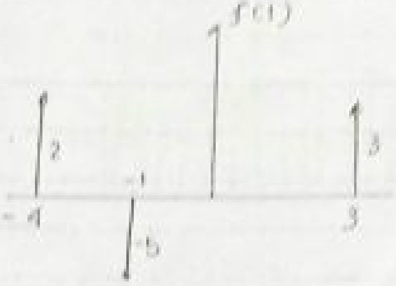
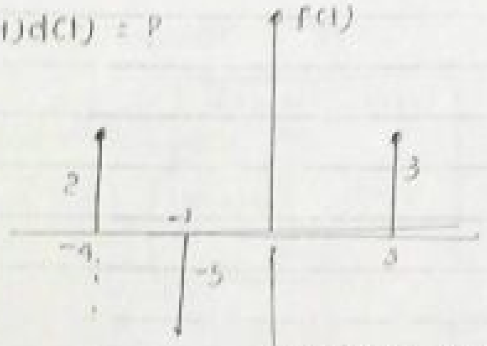
Solution:→



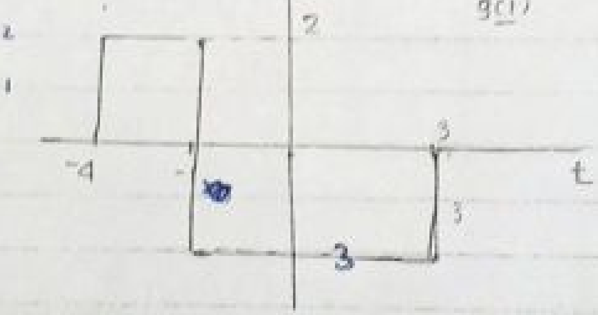
Hight of empulse is ~~[illegible]~~ the area

Now

$\int_{-\infty}^{t} f(t)d(t) = ?$



Integral functions of f(t)
g(t)



