PROBLEM:

In each of the following cases, simplify the expression using the properties of the continuous-time unit impulse signal. Provide some **explanation** or intermediate steps for each answer.

(a) $\displaystyle\int_{-\infty}^{t-1} \delta(\tau+3)e^{\tau}\,d\tau =$

(b) $\displaystyle\frac{d}{dt}\{e^{-3t}u(t-1)\} =$

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458.

SOLUTION

In each of the following cases, simplify the expression using the properties of the continuous-time unit impulse signal. Provide some **explanation** or intermediate steps for each answer.

(a) $\displaystyle\int_{-\infty}^{t-1} \delta(\tau+3)e^{\tau}\, d\tau = e^{-3}\int_{-\infty}^{t-1}\delta(\tau+3)\,d\tau$: SIFTING PROPERTY.

$\displaystyle = e^{-3}\; u(\tau+3)\Big|_{-\infty}^{t-1}$: $\delta = \dfrac{du}{dt}$

$= \boxed{e^{-3}u(t+2)}$: EVALUATION AT LIMITS

(b) $\displaystyle\frac{d}{dt}\{e^{-3t}u(t-1)\} = e^{-3t}\frac{du(t-1)}{dt} + (-3)e^{-3t}u(t-1)$: PRODUCT RULE

$= e^{-3t}\delta(t-1) - 3e^{-3t}u(t-1)$: $\delta = \dfrac{du}{dt}$

$= \boxed{e^{-3}\delta(t-1) - 3e^{-3t}u(t-1)}$: SIFTING PROPERTY

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