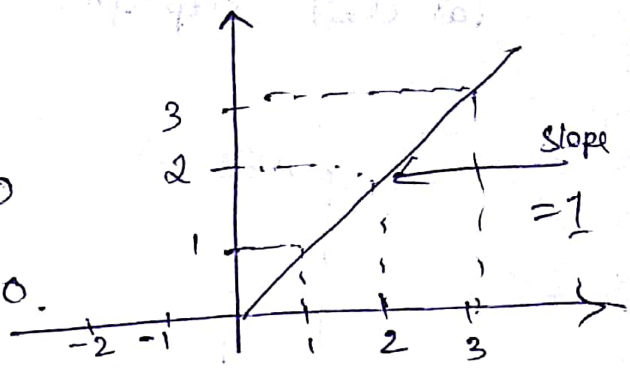
(2) Unit Ramp function :-

Continuous Unit Ramp f^n, $r(t)$:- That function that starts at $t=0$ and increases ~~later~~ linearly with time and defined as :

$$r(t) = \begin{cases} t, & \text{for } t \geq 0 \\ 0, & \text{for } t < 0. \end{cases}$$



$\therefore u(t) = 1.$

or $r(t) = t\, u(t).$

→ just explain step-wise.

how?

[Unit ramp f^n has unit slope. It can be obtained by integrating the ~~at~~ unit step f^n which means that a unit step f^n can be obtained by differentiating the unit ramp f^n.]

what is slope?

slope :- steepness of a line. change in y for a unit change in x along a line.

↓

$$r(t) = \int_0 u(t)\,dt$$

$\Downarrow$

$$r(t) = \int u(t)\,dt$$

$$= \int dt$$

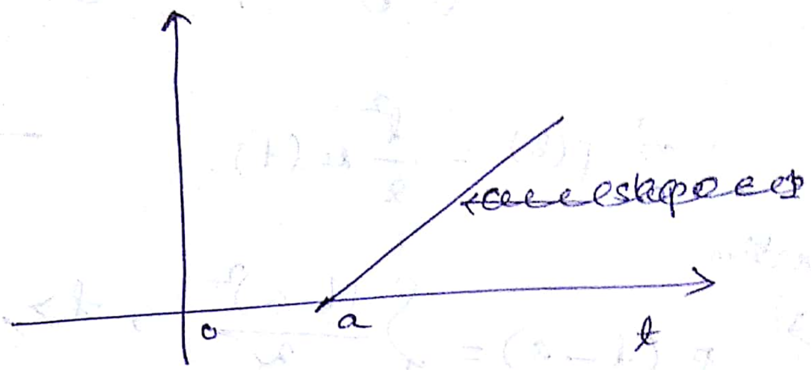
$$= dt \quad \text{for } t \geq 0$$

$$u(t) = \frac{d}{dt} r(t).$$

Delayed unit ramp signal $r(t-a)$ is given by

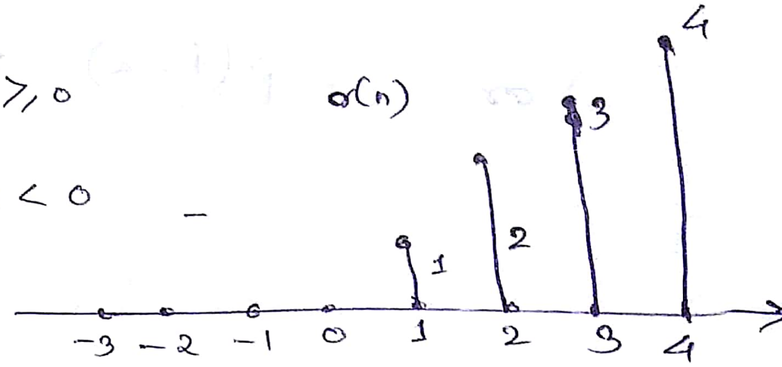
$$r(t-a) = \begin{cases} t-a, & \text{for } t \geqslant a \\ 0, & \text{for } t < a \end{cases}$$

