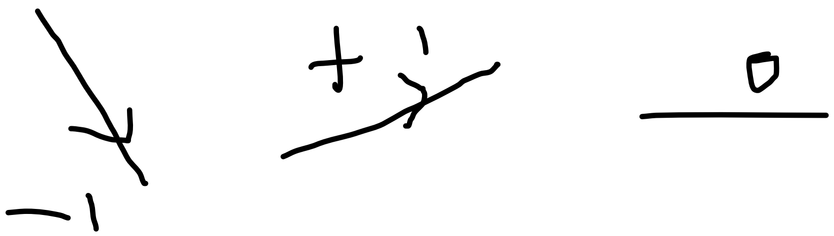
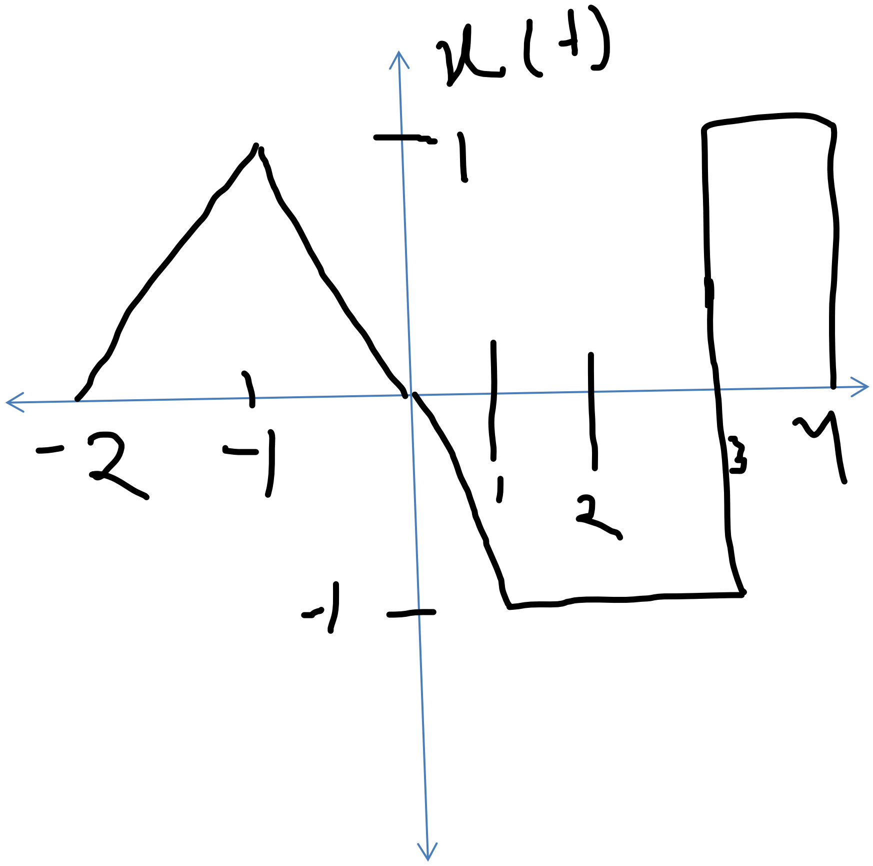
Revision – 1

Ramp: +1, -1 or zero slop. Slope is (difference in y coordinate/ difference in X coordinate)



