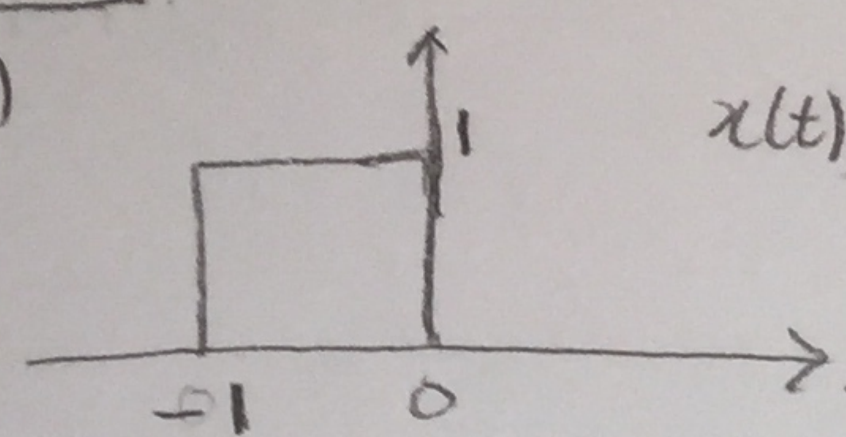
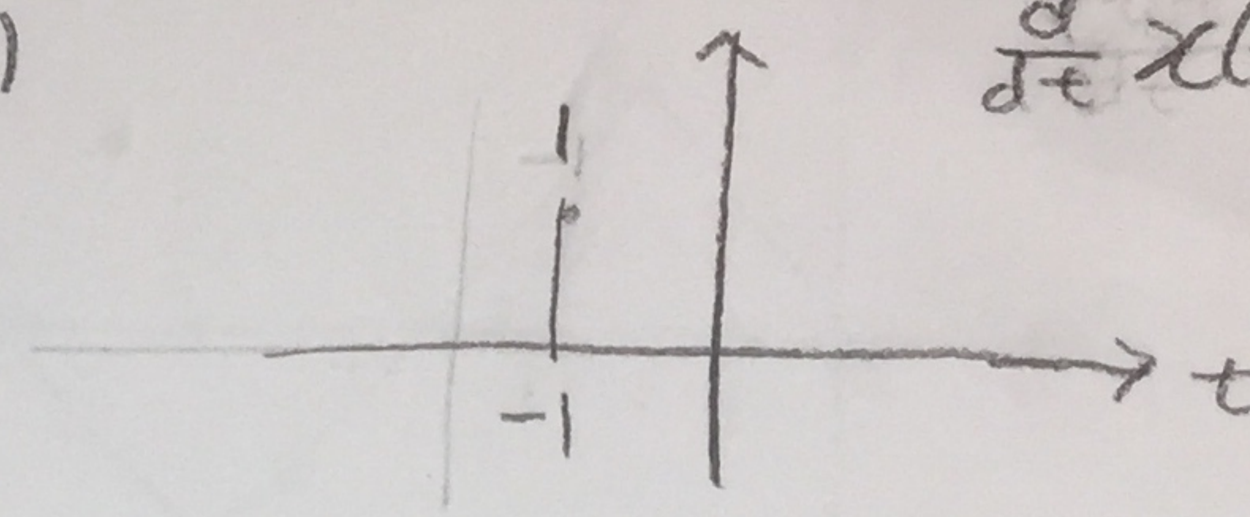
Jaeha Huh

