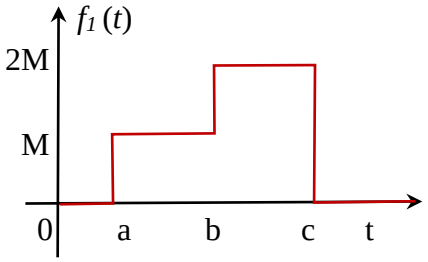
Homework # 2

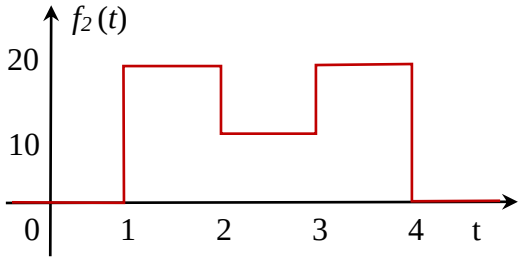
Due: Monday, June 12th

Problem 1. (10 points each) Reconstruct and sketch $f_1(t)$ and $f_2(t)$ using unit step functions. Include all signal operations and sketch all stages with time instants properly matching.

a)



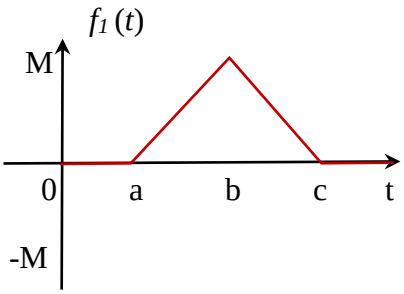
b)



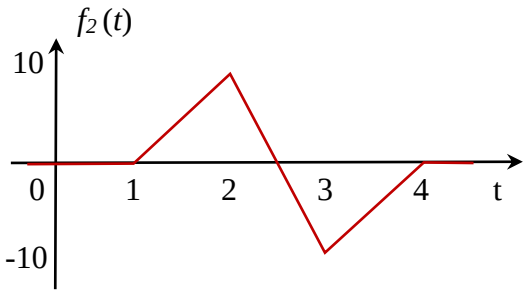
solutions below

Problem 2. (10 points each) Reconstruct and sketch $f_1(t)$ and $f_2(t)$ using ramp functions. Include all signal operations and sketch all stages with time instants properly matching.

a)



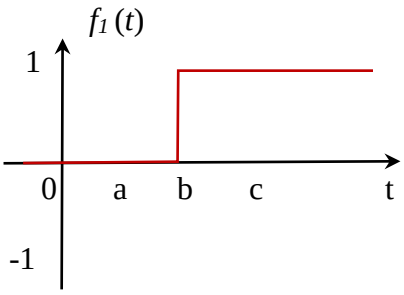
b)



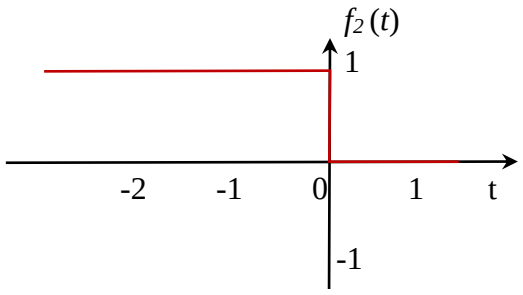
solutions below

Problem 3. (10 points each) Find and sketch the first derivative of the following functions.

a)

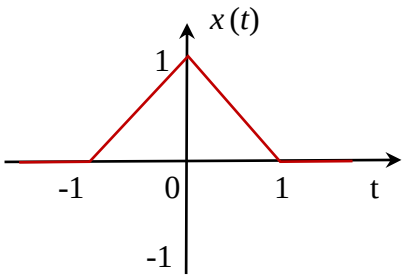


b)



solutions below

Problem 4. (10 points each) Consider the signal operations 1) DELAY by 1 time unit, 2) FLIP and 3) SHRINK by a factor of 2 on the given function $x(t)$. Check if the following sequence of signal operations matter. Show all operations clearly by sketching and writing the functions at different stages of signal operations.



a) DELAY, SHRINK and FLIP

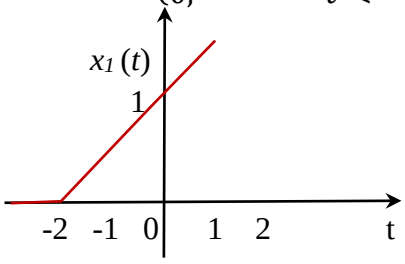
b) DELAY, FLIP and SHRINK

solutions below

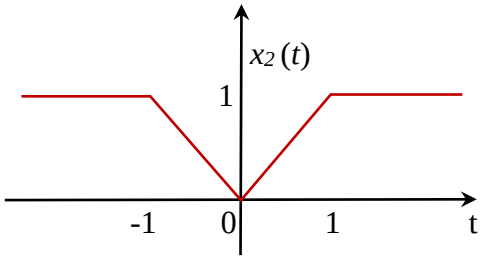
Since the delay and flip remain in the same order, it doesn't matter

Problem 5. (10 points each) For the following functions, determine the discrete time sequence using uniform sampling with a sampling interval of 0.25 seconds within the time range -1 < t < 1.

a) $x_1(t) = \begin{cases} \frac{t}{2} + 1, & t \geq -2 \\ 0, & t < -2 \end{cases}$



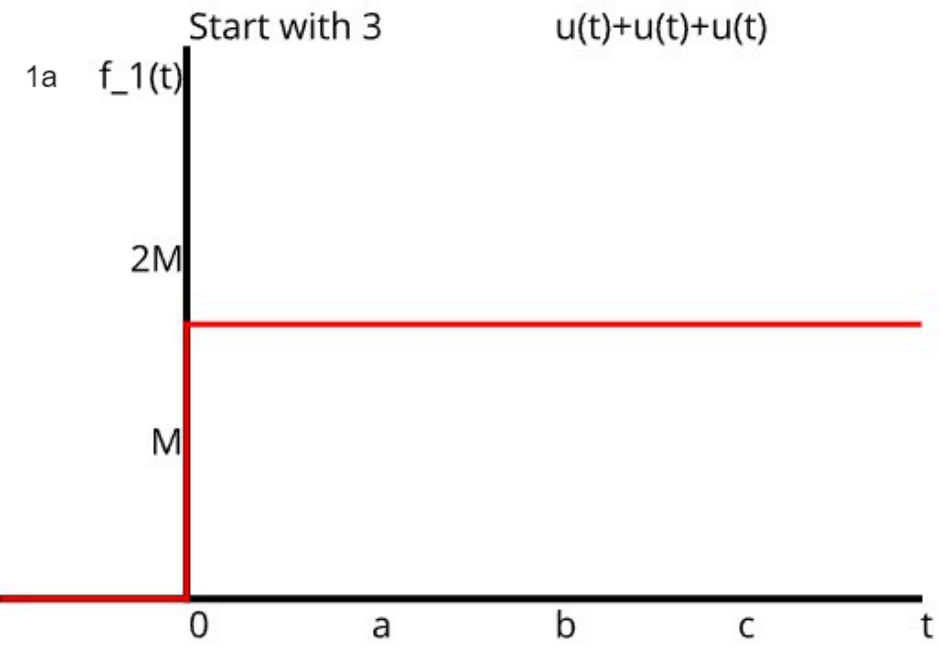
b) $x_2(t) = \begin{cases} |t|, & -1 \leq t \leq 1 \\ 1, & otherwise \end{cases}$