$f(t) = \frac{d}{dt} g(t)$

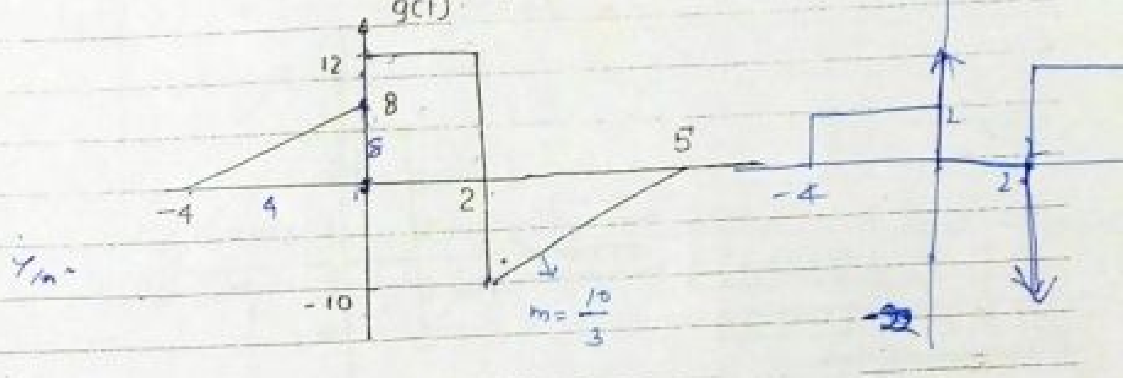
2nd method:-

$$f(t) = 2\delta(t+4) - 5\delta(t+1) + 3\delta(t-3)$$

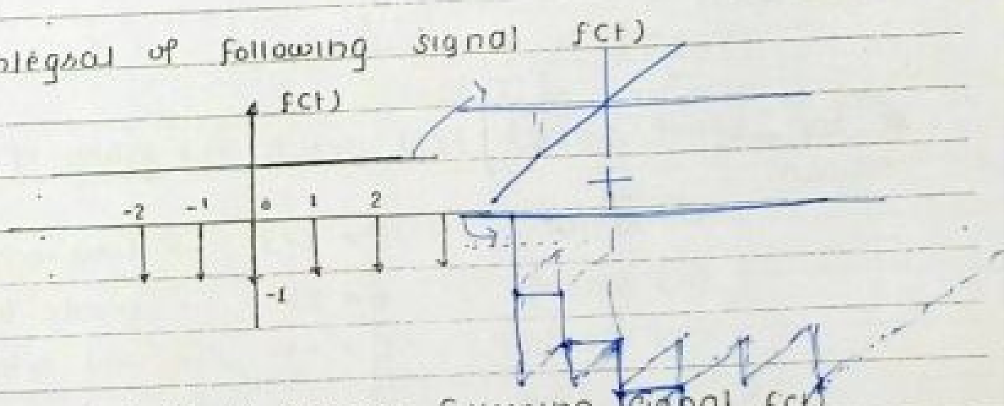
$$g(t) = 2u(t+4) - 5u(t+1) + 3u(t-3)$$

Here step size = Area of impulse

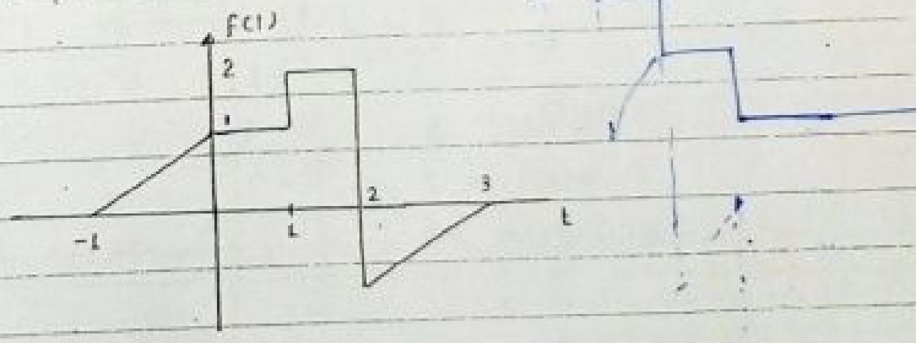
Find the deravative of following signal



Find the integral of following signal f(t)



Find the signal f(1-t) for the following signal f(t)

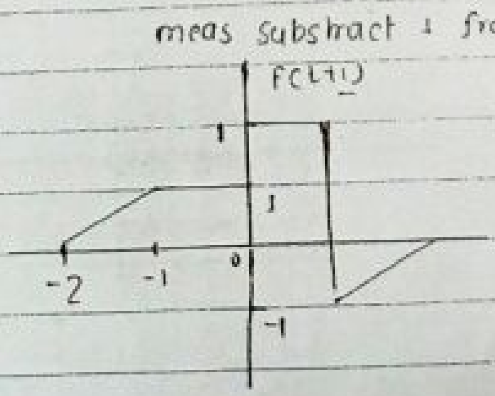


solution (i) shifting.

t → t+1

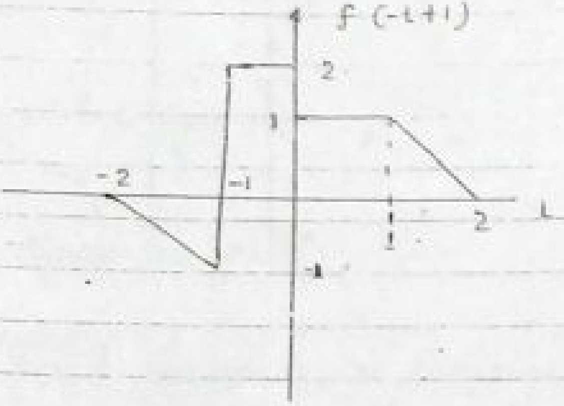
$f(t) \longrightarrow f(t+1)$

meas substract 1 from all the instance.



(ii) Time Reversal

$$f(t+1) \xrightarrow[t]{t \to -t} f(-t+1).$$



For above signal f(t) sketch the graph of $f(-2t+3)$.

Solution-

(i) Shifting. $t \to t+3$. → substract '3'

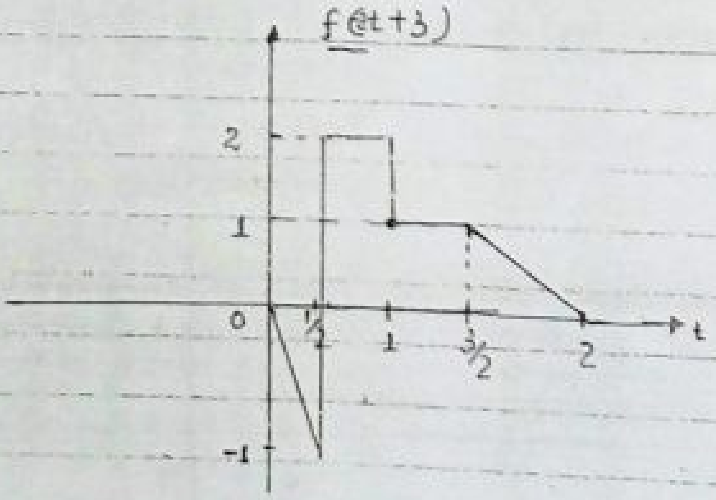
(ii) Scaling. $t \to 2t$ → Divide by 2

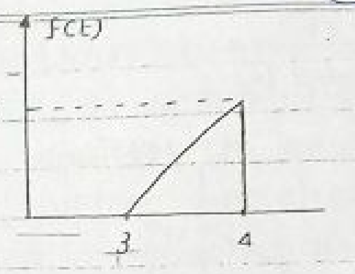
(iii) Reversal $t \to -t$ → add extra -ve sign to $\underline{t}$

(i) Shifting.

$$f(t) \xrightarrow{t \to t+3} f(t+3)$$

	-1	0	1	2	3
Substract 3	-4	-3	-2	-1	0
Divided by 2	-2	-3/2	-1	-1/2	0
add extra -ve	2	3/2	1	1/2	0





Solution:- (i) Reversal $f(t) \xrightarrow{t \to -t} f(-t)$

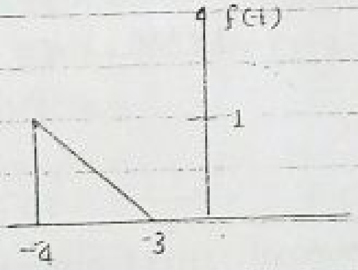
(ii) Shifting. $f(-t) \xrightarrow{t \to t+7} f(-(t+7))$

