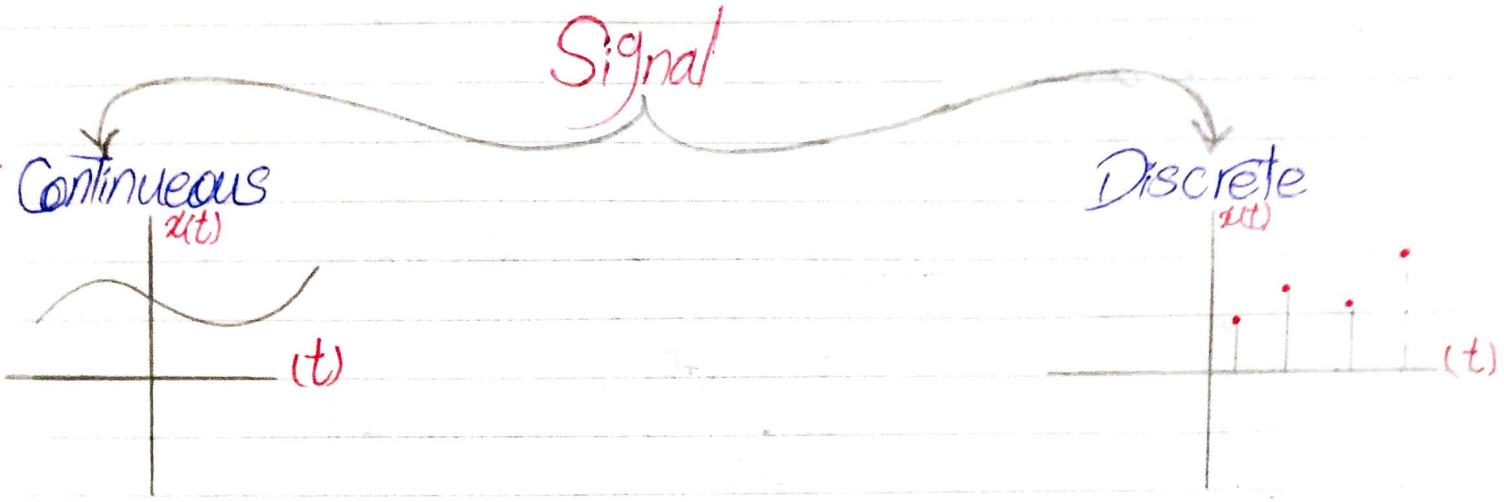
"Digital Signal"

Section 2

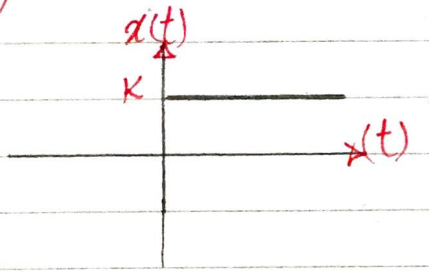


* System: interconnection between more than device « Component ».

1) Continueous Signal: -

1. Step signal:

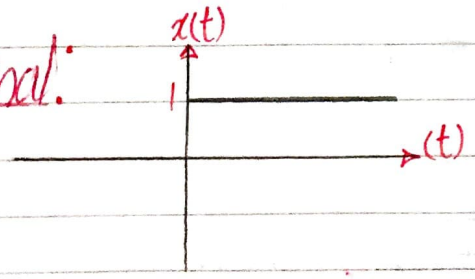
graph:



$$x(t) = \begin{cases} K & t \geq 0 \\ 0 & t < 0 \end{cases}$$

- Unit Step signal:

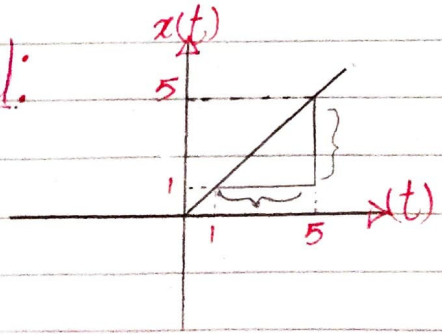
graph:



$$x(t) = \begin{cases} 1 & t \geq 0 \\ 0 & t < 0 \end{cases}$$

2. Ramp Signal:

graph:



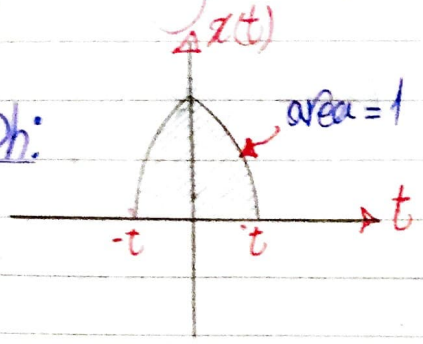
$$\text{slope} = \frac{x(t_2) - x(t_1)}{t_2 - t_1} = 1$$

$$, x(t) = \begin{cases} t & t \geq 0 \\ 0 & t < 0 \end{cases}$$

if slope $\neq 1$, $\therefore x(t) = \begin{cases} K \cdot t & t \geq 0 \\ 0 & t < 0 \end{cases}$