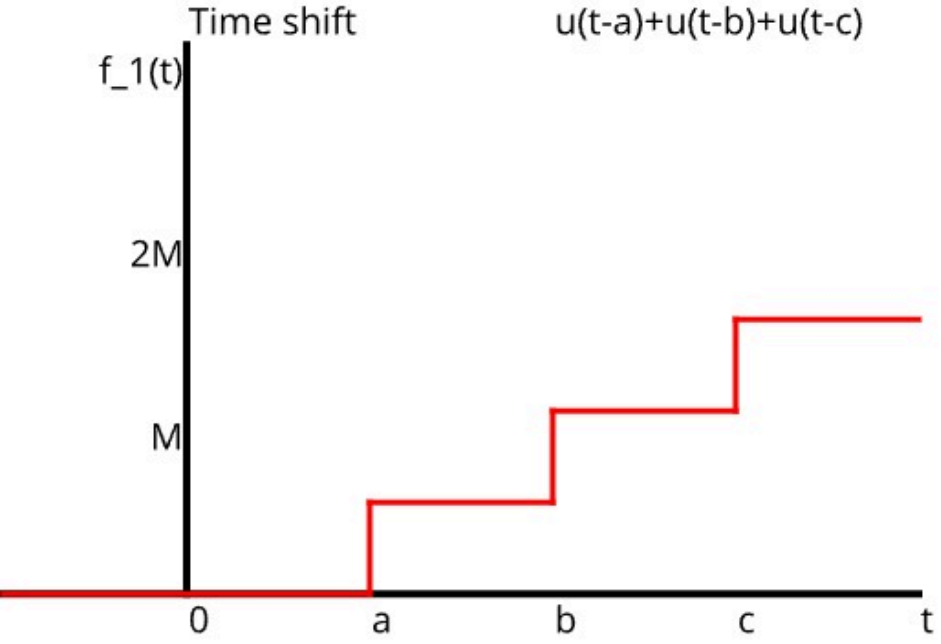


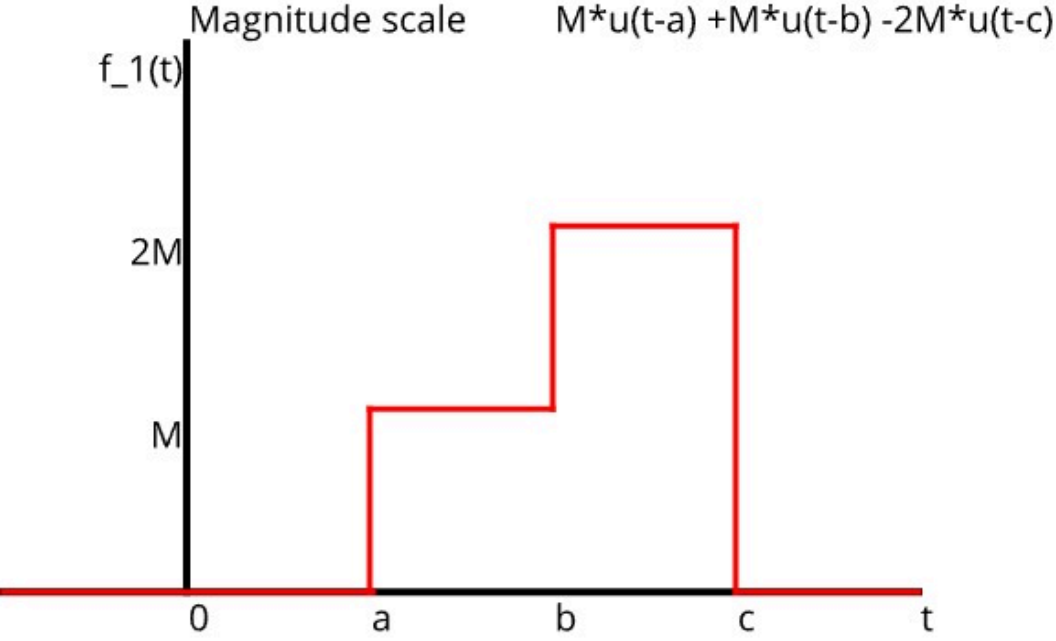
x1[n]=[.5, .625, .75, .875, _1_, 1.125, 1.25, 1.375, 1.5]

x2[n]=[1, .75, .5, .25, _0_, .25, .5, .75, 1]

