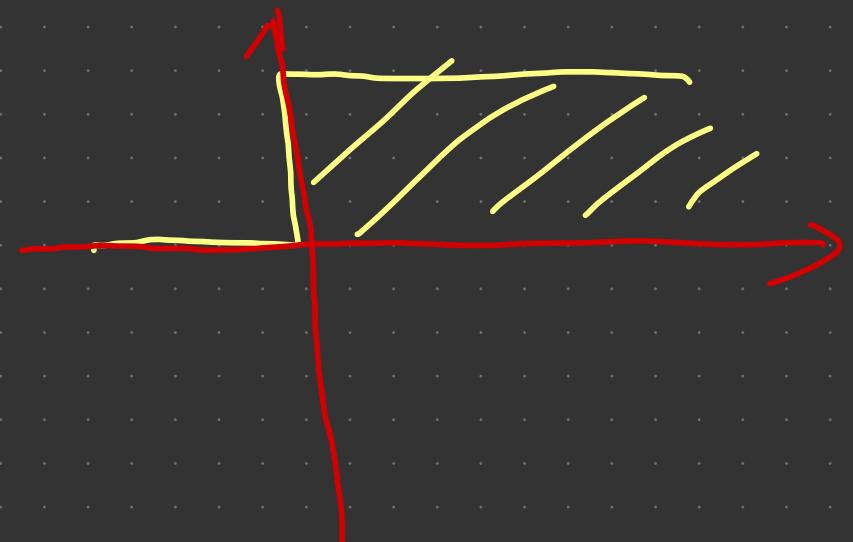


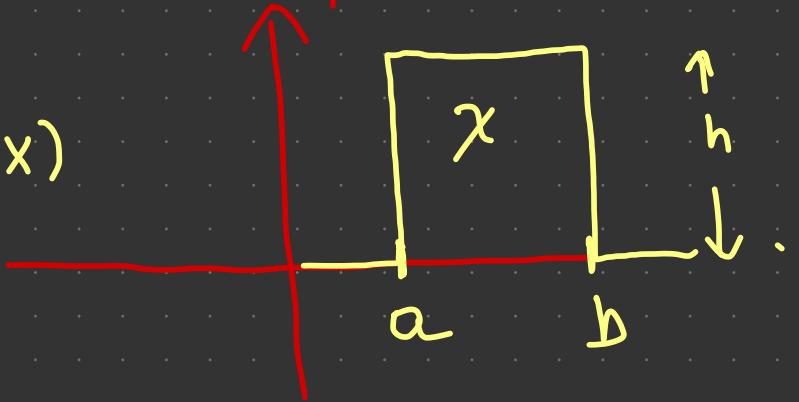
7a

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



$$\Theta'(x) = \delta(x)$$

$$*\chi'(x) = h \cdot \delta_a(x) - h \delta_b(x)$$



* Regula Leibniz

$$(f \cdot T)' = f' \cdot T + f \cdot T'$$

$$7a: f(x) = |x| = x \cdot \chi_1 - x \cdot \chi_2$$

$$\chi_1 = \Theta(x) \quad \chi_2(x) = \Theta(f(x))$$



$$f'(x) = (x \cdot \chi_1 - x \cdot \chi_2)' =$$

$$(x \cdot \chi_1)' - (x \cdot \chi_2)' =$$

$$1 \cdot \chi_1 + \underbrace{x \cdot \delta_0(x)}_{\stackrel{0}{\parallel}} - 1 \cdot \chi_2 - \underbrace{x \cdot (-\delta_0(x))}_{\stackrel{0}{\parallel}}.$$

$$\underbrace{(x \cdot \delta_0)}_0(f) = \delta_0(x \cdot f) = 0 \cdot f(0) = 0 \cdot$$

