

**Concept Question 2-8:** What is the outcome of convolving a signal with a step function? With an impulse function?

Convolving a signal with a step integrates the signal up to the time of the convolution.

$$\begin{aligned}x(t) * u(t) &= \int_{-\infty}^{\infty} x(\tau) u(t - \tau) d\tau \\ &= \int_{-\infty}^t x(\tau) d\tau,\end{aligned}\tag{2.77}$$

**(ideal integrator)**

Convolving a signal with an impulse gives the original signal. If the impulse is time-shifted, the original signal is time-shifted by the same amount.

$$\begin{aligned}x(t) * \delta(t - T) &= \int_{-\infty}^{\infty} x(\tau) \delta(t - T - \tau) d\tau \\ &= x(t - T).\end{aligned}\tag{2.74}$$