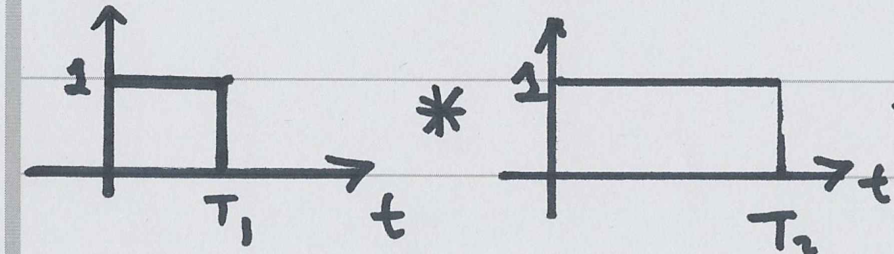
• Basic Convolution Results (CT)

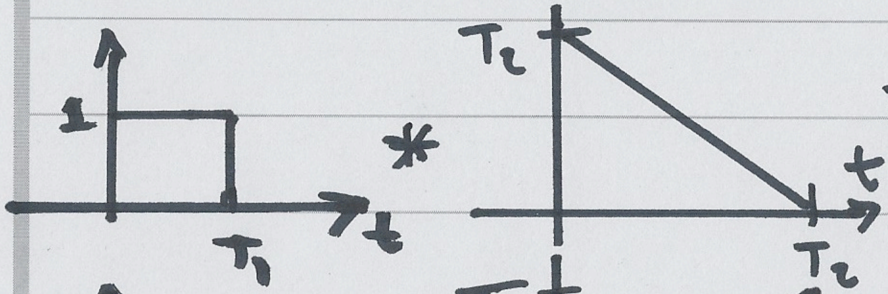
$a \neq b$

$e^{at}u(t) * e^{bt}u(t) = ?$ see notes

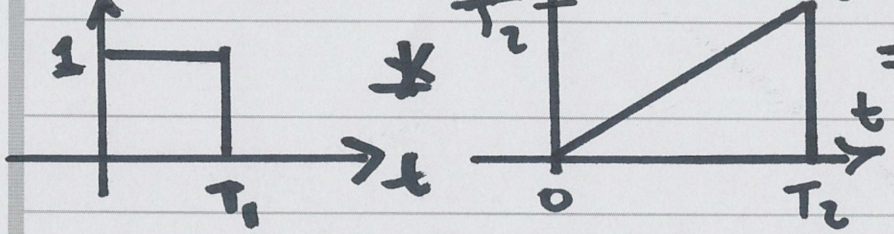


$= ?$ see notes

$x(t) * \delta(t-t_0) = x(t-t_0)$



$= ?$ see notes



$= ?$ see notes

$e^{at}u(t) * e^{at}u(t) = t e^{at}u(t)$

Properties

- Linearity:
  - Homogeneity
  - Superposition
- Time-Invariance

If: $x(t) * h(t) = y(t)$

Then:

$a x(t-t_1) * b h(t-t_2)$

$= ab\, y(t-(t_1+t_2))$

Def'n of Derivative

$$\boxed{f'(x) = \lim_{\Delta x \to 0} \frac{f(x+\Delta x) - f(x)}{\Delta x}}$$

Basic Derivative Pairs

$f(x)$	$f'(x)$
x^n	$n x^{n-1}$
e^x	e^x
$\sin(x)$	$\cos(x)$
$\ln(x)$	$1/x$
$\sin^{-1}(x)$	$1/\sqrt{1-x^2}$

Derivative Props

$$(fg)' = f'g + fg'$$

$$\left(\frac{f}{g}\right)' = \frac{f'g - fg'}{g^2}$$

$$\frac{d}{dx}\left(f(g(x))\right) = f'(g(x))g'(x)$$

$$(af + bg)' = af' + bg'$$

• Recall notation from Calculus:

1. $y = f(x)$ $\quad \dfrac{dy}{dx}$ is notation for $\displaystyle \lim_{\Delta x \to 0} \frac{f(x+\Delta x) - f(x)}{\Delta x}$

2. $x(t)$ $\quad \dfrac{dx(t)}{dt}$ is notation for $\displaystyle \lim_{\Delta t \to 0} \frac{x(t+\Delta t) - x(t)}{\Delta t}$

function of time, t

3. Similarly, for convolution:

$y(t) = x(t) * h(t)$ is notation for $\displaystyle \int_{-\infty}^{\infty} x(\tau) h(t-\tau) d\tau$

$= y(t)$

the asterisk is universal notation for convolution } $*$