

$$\begin{aligned}
F(z) &= \sqrt{\frac{z-9}{z+9}} = \left(\frac{z-9}{z+9}\right)^{1/2} \Rightarrow \\
F'(z) &= \frac{1}{2} \left(\frac{z-9}{z+9}\right)^{-1/2} \cdot \frac{d}{dz} \left(\frac{z-9}{z+9}\right) = \frac{1}{2} \left(\frac{z+9}{z-9}\right)^{1/2} \cdot \frac{(z+9)(1) - (z-9)(1)}{(z+9)^2} \\
&= \frac{1}{2} \cdot \frac{(z+9)^{1/2}}{(z-9)^{1/2}} \cdot \frac{z+9 - z+9}{(z+9)^2} = \frac{1}{2} \cdot \frac{(z+9)^{1/2}}{(z-9)^{1/2}} \cdot \frac{18}{(z+9)^2} \\
&= \frac{9}{(z-9)^{1/2}(z+9)^{3/2}}
\end{aligned}$$