

$$\begin{array}{c}
\frac{}{\vdash \textcolor{red}{p}^\perp \Downarrow [\cdot][\cdot]p; \cdot} \text{I} \\
\hline
\vdash [\cdot][3 : p^\perp]\cdot; \cdot //^1 \vdash [\cdot][\cdot]p; \cdot \quad \text{K} \\
\hline
\vdash [\cdot][3 : p^\perp]\cdot; \cdot //^1 \vdash [\cdot][\cdot]\cdot; p \quad * \\
\hline
\vdash \textcolor{red}{!}^1 p \Downarrow [\cdot][3 : p^\perp]\cdot; \cdot \quad ! \\
\hline
\vdash [\cdot][3 : p^\perp]\cdot; \cdot //^2 \vdash [\cdot][\cdot]\textcolor{red}{!}^1 p; \cdot \quad 4 \\
\hline
\vdash [\cdot][3 : p^\perp]\cdot; \cdot //^2 \vdash [\cdot][\cdot]\cdot; \textcolor{red}{!}^1 p \quad * \\
\hline
\vdash \textcolor{red}{!}^2 \textcolor{red}{!}^1 p \Downarrow [\cdot][3 : p^\perp]\cdot; \cdot \quad ! \\
\hline
\vdash [\cdot][\cdot]\cdot; ?^3 p^\perp, \textcolor{red}{!}^2 \textcolor{red}{!}^1 p \quad *
\end{array}$$