2.1.1

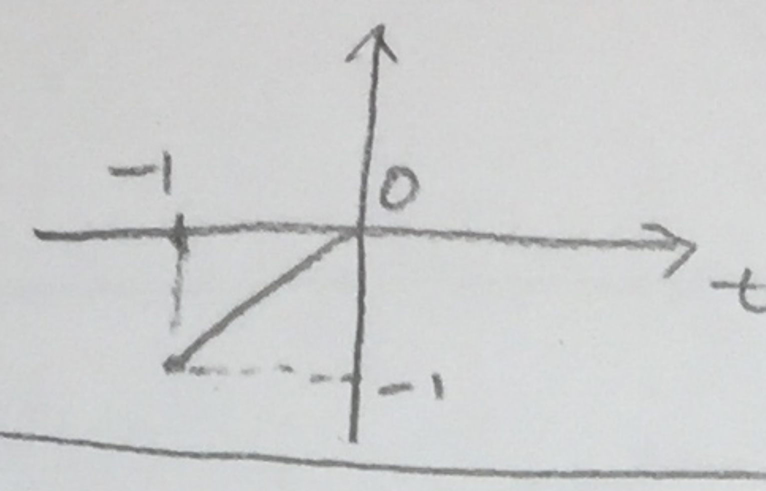
(a) $x(t) = u(t+1) - u(t)$



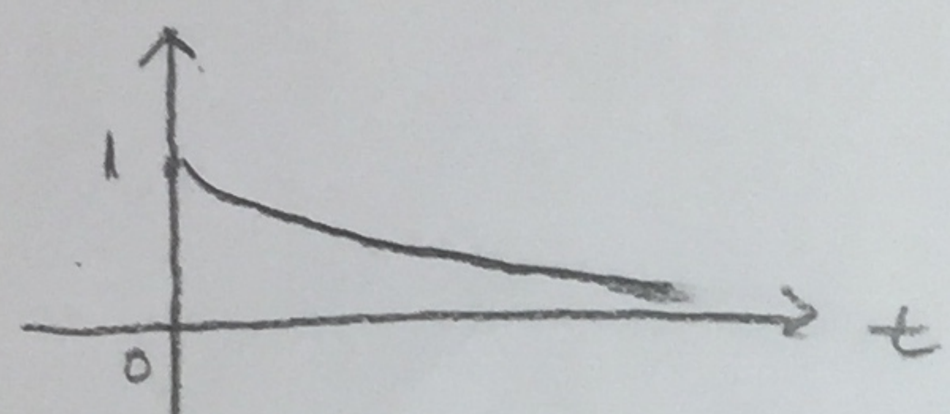
$\frac{d}{dt} x(t)$



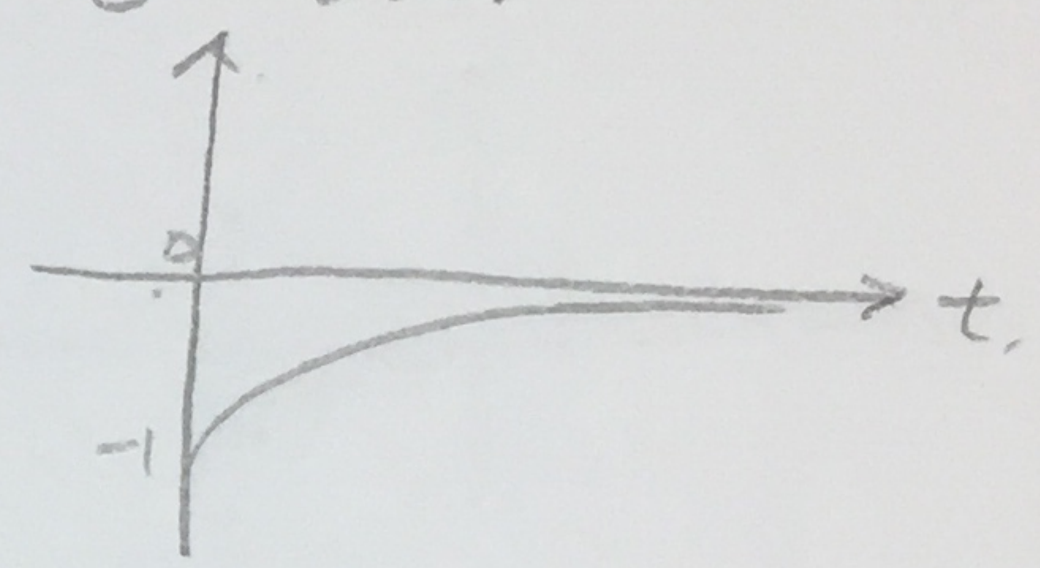
$\int_{-\infty}^{t} x(\tau)d\tau$



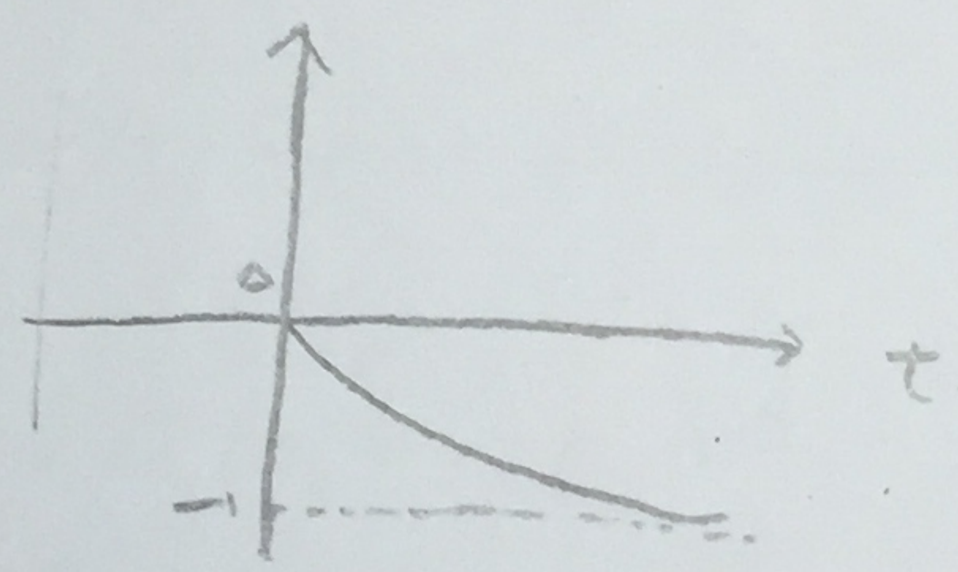
(b) $x(t) = e^{-t}u(t)$



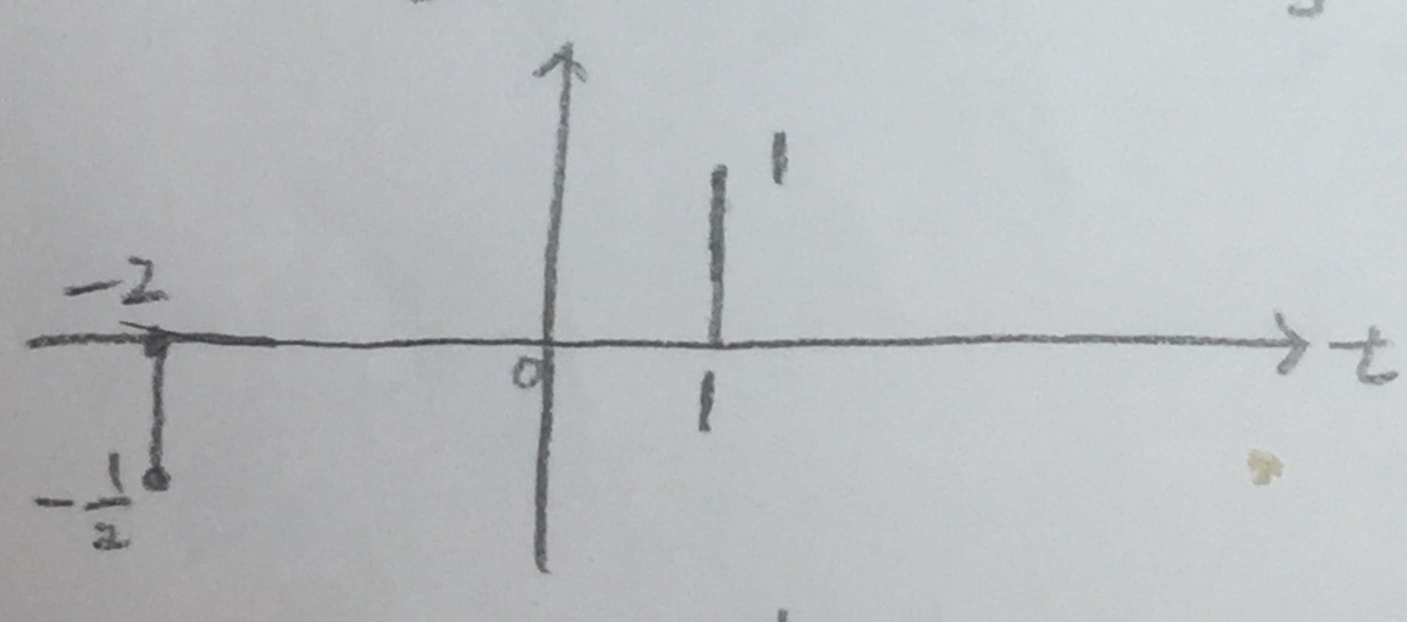
$\frac{d}{dt} x(t) = -e^{-t}u(t)$



$\int_{-\infty}^{t} x(\tau)d\tau$



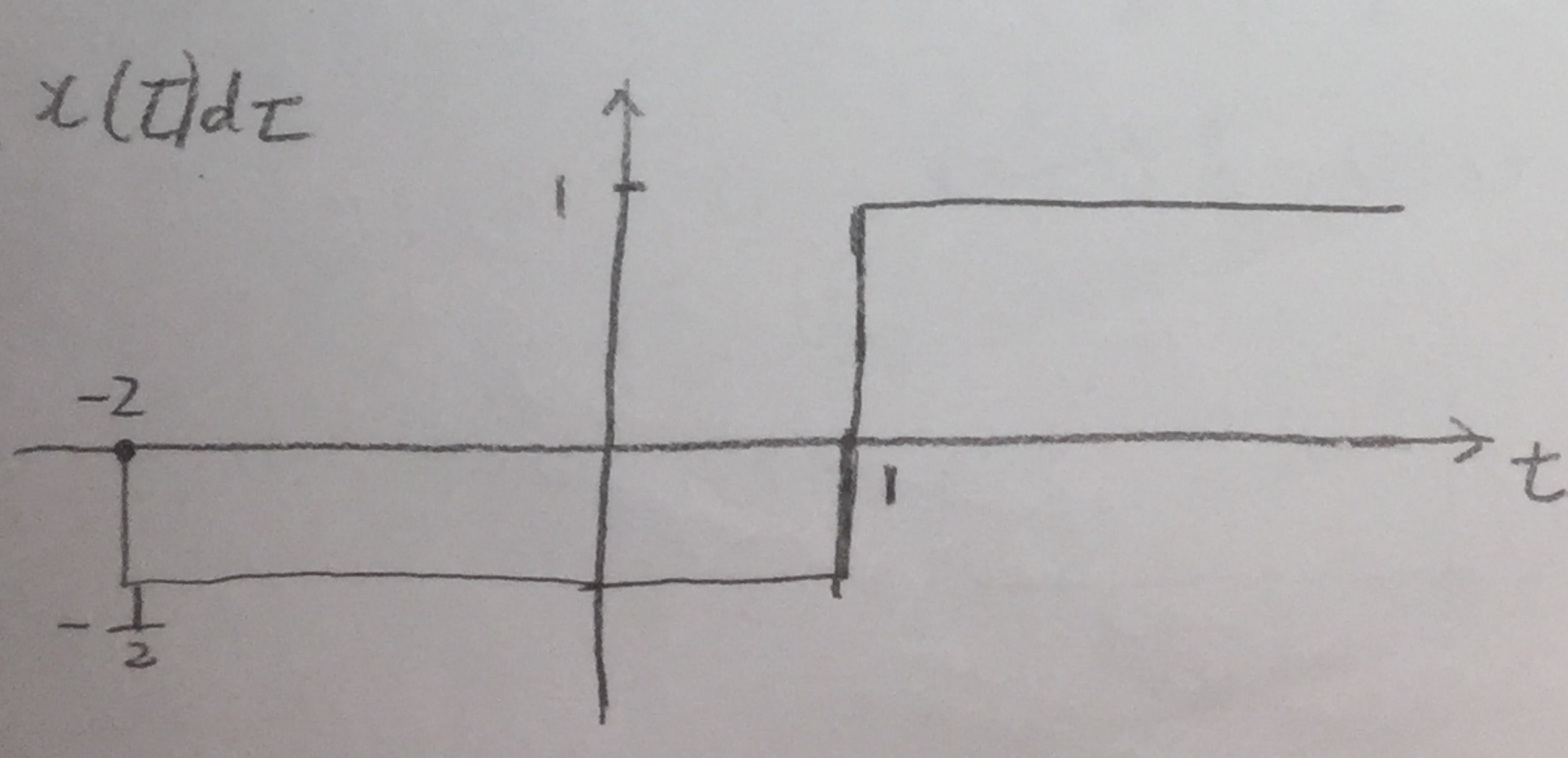
(c) $x(t) = \frac{1}{t}[\delta(t-1) + \delta(t+2)]$



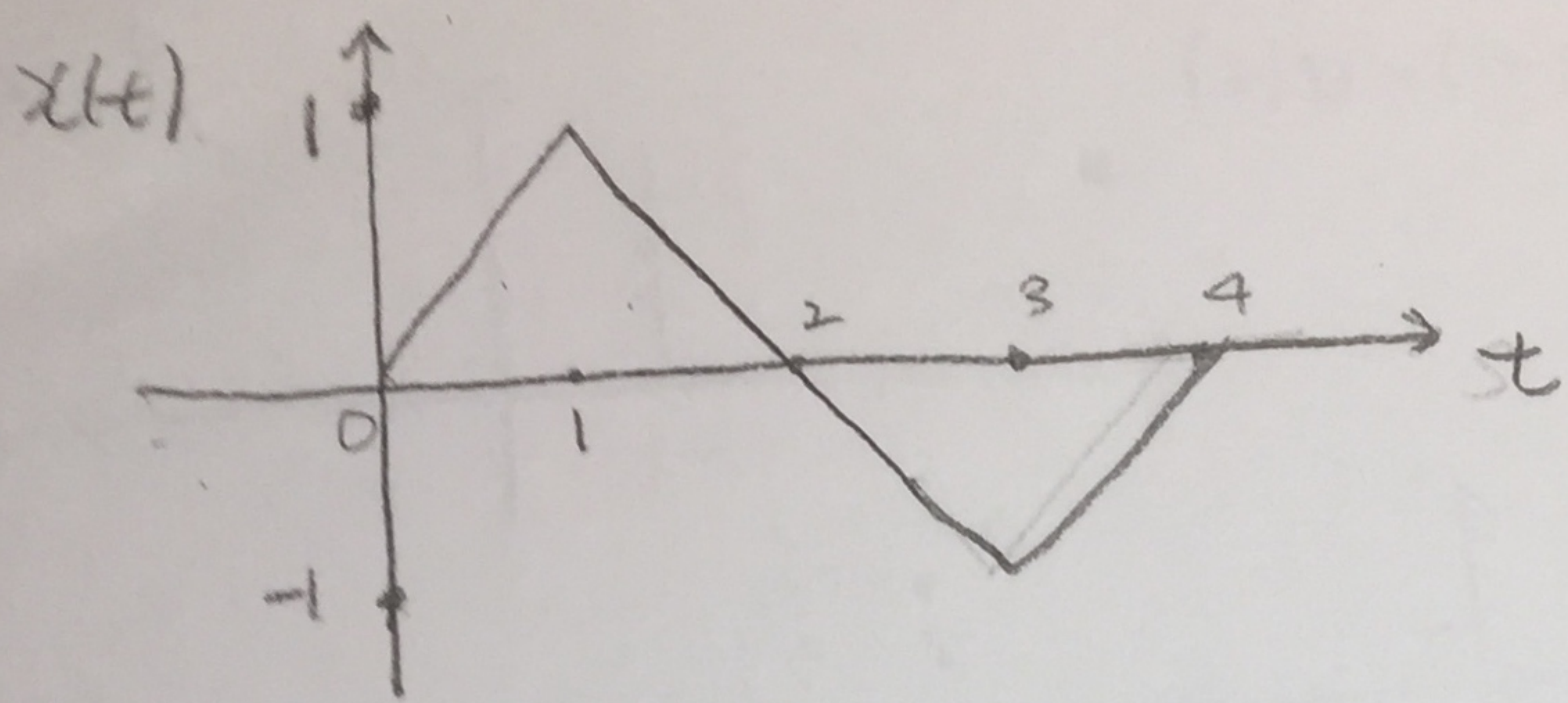
$x(t) = -\frac{1}{2}\delta(t+2) + \delta(t-1)$

$$\int_{-\infty}^{t} x(\tau)d\tau = \int_{-\infty}^{t} [-\tfrac{1}{2}\delta(t+2) + \delta(t-1)]d\tau = -\tfrac{1}{2}u(t+2) + u(t-1)$$