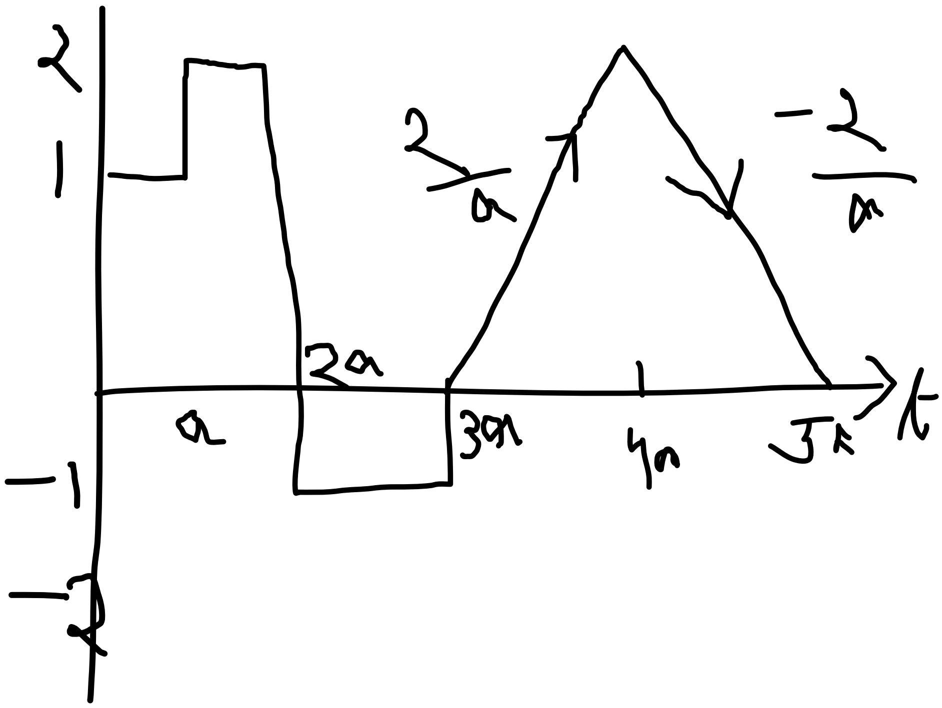
Q1. Representation of signal in terms of unit step and unit ramp function.



Solution:

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

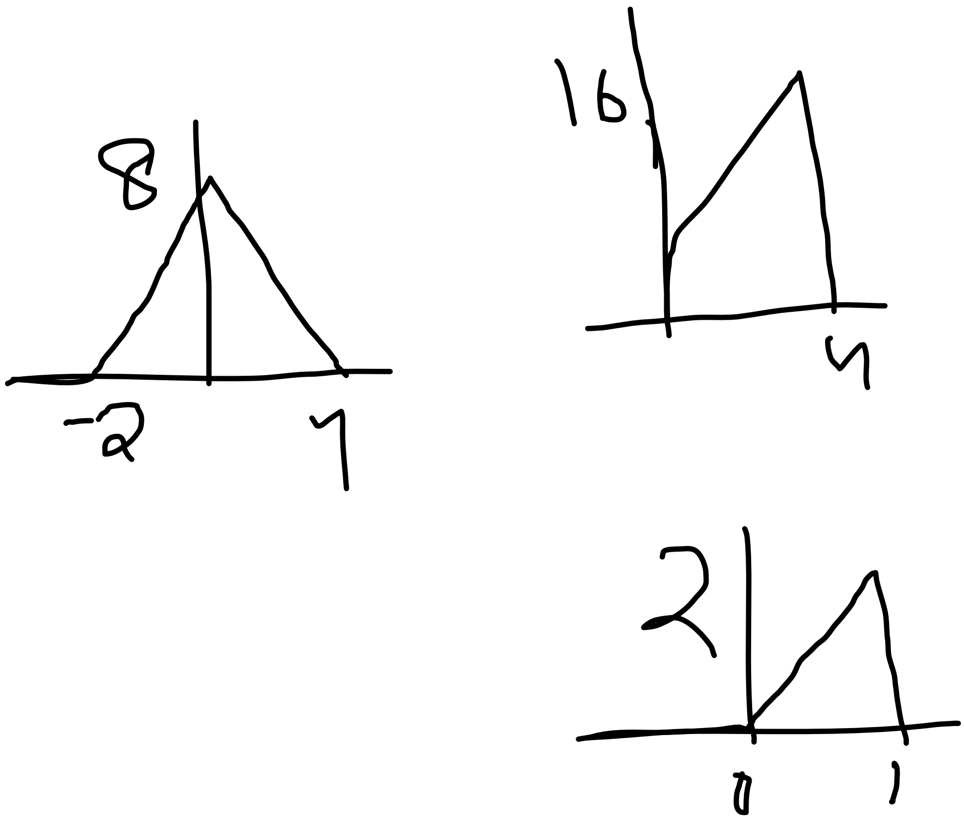
Q2.



