Tutorial Problem

1. Energy of a trapezoidal pulse $x(t)$.

$$x(t) = \begin{cases} 5-t & 4 \le t \le 5 \\ 1 & -4 \le t \le 4. \\ t+5 & -5 \le t \le -4. \\ 0 & \text{otherwise}. \end{cases}$$

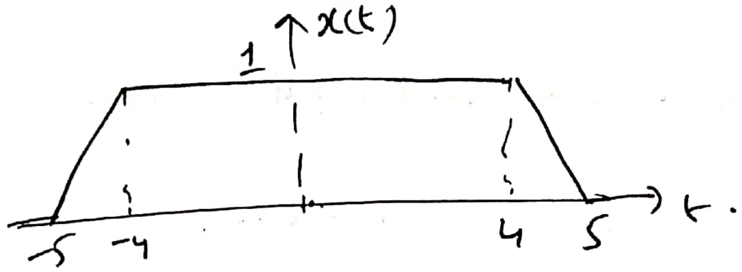
$$E = \int_{-\infty}^{\infty} x^2(t)\, dt.$$

$$= \int_{-5}^{-4} (t+5)^2 dt + \int_{-4}^{4} 1 \cdot dt + \int_{4}^{5} (5-t)^2 dt$$

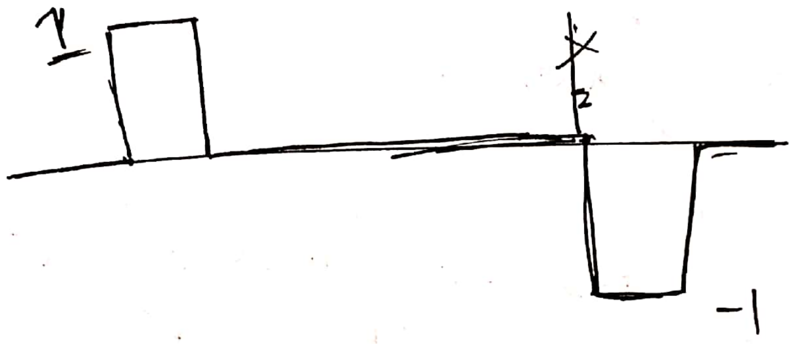
$$= \frac{t^3}{3} + 5t^2 + 25t \Big|_{-5}^{-4} + t\Big|_{-4}^{4} + 25t + \frac{t^3}{3} - 5t^2 \Big|_{4}^{5}$$

$$\therefore E = \frac{1}{3} + 8 + \frac{1}{3} = 8\frac{2}{3} = \underline{8.667}$$

2. $x(t)$



find $y(t) = \frac{d}{dt} x(t)$.



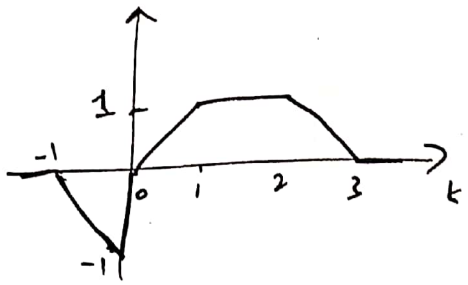
energy of $y(t)$

here $y(t) = \begin{cases} 1 & -5 \le t \le -4 \\ 1 & 4 \le t \le 5 \\ 0 & \text{elsewhere} \end{cases}$

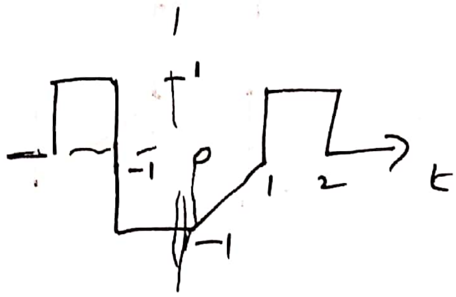
$$\therefore E = \int_{-5}^{-4} (1)\, dt + \int_{4}^{5} (1)\, dt = 2.$$

Transformations.

x(t)