$\int_{-\infty}^{t} x(\tau)d\tau$

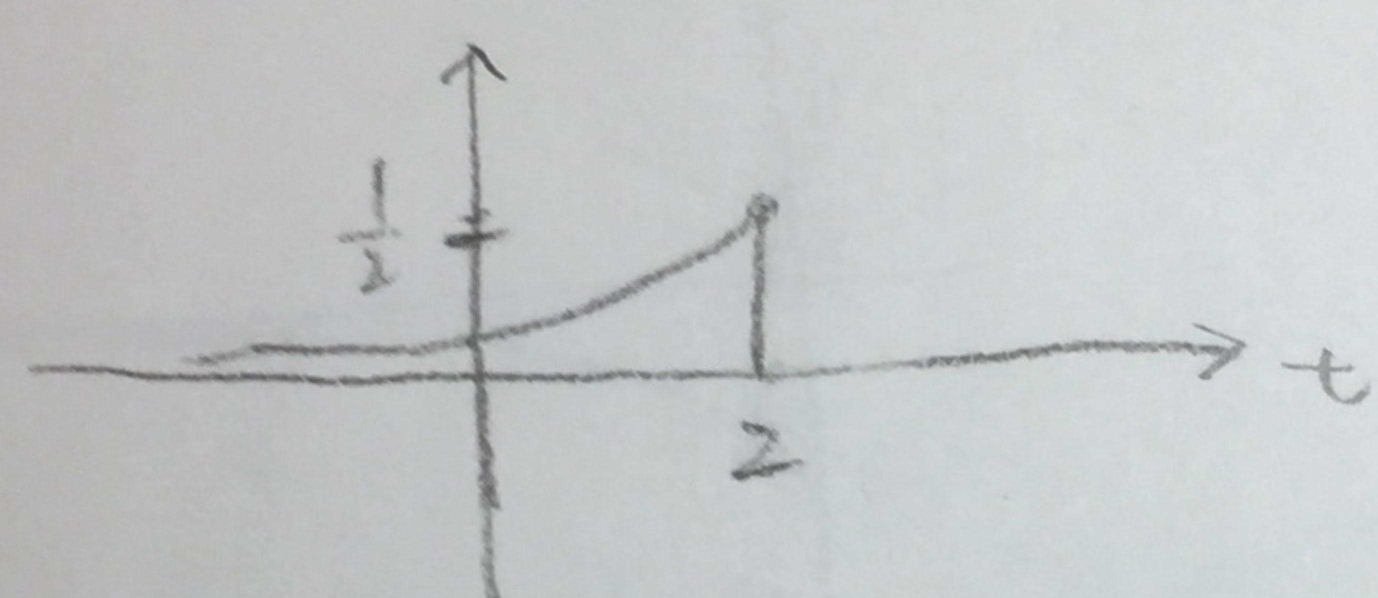


(d) $x(t) = r(t) - 2r(t-1) + 2r(t-3) - r(t-4)$



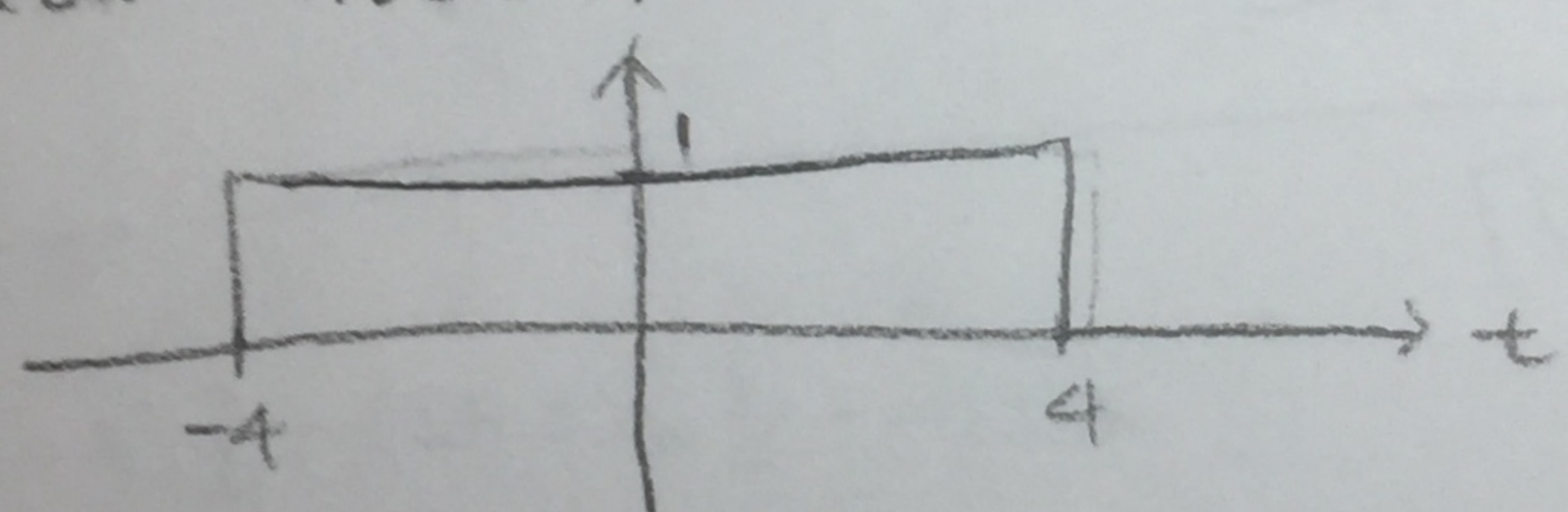
(e) $x(t) = 2^{-t} u(t-1)$

$g(t) = x(3-2t) =$

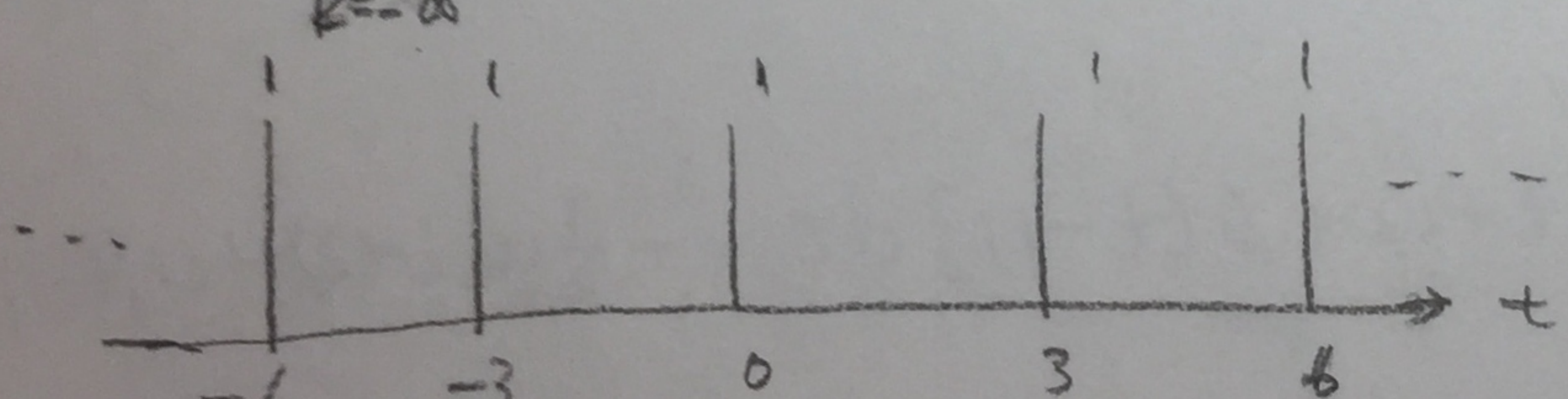


2.1.2

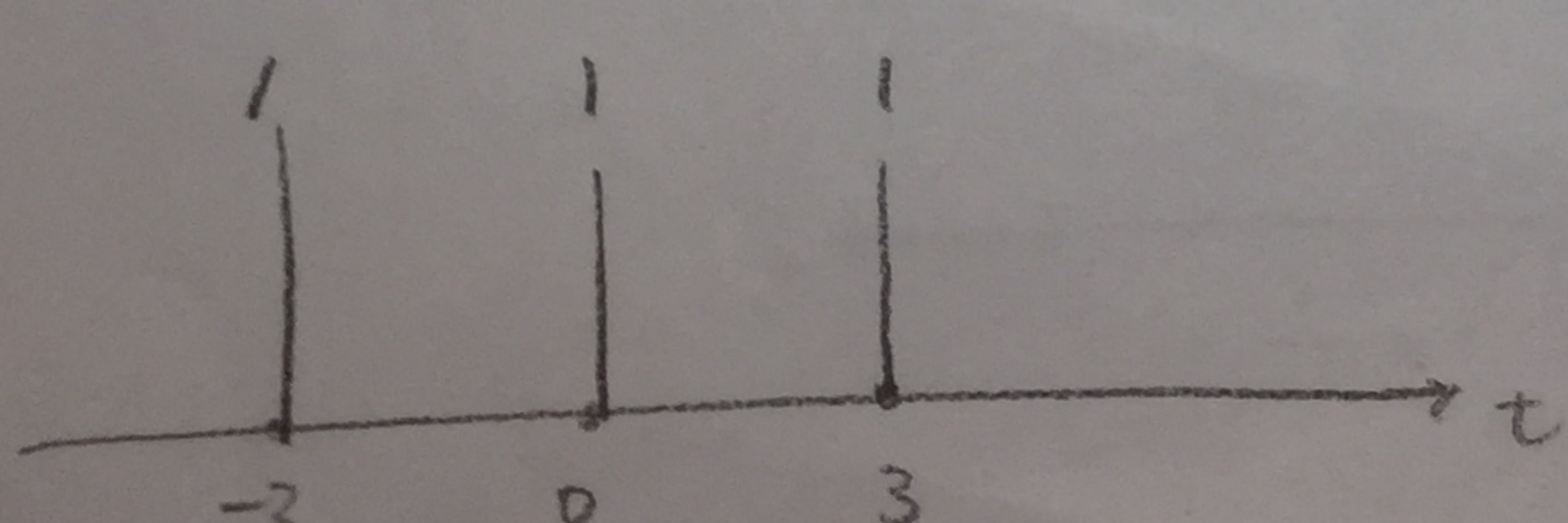
(a) $f(t) = u(t+4) - u(t-4)$



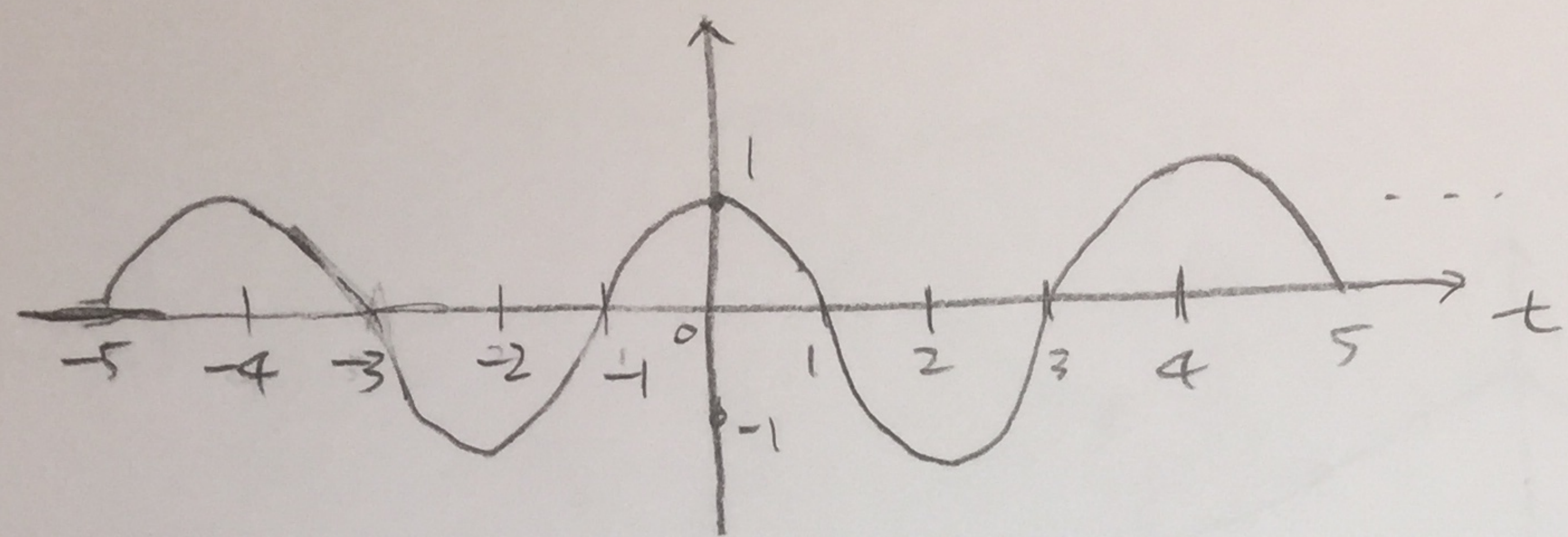
$g(t) = \sum_{k=-\infty}^{\infty} \delta(t-3k)$



