

Step-1

Consider the solution:

$$u_2 = e^{8t} (tx_1 + x_2)$$

By differentiating with respect to t, we get,

$$\begin{aligned}\frac{du_2}{dt} &= e^{8t} \frac{d}{dt}(tx_1 + x_2) + (tx_1 + x_2) \frac{d}{dt}(e^{8t}) \\ &= e^{8t} x_1 + (x_1 + x_2) 8e^{8t} \\ &= e^{8t} x_1 + 8x_1 e^{8t} + 8x_2 e^{8t} \\ &= 8x_1 e^{8t} + (8x_2 + x_1) e^{8t}\end{aligned}$$

Step-2

Thus, $\boxed{\frac{du_2}{dt} = 8x_1 e^{8t} + (8x_2 + x_1) e^{8t}}$.