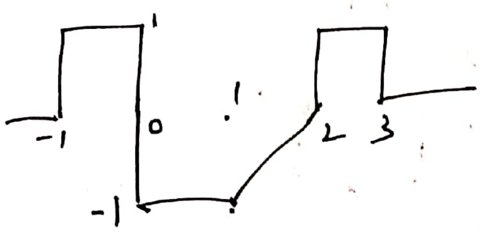


y(t)

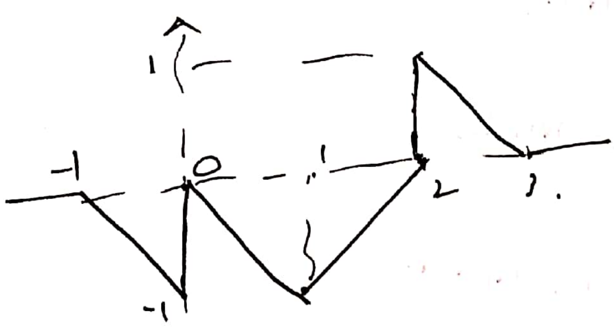


(1) plot x(t) y(t-1).

y(t-1)



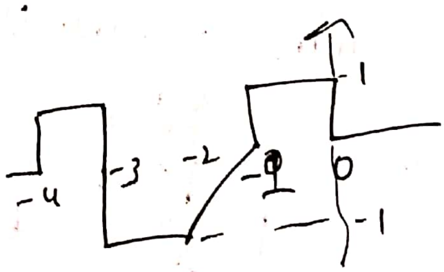
x(t)y(t-1).



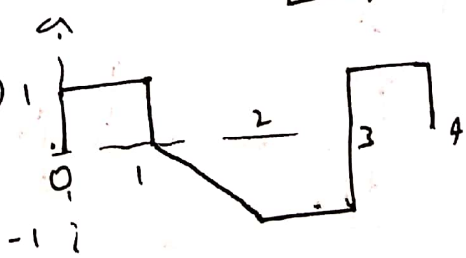
(2). x(t) y(2-t).

y(2-t).

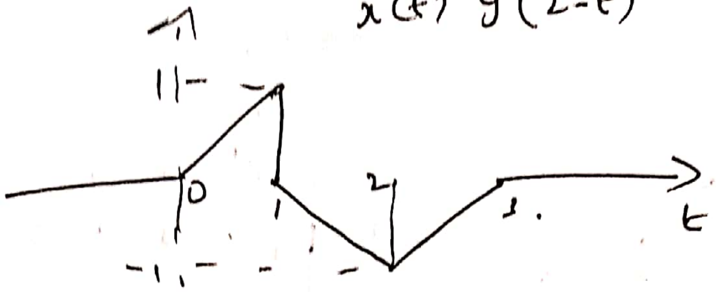
- y(2+t) →



y(2-t)



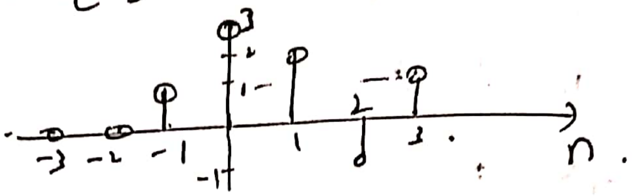
$x(t)\ y(2-t)$



Convolution sum

$x[n] = 3\delta[n] - 2\delta[n-1]$.

$h[n] =$



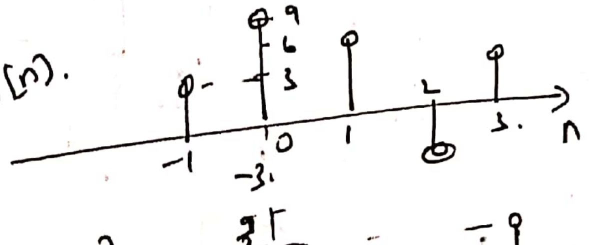
$y[n] = x[n] * h[n]$.