$= f(-t-7)$. This is not our Requirement

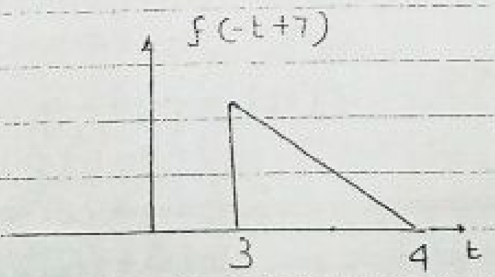
$f(-t) \xrightarrow[f[-(t-7)]]{t \to t-7} f(-t+7)$

This is our Requirement

Reversal:



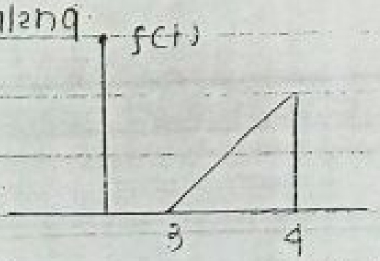
Shifting



⊞ f(t) f(2t+4)

(i) Shifting

(ii) Scaling

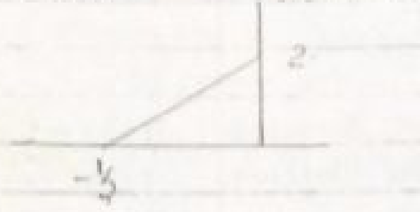


Shifting $t \to t+4$.

$f(t) \xrightarrow[\text{subtract } 4]{} f(t+4)$

$f(t+4) \xrightarrow[\text{Divided by 2}]{t\to 2t} f(2t+4)$

Final Graph



Now 2nd order.

(i) Scalling

(ii) Shifting

$f(t) \xrightarrow{t\to 2t} f(2t)$

$f(2t) \xrightarrow{t\to t+4} f(2(t+4)$

$\therefore f(2t+8)$ which is not same as first order.

original shift amout by Divided by Scaling amout.

$\therefore f(2t) \xrightarrow[t\to t+4/2]{} f(2(t+4/2)$

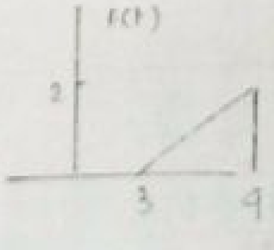
$= f(2t+4)$

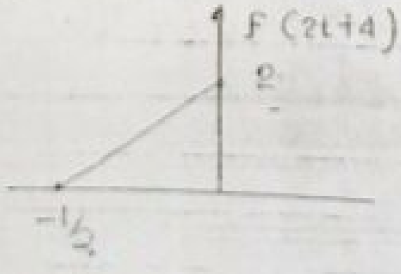
same as first

Now Graph plotting

(i) Divided by 2.

(ii) Subtract by 2.





If shifting is perform after Reversal the nature of Shift must be change that is the Delay shifting operation changes to advance shifting operation and Advance shifting operation change to delay operation if shifting is perform after Reversal.

If shifting is perform after scaling the orignal shift amount has to be divided by scalling factor.

Among scaling and Reversal the order of application of operat does not matter.

Relalize the Transformation Require to get $f(-at+b)$ if the operations are to perform in the order scaling Reversing and shifting.

Solution.

$$f(t) \longrightarrow f(-at+b)$$

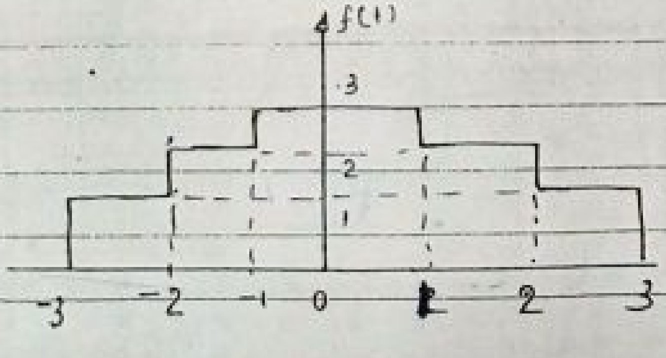
Scaling $\quad f(t) \xrightarrow{t \to at} f(at)$