1a

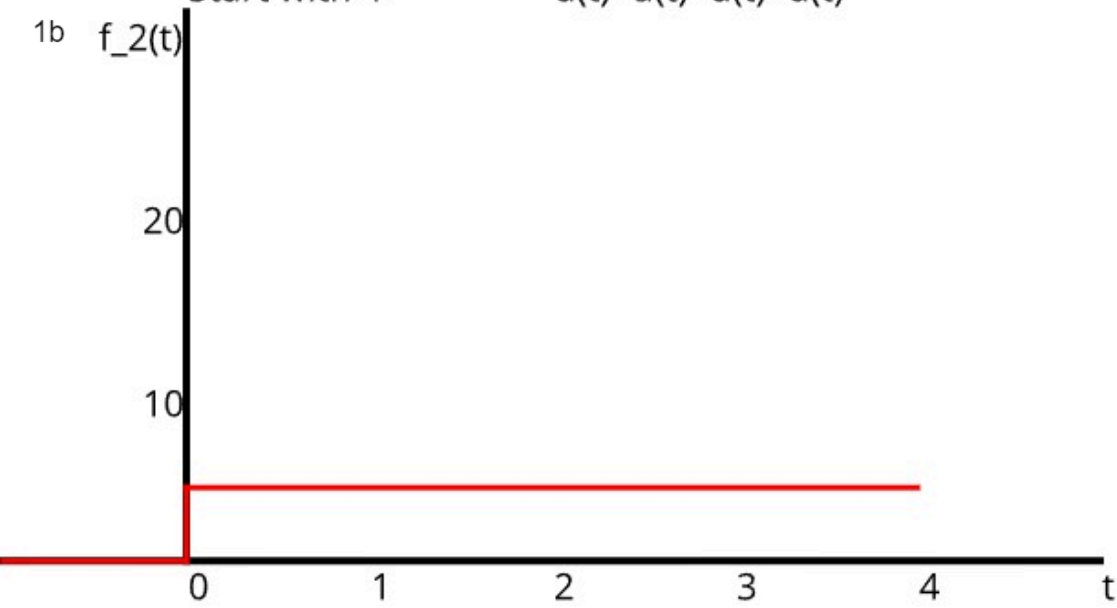

Start with 3
u(t)+u(t)+u(t)
f_1(t)
2M
M
0
a
b
c
t


Time shift
u(t-a)+u(t-b)+u(t-c)
f_1(t)
2M
M
0
a
b
c
t

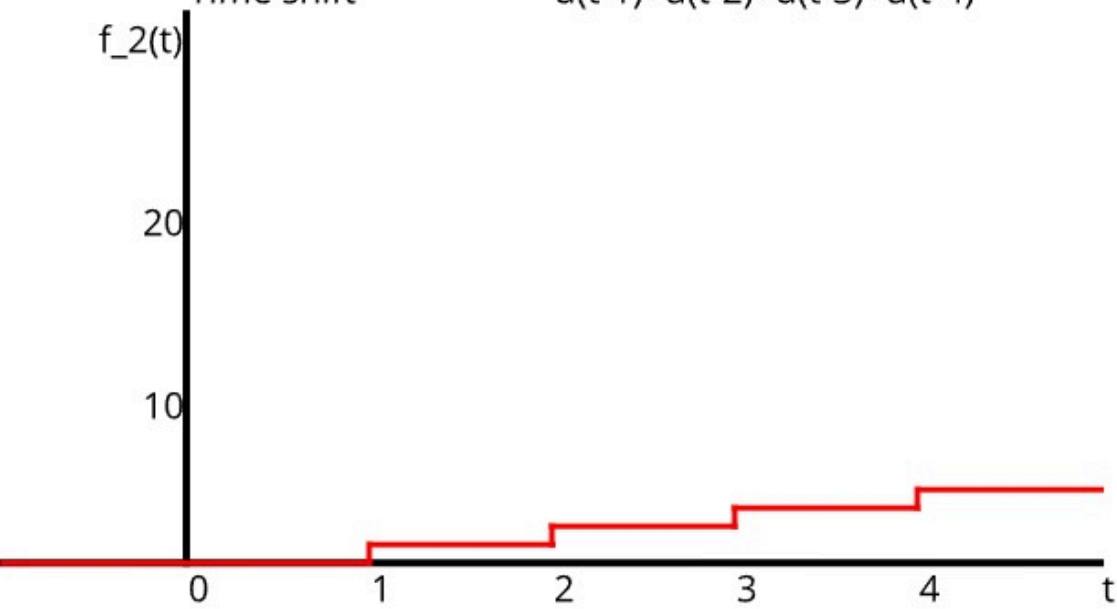

Magnitude scale
M*u(t-a) +M*u(t-b) -2M*u(t-c)
f_1(t)
2M
M
0
a
b
c
t

1b

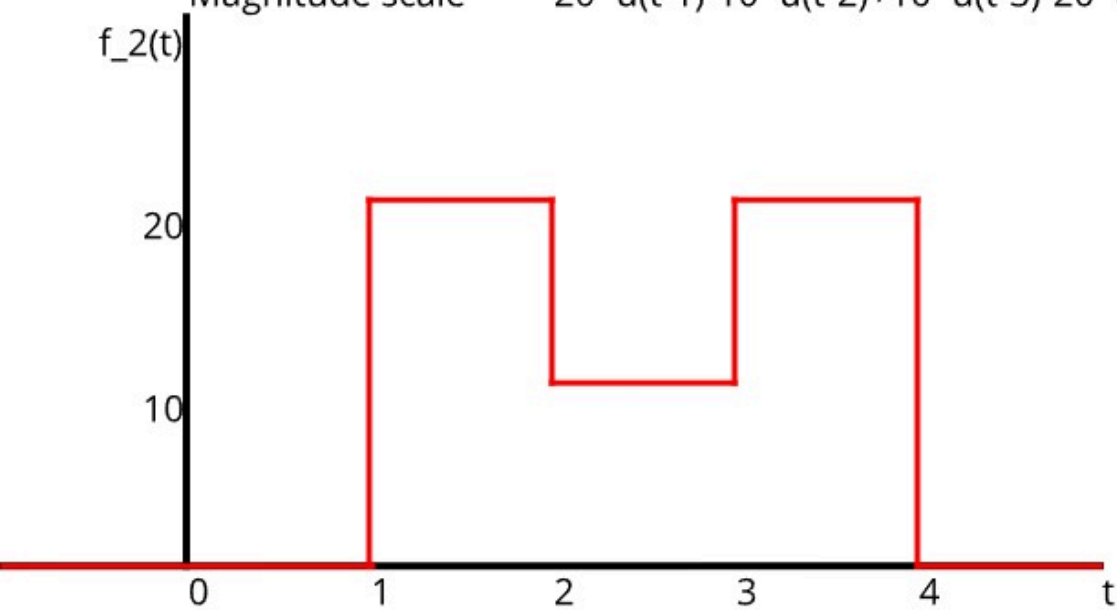
Start with 4 u(t)+u(t)+u(t)+u(t)