or $r(t-a) = (t-a)\,u(t-a)$



Discrete - time unit ramp signal :-

$$r(n) = \begin{cases} n, & n \geq 0 \\ 0, & n < 0 \end{cases}$$

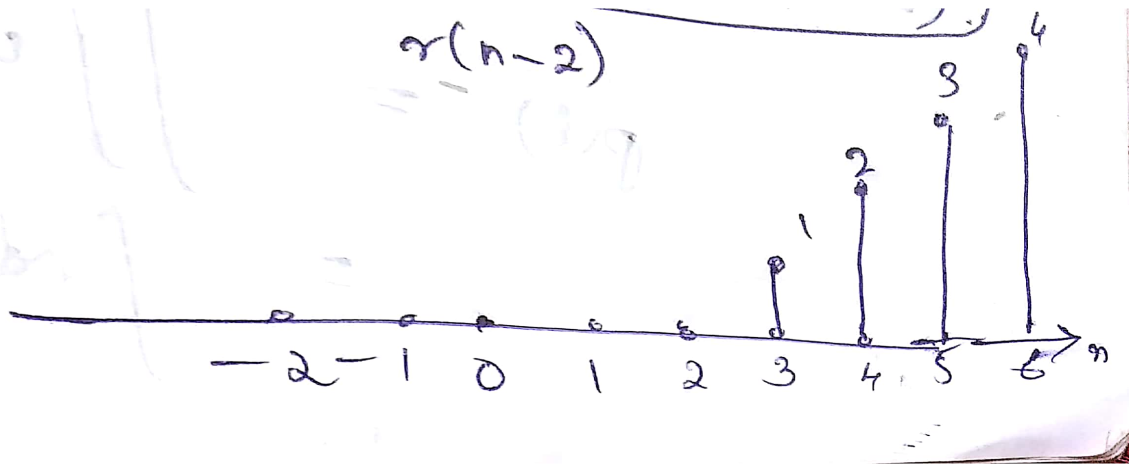


or $r(n) = n\,u(n)$.

shifted version $\rightarrow$

$$r(n-k) = \begin{cases} n-k, & \text{for } n \geq k \\ 0, & \text{for } n < k \end{cases}$$

'or' $r(n) = \cancel{n\,u(n)}\,(n-k)\,u(n-k)$

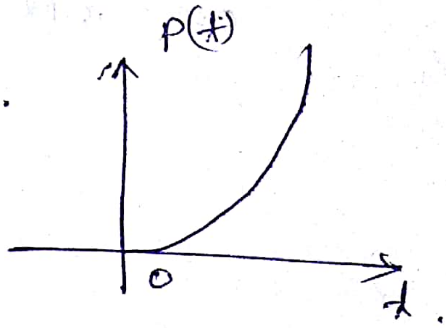


r(n-2)
1
2
3
4
-2 -1 0 1 2 3 4 5 6
n

(3) Unit Parabolic function:—

Continuous-time unit parabolic function $p(t)$ also called unit acceleration s/g starts at $t=0$ & defined as,

$$p(t) = \begin{cases} \frac{t^2}{2} & , t \geq 0 \\ 0 & , t < 0. \end{cases}$$

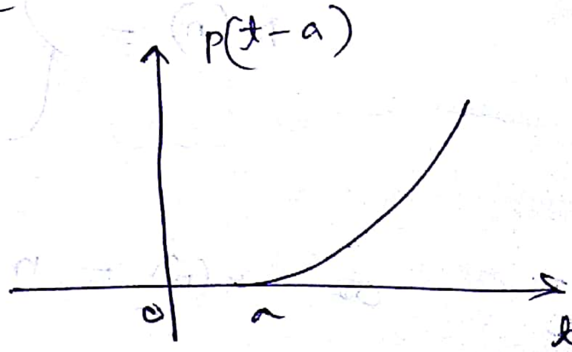


'or' $p(t) = \frac{t^2}{2} u(t)$.

shifted version →

$$p(t-a) = \begin{cases} \frac{(t-a)^2}{2} & , t \geq a \\ 0 & , t < a \end{cases}$$

'or' $p(t-a) = \frac{(t-a)^2}{2} u(t-a)$.



Unit parabolic fn can be obtained by integrating the unit ramp fn or double integrating the unit step fn.

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Unit parabolic fn can be obtained by integrating the unit ramp fn or double integrating the unit step fn.

$$p(t) = \iint u(t)\,dt$$

$$= \int r(t)\,dt = \int t\,dt = \frac{t^2}{2} \text{ for } t \geq 0$$

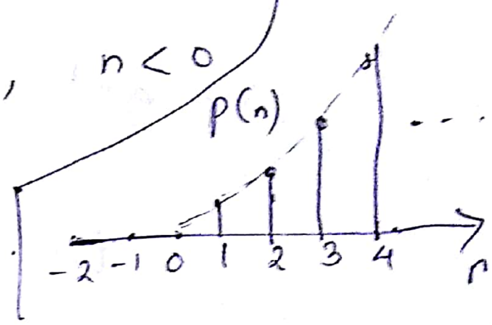
The ramp fn is derivative of parabolic fn and step fn is double derivative of parabolic fn.

$$r(t) = \frac{d}{dt} p(t)$$

$$u(t) = \frac{d^2}{dt^2} p(t).$$

Discrete-time unit parabolic sequence $p(n)$,

$$p(n) = \begin{cases} \frac{n^2}{2}, & n \geq 0 \\ 0, & n < 0 \end{cases}$$



$$\Rightarrow p(n) = \frac{n^2}{2} u(n).$$

$$p(n-k) = \begin{cases} \frac{(n-k)^2}{2}, & n \geq k \\ 0, & n < k. \end{cases}$$

$$\Rightarrow p(n-k) = \frac{(n-k)^2}{2} u(n-k).$$

$p(n-3)$