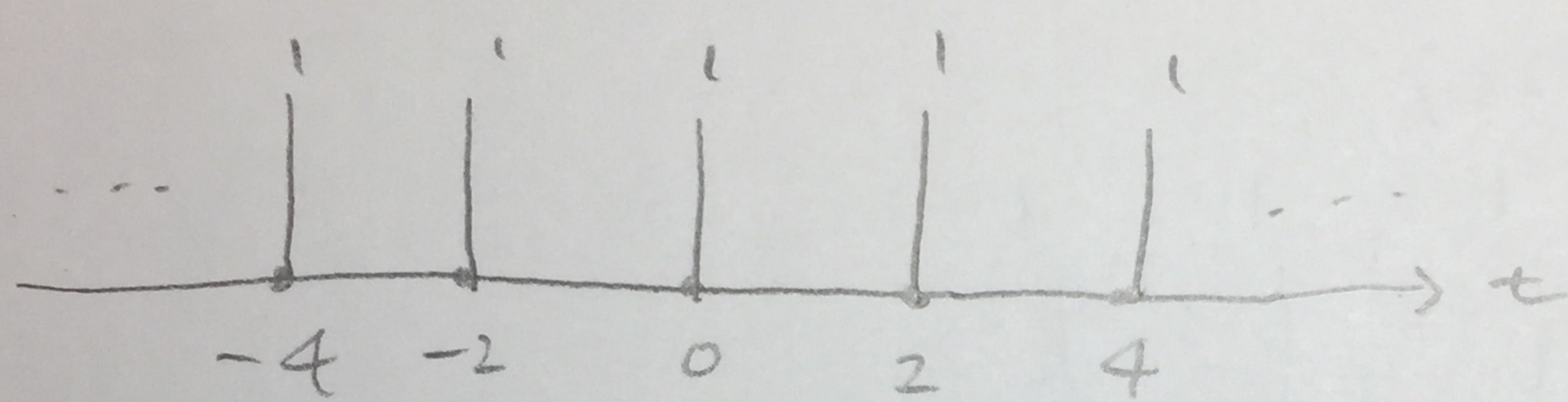
$f(t) \cdot g(t) = \delta(t+3) + \delta(t) + \delta(t-3)$



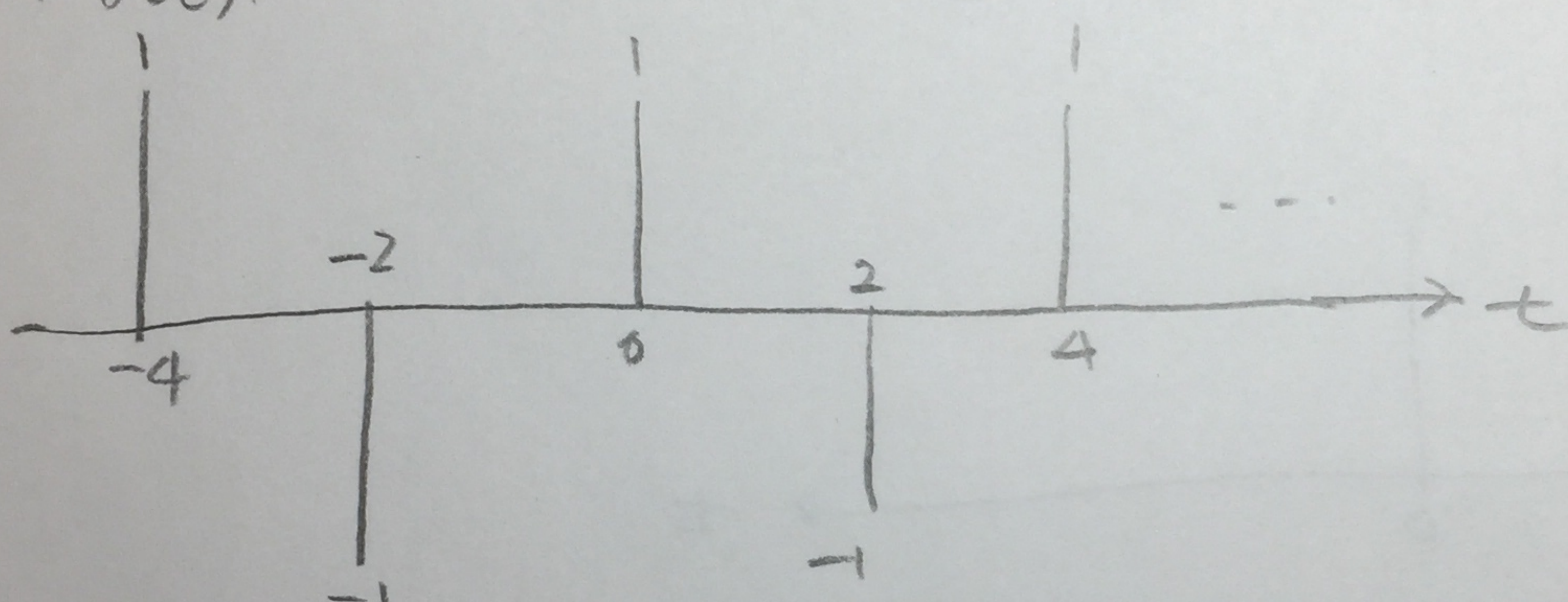
(b) $f(t) = \cos(\frac{\pi}{2}t)$



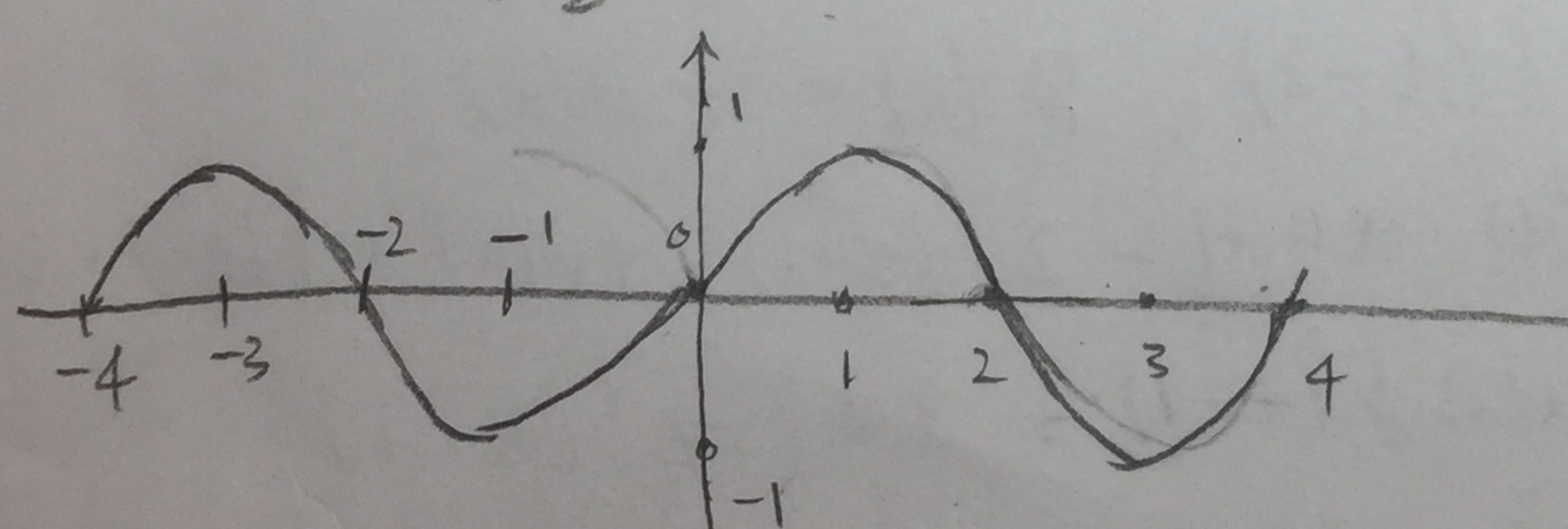
$g(t) = \sum_{k=-\infty}^{\infty} \delta(t-2k)$