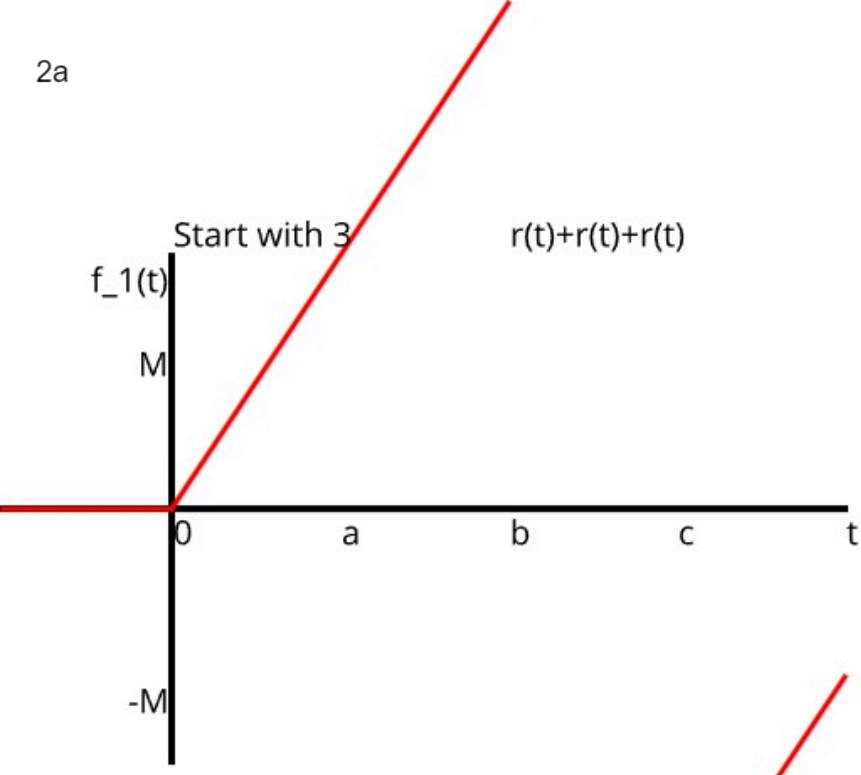
Time shift u(t-1)+u(t-2)+u(t-3)+u(t-4)

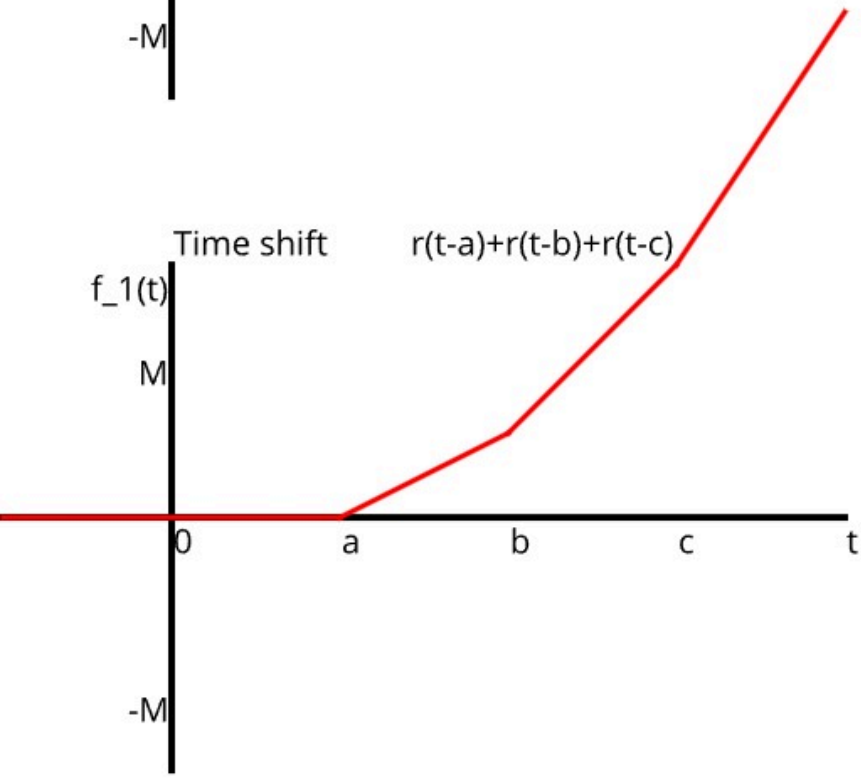


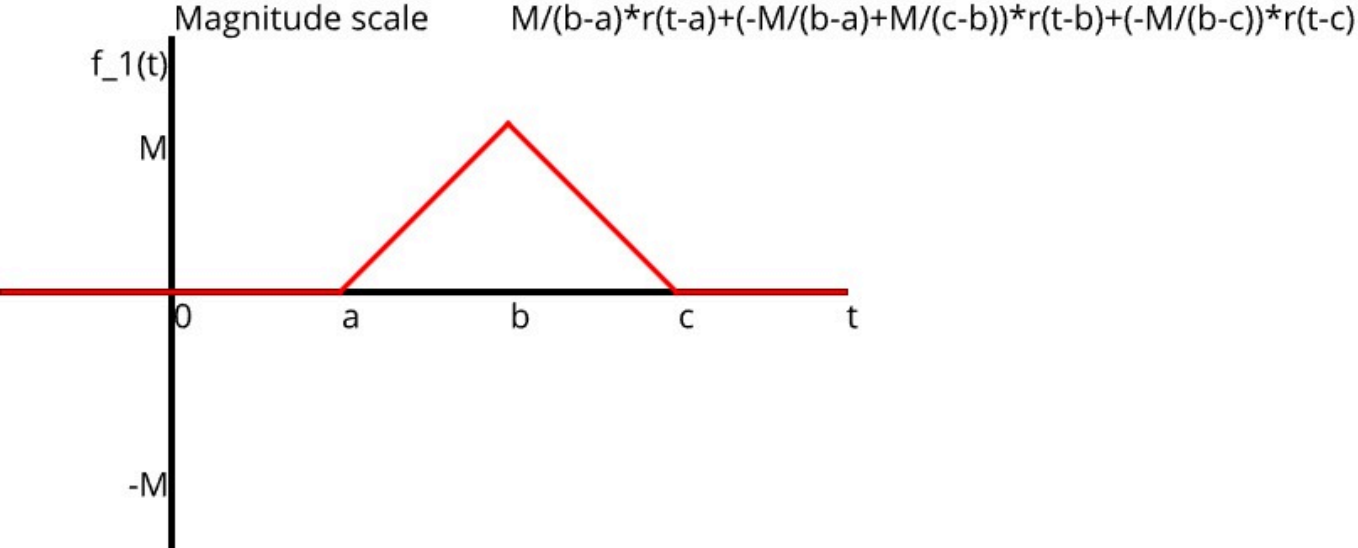
Magnitude scale 20*u(t-1)-10*u(t-2)+10*u(t-3)-20*u(t-4)



