Step-1

Consider the matrix:

$$B=\begin{bmatrix}0 & 1 & 2\\ 0 & 0 & 0\\ 0 & 0 & 0\end{bmatrix}$$

Calculate eigenvalue of B by putting $|B-\lambda I|=0$

By differentiating with respect to t, and get;

$$M=\begin{bmatrix}0 & 1 & 2\\ 0 & 0 & 1\\ 0 & 0 & 0\end{bmatrix}$$

$$e^{Bt}=\begin{bmatrix}1 & t & 2t\\ 0 & 1 & 0\\ 0 & 0 & 0\end{bmatrix}$$

Step-2

Thus, $\boxed{\frac{du_2}{dt}=8x_1e^{8t}+\left(8x_2+x_1\right)e^{8t}}$.