# Exercise 7.1

Show

$$\frac{\partial U'}{\partial t} + \frac{\partial F'}{\partial \xi} + \frac{\partial G'}{\partial \tau} = 0 \quad \text{is equiv to} \quad \frac{\partial U}{\partial t} + \frac{\partial F}{\partial x} + \frac{\partial G}{\partial y} = 0$$

$$\frac{\partial}{\partial t}\left(d_{xy} U\right) + \frac{\partial}{\partial \xi}\left(F \frac{\partial y}{\partial \tau} - G \frac{\partial x}{\partial \tau}\right) + \frac{\partial}{\partial \tau}\left(-F \frac{\partial y}{\partial \xi} + G \frac{\partial x}{\partial \xi}\right) = 0$$

$$d_{xy} \frac{\partial U}{\partial t} + \frac{\partial F}{\partial \xi}\frac{\partial y}{\partial \tau} + F \frac{\partial^2 y}{\partial \tau \partial \xi} - \frac{\partial G}{\partial \xi}\frac{\partial x}{\partial \tau} - G \frac{\partial^2 x}{\partial \tau \partial \xi}$$

$$- \frac{\partial F}{\partial \tau}\frac{\partial y}{\partial \xi} - F \frac{\partial^2 y}{\partial \xi \partial \tau} + \frac{\partial G}{\partial \tau}\frac{\partial x}{\partial \xi} + G \frac{\partial^2 x}{\partial \tau \partial \xi} = 0$$

$$d_{xy} \frac{\partial U}{\partial t} + \frac{\partial F}{\partial \xi}\frac{\partial y}{\partial \tau} - \frac{\partial G}{\partial \xi}\frac{\partial x}{\partial \tau} - \frac{\partial F}{\partial \tau}\frac{\partial y}{\partial \xi} + \frac{\partial G}{\partial \tau}\frac{\partial x}{\partial \xi} = 0$$

ID's: $\frac{\partial y}{\partial \tau} = \frac{1}{d_{\xi\tau}}\frac{\partial \xi}{\partial x}$ ; $\frac{\partial x}{\partial \tau} = \frac{-1}{d_{\xi\tau}}\frac{\partial \xi}{\partial y}$ ;

$\frac{\partial y}{\partial \xi} = \frac{-1}{d_{\xi\tau}}\frac{\partial \tau}{\partial x}$ ; $\frac{\partial x}{\partial \xi} = \frac{1}{d_{\xi\tau}} \cdot \frac{\partial \tau}{\partial y}$

$$d_{xy} \frac{\partial U}{\partial t} + \frac{\partial F}{\partial \xi}\frac{\partial \xi}{\partial x} \cdot \frac{1}{d_{\xi\tau}} + \frac{\partial G}{\partial \xi}\frac{\partial \xi}{\partial y} \cdot \frac{1}{d_{\xi\tau}} + \frac{\partial F}{\partial \tau} \cdot \frac{\partial \tau}{\partial x} \cdot \frac{1}{d_{\xi\tau}} + \frac{\partial G}{\partial \tau}\frac{\partial \tau}{\partial y} \cdot \frac{1}{d_{\xi\tau}} = 0$$

$$d_{xy} \frac{\partial U}{\partial t} + \frac{\partial F}{\partial x} \cdot \frac{1}{d_{\xi\tau}} + \frac{\partial G}{\partial y}\frac{1}{d_{\xi\tau}} = 0$$

$$\frac{\partial U}{\partial t} + \frac{1}{d_{xy} d_{\xi\tau}}\left(\frac{\partial F}{\partial x} + \frac{\partial G}{\partial y}\right) = 0$$

$d_{xy} d_{\xi\tau} = 1$ ← ID's find this from text. From def of transformation

$$\frac{\partial U}{\partial t} + \frac{\partial F}{\partial x} + \frac{\partial G}{\partial y} = 0 \quad \square$$