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Question 1

$$X(t) = \begin{cases} 0, & t < 0 \\ 3t, & 0 \le t < 1 \\ -3t+6, & 1 \le t < 2 \\ 0, & 2 \le t < 3 \\ -1, & 3 \le t < 4 \\ 0, & t > 4 \end{cases}$$

$s = 2t + 1$ $y(t) = x(s)$

$t = \frac{s-1}{2}$

$t = \frac{0-1}{2}$ $t = \frac{1-1}{2}$ $t = \frac{2-1}{2}$ $t = \frac{3-1}{2}$

$t = \frac{-1}{2}$ $t = 0$ $t = \frac{1}{2}$ $t = 1$

$t = \frac{4-1}{2}$

$t = \frac{3}{2}$

$$y - y_2 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_2)$$

$$y - 3 = \frac{3-0}{1-0}(x-1)$$

$$y = 3x - 3 + 3$$
$$y = 3x$$
$$y = 3t$$

$$y - 0 = \frac{0-3}{2-1}(x-2)$$

$$y = \frac{-3}{1}(x-2)$$

$$y = -3x + 6$$
$$y = -3t + 6$$

$$y + 1 = \frac{-1-0}{3-3}(x+1)$$
$$y + 1 = 0$$
$$y = -1$$

Question 2

$$y(t) = \begin{cases} 0, & t < -\frac{1}{2} \\ 6t+3, & -\frac{1}{2} \le t \le 0 \\ -6t+3, & 0 \le t \frac{1}{2} \\ 0, & \frac{1}{2} \le t < 1 \\ -1, & 1 \le t \le \frac{3}{2} \\ 0, & t > \frac{3}{2} \end{cases}$$

Question 3. $(at + b)[u(t-t_1) - y(t-t_2)]$

$6t + 3[u(t - -\frac{1}{2}) - v(t)] + (-6t+3)[u(t) - u(t-0.5)] - [u(t-1) - u(t-1.5)]$

$6t + 3[u(t+3) - u(t)] + (-6t+3)[u(t) - u(t-0.5)] - [u(t-1) - u(t-1.5)]$

Question 4

$$y(t) = \int_{\infty}^{t} x(\tau)\,d\tau$$

$x(\tau)=0 \quad \int_{\infty}^{0} 0\,d\tau = 0$

$x(\tau)=3\tau \quad \int_{0}^{t} 3\tau\,d\tau = \frac{3}{2}t^2$

$x(\tau)=-3\tau+6 \quad \int_{1}^{t} -3\tau+6\,d\tau = -\frac{3}{2}t^2 + 6t - 4.5$

$r(1) = \frac{3}{2} \quad r(t) = \frac{3}{2}t^2$

$\left[-\frac{3}{2}t^2 + 6\tau\right]_{1}^{t} = -\frac{3}{2}t^2 + 6t - \left(\frac{3}{2}+6\right)$

$= -\frac{3}{2}t^2 + 6t - 4.5$

$r(t) = \frac{3}{2} + \left(\frac{3}{2}t^2 + 6t - 4.5\right) = -\frac{3}{2}t^2 + 6t - 3$

$r(2) = 3$

$r(t) = -\frac{3}{2}t^2 + 6t - 3$

$x(\tau) = 0 \quad \int_{2}^{t} x(\tau)\,d\tau = 0$

$r(t) = 0 + 3 = 3$

$r(3) = 3$

$r(t) = 3$

$x(\tau) = -1 \quad \int_{3}^{t} (-1)\,d\tau = -t - 3 = -(t-3)$

$r(t) = r(3) + (-(t-3))$

$r(t) = 3 - (t-3)$

$r(t) = 6 - t$

$r(4) = 6 - 4 = 2$

$x(\tau) = 0 \quad \int_{4}^{t} 0\,d\tau = 0$

$r(t) = r(4) + 0$

$r(t) = 2$

$$r(t) = \begin{cases} 0, & t < 0 \\ \frac{3}{2}t^2, & 0 \le t < 1 \\ -\frac{3}{2}t^2 + 6t - 3, & 1 \le t < 2 \\ 3, & 2 \le t < 3 \\ 6 - t, & 3 \le t < 4 \\ 2, & t > 4 \end{cases}$$