1. Since we know that X is a random variable under uniform distribution on $[0, 1]$, we can get the probability distribution of $Y = f(X)$.

$$F_Y(y) = P\{Y \le y\} = P\{f(X) \le y\} = P\{X \le f^{-1}(y)\} = F_X(f^{-1}(y))$$

As a result,

$$q(x) = F'_X(f^{-1}(x)) = (f^{-1}(x))' = \frac{df^{-1}(x)}{dx}$$

2. Since $f(x) = \sqrt{x}$, then by the formula we gave above,

$$q(x) = \frac{df^{-1}(x)}{dx} = \frac{dx^2}{dx} = 2x$$