

Introductory negation introduction proof problems. Derive each of the following using the rule of  $\sim I$  at least once, even if it may be solved without it. You will sometimes need to combine  $\sim I$  with  $\rightarrow I$  and/ or  $\vee E$ .

1.  $P \rightarrow Q \vdash \sim Q \rightarrow \sim P$
2.  $P \& Q \vdash \sim(P \rightarrow \sim Q)$
3.  $(P \& Q) \rightarrow (R \vee S), \sim(R \vee S) \vdash \sim(P \& Q)$
4.  $P, \sim S \vee \sim P, P \rightarrow R, \vdash \sim S \& R$
5.  $\sim P \vee \sim R \vdash \sim(P \& R)$
6.  $P \vee Q, P \rightarrow R, \sim R \vdash Q$
7.  $\sim Q \vee \sim P \vdash P \rightarrow \sim Q$
8.  $S \rightarrow T \vdash T \vee \sim S$
9.  $R \vdash \sim\sim R$
10.  $S \& R, ((S \vee M) \rightarrow Q), ((R \vee L) \rightarrow \sim Q) \vdash P$
11.  $(M \vee N) \vee S \vdash \sim S \rightarrow (\sim M \rightarrow N)$