Suppose g is a decreasing function on $\mathbb{R}$ and X is a continuous random variable with density $f_X(x)$. Show that $Y = g(X)$ has density given by:

$$f_Y(y) = \begin{cases} f_X\left[g^{-1}(y)\right] \left|\frac{d}{dy} g^{-1}(y)\right| & \text{if } y = g(x) \text{ for some } x \\ 0 & \text{otherwise.} \end{cases}$$