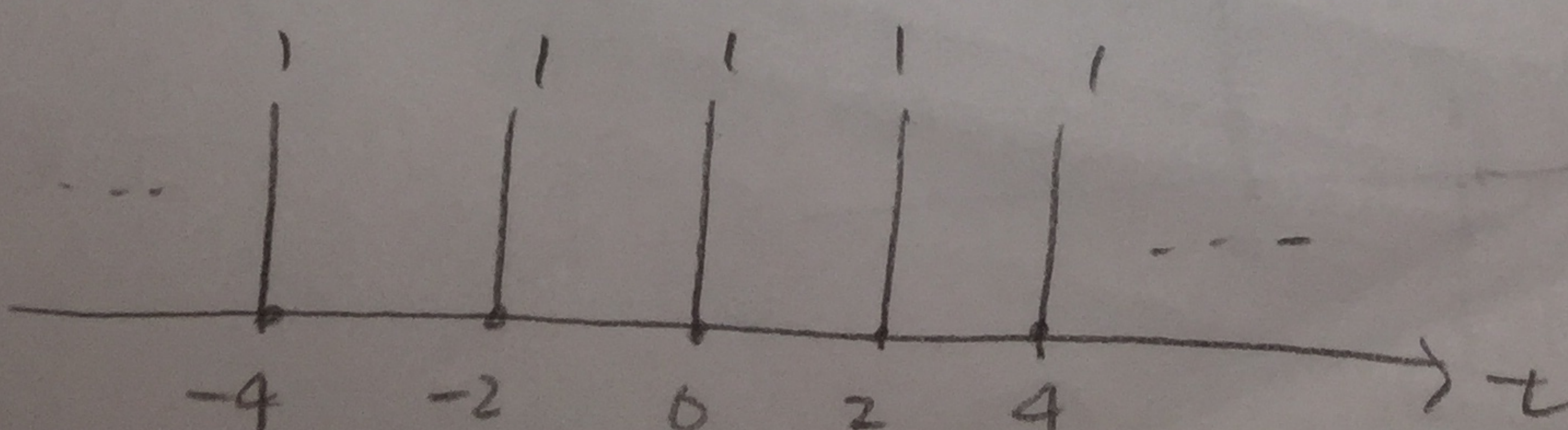
$f(t) \cdot g(t)$



(c). $f(t) = \sin(\frac{\pi}{2}t)$

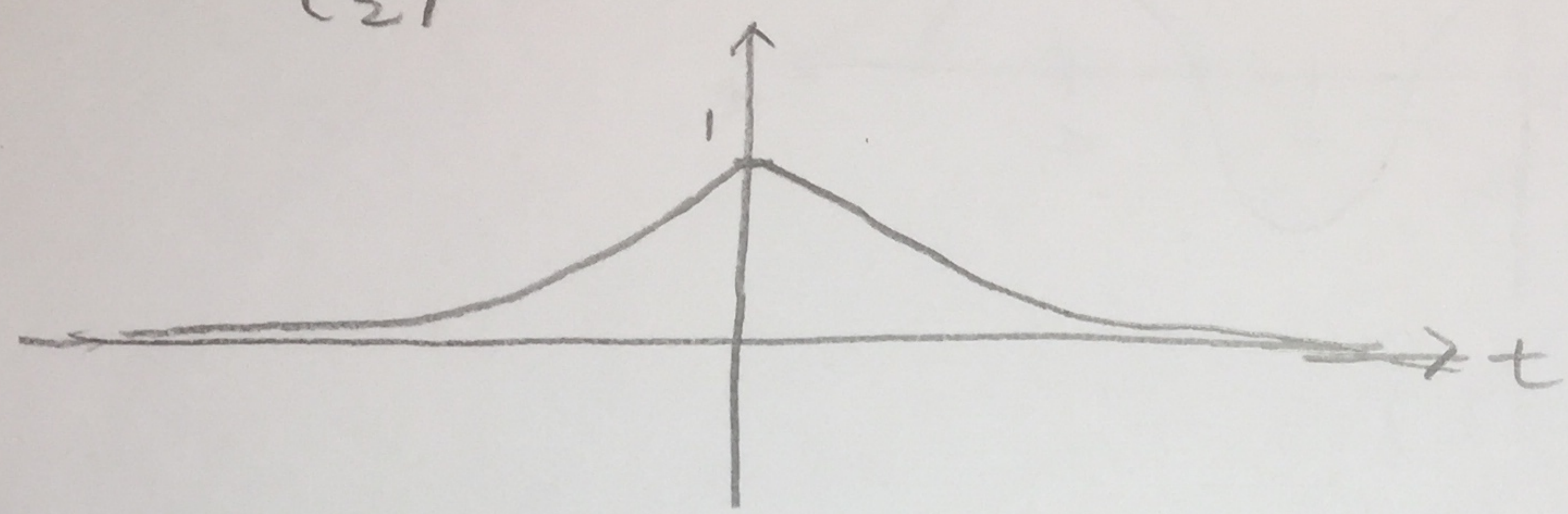


$g(t) = \sum_{k=-\infty}^{\infty} \delta(t-2k)$

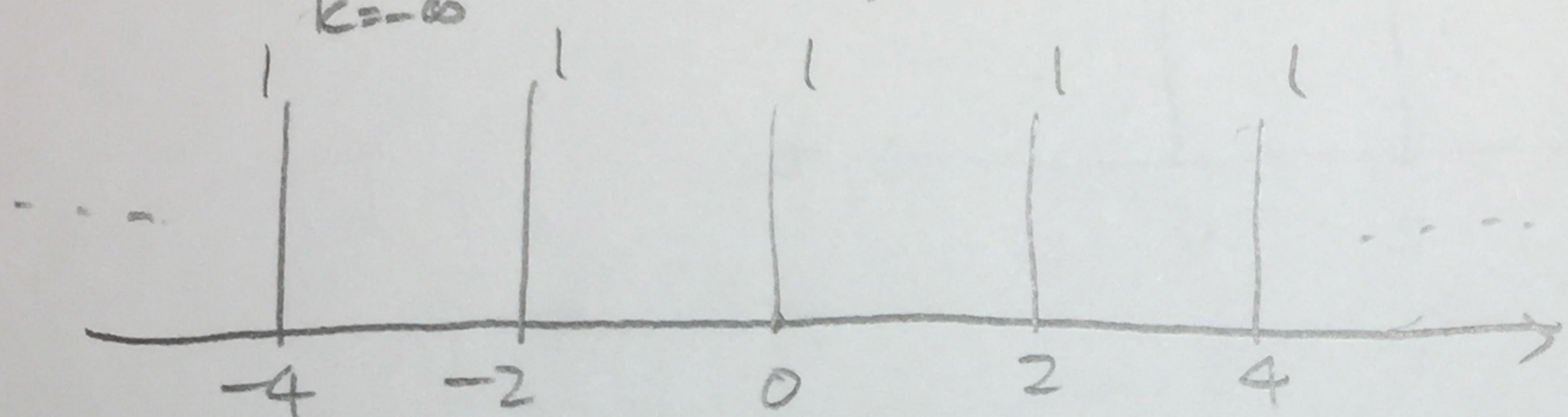


$f(t) \cdot g(t) = 0$

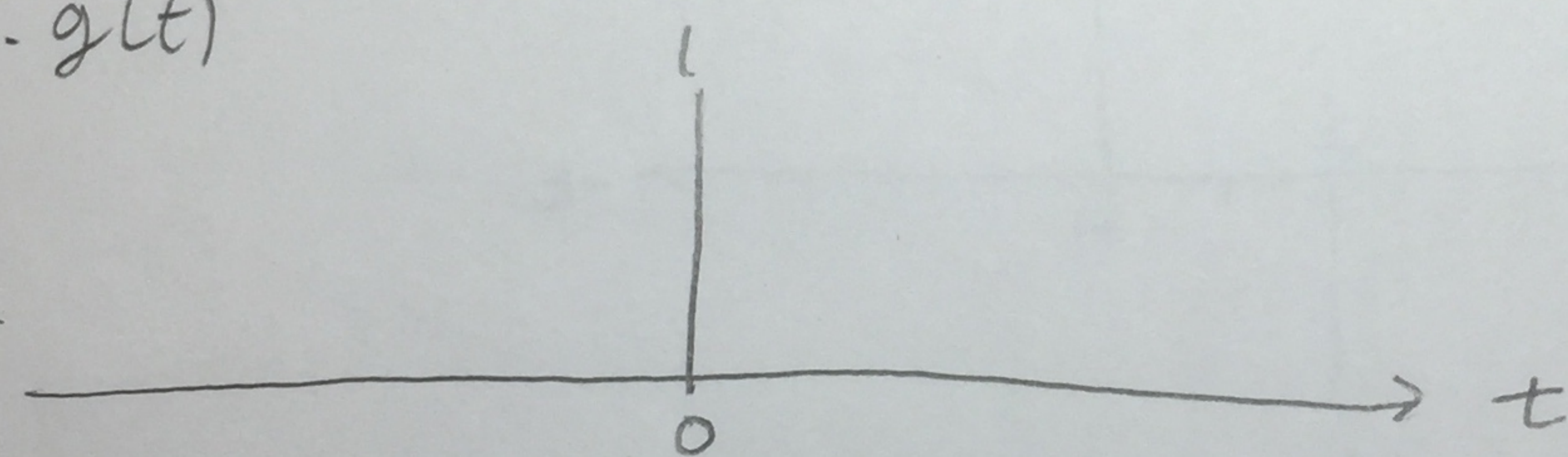
(e) $f(t) = \left(\frac{1}{2}\right)^{|t|}$



$$g(t) = \sum_{k=-\infty}^{\infty} \delta(t-2k)$$



$f(t) \cdot g(t)$



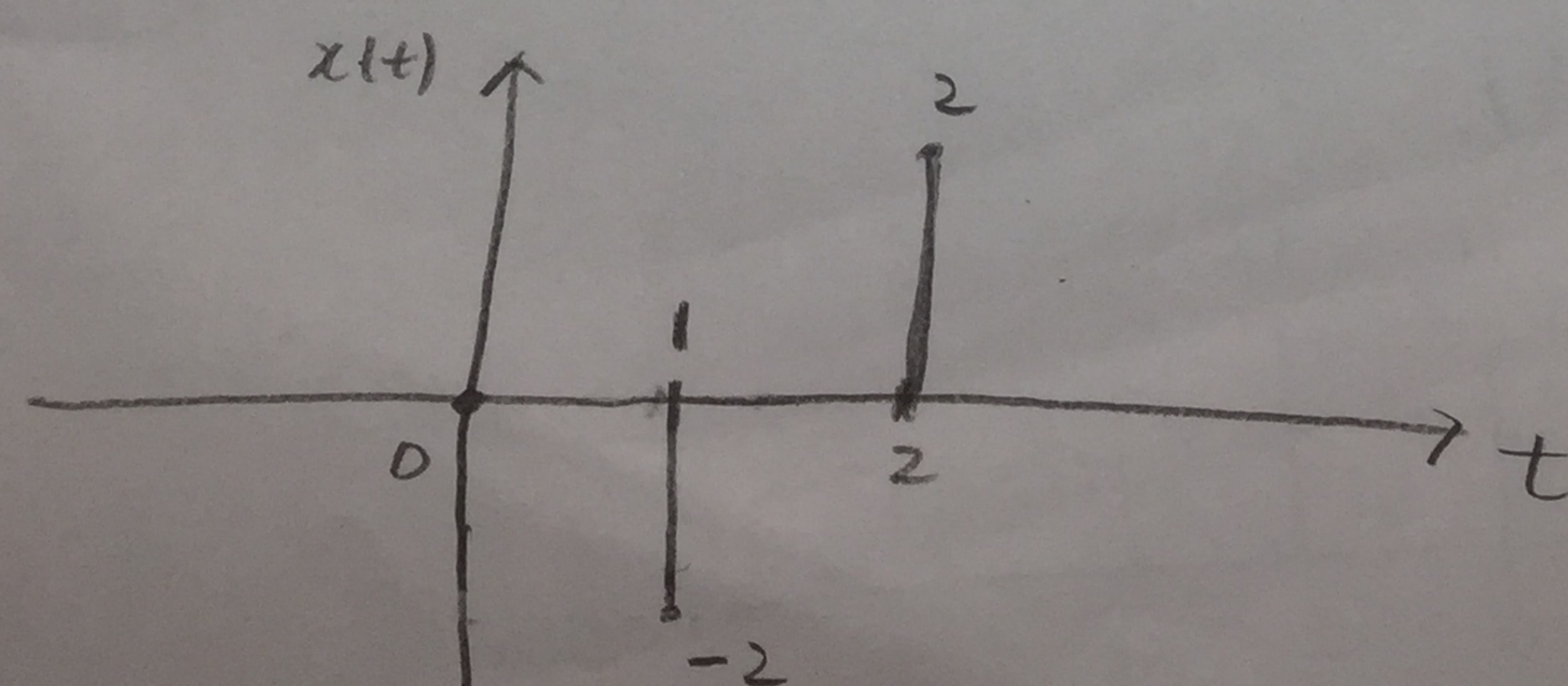
2.1.3

$f(t) = \delta(t) - 2\delta(t-1) + \delta(t-2)$, $g(t) = t\,u(t)$

$x(t) = f(t) \cdot g(t) = \delta(t) \cdot t u(t) - 2\delta(t-1) \cdot t u(t) + \delta(t-2) \cdot t u(t)$

