

$$\begin{aligned}
 x(\varepsilon) &= x(0) + \frac{1}{1!} x'(0)(\varepsilon-0) + \frac{1}{2!} x''(0)(\varepsilon-0)^2 + \frac{1}{3!} x'''(0)(\varepsilon-0)^3 \\
 &\quad + O(\varepsilon^4) \\
 &= a + e^{-a} \varepsilon - \frac{2e^{-2a}}{2} \varepsilon^2 + \frac{8e^{-3a}}{6} \varepsilon^3 + O(\varepsilon^4) \\
 &= a + \varepsilon e^{-a} - \varepsilon^2 e^{-2a} + \frac{4}{3} \varepsilon^3 e^{-3a} + O(\varepsilon^4) \text{ as required.}
 \end{aligned}$$

(10/10)