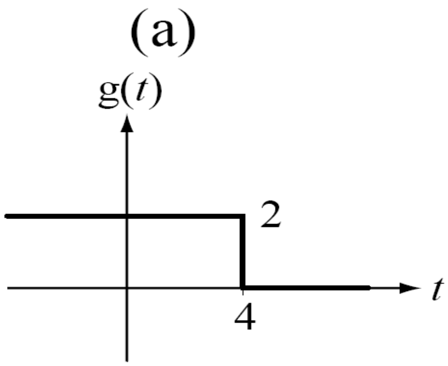
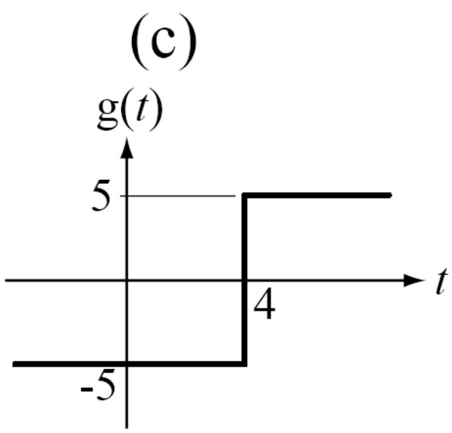
Homework 2 Solution (EE2111)

Q1)

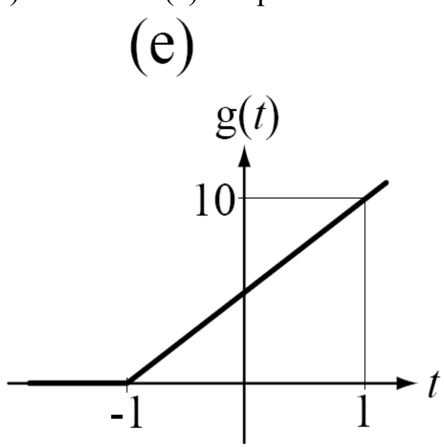
29 a)The unit step function is first inversed in time and advanced by 4 units.



c) The signum function is multiplied by 5 and delayed in time by 4 units

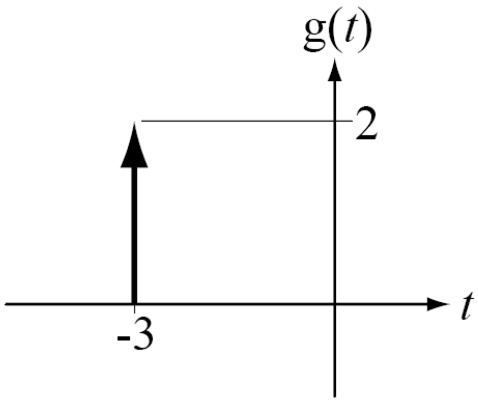


e) Similar to (c) ramp function is multiplied by 5 and advanced by 1 unit.

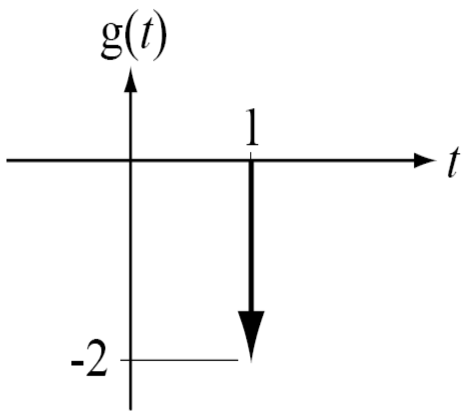


g) Delta function is multiplied by 2 and advanced by 3 units.

(g)

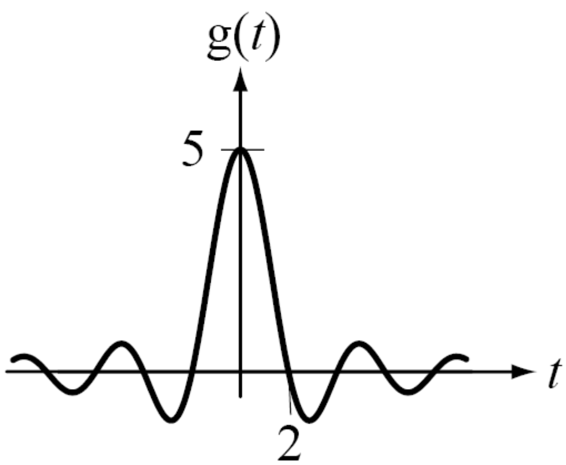


i) Delay the Delta function by 1 unit. Compress in time domain and multiply with -4.

