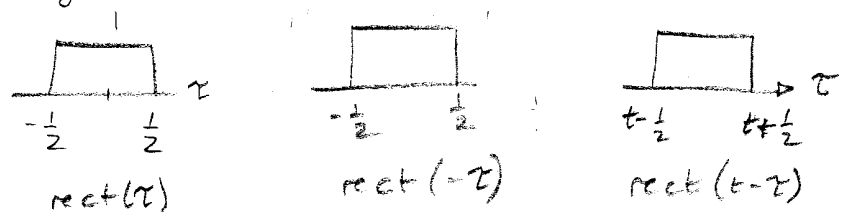
(1) Text 6-5 a, c

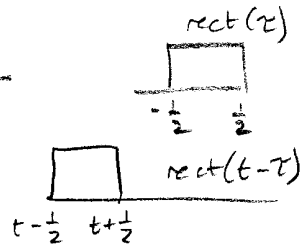
(a) $g(t) = \text{rect}(t) * \text{rect}(t)$



$$g(t) = \int_{-\infty}^{\infty} \text{rect}(\tau)\,\text{rect}(t-\tau)\,d\tau$$

<u>case 1</u>

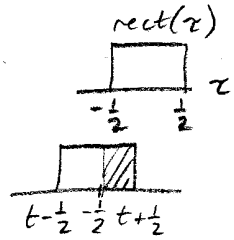
$t < -1$



no overlap, $g(t) = 0$

<u>case 2</u>

$-1 \le t \le 0$

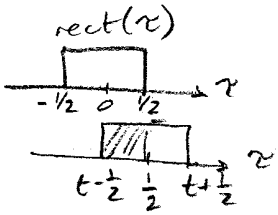


partial overlap w/ leading edge

$$g(t) = \int_{-\frac{1}{2}}^{t+\frac{1}{2}} 1\,d\tau = t + \tfrac{1}{2} - -\tfrac{1}{2} = \boxed{t+1}$$

<u>case 3</u>

$0 \le t \le 1$



partial overlap w/ trailing edge

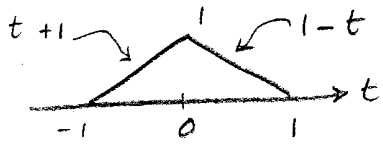
$$g(t) = \int_{t-1/2}^{1/2} 1\,d\tau = 1/2 - (t - 1/2) = \boxed{1-t}$$

<u>case 4</u>

$t > 1$

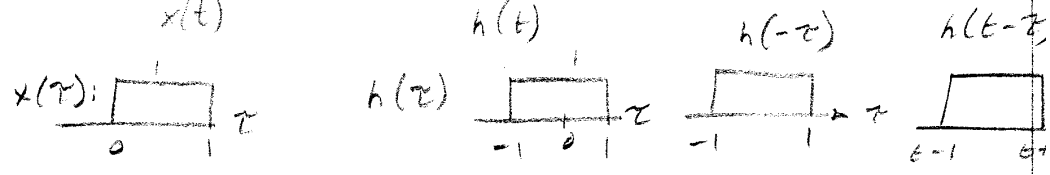
no overlap, $g(t) = 0$

$g(t)$:

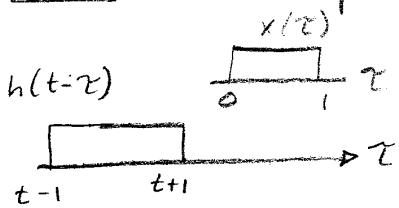


6.5

(c) $g(t) = \underbrace{\mathrm{rect}(t-1)}_{x(t)} * \underbrace{\mathrm{rect}(t/2)}_{h(t)}$