$x(t) = 0 \cdot u(0)\,\delta(t) - 2\,u(1)\,\delta(t-1) + 2\,u(2)\,\delta(t-2)$

$x(t) = 0 - 2\delta(t-1) + 2\delta(t-2)$



④

2.2.1 $y(t) = \sin(\pi t)\, x(t) + \cos(\pi t)\, x(t-1)$

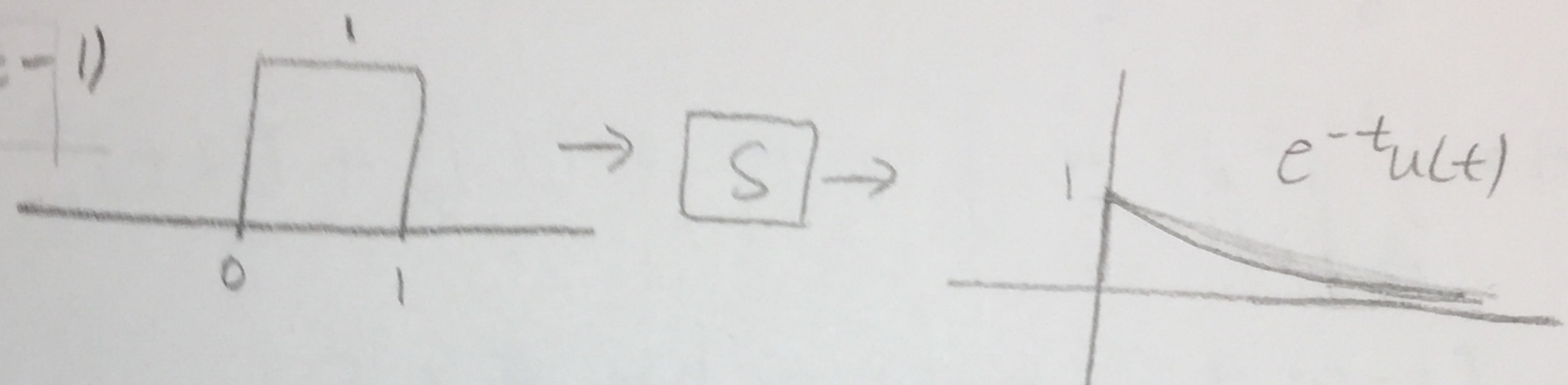
(a) linear

(b) time-Invariant

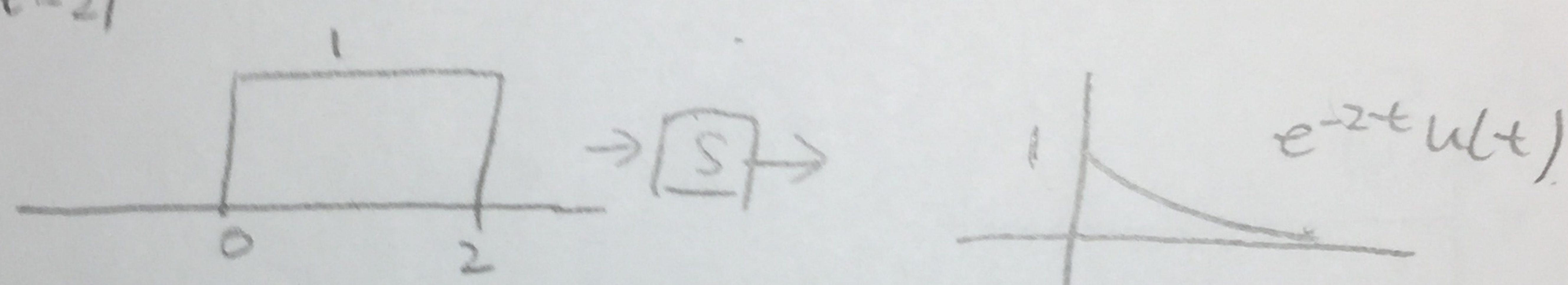
(c) stable

2.2.3

$u(t) - u(t-1)$

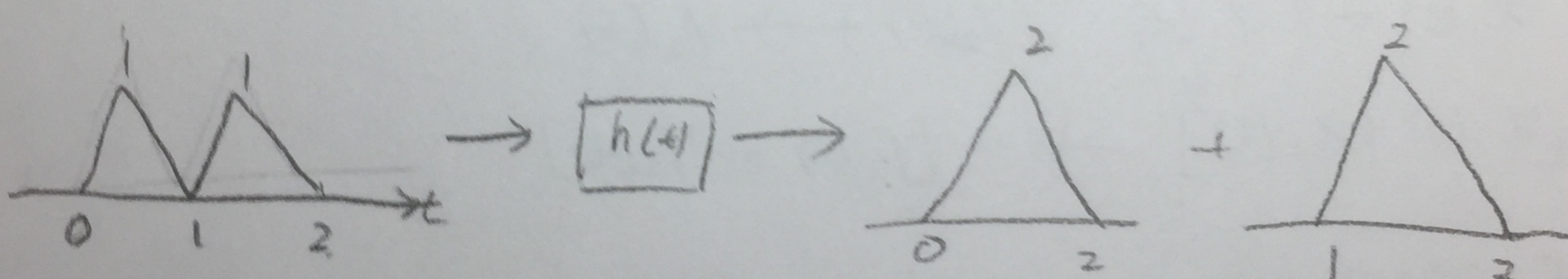


$u(t) - u(t-2)$

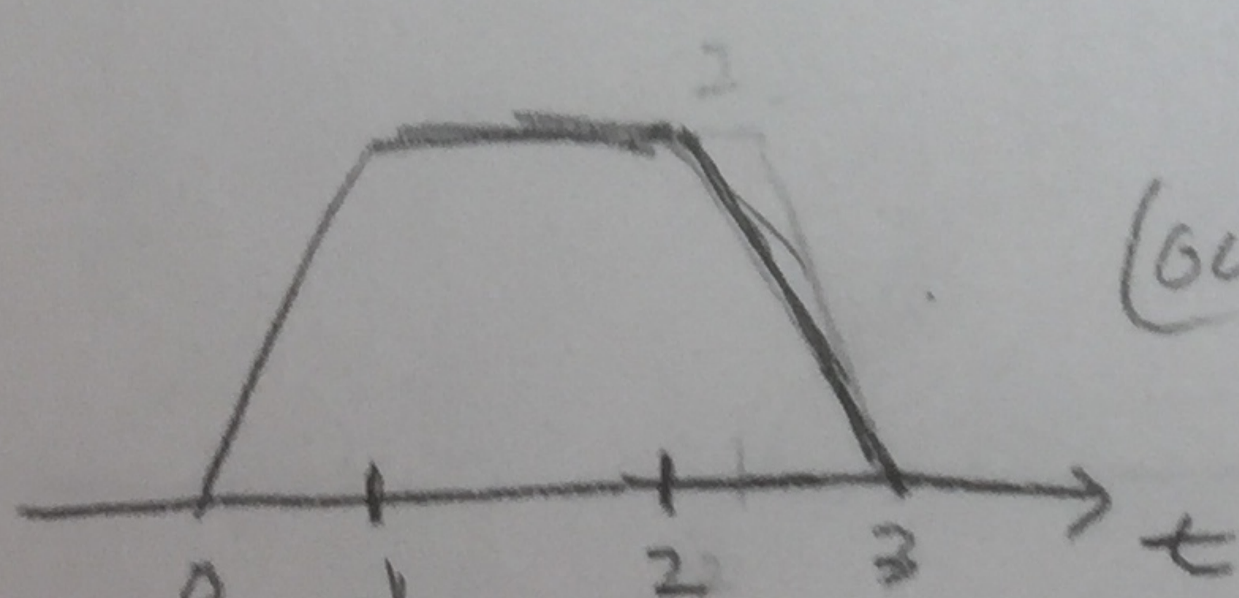


$\therefore$ (a) The system is not LTI

2.2.4



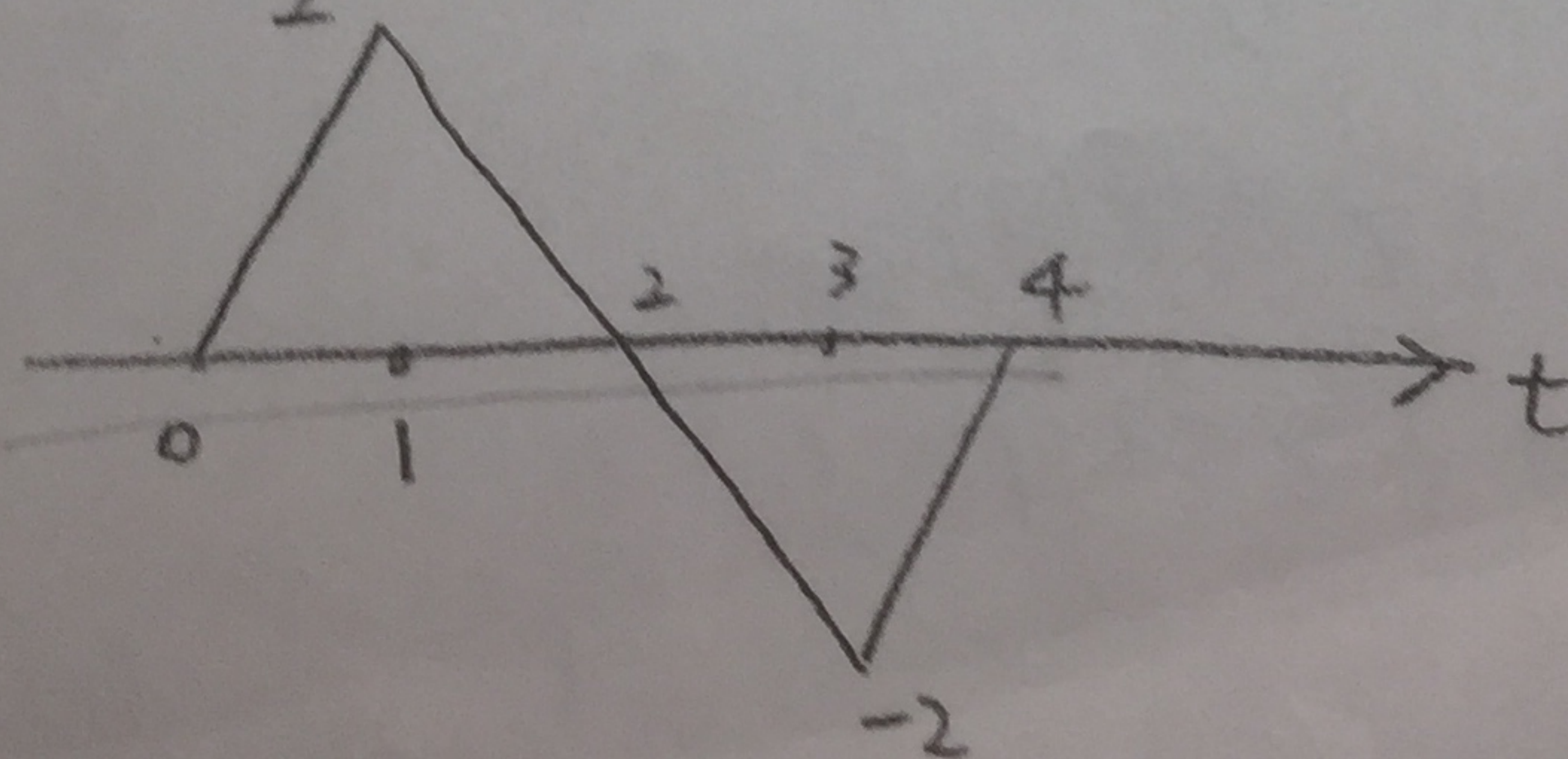
$\therefore$



(output)