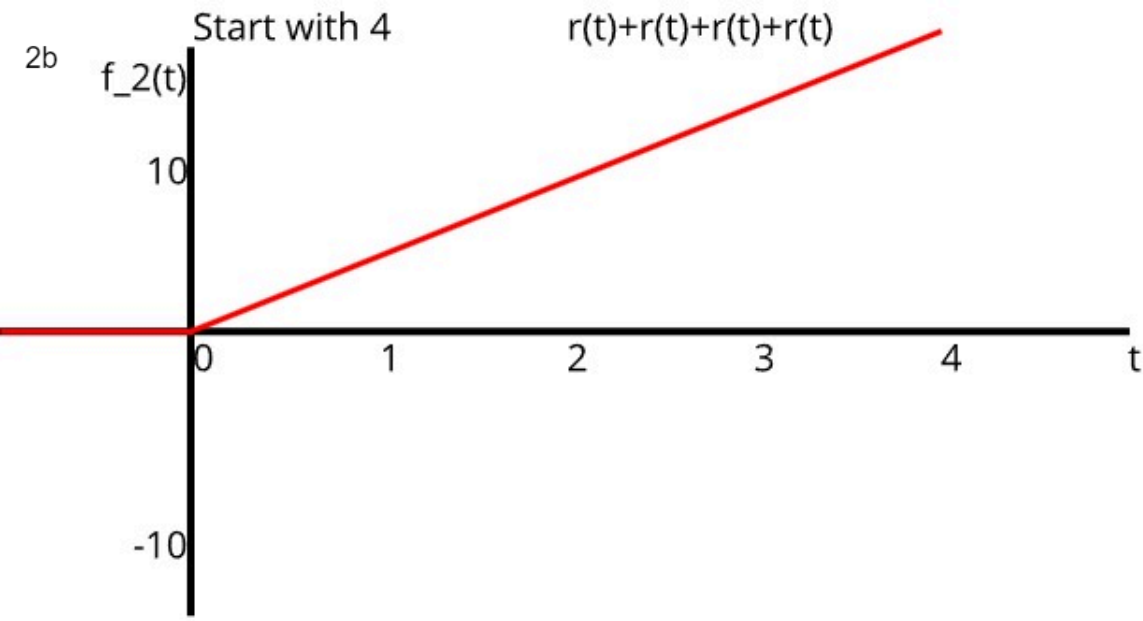
2a

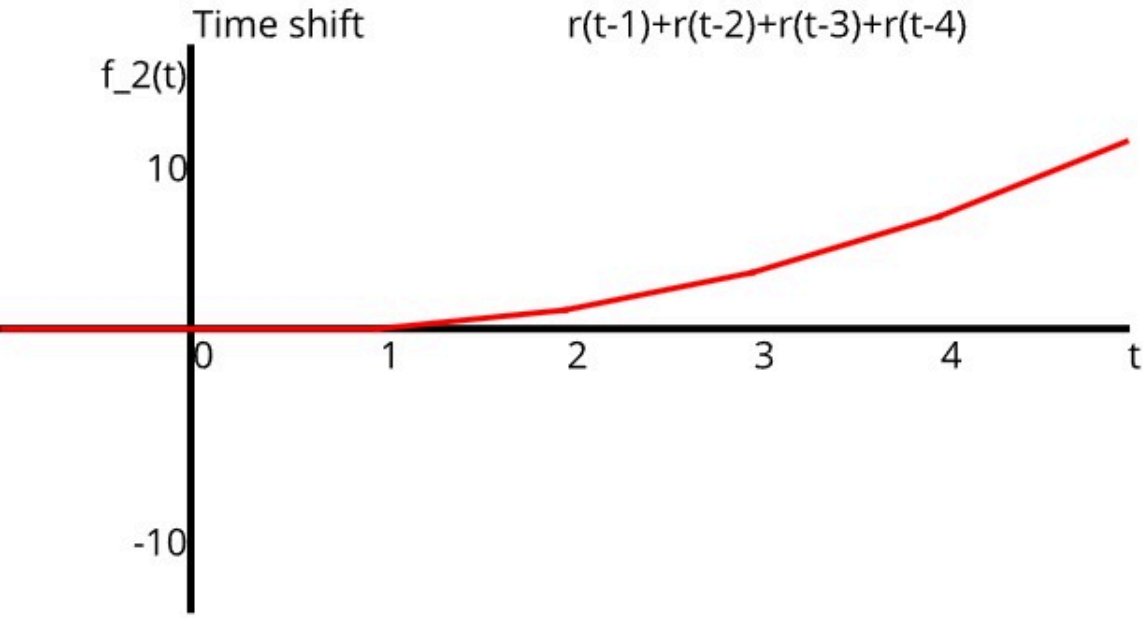

Start with 3
r(t)+r(t)+r(t)
f_1(t)
M
0
a
b
c
t
-M

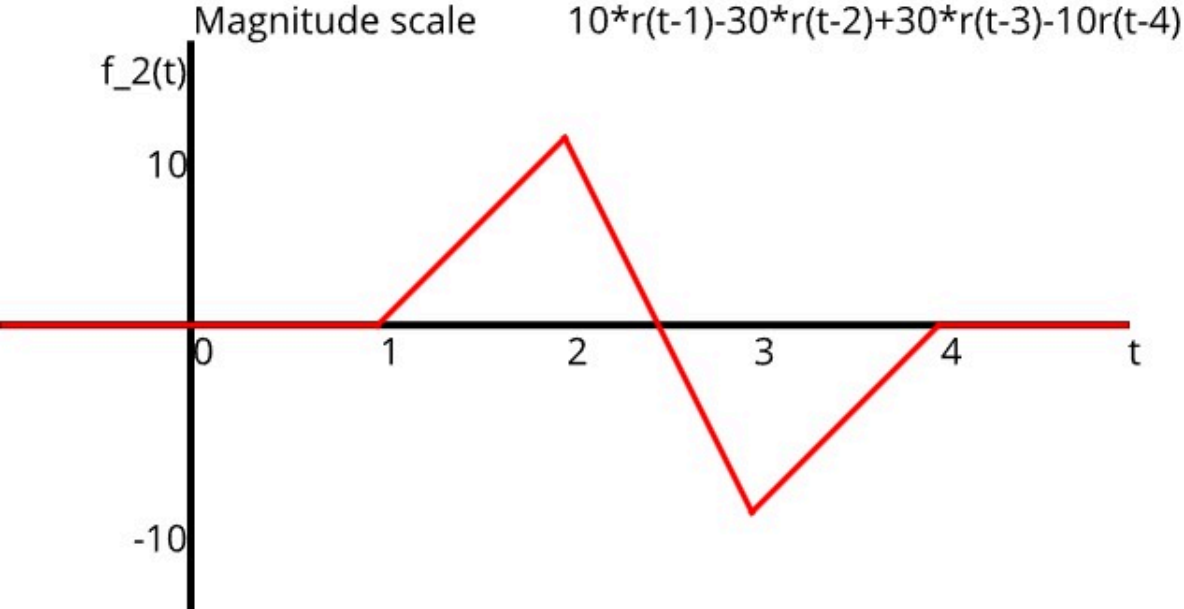

Time shift
r(t-a)+r(t-b)+r(t-c)
f_1(t)
M
0
a
b
c
t
-M


Magnitude scale
M/(b-a)*r(t-a)+(-M/(b-a)+M/(c-b))*r(t-b)+(-M/(b-c))*r(t-c)
f_1(t)
M
0
a
b
c
t
-M