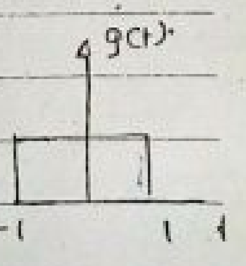
$$f(t) \xrightarrow{t \to -t} f(-at)$$

$$f(-at) \xrightarrow[t \to t - b/a]{t \to \cancel{t+} b/a} f(-a(t - b/a)$$

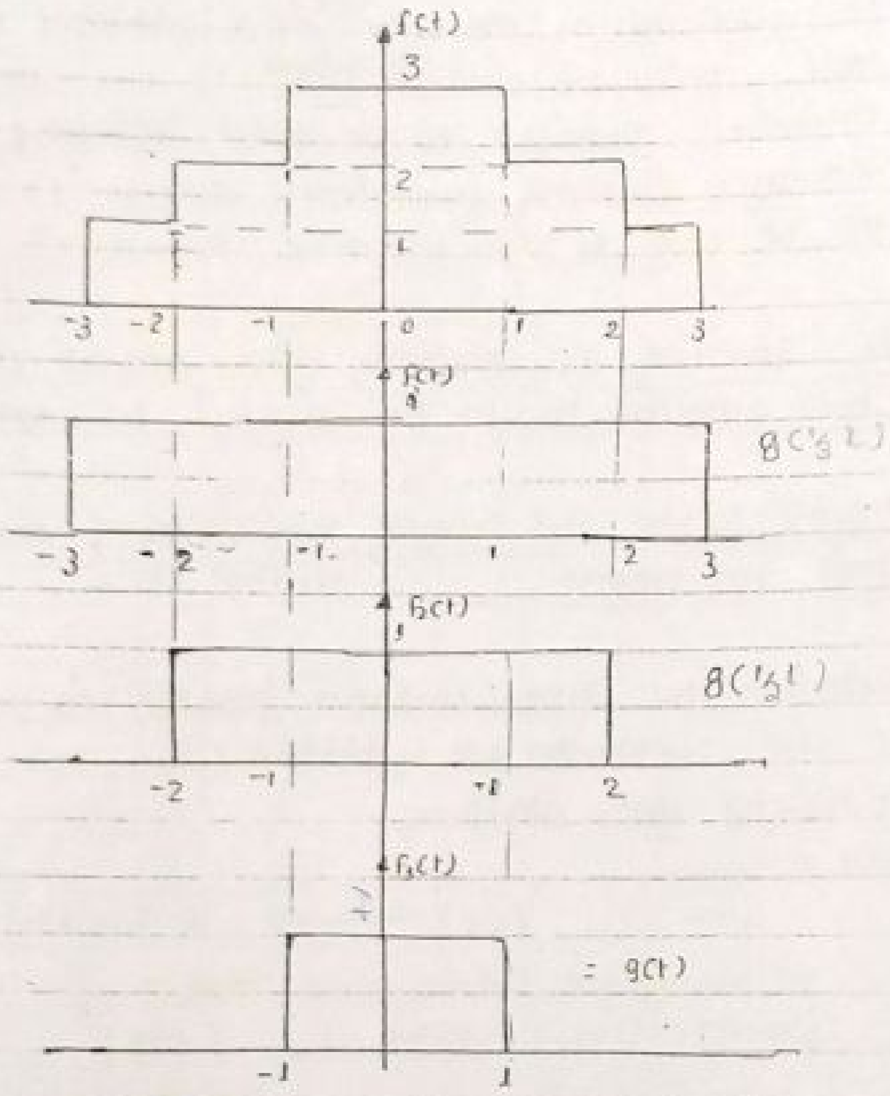
$$= \underline{f(-at+b)}$$

⇒ Repersent following signal f(t) in term of g(t).





Solution :→

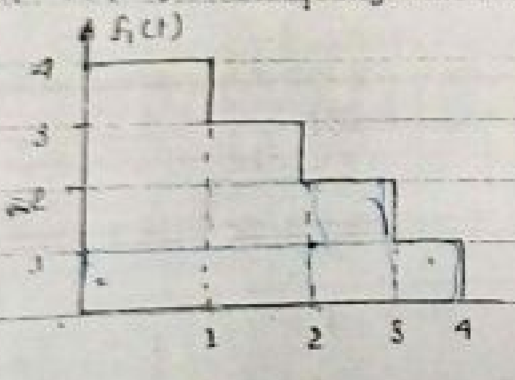


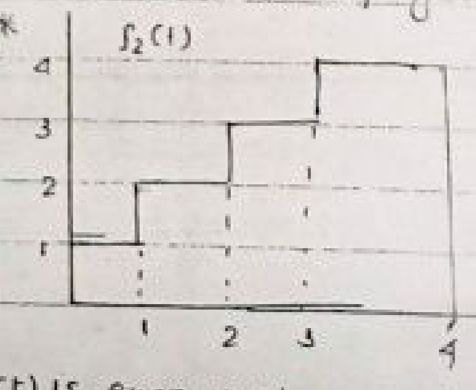
$f(t)\ g(t) = f_1(t) + f_2(t) + f_3(t)$

$= g(\tfrac{1}{3}t) + g(\tfrac{1}{2}t) + g(t)$.

$\boxed{f(t) = g(\tfrac{1}{3}t) + g(\tfrac{1}{2}t) + g(t)}$.

Represent the following signal $f_1(t)$ & $f_2(t)$ in term of $g(t)$





g(t) is given in above problem.

Classification OF Signal :-

1. Real value or Complex valued signal

If a signal is defined as- Imiginory alone with Real part then signa is complex valued signal

$$\boxed{f(t) = 3t + j2t}$$

$$e^{jt} \rightarrow \cos t + j\sin t$$

↳ Eular signal.

Real value signal when add with Imiginory part becum Complex valued signal

Complex valued signal consisting of the non physical imiginary part are used in signal analysis as they reduce amount of analysis require to get the Result.

