

STEP III, 2011 Q1

- 1 (i) Find the general solution of the differential equation

$$\frac{du}{dx} - \left(\frac{x+2}{x+1}\right)u = 0.$$

- (ii) Show that substituting $y = ze^{-x}$ (where z is a function of x) into the second order differential equation

$$(x+1)\frac{d^2y}{dx^2} + x\frac{dy}{dx} - y = 0 \quad (*)$$

leads to a first order differential equation for $\frac{dz}{dx}$. Find z and hence show that the general solution of (*) is

$$y = Ax + Be^{-x},$$

where A and B are arbitrary constants.

- (iii) Find the general solution of the differential equation

$$(x+1)\frac{d^2y}{dx^2} + x\frac{dy}{dx} - y = (x+1)^2.$$



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