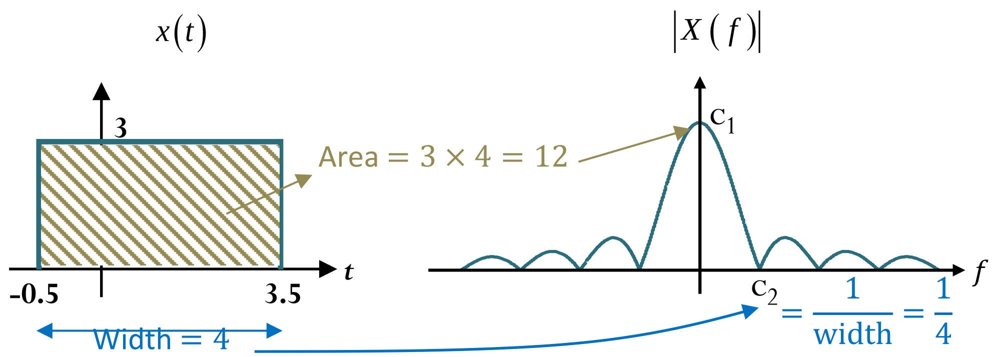
ECS 332: In-Class Exercise # 4 - Sol

Instructions

1. Separate into groups of no more than three students each.
   The group cannot be the same as any of your former groups.
2. **[ENRE]** = Explanation is not required for this exercise
3. **Do not panic.**

Date: 0 4 / 0 9 / 2019			
Name	ID (last 3 digits)		

[ENRE] A signal and its magnitude spectrum are plotted below.



1. Find the values of the constants (corresponding to some zero and the peak value) shown in the plots.

$$c_1 = \underline{\ 12\ },\ c_2 = \underline{\ \tfrac{1}{4}\ }.$$

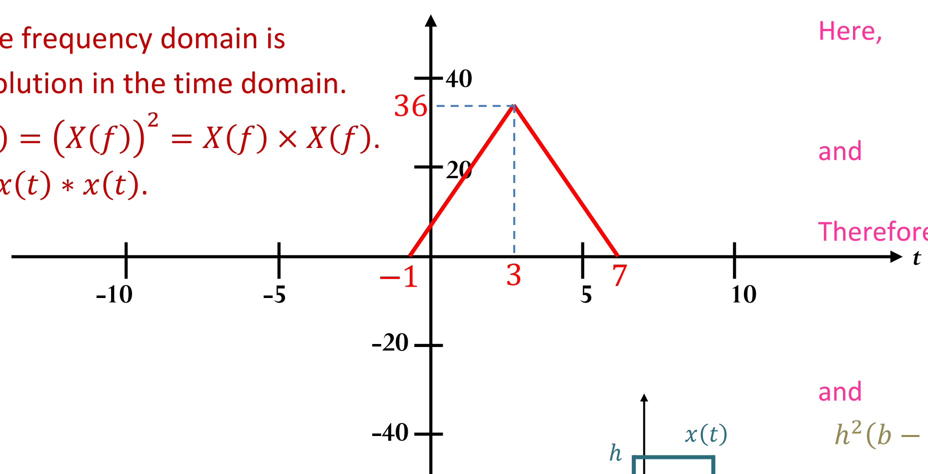
This problem is similar to the one we have worked on in the previous exercise. However, the rectangular function is not centered at t = 0; it is time-shifted. From the time-shift property (2.31), we know that the magnitude spectrum plot won't be affected by this time-shifting. So, we can still use 2.13. In particular,
(0) The Fourier transform of a rectangular function is a sinc function.
(i) The height of the sinc function's peak is the same as the area under the rectangular function.
(ii) The first zero crossing of the sinc function occurs at 1/(width of the rectangular function).

2. Define another signal $y(t)$ whose Fourier transform is given by

$$Y(f) = (X(f))^2.$$

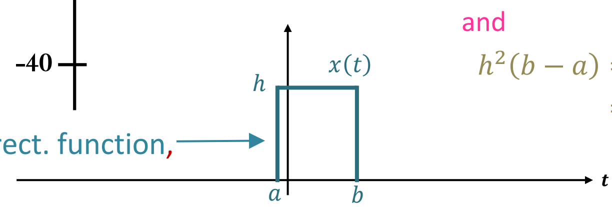
Plot $y(t)$.

Multiplication in the frequency domain is equivalent to convolution in the time domain.
Here, we have $Y(f) = (X(f))^2 = X(f) \times X(f)$.
Therefore, $y(t) = x(t) * x(t)$.

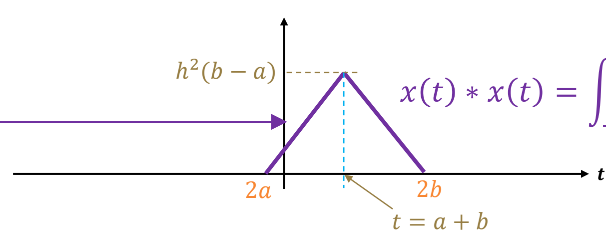


Here,
$a = -0.5$,
$b = 3.5$,
and
$h = 3$.
Therefore,
$2a = -1$,
$2b = 7$,
$a + b = 3$,
and
$h^2(b-a) = 3^2(3.5-(-0.5))$
$= 9 \times 4 = 36$.

In class, we have shown that when we have a rect. function,



its self-convolution is a triangular func.



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