RW 8.17

$$y_{step}(t) = 1 - e^{-2t}$$

$$u(t) = 2\delta(t) + 5\,u_s(t) - r(t)$$

input	output
$u_s(t)$	$1 - e^{-2t}$
$\delta(t)$	$2e^{-2t}$
$r(t)$	$t + \frac{e^{-2t}}{2} - \frac{1}{2}$

$$\delta(t) = \frac{d}{dt} u_s(t)$$

$$r(t) = \int_0^t u_s(\tau)\, d\tau$$

$$y_\delta(t) = \frac{d}{dt} y_{step}(t) = \frac{d}{dt}(1 - e^{-2t})$$

$$= 2e^{-2t}$$

$$y_r(t) = \int_0^t y_{step}(\tau)\, d\tau$$

$$= \int_0^t 1 - e^{-2\tau}\, d\tau$$

$$= \tau + \frac{e^{-2\tau}}{2}\Big|_0^t = t + \frac{e^{-2t}}{2} - 0 - \frac{1}{2}$$

$$y(t) = 2\,y_\delta(t) + 5\,y_{step}(t) - y_r(t)$$

$$= 2\left(2e^{-2t}\right) + 5\left(1 - e^{-2t}\right) - \left(t + \frac{e^{-2t}}{2} - \frac{1}{2}\right)$$

$$= 4e^{-2t} + 5 - 5e^{-2t} - t - \frac{e^{-2\tau}}{2} + \frac{1}{2}$$

$$\boxed{= 5.5 - 1.5e^{-2t} - t}$$