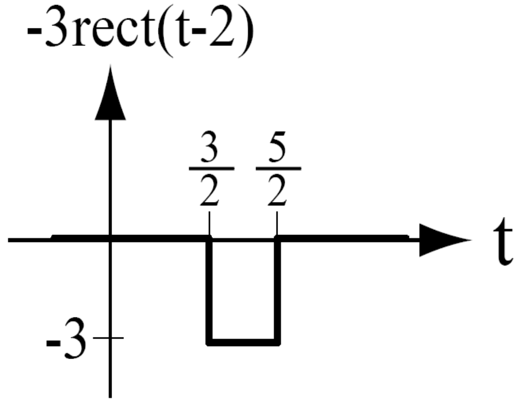


q) Expand Sinc Function by 2 units and multiply with 5.

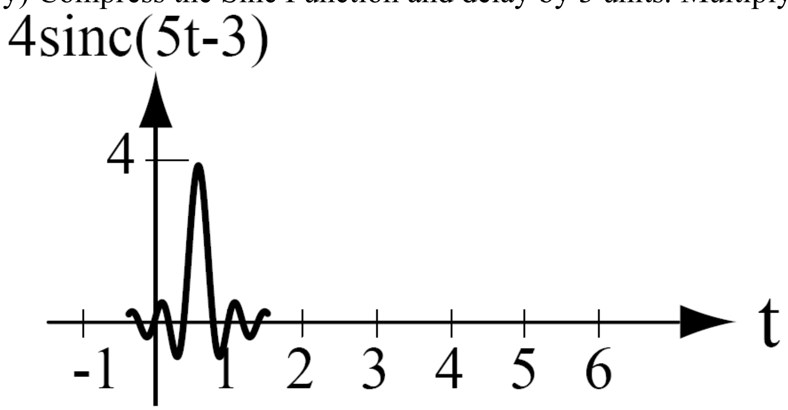
(q)



u) Delay the rect function by 2 units and multiply with -3

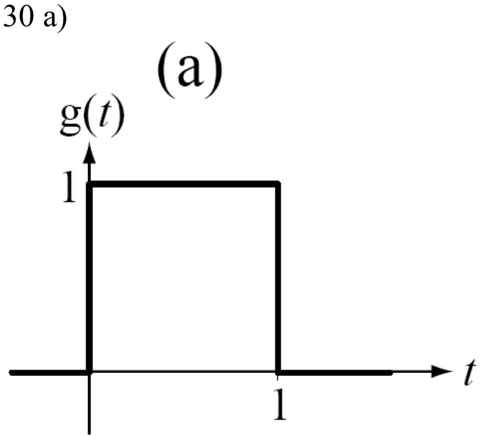


y) Compress the Sinc Function and delay by 3 units. Multiply by 4.

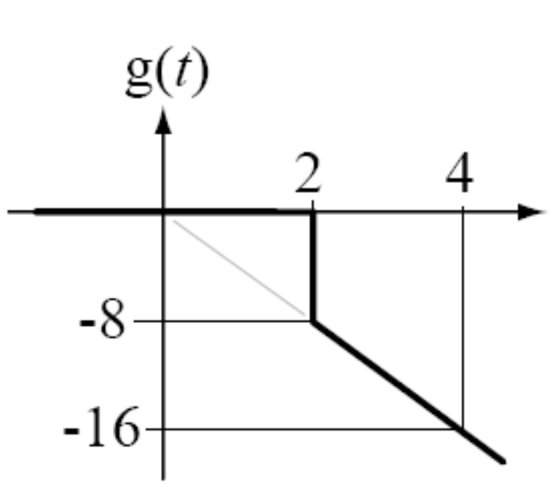


Q 2)

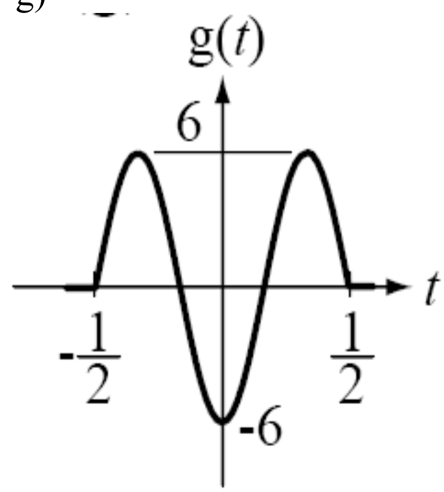
30 a)