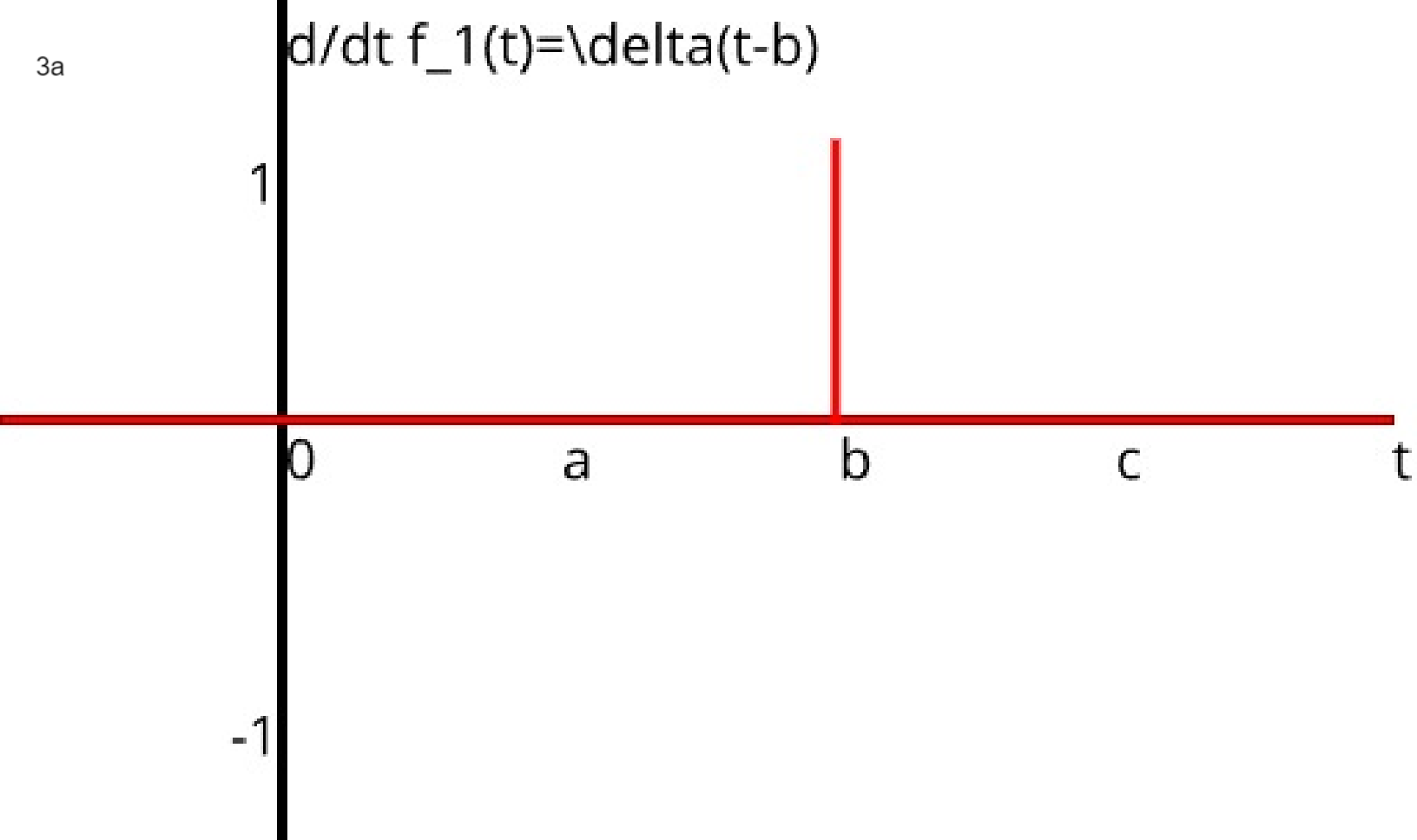
2b

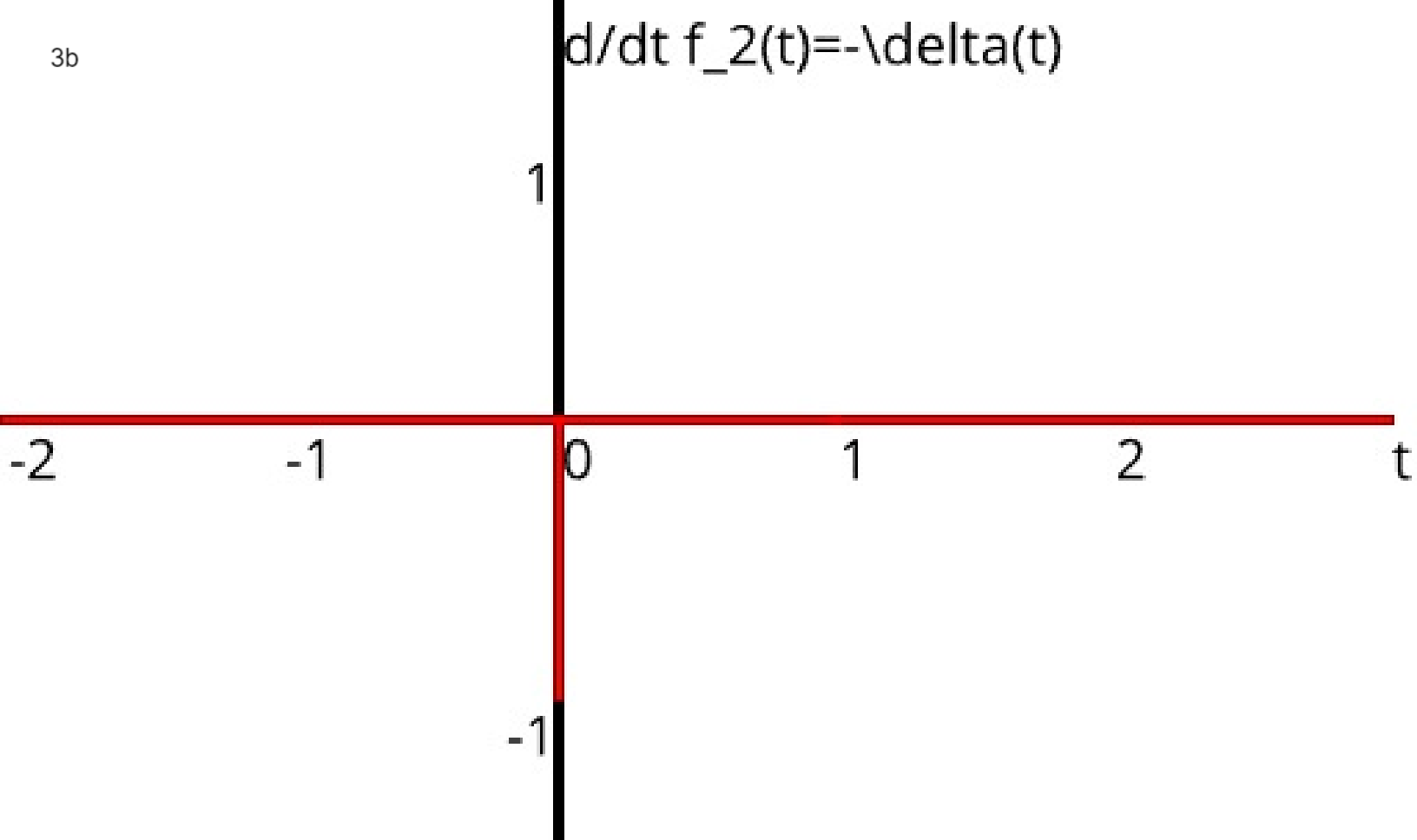

Start with 4
r(t)+r(t)+r(t)+r(t)
f_2(t)
10
-10
0
1
2
3
4
t


Time shift
r(t-1)+r(t-2)+r(t-3)+r(t-4)
f_2(t)
10
-10
0
1
2
3
4
t

