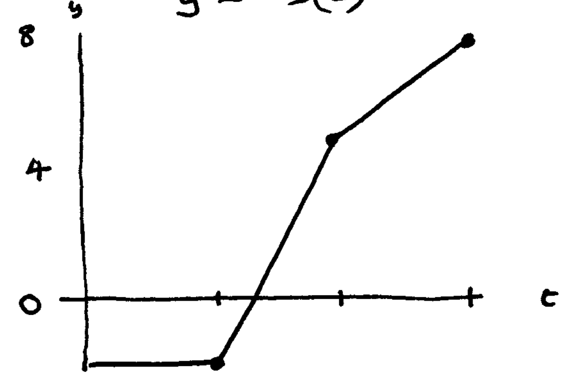
ξ is piecewise-linear, hence the only possible discontinuity is at $t=1$ or $t=2$. But $\xi(1-) = \lim_{t\to 1-} \xi(t) = -2$ and $\xi(1+) = \lim_{t\to 1+} \xi(t) = 7\cdot 1 - 9 = -2 \Rightarrow \xi(1-) = \xi(1+) \Rightarrow$ ξ continuous at $t=1$; and similarly, $\xi(2-) = 7\cdot 2 - 9 = 5 = 3\cdot 2 - 1 = \xi(2+) \Rightarrow \xi$ continuous at $t=2$. So ξ is continuous.

$\underline{\underline{0 \le t \le 1}}$: $\phi(t) = \int_0^t \xi(x)\,dx = \int_0^t -2\,dx = \int_0^t -2\cdot 1\,dx$

$= -2\int_0^t 1\,dx = -2(t-0) = -2t$. In particular, $\phi(1) = -2$.

$\underline{\underline{1 \le t \le 2}}$: $\phi(t) = \int_0^t \xi(x)\,dx = \int_0^1 \xi(x)\,dx + \int_1^t \xi(x)\,dx$

$y = \xi(t)$



$= \phi(1) + \int_1^t (7x-9)\,dx$

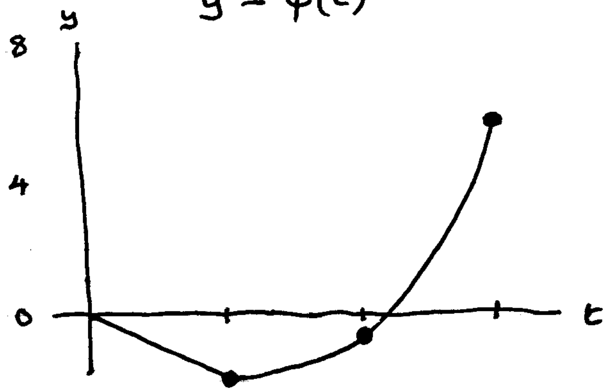
$= -2 + 7\int_1^t x\,dx - 9\int_1^t 1\,dx$

$= -2 + 7\left(\frac{t^2 - 1^2}{2}\right) - 9(t-1)$

$= \frac{7}{2}t^2 - 9t + \frac{7}{2}$. In particular,

$\phi(2) = \frac{7}{2}\cdot 2^2 - 9\cdot 2 + \frac{7}{2} = -1/2$.

$y = \phi(t)$



Finally:

$\underline{\underline{2 \le t \le 3}}$: $\phi(t) = \int_0^t \xi(x)\,dx$

$= \int_0^2 \xi(x)\,dx + \int_2^t \xi(x)\,dx$

$= \phi(2) + \int_2^t (3x-1)\,dx$

$= \frac{-1}{2} + 3\int_2^t x\,dx - \int_2^t 1\,dx$

$= -\frac{1}{2} + 3\left(\frac{t^2 - 2^2}{2}\right) - (t-2) = \frac{3}{2}t^2 - t - \frac{9}{2}$

So $\phi(t) = \begin{cases} -2t & \text{if } 0 \le t \le 1 \\ \frac{7}{2}t^2 - 9t + \frac{7}{2} & \text{if } 1 \le t \le 2 \\ \frac{3}{2}t^2 - t - 9/2 & \text{if } 2 \le t \le 3 \end{cases}$