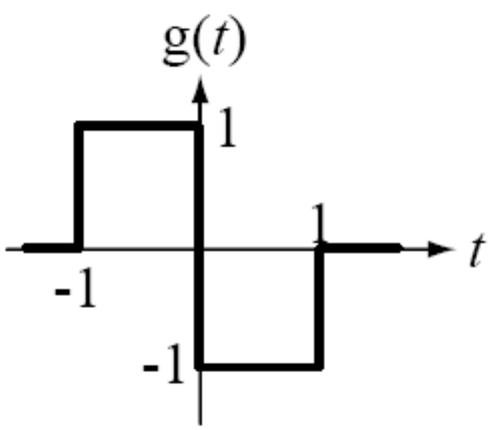
c)



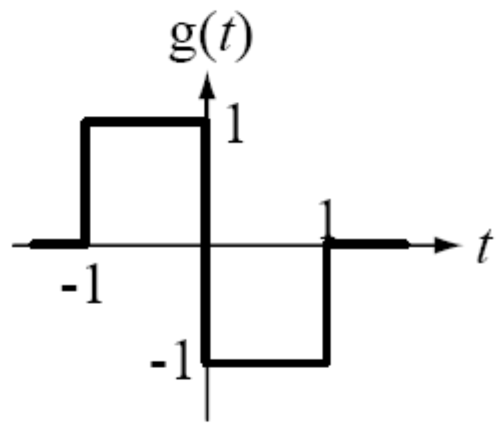
g)



n)



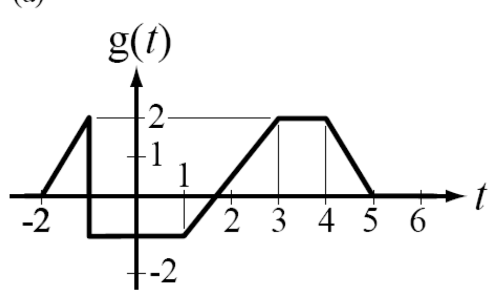
o)



Q3)

33. Given the graphical definition of a function, graph the indicated transformation(s).

(a)