3. Impulse Signal: "$\delta(t)$"

graph:



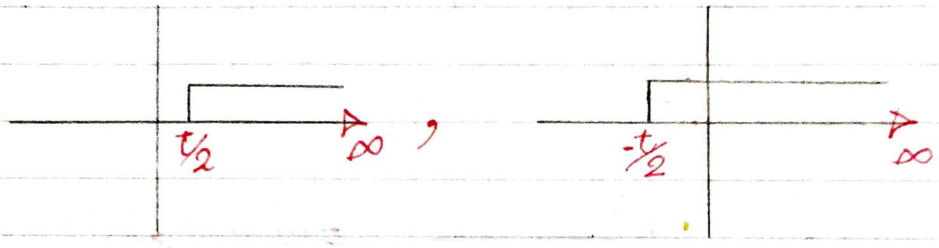
$\delta(t) = 0$, at $t \neq 0$

$\int_{-t}^{t} \delta(t)\, dt = 1$

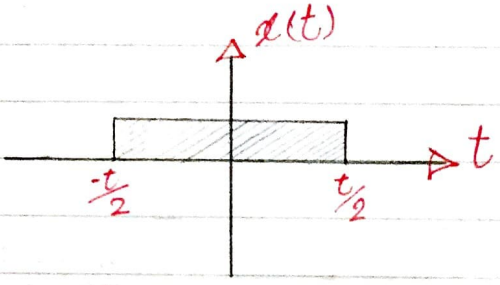
$\int_{-t_1+t}^{t_1+t} \delta(t - t_1)\, f(t_1) = f(t)$

4. Pulse Signal:

- Consists of 2 Signals:



graph:



5. Periodic Signal:

$x(t) \rightarrow x(t+T)$ → period.

- example: $x(t) = \sin(\omega t + \theta)$

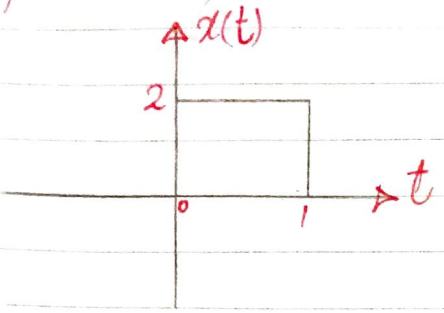
$= \sin(\omega t + \theta + 2\pi)$

$= \sin[\omega(t + \frac{2\pi}{\omega}) + \theta]$

$= x(t) + 2\pi$

* operations on Continueous Signal:-

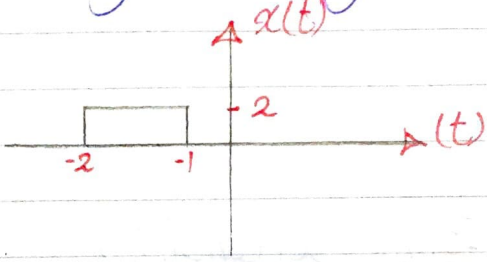
1) Phase Shift: For Time «a,l» Not magnitude



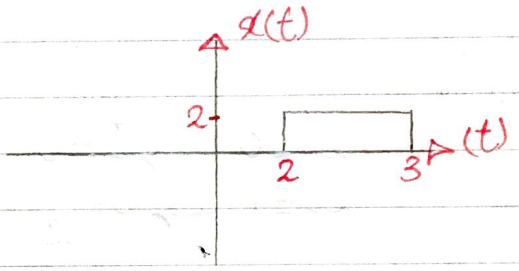
→ x(t+2) positive shift Left

→ x(t-2) negative shift right

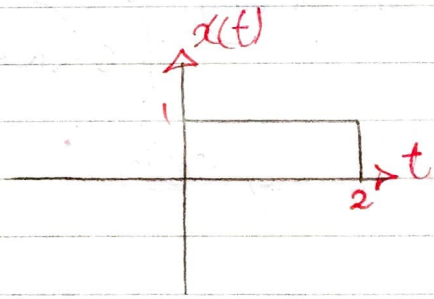
- positive shift Left: $t+2=0 \rightarrow t=-2$
$t+2=1 \rightarrow t=-1$



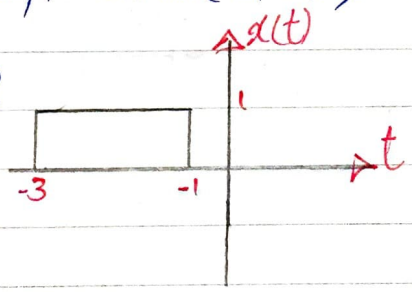
- negative shift right: $t-2=0 \rightarrow t=2$
$t-2=1 \rightarrow t=3$



