

STEP II, 1999, Q6

6 Find $\frac{dy}{dx}$ if

$$y = \frac{ax + b}{cx + d}.$$

By using changes of variable of the form (*), or otherwise, show that

$$\int_0^1 \frac{1}{(x+3)^2} \ln\left(\frac{x+1}{x+3}\right) dx = \frac{1}{6} \ln 3 - \frac{1}{4} \ln 2 - \frac{1}{12},$$

and evaluate the integrals

$$\int_0^1 \frac{1}{(x+3)^2} \ln\left(\frac{x^2+3x+2}{(x+3)^2}\right) dx \quad \text{and} \quad \int_0^1 \frac{1}{(x+3)^2} \ln\left(\frac{x+1}{x+2}\right) dx.$$



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