2.2.5

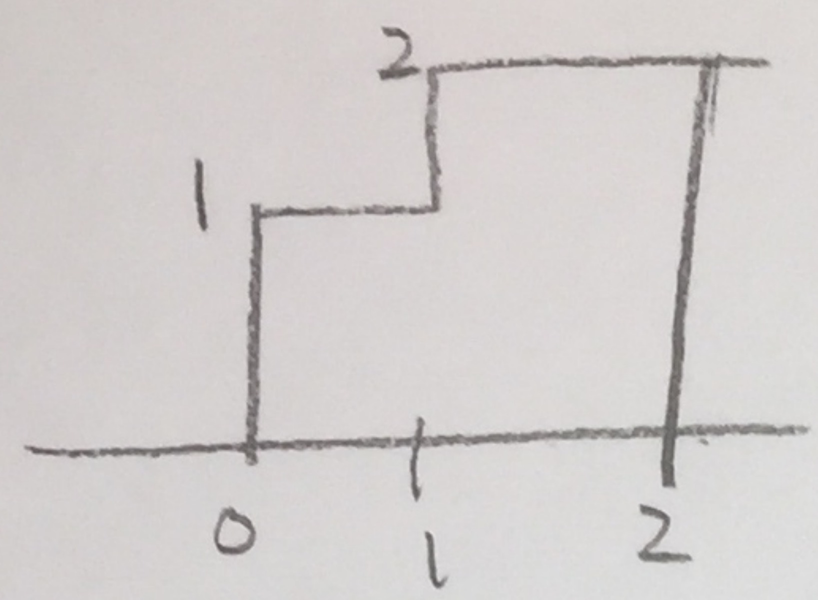
$\therefore$ output



2.2.8

$$x(t) \rightarrow \boxed{S} \rightarrow y(t) = \int_{-\infty}^{t} [x(\tau)]^2 \, d\tau$$

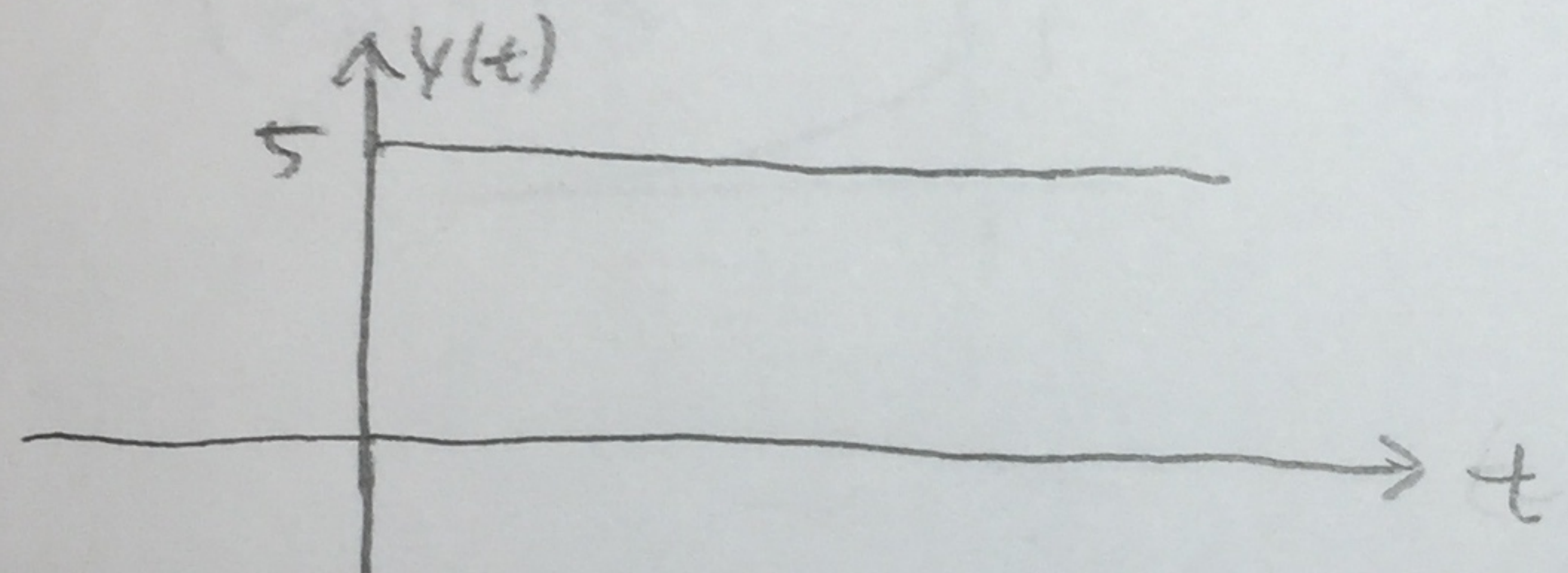
(a) $x(t)$



$$y(t) = \int_0^1 1^2 \, dt + \int_1^2 2^2 \, dt = [t]_0^1 + [4t]_1^2$$

$$= (1-0) + (8-4) = 1 + 4 = 5.$$

$y(t) = 5$



(b) $x_1(t) \rightarrow y_1(t)$, $x_2(t) \rightarrow y_2(t)$.

$$[x_1(t) + x_2(t)] \not\rightarrow [y_1(t) + y_2(t)]$$

$\therefore$ system is non-linear.

(c) system is time-invariant

2.2.13

$$y(t) = x(t-5) + \frac{1}{2} x(t-7)$$

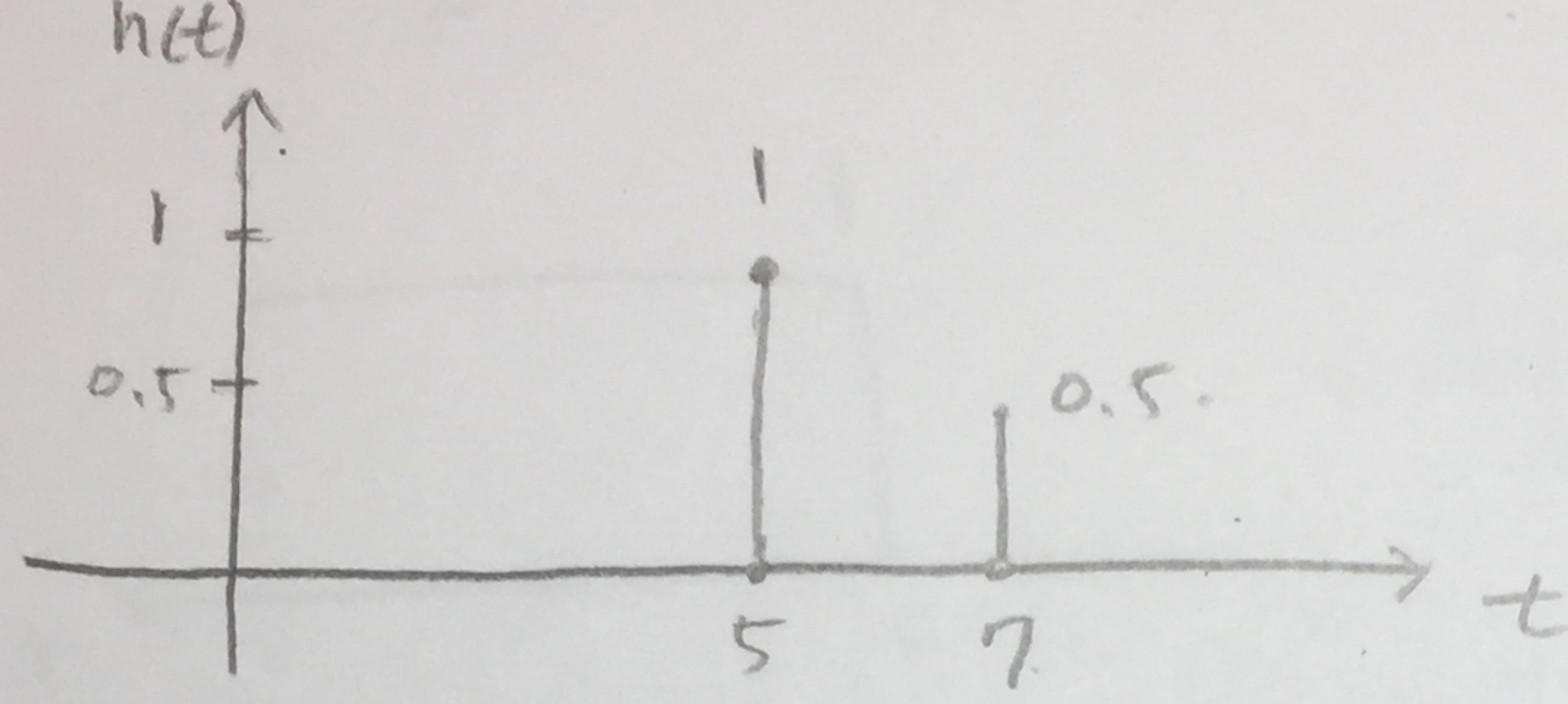
$$Y(z) = z^{-5} X(z) + \frac{1}{2} z^{-7} X(z).$$