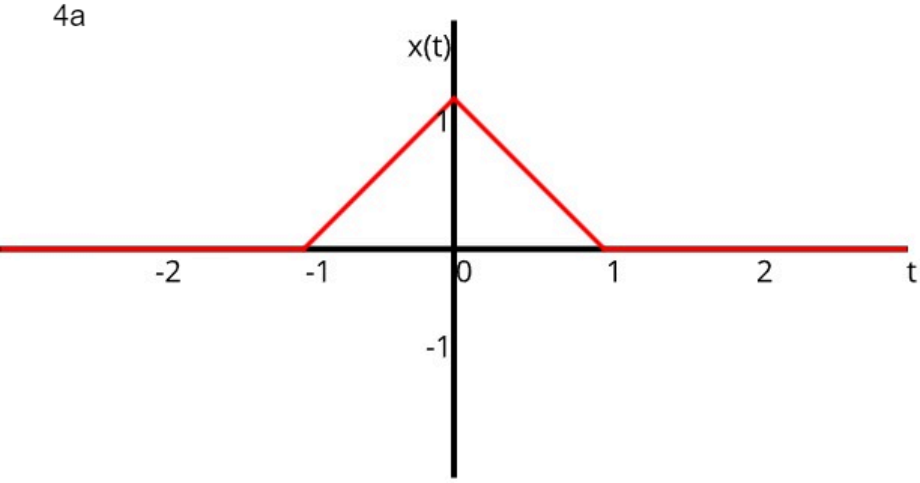

Magnitude scale
10*r(t-1)-30*r(t-2)+30*r(t-3)-10r(t-4)
f_2(t)
10
-10
0
1
2
3
4
t

3a

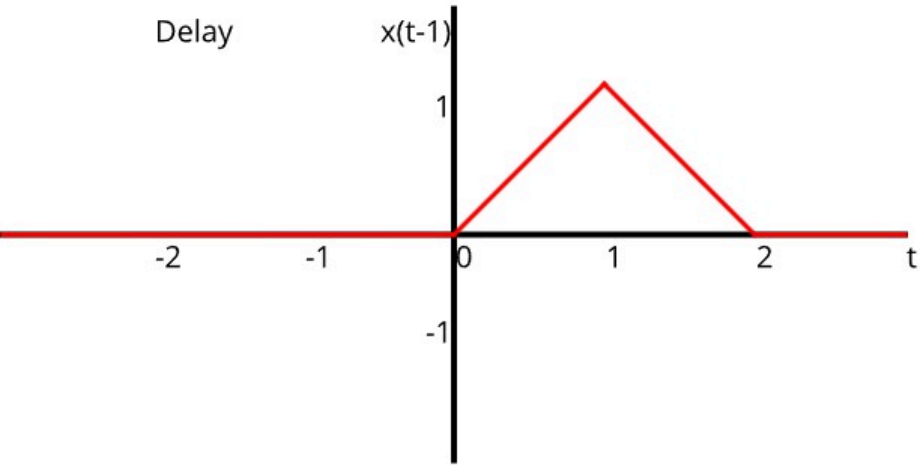



3b
d/dt f_2(t)=-\delta(t)
1
-1
-2
-1
0
1
2
t

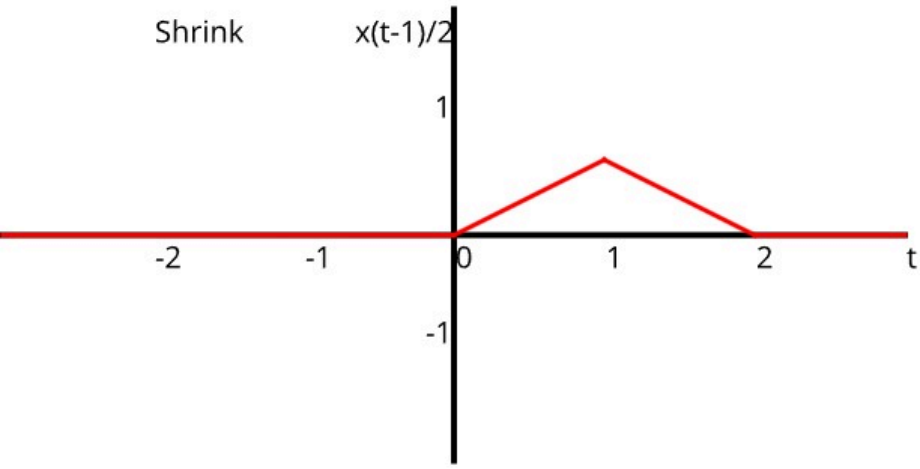
