

STEP III, 2004, Q8

8 Show that if

$$\frac{dy}{dx} = f(x)y + \frac{g(x)}{y}$$

then the substitution $u = y^2$ gives a linear differential equation for $u(x)$.

Hence or otherwise solve the differential equation

$$\frac{dy}{dx} = \frac{y}{x} - \frac{1}{y}.$$

Determine the solution curves of this equation which pass through $(1, 1)$, $(2, 2)$ and $(4, 4)$ and sketch graphs of all three curves on the same axes.



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