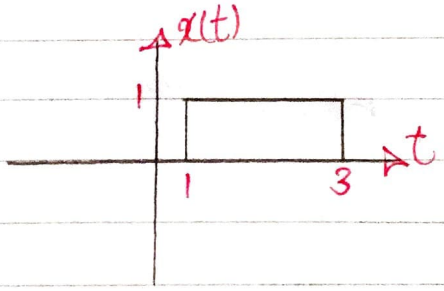
- Example: Find phase shift at x(t+3), x(t-1)



⇒ $t+3=0 \rightarrow t=-3$
$t+3=2 \rightarrow t=-1$



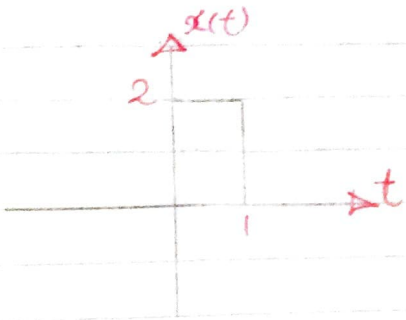
⇒ $t-1=0 \rightarrow t=1$
$t-1=2 \rightarrow t=3$



2) Scaling: "For magnitude and time"

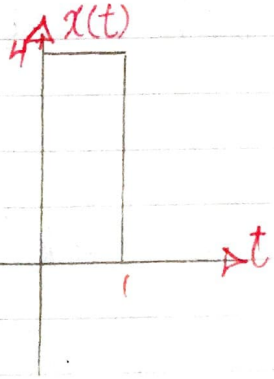
1- magnitude:

- Form: Const. $x(t)$



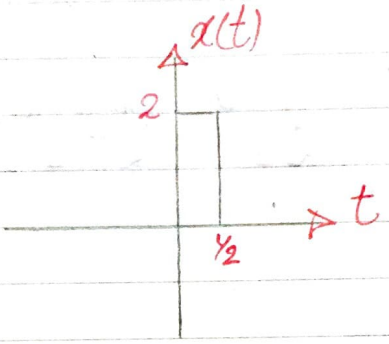
ex: Find $2x(t)$

$\Rightarrow$



2- Time:

- Form: $x(\text{Const.}\, t)$



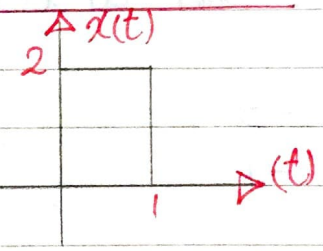
ex: Find $x(2t)$

$\Rightarrow 2t=0 \rightarrow t=0$

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

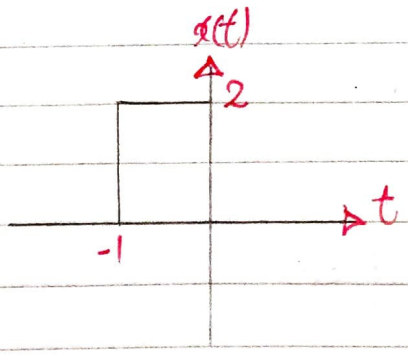
* at time scaling, if $K>1 \rightarrow$ Compression
if $0<K<1 \rightarrow$ Stretching

3) mirror «reflection»: "$x(-t)$"

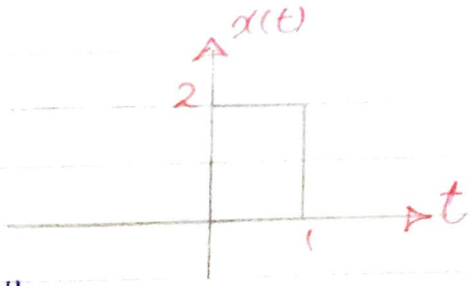


$\Rightarrow -t=0 \rightarrow t=0$

$-t=1 \rightarrow t=-1$



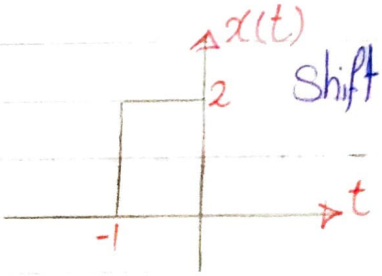
* General Example:



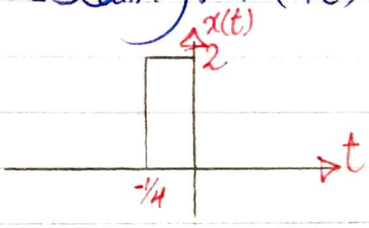
- Find: 1) $x(-4t+1)$
2) $3x(-2t+3)$

- we have to Solve by order: Shift then Scaling then mirror.

