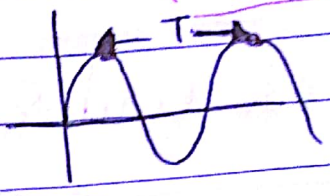
Periodic discrete signals

$$\cos[\omega_0 n] = \cos[\omega_0 (n+N)] \quad \leftarrow \text{Period}$$

$$= \cos[\omega_0 n + \omega_0 N]$$

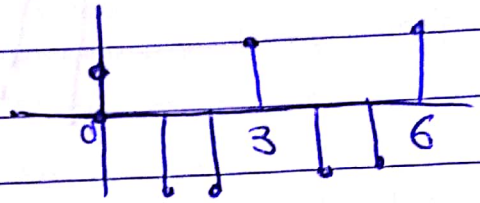
$$\omega_0 N = 2\pi, 4\pi, 6\pi, \ldots = 2\pi m \quad \leftarrow \text{integer}$$

$$N = \frac{2\pi m}{\omega_0} = T$$

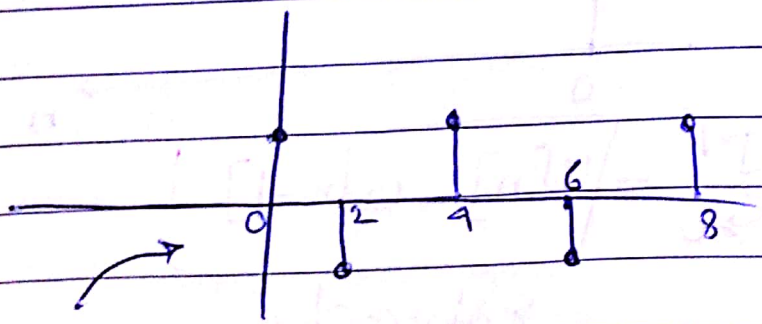


ex: $x[n] = \cos\left[\frac{2\pi}{3} n\right]$

$N = 3$



ex: $x[n] = \cos\left[\frac{5\pi}{2} n\right]$ $\quad N = \frac{4}{5} * m = \frac{4}{5} * 5 = \boxed{4}$



Periodic

Qu2

$$X[n] = \cos\left[2\frac{\pi}{3}n\right] + \cos\left[5\frac{\pi}{4}n\right]$$

is it periodic? & what is the Period?

$$N_1 = \frac{2\pi}{2\pi/3} = \boxed{3}, \quad 6, 9, 12, \cdots, 21$$

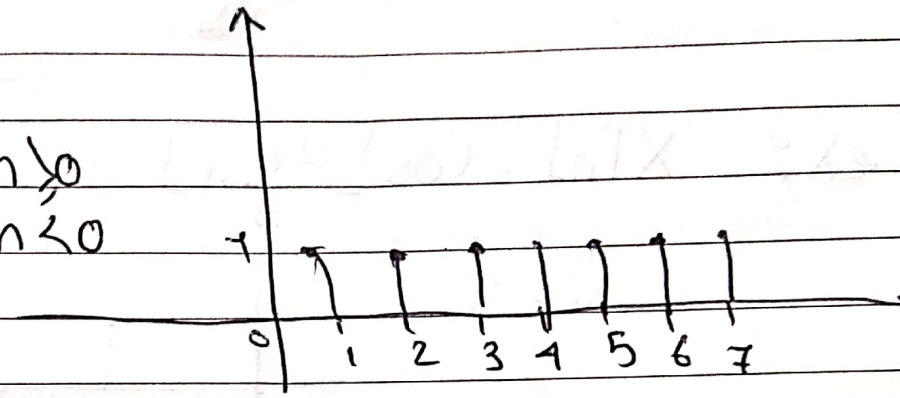
$$N_2 = \frac{2\pi}{5\pi/4} \cdot \frac{8}{5} * 5 = \boxed{8}, 16, 21$$

The Period is $\boxed{24}$ and it's periodic

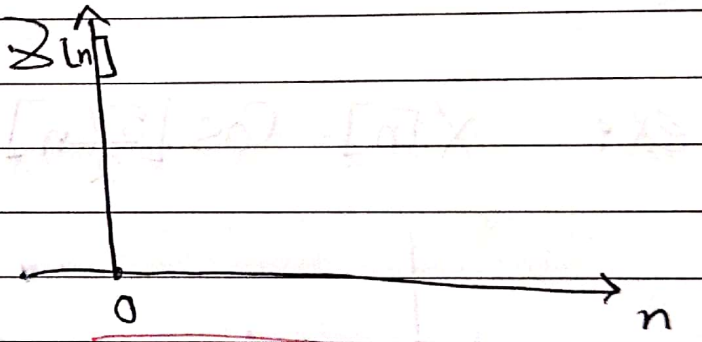
Discrete unit step:

$u[n] = 1 \quad n \geq 0$

$= 0 \quad n < 0$



Discrete unit Impulse



$$\delta[n] = \frac{d}{dn} u[n]$$

$$= \lim_{\Delta \to 0} \frac{u[n] - u[n-\Delta]}{\Delta}$$

$u[n] \to 1$, $u[n-\Delta] \to 1$, $\Delta \to 0$

$$= \frac{1-0}{1} = 1$$

$$= u[n] - u[n-1]$$

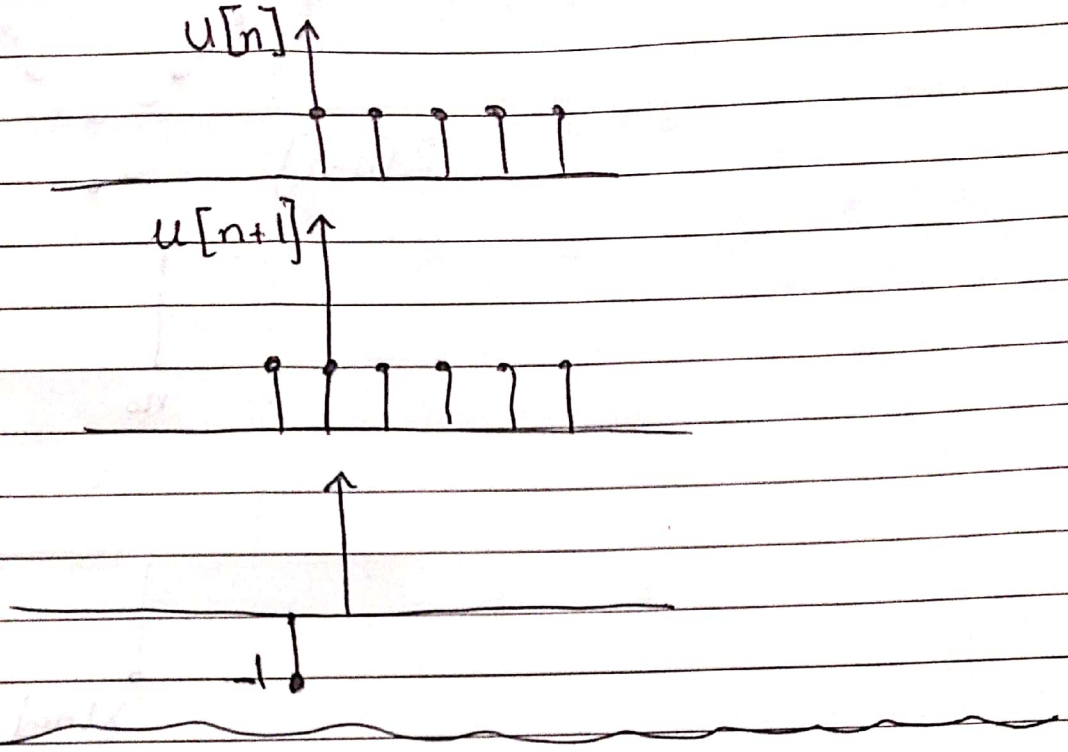
Subtraction
No derivation

$\delta[n] = 1 \quad n = 0$

$= 0 \quad n \neq 0$

$\delta[n] = u[n] - u[n-1]$

$\delta[n+1] = u[n] - u[n+1]$



$\sum_{-\infty}^{\infty} \delta[n] = 1$ $\quad$ $\sum_{k=-\infty}^{\infty} \delta[k] = 1$ "dummy name"

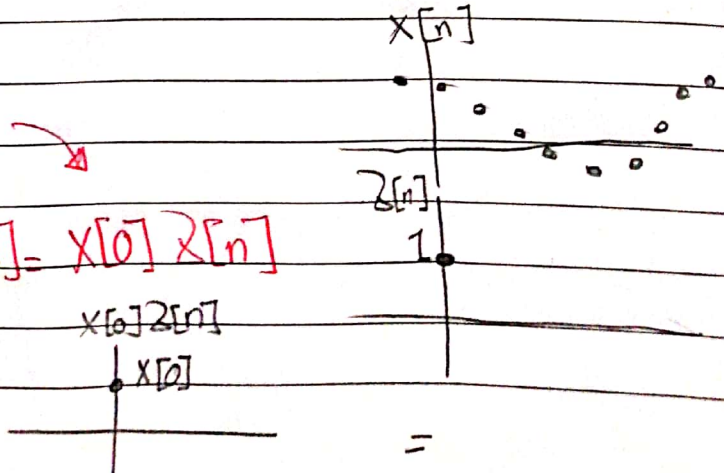
$\sum_{k=-\infty}^{n} \delta[k] = \begin{cases} 1 & n \geq 0 \\ 0 & n < 0 \end{cases} = u[n]$

$\sum_{k=-\infty}^{\infty} \delta[k-n_0] = 1$, $\sum_{k=-\infty}^{n} \delta[k-n_0] = \begin{cases} 1 & n \geq n_0 \\ 0 & n < n_0 \end{cases}$

$= u[n-n_0]$

$\delta[n] = \begin{cases} 1 & n=0 \\ 0 & n \neq 0 \end{cases}$

$x[n]\delta[n] = x[0]\delta[n]$



$$x[n]\,\delta[n-n_0] = x[n_0]\,\delta[n-n_0]$$