

$$\begin{array}{c}
\frac{\vdash \textcolor{red}{p}^\perp \Downarrow [\cdot][1 : p]\cdot; \cdot}{\vdash [\cdot][1 : p]\cdot; \cdot //^1 \vdash [\cdot][\cdot]p^\perp; \cdot} \text{I} \\
\vdash [\cdot][1 : p]\cdot; \cdot //^1 \vdash [\cdot][\cdot]\cdot; p^\perp \quad * \\
\vdash \textcolor{red}{!}^1 p^\perp \Downarrow [\cdot][1 : p]\cdot; \cdot \quad 4 \\
\vdash [\cdot][1 : p]\cdot; \cdot //^1 \vdash [\cdot][\cdot]\textcolor{red}{!}^1 p^\perp; \cdot \quad * \\
\vdash [\cdot][1 : p]\cdot; \cdot //^1 \vdash [\cdot][\cdot]\cdot; \textcolor{red}{!}^1 p^\perp \quad 4 \\
\vdash \textcolor{red}{!}^1 \textcolor{red}{!}^1 p^\perp \Downarrow [\cdot][1 : p]\cdot; \cdot \quad * \\
\vdash [\cdot][\cdot]\cdot; ?^1 p, \textcolor{red}{!}^1 \textcolor{red}{!}^1 p^\perp \quad !
\end{array}$$