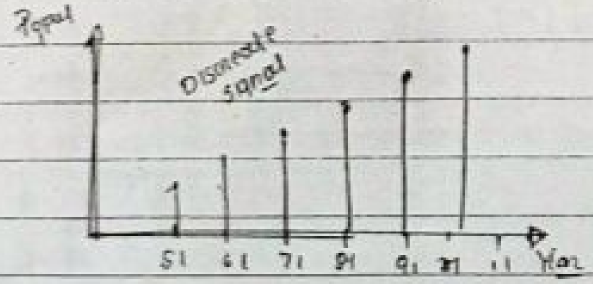
The most common complex valued signal is Eular signal is Defined as

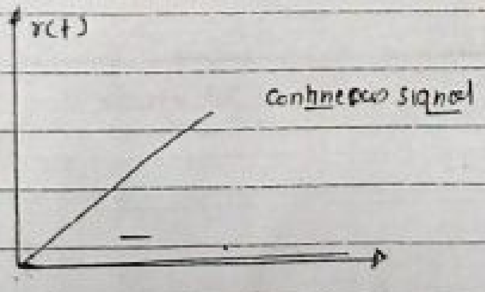
$$e^{jt} = \cos t + j\sin t$$

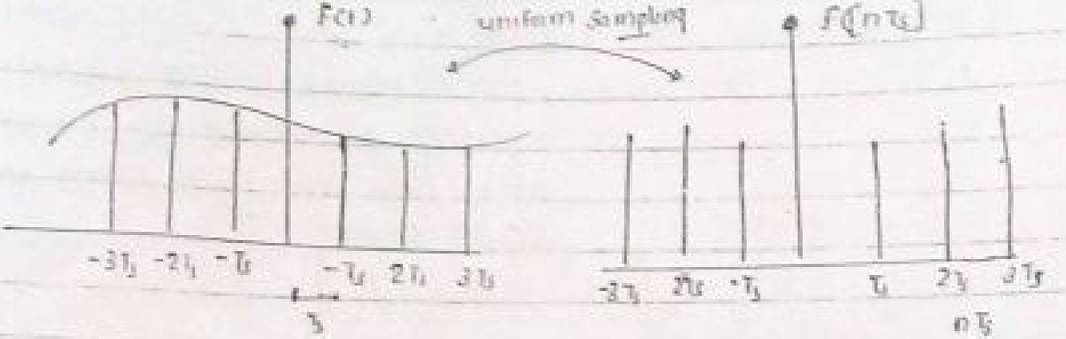
2. Contineous time or Discreate time signal :→

If a signal value is defined for all value of time over a range of time it is called as Contineous time signal.

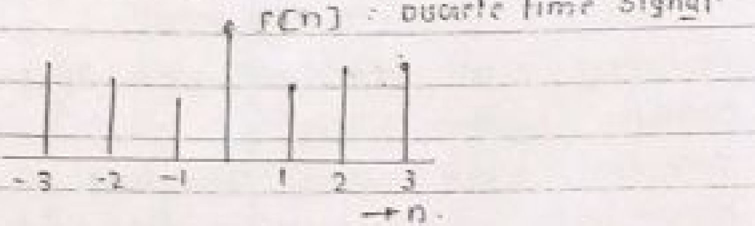
If a signal has a defined value only for some specific instant of time and if the value is not define for remaning time then the signal is discreate time signal.







If Ts = 1



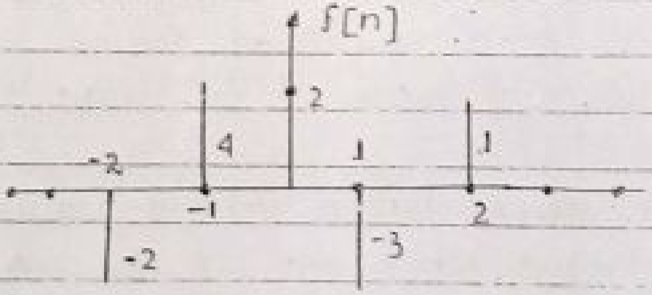
$f(t) \xrightarrow[t \to nT_s]{} f[nT_s] \xrightarrow{T_s=1} f[n]$: Discreate time signal

↳ any Real value

↳ integer

→ Functional difference

Graphical model of Discreate time signal



Equational Represanhon-

$f[n] = -2$	$n = -2$	n
$= 4$	$n = -1$	$n+5$
$= 2$	$n = 0$	$n+2$
$= -3$	$n = 1$	$n-4$
$= 1$	$n = 2$	$n-1$
$= 0$	other	

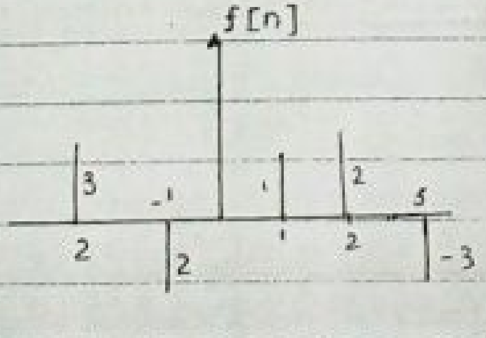
other Represantion $\{-2\ 4,\ \underset{\uparrow}{\overset{n=0}{2}}\ -3\ 1\}$

A Discreate time signal is arived from a Contineous time signal by procedure called as uniform sampling
The functional Differance b/w a Contineous & Discreate time signal is that the argument of contineous time signal can take any real value but argument of Discreate time Signal can take integer value
that is Discreate time signal value like this
f[3] f[5] f[9] - - - -
f[3/5] f[4/9] - - - are undefined

For a Discreate time signal model proposed above there is only space for integer ~~time~~ value for time axis.
There is no space of non integer value

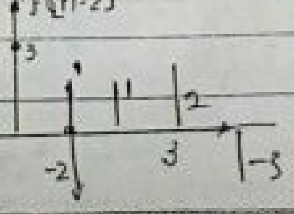
Discreate time signal information also
as a sequence of no which indicate the sample value of the signal with proper indexing
$\{-2\ 4\ \underset{\uparrow}{\overset{n=0}{2}}\ -3\ 1\}$

Graphical model of Discrete time signal.