$x(t) = +1\,u(t) + (+1)u(t-a) + (-3)u(t-2a) + u(t-3a) + (+1)u(t-3a) + \left(\frac{2}{a} - 0\right) r(t-3a) + \left(-\frac{2}{a} - \frac{2}{a}\right) r(t-4a) + (0 - (-\frac{2}{a}))r(t-5a)$

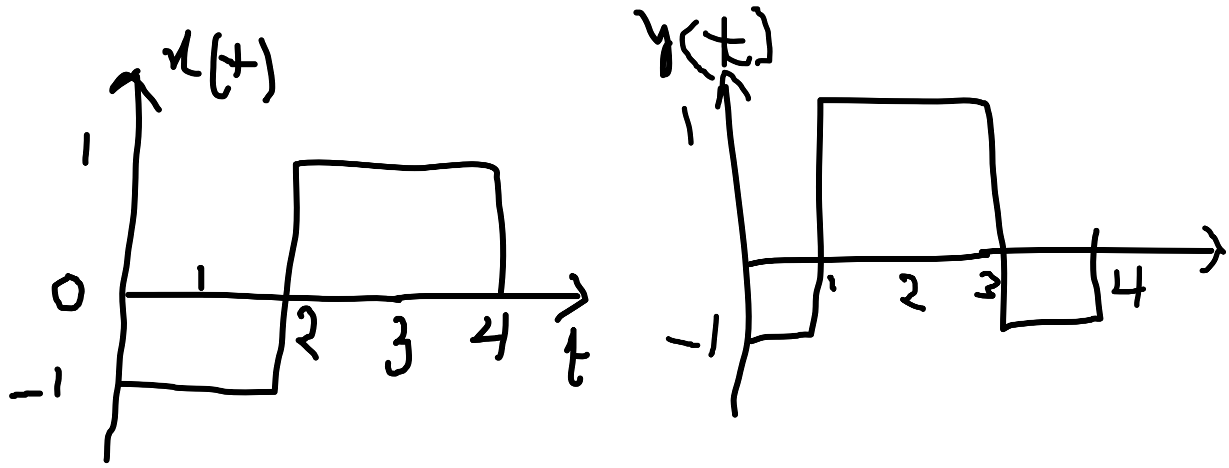
$$x(t) = u(t) + u(t-a) - 3\,u(t-2a) + u(t-3a) + u(t-3a) + \frac{2}{a} r(t-3a) - \frac{4}{a} r(t-4a) + \frac{2}{a}\,r(t-5a)$$

Q3.



a. $x(t) = \frac{8}{2} r(t+2) - \frac{4}{4} r(t)$

Q. Show that the following signals are orthogonal.



Solution:

$$\int_{t1}^{t2} x(t)y(t)dt = 0$$

$$\int_0^4 x(t)y(t)dt = \int_0^1 (-1 \times -1)dt + \int_1^2 (-1 \times 1)dt + \int_2^3 (1 \times 1)dt + \int_3^4 (1 \times -1)dt$$

$= \int_0^1 1\,dt + \int_1^2 -1\,dt + \int_2^3 1\,dt + \int_3^4 -1\,\ dt =$

$= 1 - 1 + 1 - 1 = 0$

The signals are orthogonal.

Q. Show that the following signals are orthogonal over the interval [0, 1].

$x_1(t) = 2, x_2(t) = \sqrt{3}(1 - 2t)$

Solution:

$$\int_{t1}^{t2} x_1(t)x_2 dt = 0$$

$$=> \int_0^1 2\sqrt{3}(1 - 2t)\ dt = \int_0^1 2\sqrt[2]{3}\ dt - \int_0^1 4\sqrt[2]{3}\ t\ dt$$

$$=> 2\sqrt[2]{3} \int_0^1 1\ dt - 4\sqrt[2]{3} \int_0^1 t\ dt$$

$= 2\sqrt[2]{3}\ \ \boldsymbol{t}\Big]_{\mathbf{0}}^{\mathbf{1}} - 4\sqrt[2]{3}\ \ \frac{\boldsymbol{t}^2}{2}\Big]_{\mathbf{0}}^{\mathbf{1}}$ =$2\sqrt[2]{3}[1 - 0] - 2\sqrt[2]{3}[1 - 0]$=0

The signals are orthogonal.