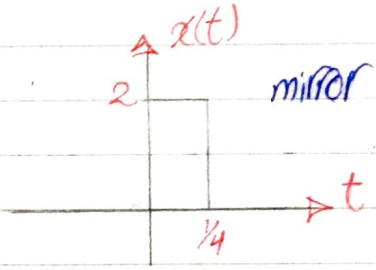
⇒ 1) - Shift: $x(t+1)$ $\quad t+1=0 \rightarrow t=-1$, $\quad t+1=1 \rightarrow t=0$



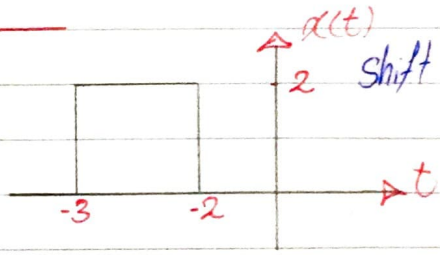
- Scaling: $x(4t)$ $\quad 4t=-1 \rightarrow t=-1/4$, $\quad 4t=0 \rightarrow t=0$



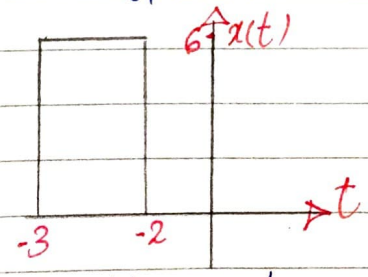
- mirror: $x(-t)$ $\quad -t=\frac{-1}{4} \rightarrow t=\frac{1}{4}$, $\quad -t=0 \rightarrow t=0$



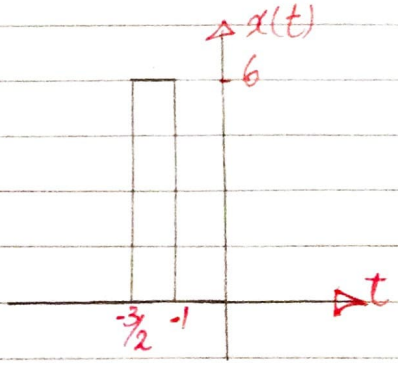
⇒ 2) - Shift: $x(t+3)$ $\quad t+3=0 \rightarrow t=-3$, $\quad t+3=1 \rightarrow t=-2$



- mag. scaling: $3x(t)$

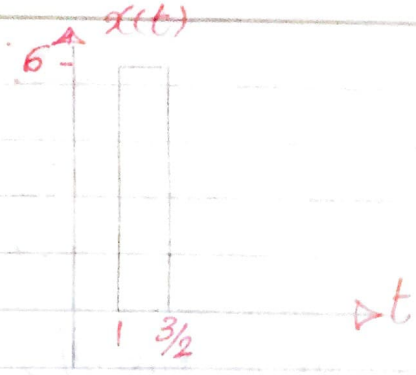


- Time Scaling: $x(2t)$ $\quad 2t=-2 \rightarrow t=-1$, $\quad 2t=-3 \rightarrow t=-3/2$

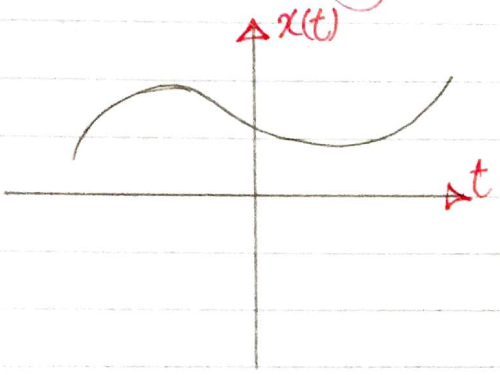


- mirror: $x(-t)$ $\quad -t = -1 \rightarrow t = 1$

$-t = \frac{-3}{2} \rightarrow t = 3/2$

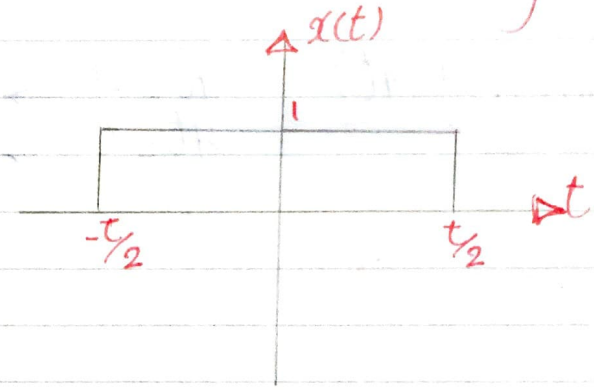


- Continuous Signal



- There is low change in signal values.

- Piecewise Continuous Signal



- There is Sudden change in signal values.