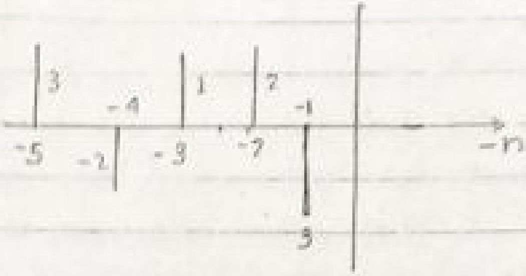
Sequence : $\{3, -2, 1, 2, -3\}$

$f[n] \xrightarrow[\text{add } 2]{n \to n-2} f[n-2]$



$\{\underset{\uparrow}{-3}\ -2\ 1, 2\ -$

F[n+3] : ?

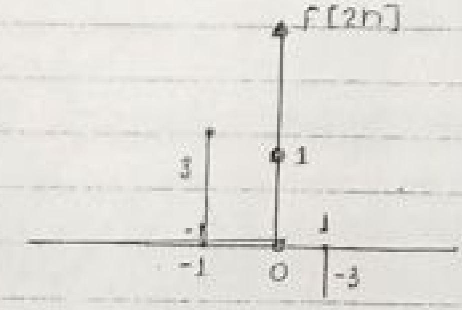
$$F(n) \xrightarrow[\text{Subshract 3}]{n \to n+3} f(n+3]$$

$\{3, -2, 1, 2, -3, 0\}$

3 unit

Shift Right by 3 unit

F[2n] : ?

$$f(n] \xrightarrow[\text{Divided by 2 transformation}]{n \to 2n} f[2n]$$



n = 1 is not Repesent on the graph bc'z on the axis only Repessent enteges value but $\frac{1}{2} = 0.5$

Sequence : $\{3 \underset{\uparrow}{1} -3\}$

-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6

f[n] : $\{1, 2, 3, 4, 5, 6, \underset{\uparrow}{7}, 6, 5, 4, 3, 2, 1\}$

f[2n] : $\{1, 3, 5, \underset{\uparrow}{7}, 5, 3, 1\}$

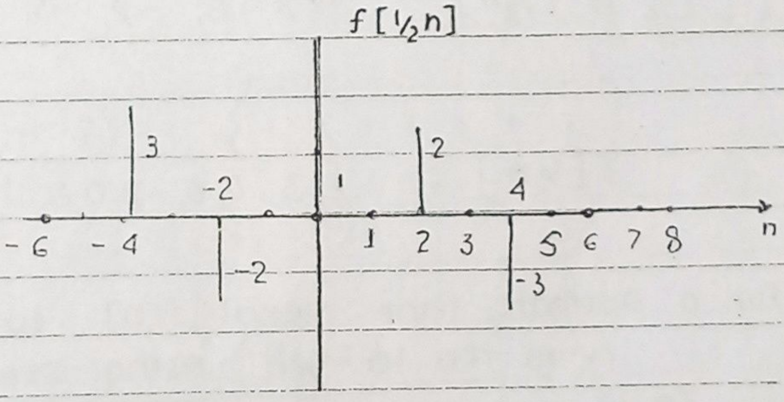
f[3n] : $\{1, 4, \underset{\uparrow}{7}, 4, 1\}$.

$f[4n] = \{3, \underset{\uparrow}{7}, 3\}$

To transform $n \to an$ for a discreate time signal retain the sample value occuring at $n=0$ as it is from then on retain every a_{th} sample towards both side of $n=0$ sample value

$f(n] \longrightarrow f[\frac{1}{2}n]$

$$f[n] \xrightarrow[\text{Divided by } \frac{1}{2}]{n \to \frac{1}{2}n} f[\frac{1}{2}n]$$



Interpolution
(i) Zero Interpolution
(ii) Unity Interpolution
(iii) Average interpolution.

For a discreate time signal f[n] if n is transfor to an [a>1] The resulting time scale signal will have lesser no. of sample value than that were originaly present in given discrele time signal this procedure is called as Desimation of Discrete time signal.

For a Discreate time signal if n is transform to $\frac{1}{a}n$ (a>1) there are some ~~unspecified~~ unspaced sample value in the Really which have to be specified by using a Suitable enterpolution formula and Resulteng time Scale signal have will have more no of sample value than that are originaly present on the Consider Discreate time signal This process is enterpolution of Discrete time signal.

By Default Zero Interpolution is use to Specifies the unknown sample value.

