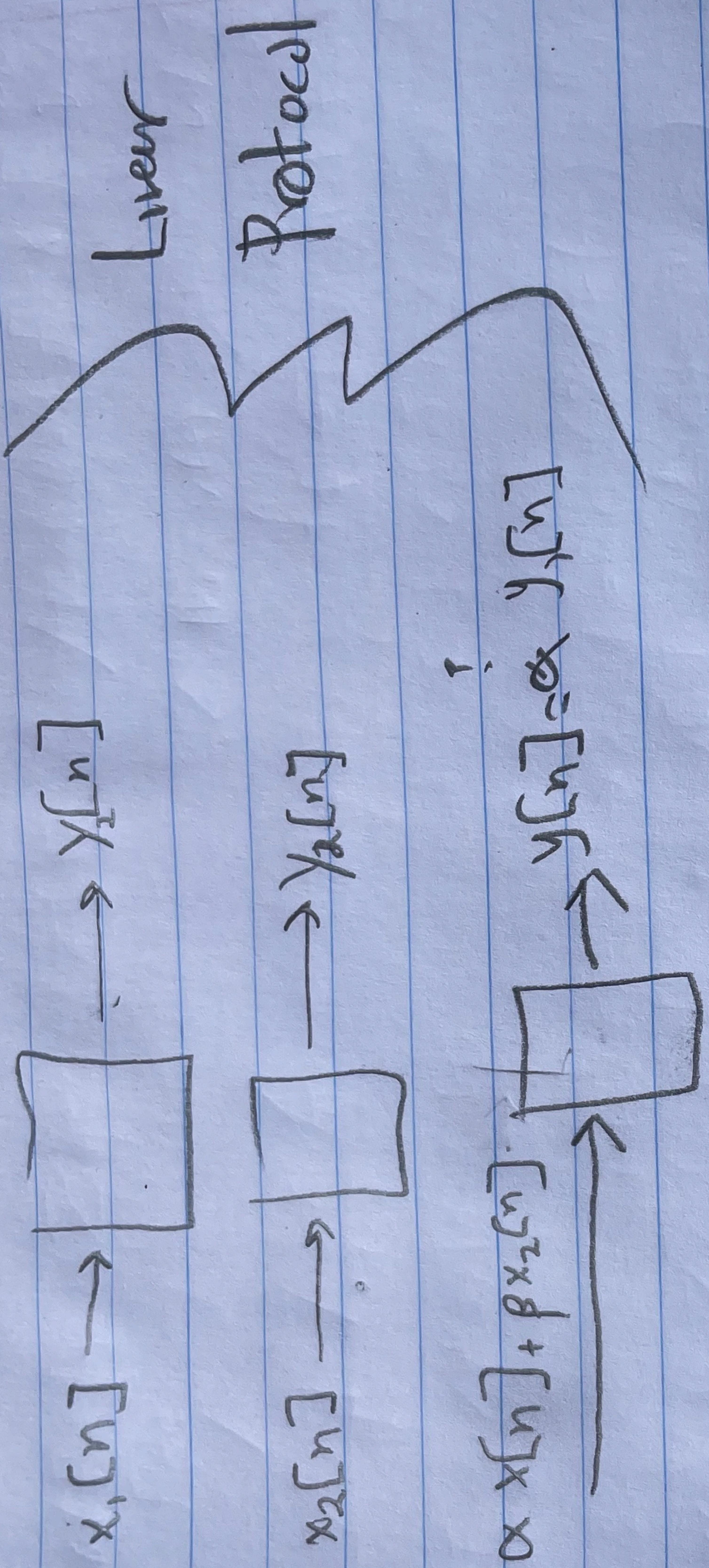
$$N+M = P = N+L+1$$

$$N_3 \leq N_1$$

$$N_4 - N_2 + 1 = M+1 \Rightarrow N_4 = N_2 + M$$



Time base



$$y_1[n] = |x_1[n]|, \quad y_2[n] = |x_2[n]|$$
$$y[n] = \alpha x_1[n] + \beta x_2[n] \neq \alpha y_1[n] + \beta y_2[n]$$

$$y_1[n] = Ax_1[n] + B \quad y_2[n] = Ax_2[n] + B$$

$$y[n] = A(\alpha x_1[n] + \beta x_2[n]) + B \neq \alpha y_1[n] + \beta y_2[n]$$