$$Y(z) = X(z) \left[z^{-5} + \frac{1}{2} z^{-7} \right]$$

2.2.13 $\frac{Y(z)}{X(z)} = z^{-5} + \frac{1}{2} z^{-7}$

$H(z) = z^{-5} + \frac{1}{2} z^{-7}$

$$\boxed{h(t) = \delta(t-5) + \frac{1}{2}\delta(t-7)}$$

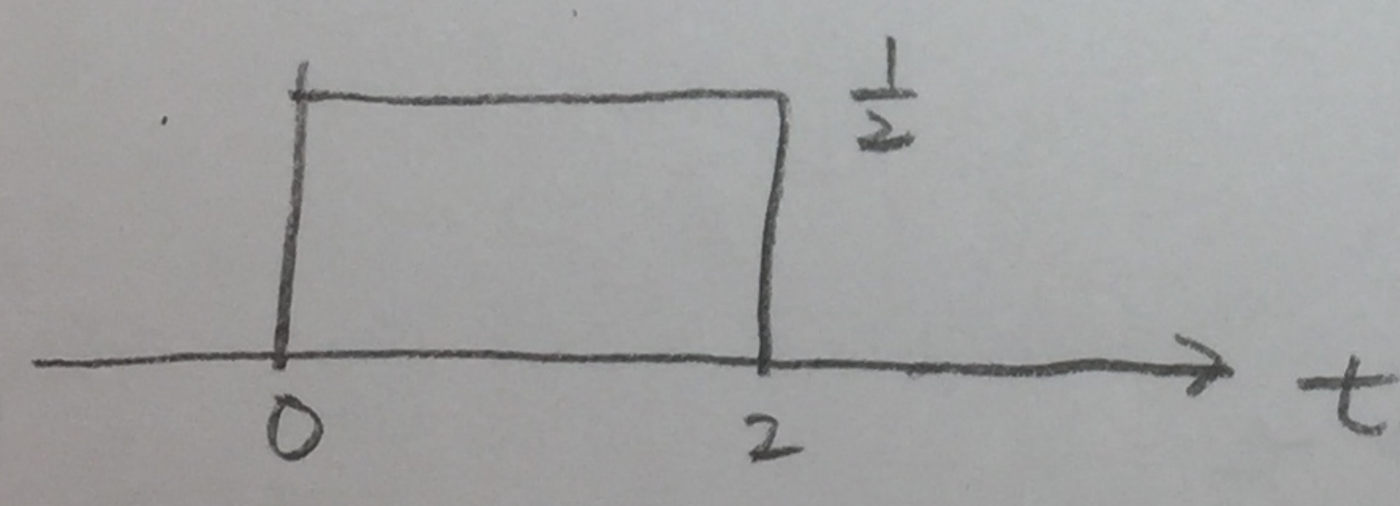


2.2.18

$Y(t) = \frac{1}{2}\int_{t-2}^{t} x(\tau)\,d\tau$

(a) This system integrates input signal from $t-2$ to t and multiplied by $\frac{1}{2}$.

(b) $h(t) = \begin{cases} \frac{1}{2}, & 0 < t < 2 \\ 0, & t < 0 \ \& \ t > 2 \end{cases}$

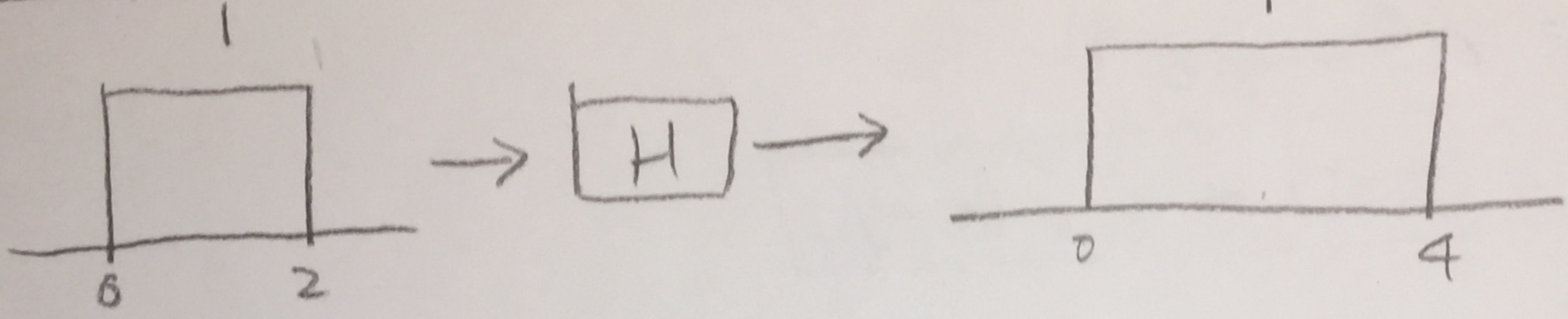


(c) $\int_0^2 \frac{1}{2}dt = \frac{1}{2}t\Big|_0^2 = 1$

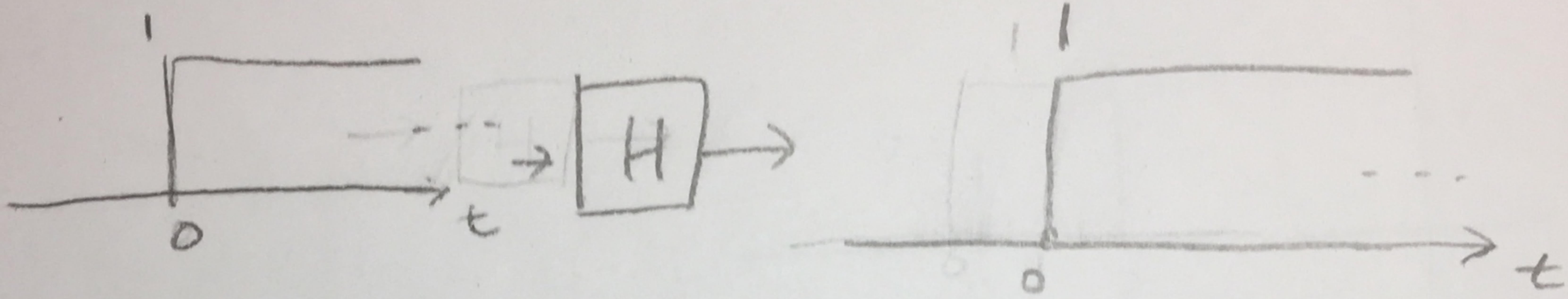
⑦

2.20

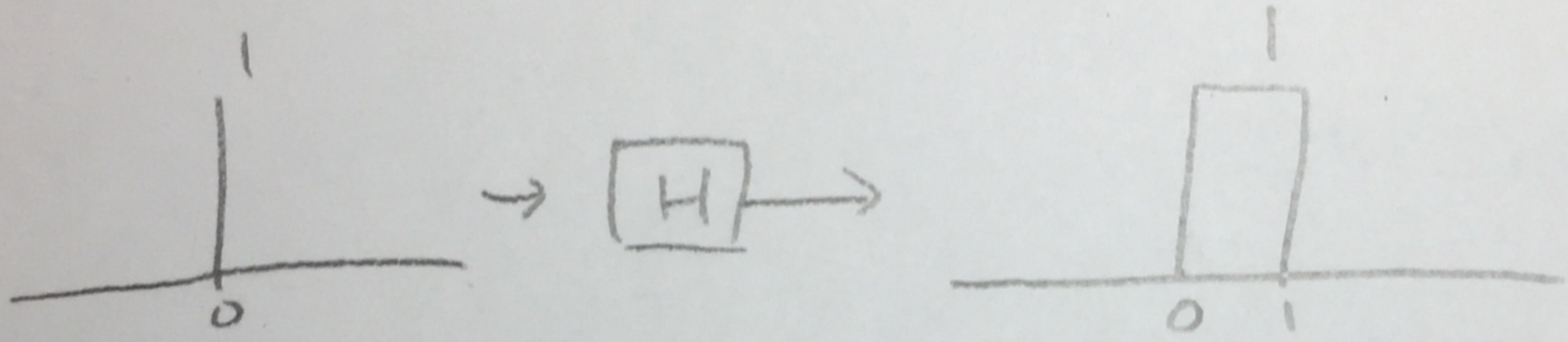
a)



b)



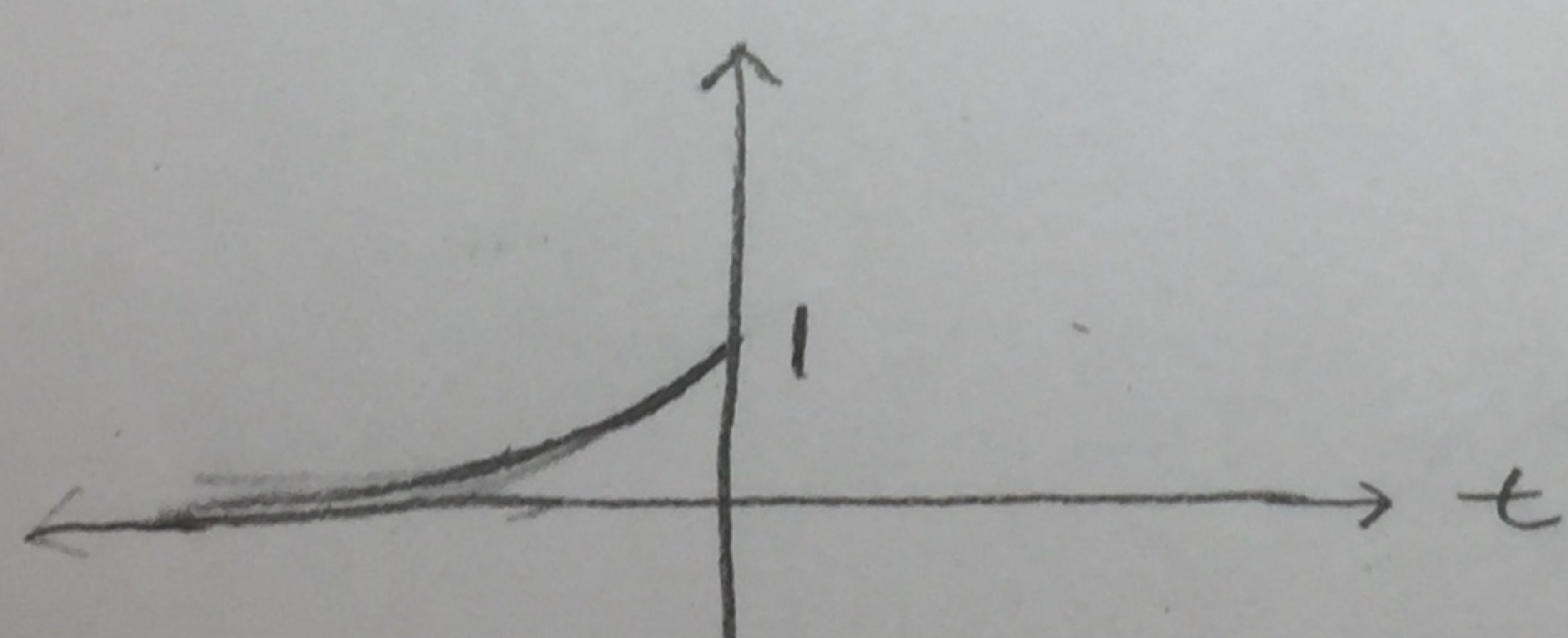
(c)



2.2.22

$x(t) = e^{t} u(-t)$

(a) $\int x(t) = \int e^{t} u(-t) = e^{t} u(-t)$



(b) $\frac{d}{dt} x(t) = \frac{d}{dt}[e^{t} u(-t)] = e^{t} u(-t)$