$f[\frac{1}{2}n]$:

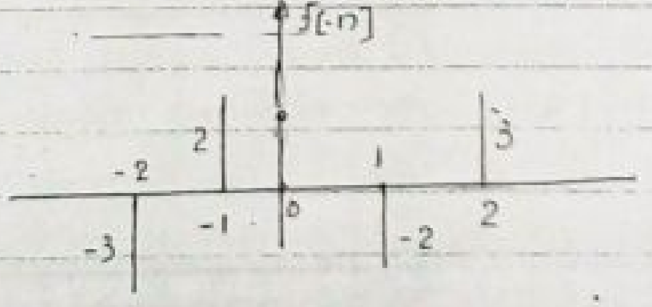
$f[\frac{1}{2}n]$: $\{3, 0, -2, 0, \underset{\uparrow}{1}, 0, 2\ 0, -3\}$

$f[\frac{1}{3}n]$: $\{3\ 0, 0, -2\ 0\ 0.\ 1.\ 0, 0, 2, 0, 0, -3\}$

For a Discreate time signal f[n] to transform a n to $\frac{1}{a}n$ using zero Interpolution techinq (a-1) zero have to be added b/w every two value.

f[-n]: ?

$$f[n] \xrightarrow[\text{add extra -ve sign to all 'n'}]{n \to -n} f[-n]$$



Sequence: $\{-3, +2, \underset{\uparrow}{1}\ -2, 3\}$

[PS/19] :-

Given

$x[n] = \begin{cases} 0 & n<-2, \quad n>4 \\ 1 & \text{otherwise} \end{cases}$

Find $x[-n-2]$: ?

Solution:-

$x[n] : \{ \overset{-2}{1} \; \overset{-1}{1} \; \underset{\uparrow}{\overset{0}{1}} \; \overset{1}{1} \; \overset{2}{1} \; \overset{3}{1} \; \overset{4}{1} \}$

Shifting-

$x[n] \xrightarrow[\text{shift the arrow left by 2 unit}]{n \to n-2} x[n-2] \cdot \; \{ \underset{\uparrow}{1}, 1, 1, 1, 1, 1, 1 \}$

Reversal

$x[n-2] \xrightarrow{n \to -n} x[-n-2] \cdot$

$\Rightarrow \; \{ 1 \; 1 \; 1 \; 1 \; 1 \; 1 \; \underset{\uparrow}{1} \}$

$x[-n-2] = \{ \overset{n=-6}{1}, \; 1, \; 1, \; 1, \; 1 \; 1 \; \overset{n=0}{1} \}$

[C] $n<-6, \quad n>0$

Question-29.

Solution

$y[n] = \begin{cases} x\left(\frac{n}{2}-1\right) & n = \text{even} \\ 0 & n = \text{odd} \end{cases}$

$x[n] \longrightarrow x\left[\frac{n}{2}-1\right]$

Shifting

$x[n] \xrightarrow[\text{add 1}]{n \to n-1} x[n-1]$

$x[n]$

○

● 1

Scaling

$x[n-1] \xrightarrow[\text{Divided by } \frac{1}{2}]{n \to \frac{1}{2}n} x\left[\frac{1}{2}n-1\right]$

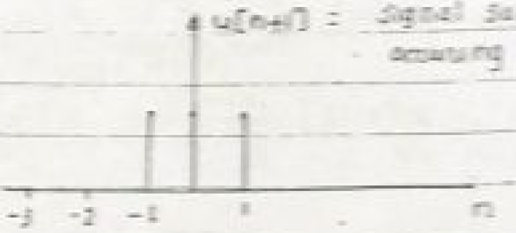
$\frac{1}{2} = 2$

$y[n]$

- Discrete time unit step signal

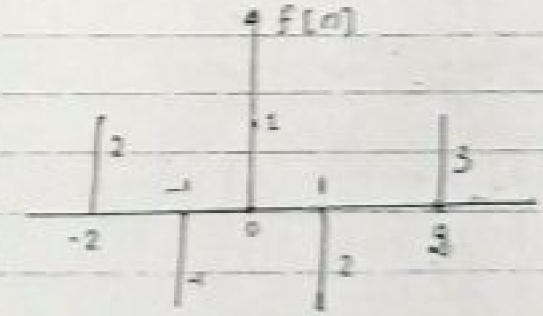
$$u[n] = 1 \quad n \geq 0$$
$$= 0 \quad n < 0$$

u[n+1] = signal sample value change occuring at n=-1



u[n-1] = signal sample value change occuring at n=1

- $u[n-n_0]$
  : Sample value change at $n = n_0$



$$\{2, -1, \underset{\uparrow}{1}, -2, 3\}$$

u[n+2] : sample value chang 0 to 2 at n=-2.
u[n+1] : Sample value change 2 to -1 at n=-1
u[n] : Sample value change -1 to 1 at n=0
u[n-1]
u[n+2]
u[n-3

$f[n] = 2u[n+2] - 3u[n+1] + 2u[n] - 3u[n-1] + 5u[n-2] - 3u[n-3]$

f[n]: In term of shifted unit step signal.

Some of co-efficient = 0

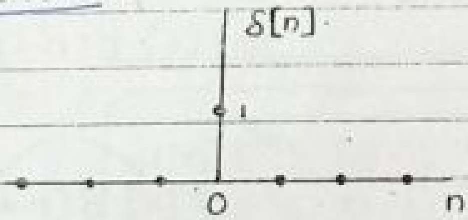
Or ~~at~~ in f[n]
at n:1 f[n]: 1 Then f[n] becoms.

$f[n]: 2u[n+2] - 3u[n+1] + 2u[n] + 0 + 2u[n-2]$
$+ 3u[n-3]$.

In the above Repersentation sum of co-efficeient will be equal to zero of there are finite no of non-zero sample value en the consides f[n].