$$y[n] = \sum_{k} x[k]\, h[n-k]$$

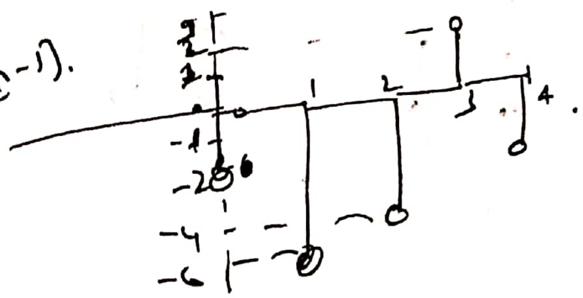
$$= \sum_{k=0}^{1} x[k]\, h[n-k]$$

$$= 3\, h[n] - 2\, h[n-1]$$

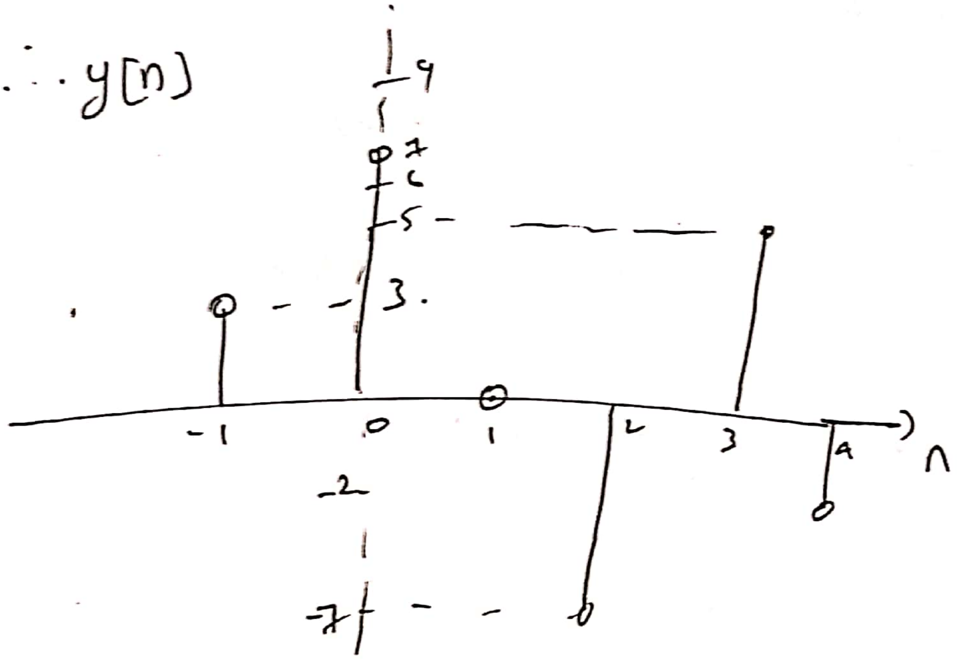
$3\, h[n]$.



$-2\, h[n-1]$.



$\therefore y[n]$



$y[n] = \{3, \underset{\uparrow}{7}, 0, -7, 5, -2\}$

Method(2)

$$y[-1] = \sum_{k=0}^{1} x(k)\, h(-1-k)$$

$$= 3.(1) + (-2)(0) = 3.$$

$$y(0) = \sum_{k=0}^{1} x(k)\, h(-k)$$

$$= 3(3) + (-2)(1) = 7.$$

$$y(1) = \sum_{k=0}^{1} x(k)\, h(1-k)$$

$$= 3(2) + (-2)(3) = 0$$

$$y(2) = \sum_{k=0}^{1} x(k)\, h(2-k)$$

$= 3(-1) + (-2)(2) = -7.$

$$y[3] = \sum_{k=0}^{1} x(k)\, h(3-k)$$

$$= 3(1) + (-2)(-1) = 5$$

$$y[4] = \sum_{k=0}^{1} x(k)\, h(4-k)$$

$$= 3(0) + (-2)1 = -2$$

$$\therefore y(n) = \{3, \underset{\uparrow}{7}, 0, -7, 5, -2\}$$