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The diagram shows the curve M with equation $y = xe^{-2x}$.

(a) Show that M has a point of inflection at the point P where $x = 1$. **[5]**

The line L passes through the origin O and the point P. The shaded region R is enclosed by the curve M and the line L.

(b) Show that the area of R is given by

$$\tfrac{1}{4}(a + be^{-2}),$$

where a and b are integers to be determined. **[6]**