4a



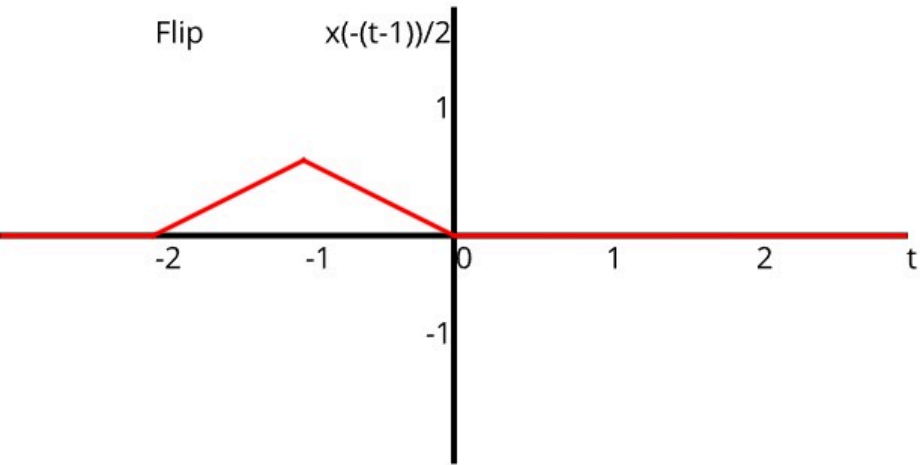
Delay



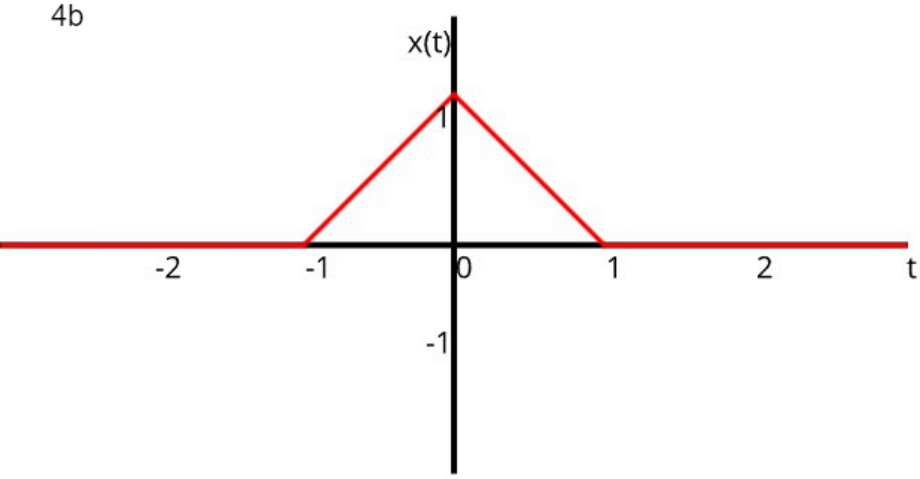
Shrink



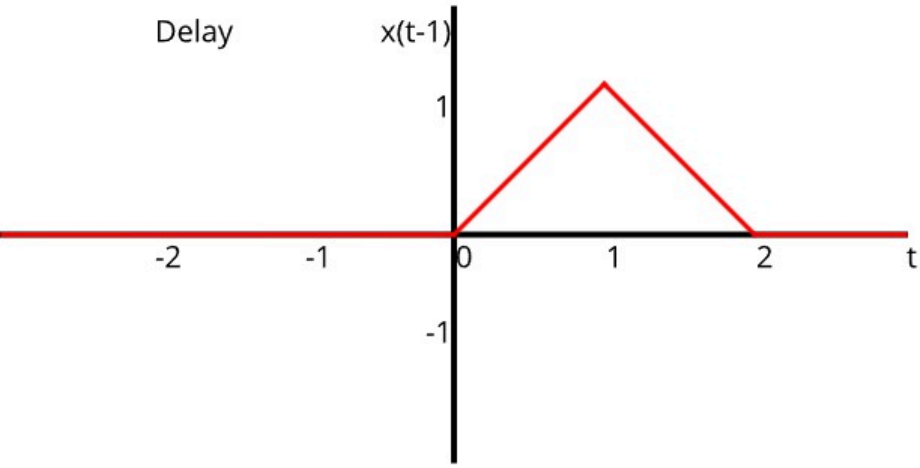
Flip



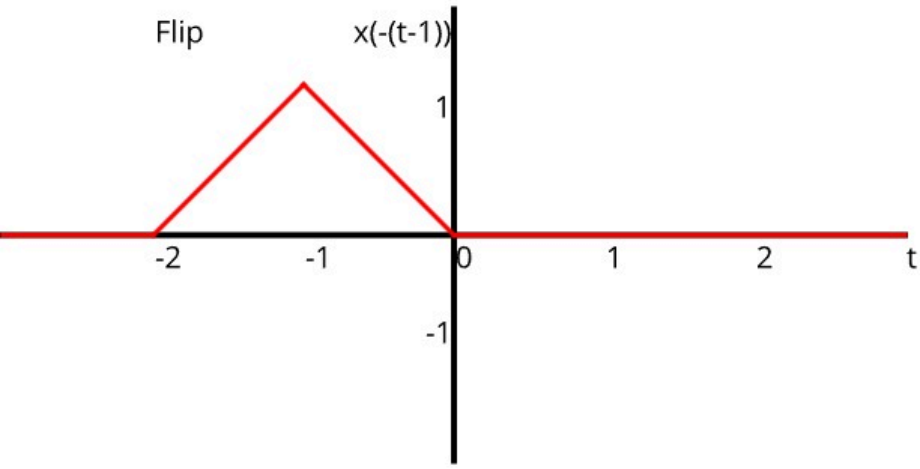
4b



Delay



Flip



Shrink