Problem 1. Compute the fractional linear transformation determined by the correspondence:

$$(0, 1, \infty) \mapsto (1, 1 + i, 2)$$

$$f(z) = \frac{z(2 - 2i) - 2}{z(1 - i) - 2}$$

Then $f(0) = 1$, $f(1) = \frac{2i}{1+i} = \frac{2i(1-i)}{|1+i|} = i(1 - i) = i + 1$, and $f(\infty) = 2$.

Problem 2. Show that the differential

$$\frac{-ydx + xdy}{x^2 + y^2}, \quad (x, y) \neq (0, 0)$$

is closed. Show that it is not independent of path on any annulus centered at 0.