1. Plot the following convolutions of $x_1(t)$ and $x_2(t)$:
   a. $x_1(t) = \text{rect}((t-5)/10)$; $x_2(t) = \sin(2\pi t)\text{rect}(t-0.5)$
   b. $x_1(t) = \text{ramp}(t)\text{rect}((t-2)/4)$; $x_2(t) = x_1(-t)$
   c. $x_1(t) = \sin(2\pi t)$; $x_2(t) = \text{rect}(t)$
   d. $x_1(t) = \sin(2\pi t)u(t)$; $x_2(t) = u(t)$
   e. $x_1(t) = 2t$; $x_2(t) = \text{rect}(t+0.5) - \text{rect}(t-0.5)$
   f. $x_1(t) = g(t)$; $x_2(t) = (1/\Delta t)(\delta(t+\Delta t/2) - \delta(t-\Delta t/2))$ as $\Delta t \to 0$

2. Find the impulse response of the differential equation of the form:

$$a_2y''(t) + a_1y'(t) + y(t) = b_1x'(t) + b_0x(t) \quad (2a)$$

3. The mass, resistance, and spring equation is characterized by the equation:

$$m\dddot{y}(t) + r\ddot{y}(t) + k\dot{y}(t) = x(t) \quad (3a)$$

where $y(t)$ is the position and $x(t)$ is the input force. The stable solution due to an impulse, $x(t) = \delta(t)$, was found to be:

$$y_0(t) = \frac{e^{s_1t} - e^{s_2t}}{m(s_1 - s_2)}u(t) \quad \text{where} \quad s_{1,2} = \frac{-r \pm \sqrt{r^2 - 4mk}}{2m} \quad (3b)$$

a. Show that the eq. (3b) is the solution to (3a) when $x(t) = \delta(t)$.

b. Give an expression for $y_u(t)$ when $x(t)$ is the unit step function, $u(t)$.

c. Give an expression for $y_r(t)$ when $x(t)$ is the unit rect function, $\text{rect}(t)$.

d. Give an expression for $y(t)$ when $x(t)$ is given by the plot below (from HW03), with $T = 1$. 

![Plot of signal](image.png)