$$f' = \chi_1 - \chi_2.$$

$$f'' = x_1' - x_2' = \delta_0 - (-\delta_0) = 2\delta_0.$$

$$f''' = 2\delta_0' \quad \text{i.t.d.}$$

$$f^{(4)}(x) = 2\delta_0''(x).$$



$$g(x) = x \sin(x)$$



$$g' = x \cdot \cos(x) + (\delta_0(x) - \delta_\pi(x)) \cdot \sin(x)$$

$$= x \cdot \cos(x)$$



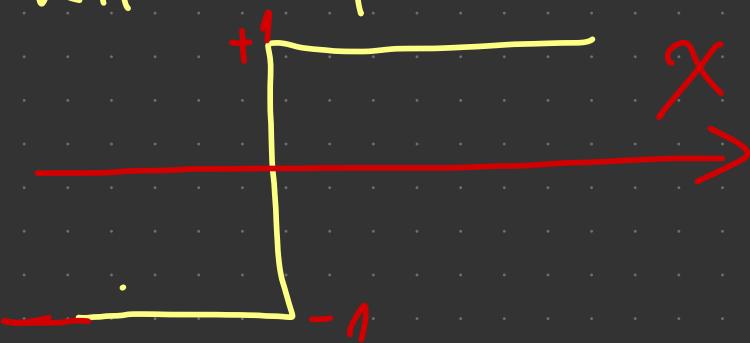
$$f'(x) = \begin{cases} \omega s(x) & : x \in [2k\pi, (2k+1)\pi] \\ -\omega s(x) & : [(2k+1)\pi, (2k+2)\pi] \end{cases}$$

$$\begin{aligned} g''(x) &= (\chi(x) \cdot \omega s(x))' = -\chi(x) \cdot \sin(x) + \\ &+ (\delta_0(x) - \delta_{\pi}(x)) \omega s(x) = -\chi(x) \cdot \sin(x) + \delta_0(x) \\ &\quad + \delta_{\pi}(x). \end{aligned}$$

$$f''(x) = -|\sin(x)| + \sum_{k=-\infty}^{+\infty} 2 \cdot \delta_{k\pi}(x)$$

The graph shows a periodic function with sharp vertical spikes at every multiple of π . The function is zero between these points. Red annotations indicate the spikes and the sum notation.

$$f(x) = |x| \cdot \sin(x).$$



$$f' = \chi(x) \cdot \sin(x) + |x| \cdot \cos x.$$

$$f'' = \chi(x) \cdot \cos(x) + \chi(x) \omega x - |x| \sin(x).$$

$$= 2\chi(x) \cdot \cos(x) - |x| \cdot \sin(x).$$

$$f''' = 4\delta_0(x) + 2x \cdot (-\sin x) - \chi(x) \sin x -$$
$$= 4\delta_0(x) - 3x \cdot \sin(x) - |x| \omega(x).$$

$$f^{(IV)} = 4\delta_0'(x) - \underline{3x \cdot (x) \cos(x)} - \overline{\chi(x) \omega x} +$$
$$\overline{|x| \sin(x)}.$$

$$\underline{f^{(IV)} - f} = 4\delta_0'(x) - h \cdot \chi(x) \omega x.$$

$$(8) \quad x^2 T' = 1.$$

$$-x^2 P\left(\frac{1}{x}\right)' = 1$$

$$-x^2 \cdot P'\left(\frac{1}{x}\right)(f) =$$

$$P'\left(\frac{1}{x}\right)(-x^2 f) = P\left(\frac{1}{x}\right)((x^2 f)') =$$

$$= P\left(\frac{1}{x}\right)\left(2x f + x^2 f'\right) = \int f dx = T_1(f).$$

$$\lim_{\varepsilon \rightarrow 0^+} \int_{|x| \geq \varepsilon} \frac{2x f + x^2 f'}{x} dx =$$

$$\lim_{\varepsilon \rightarrow 0^+} \int_{|x| \geq \varepsilon} (2f + x f') dx = \int_{\mathbb{R}} (x f' + 2f) dx = \int f(x) dx.$$

$$\underline{\underline{\int x f' = x \cdot f}} \Big|_{-\infty}^{+\infty} - \int x' \cdot f = - \underline{\underline{\int f(x)}}$$

$$-x^2 P'\left(\frac{1}{x}\right) = 1$$

RSRNJ: $x^2 T' = 1 : -P'\left(\frac{1}{x}\right)$.

RORJ: $x^2 T' = 0$.

$$x^2 S = 0 \xrightarrow{\text{cw}} S = a_0 \delta_0 + a_1 \delta'_0.$$

$$T' = a_0 \delta_0 + a_1 \delta'_0$$

$$T = a_0 \Theta(x) + a_1 \delta_0 + a_2$$

$$RDRN\mathcal{Y} = RDR\mathcal{Y}_A + RSRN\mathcal{Y} =$$
$$\left\{ \underbrace{a_0 \cdot \Theta(x) + a_1 \delta_0(x) + a_2}_{\text{RDRY}_A} - P\left(\frac{1}{x}\right) : a_i \in \mathbb{R} \right\}$$