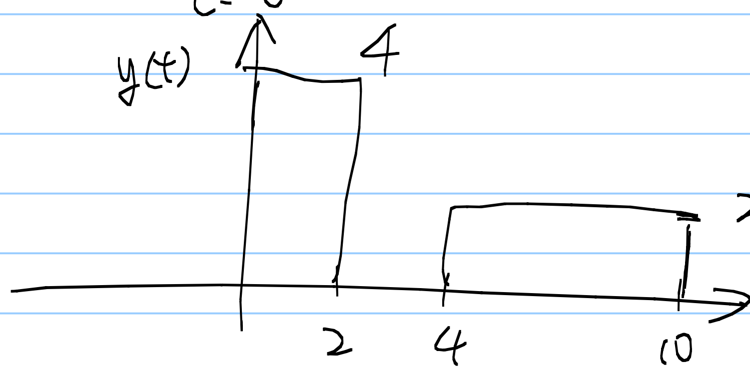
Plot $y(t) = \frac{1}{3} x(4 - 0.5t)$.

Ans: Good pts:

$t = 10$	$4 - 0.5t = -1$	$y(10) = \frac{1}{3} x(-1)$
$t = 4$	2	$y(4) = \frac{1}{3} x(2)$
$t = 2$	3	$y(2) = \frac{1}{3} x(3)$
$t = 0$	4	$y(0) = \frac{1}{3} x(4)$



Prof. Balakrishnan's handout.

* Classification #3: By the period.

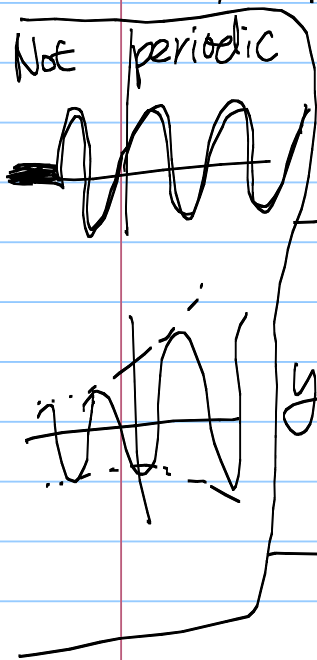
* We say $x(t)$ is a periodic signal with $\boxed{\text{period } T}$ if we let $y(t) = x(t-T)$ be the shifted version of $x(t)$, then the new signal "looks" exactly like the old signal: sometimes we just write

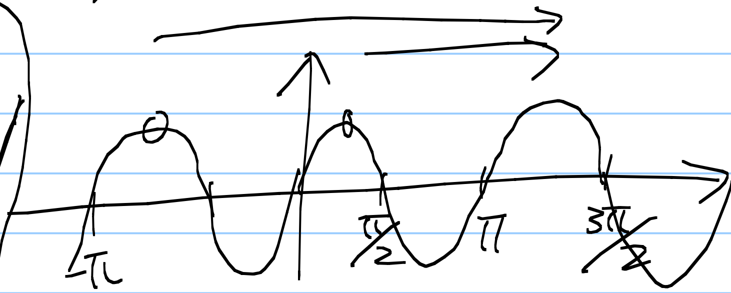
$$x(t) = x(t-T)$$

For DT: if $x[n] = x[n-N]$, then $x[n]$ is periodic with period N

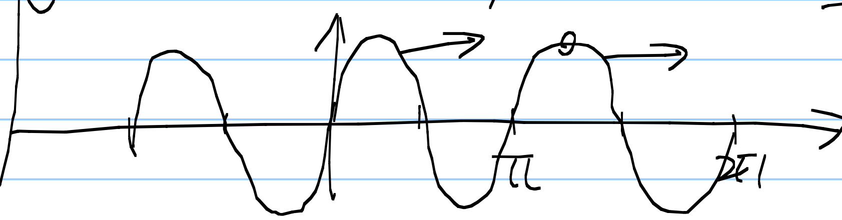
Note Title 9/2/2014

Ex: $x(t) = \sin(2t)$ Plot $x(t)$ vs. t.





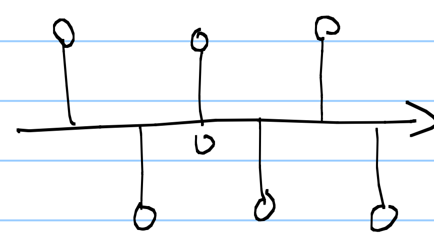
$y(t) = \sin(2(t-\pi))$



$\Rightarrow$ $x(t)$ is periodic with period π

Ex: $x[n] = (-1)^n$

Q: Is $x[n]$ periodic?



A: $x[n]$: 1 -1 1 -1 1 -1 1 -1

$\Rightarrow$ periodic with period 2.

* If $x(t)$ is periodic with period T then it is periodic with period mT for any $m \geq 1$ integers

Ex: $\pi, 2\pi, 3\pi, \cdots$ are all periods for $x(t) = \sin(2t)$

* Def: The <u>fundamental period</u> is the smallest period of a periodic signal $x(t)$ or $x[n]$.

* If $x(t) = x_{Re}(t) + j\,x_{Im}(t)$ is a periodic complex signal, then both $x_{Re}(t)$ & $x_{Im}(t)$ are <u>periodic</u> real signals.

Proof: $x(t)$ is periodic with period T

$$\Leftrightarrow x(t) = x(t-T)$$

$$\Leftrightarrow x_{Re}(t) + j\,x_{Im}(t) = x_{Re}(t-T) + j\,x_{Im}(t-T)$$

$$\Rightarrow \begin{cases} x_{Re}(t) = x_{Re}(t-T) \\ x_{Im}(t) = x_{Im}(t-T) \end{cases}$$

both $x_{Re}(t)$ & $x_{Im}(t)$ are periodic

Question for the teams If both $x_1(t)$ and $x_2(t)$ are periodic, must $x_1(t) + x_2(t)$ periodic?

How to decide the period of a signal?

Ans: ① Inspection

② If $x_1(t)$ has fund. period T_1

$x_2(t)$ has fund. period T_2

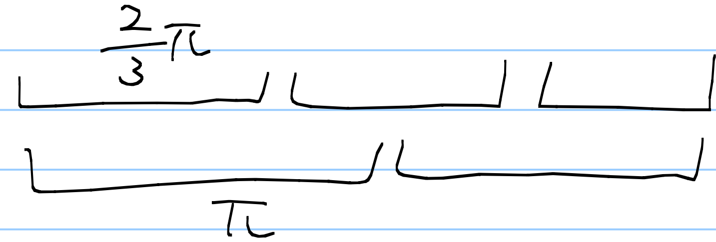
then $x_1(t) + x_2(t)$ is of period

Least Common Multiple

$L.C.M(T_1, T_2)$

ex: $\underbrace{\cos(3t)} + \sin\underbrace{(2t)}$

$T_1 = \frac{2\pi}{3}$ $\qquad$ $T_2 = \frac{2\pi}{2} = \pi$



$LCM(\frac{2\pi}{3}, \pi) = 2\pi$ new period