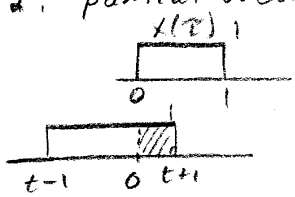


<u>Case 1</u>: no overlap to the left



for $t < -1$, $g(t) = 0$

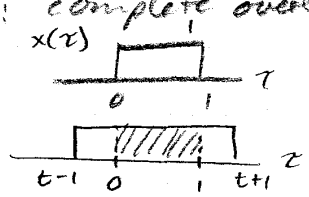
Case 2: partial overlap w/ leading edge



$$g(t) = \int_0^{t+1} 1\, d\tau = \boxed{t+1}$$

$$\boxed{-1 \le t \le 0}$$

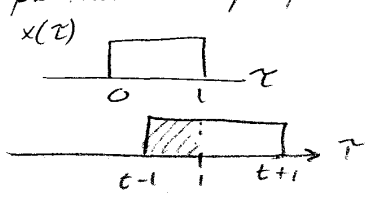
Case 3: complete overlap



$$g(t) = \int_0^1 1\, d\tau = \boxed{1}$$

$$\boxed{0 \le t \le 1}$$

Case 4: partial overlap w/ trailing edge



$$g(t) = \int_{t-1}^{1} 1\, d\tau = 1-(t-1) = \boxed{2-t}$$

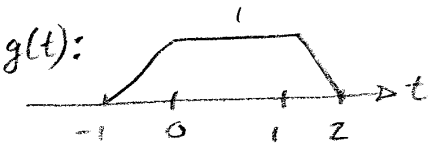
$$\boxed{1 \le t \le 2}$$

Case 5: no overlap to the right

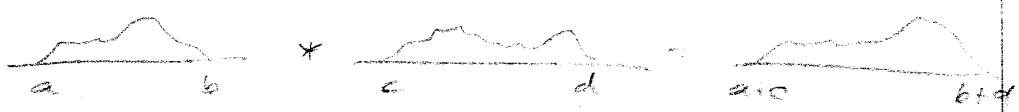
$g(t) = 0$ for $t > 2$

$$g(t) = \begin{cases} 0, & t < -1 \\ t+1, & -1 \le t \le 0 \\ 1, & 0 \le t \le 1 \\ 2-t, & 1 \le t \le 2 \end{cases}$$

g(t):



(2) Text 6-20



so for this problem,

The convolution result will start at time −3, end at time 3

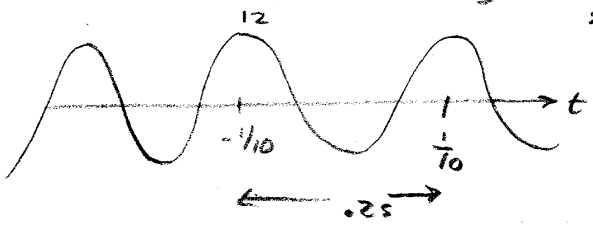
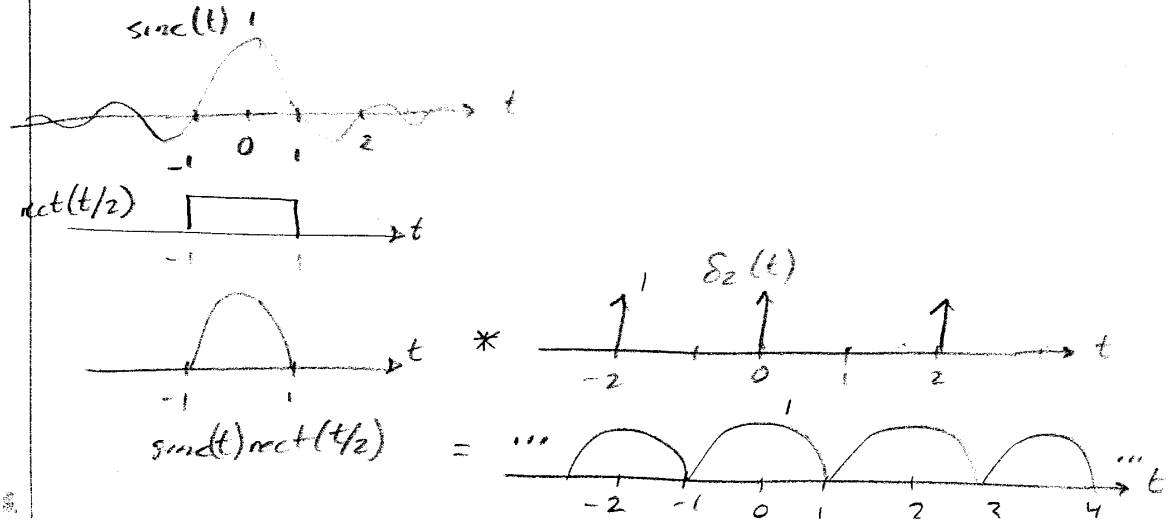
(3) Text 6-22a, g

(a) $g(t) = 3\cos(10\pi t) * 4\delta(t + \frac{1}{10})$

note: convolving a function w/ a shifted delta function results in the function being shift

$= 12\cos[10\pi(t + \frac{1}{10})]$

frequency = 5 Hz, so period = 0.2 s



(g) $[\text{sinc}(t)\,\text{rect}(t/2)] * \delta_2(t)$