

STEP II, 2002, Q8

8 Find y in terms of x , given that:

$$\begin{aligned} \text{for } x < 0, \quad \frac{dy}{dx} &= -y \quad \text{and} \quad y = a \quad \text{when } x = -1; \\ \text{for } x > 0, \quad \frac{dy}{dx} &= y \quad \text{and} \quad y = b \quad \text{when } x = 1. \end{aligned}$$

Sketch a solution curve. Determine the condition on a and b for the solution curve to be continuous (that is, for there to be no 'jump' in the value of y) at $x = 0$.

Solve the differential equation

$$\frac{dy}{dx} = |e^x - 1|y$$

given that $y = e^e$ when $x = 1$ and that y is continuous at $x = 0$. Write down the following limits:

$$(i) \lim_{x \rightarrow +\infty} y \exp(-e^x); \quad (ii) \lim_{x \rightarrow -\infty} y e^{-x}.$$



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