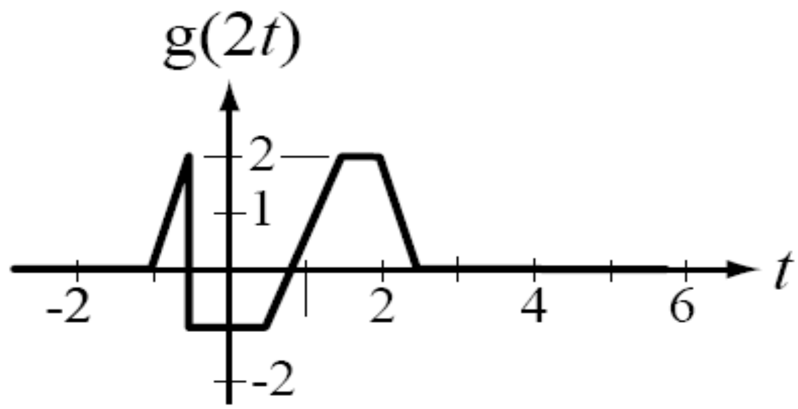


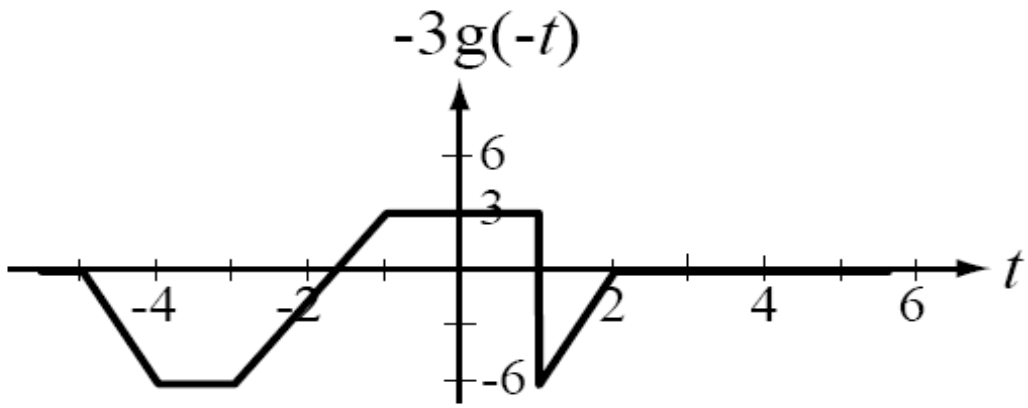
$g(t) \rightarrow g(2t)$

$g(t) \rightarrow -3g(-t)$

$g(t) = 0$, $t > 6$ or $t < -2$

The transformation, $g(t) \rightarrow g(2t)$, simply compresses the time scale by a factor of 2. The transformation $g(t) \rightarrow -3g(-t)$ time inverts the signal, amplitude inverts the signal and then multiplies the amplitude by 3.





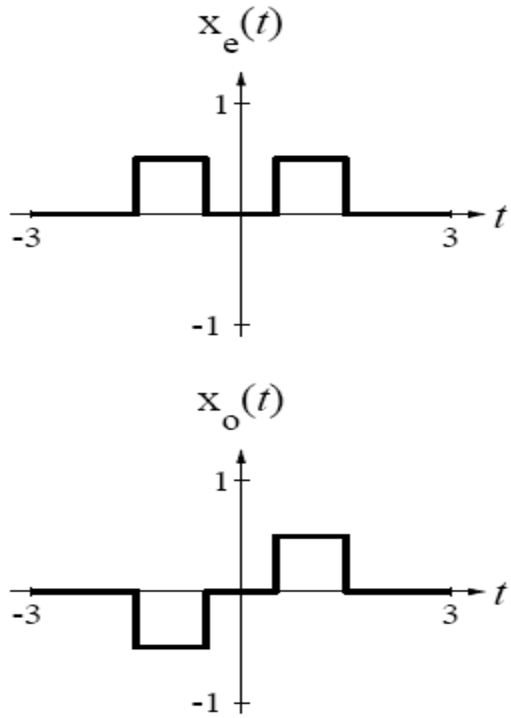
Q 4)

37)

(a) $\mathrm{x}(t) = \mathrm{rect}(t-1)$

$$\mathrm{x}_e(t) = \frac{\mathrm{rect}(t-1) + \mathrm{rect}(t+1)}{2} \quad , \quad \mathrm{x}_o(t) = \frac{\mathrm{rect}(t-1) - \mathrm{rect}(t+1)}{2}$$

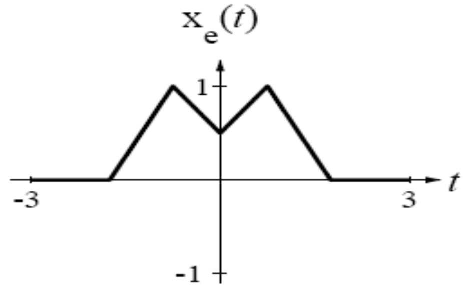
(a)

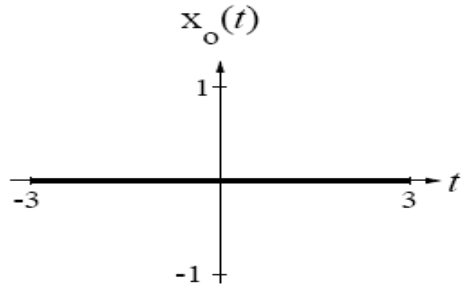


(b) $$x(t) = \text{tri}\left(t - \frac{3}{4}\right) + \text{tri}\left(t + \frac{3}{4}\right)$$

$$x_e(t) = \text{tri}\left(t - \frac{3}{4}\right) + \text{tri}\left(t + \frac{3}{4}\right) \quad , \quad x_0(t) = 0$$

(b)





Q 5)

39. Using a change of variable and the definition of the unit impulse, prove that

$$\delta(a(t-t_0)) = \frac{1}{|a|}\delta(t-t_0) \quad .$$

$$\delta(x) = 0 \;,\; x \neq 0 \;,\; \int_{-\infty}^{\infty} \delta(x)dx = 1$$

$$\delta[a(t-t_0)] = 0 \;,\; \text{where } a(t-t_0) \neq 0 \;\text{ or }\; t \neq t_0$$