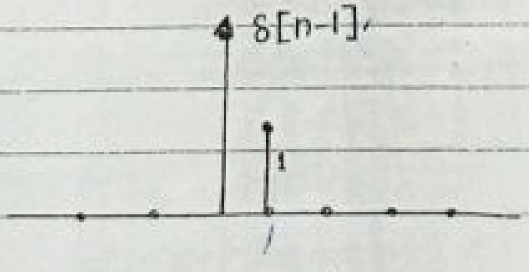
Discreate time.

Impulse Function:→



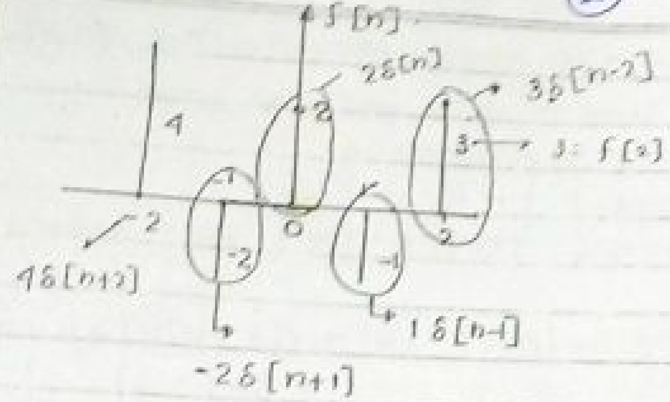
mathematically

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



$\delta[n-1] = 1 \quad n = 1$
$\quad\quad = 0 \quad n \neq 0$.

$\delta[n+1]: 1 \quad n: -1$
$\quad\quad : 0 \quad n \neq -1$

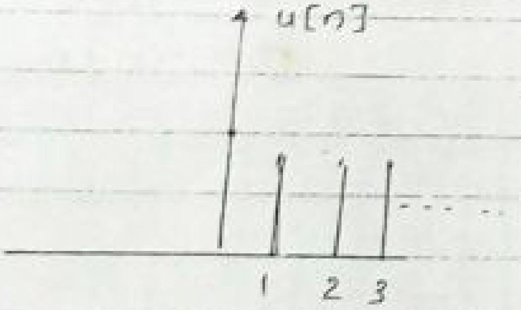


f [n]: combination of shifted discreate impulse signal

$f[n] = 4\delta[n+2] - 2\delta[n+1] + 2\delta[n] - 1\delta[n-1] + 3[n-2]$

$= f[-2]\delta[n-(-2)] + f(-1)\delta[n-(-1)] + f[0]\delta[n-0]$
$+ f[1]\delta[n-1] + f[2]\delta[n-2].$

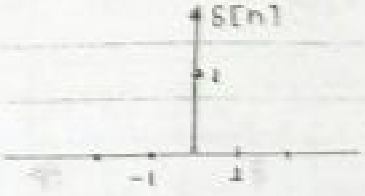
$$\boxed{f[n] = \sum_{k=-\infty}^{\infty} f[k]\,\delta[n-k]}$$



$u[n] = \sum_{k=0}^{\infty} u[k]\,\delta[n-k]$

$$\boxed{u[n] = \sum_{k=0}^{\infty} \delta[n-k]}$$

Repersantation of δ[n] in term of u[n]



$\delta[n] : u[n] - u[n-1]$.

→ sample value c
from 1 to 0 at

Sample value change from 0 t
1 hence coefficient is (1-0) = 1
at n=0

$$\sum_{k=-\infty}^{n} \delta[k] = 0$$

$$\delta[n] + \delta[n-1] + \delta[n-2] + \cdots \delta[-\infty].$$

$= 0 \quad n<0,$

$= 1 \quad n=0 \quad \left[\underset{1}{\delta[0]} + \underset{0}{\delta[-1]} + \underset{0}{\delta[-2]} \ldots\right.$

$= 1 \quad n>0 \quad \left.\right\} \underset{0}{\delta[1]} + \underset{1}{\delta[0]} + \underset{0}{\delta[-1]} \ldots = 1$

Hence

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

So,

$$\boxed{u[n] : \sum_{k=-\infty}^{n} \delta[k]}$$

Relation b/w δ[n] and u[n].

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

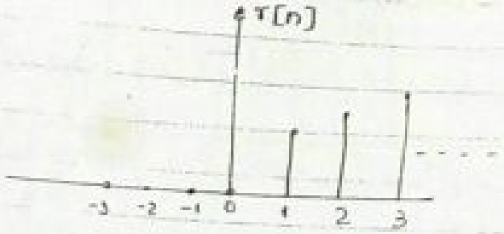
$$u[n] : \sum_{k=-\infty}^{n} \delta[k].$$

In continuous time signal:-

$$\delta(t) : \frac{du}{dt}$$

$$u(t) = \int_{-\infty}^{t} \delta(t)\,dt$$

Discreate Time Ramp Signal:→



r[n] = n n≥0
 = 0 n<0

$r(n) = \sum_{n=-\infty}^{\infty} n\,u(n)$

In continuous time signal

$u(t) = \frac{dr(t)}{dt}$

$r(t) = \int_{-\infty}^{t} u(t)dt$

Find out the Relation b/w DT unit Ramp and Discrete time unit step signal.

3 Even Signal OR Odd Signal

→ Symmetrical Signal