$$\text{Strength} = \int_{-\infty}^{\infty} \delta[a(t-t_0)]dt$$

Let

$$a(t-t_0) = \lambda \;\text{ and }\; \therefore adt = d\lambda$$

Then, for a > 0,

$$\text{Strength} = \int_{-\infty}^{\infty} \delta(\lambda)\frac{d\lambda}{a} = \frac{1}{a}\int_{-\infty}^{\infty} \delta(\lambda)d\lambda = \frac{1}{a} = \frac{1}{|a|}$$

and for a < 0,

$$\text{Strength} = \int_{\infty}^{-\infty} \delta(\lambda)\frac{d\lambda}{a} = \frac{1}{a}\int_{\infty}^{-\infty} \delta(\lambda)d\lambda = -\frac{1}{a}\int_{-\infty}^{\infty} \delta(\lambda)d\lambda = -\frac{1}{a} = \frac{1}{|a|}$$

Therefore for a > 0 and a < 0,

$$\text{Strength} = \frac{1}{|a|} \;\text{ and }\; \delta[a(t-t_0)] = \frac{1}{|a|}\delta(t-t_0) \quad .$$

Q 6)
43)

(a) $$\int_{-\infty}^{\infty} \delta(t)\cos(48\pi t)dt = \cos(0) = 1$$

(c) $$\int_{0}^{20} \delta(t-8)\ \mathrm{tri}\frac{t}{32}\ \mathrm{dt} = \mathrm{tri}\ \frac{8}{32} = \frac{3}{4}$$

Q 7)
56)

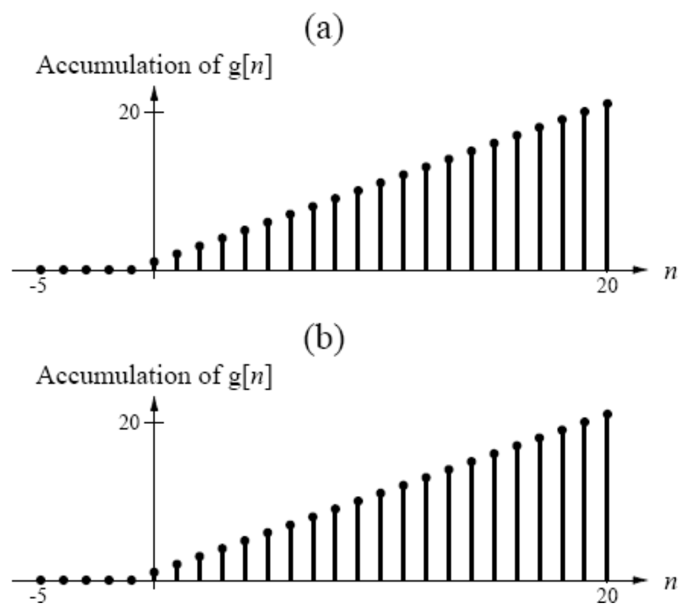
(a) $2\,\mathrm{rect}(-t)$, $$E = \int_{-\infty}^{\infty} [2\,\mathrm{rect}(-t)]^2\,dt = 4\int_{-\frac{1}{2}}^{\frac{1}{2}} dt = 4$$

(b) $\mathrm{rect}(8t)$, $$E = \int_{-\infty}^{\infty} [\mathrm{rect}(8t)]^2\,dt = \int_{-\frac{1}{16}}^{\frac{1}{16}} dt = \frac{1}{8}$$

Q 8)

65. Sketch the accumulation from negative infinity to n of each of these DT functions.

(a) $\mathrm{g}[n] = \cos(2\pi n)\mathrm{u}[n]$ (b) $\mathrm{g}[n] = \cos(4\pi n)\mathrm{u}[n]$



Q 9)

73)

(a) $\mathrm{x}[n] = 5\,\mathrm{rect}_4[n]$ $\quad E_x = \sum_{n=-\infty}^{\infty} |\mathrm{x}[n]|^2 = 25 \sum_{n=-\infty}^{\infty} |\mathrm{rect}_4[n]|^2 = 25 \sum_{n=-4}^{4} (1) = 225$

(b)

$\mathrm{x}[n] = 2\delta[n] + 5\delta[n-3]$ $\; E_x = \sum_{n=-\infty}^{\infty} |2\delta[n] + 5\delta[n-3]|^2 = \sum_{n=-\infty}^{\infty} 4|\delta[n]|^2 + 25|\delta[n-3]|^2 = 29$

10)

a) 0.2 sec, 5 Hz
b) 0.15 sec, 6.7 Hz
c) 100, 213, 1 sec
d) 5, 6, 0.05 sec