

1. Prove that s is a valid conclusion from the premises $P \rightarrow Q$, $P \rightarrow \sigma$, $\sim(Q \wedge \sigma)$ and $s \vee p$.
2. Establish the validity of the following arguments.

$$\begin{array}{l}
 \textcircled{i} \quad P \rightarrow Q \\
 Q \rightarrow (\sigma \wedge s) \\
 \sim \sigma \vee (\sim t \vee u) \\
 P \wedge t \\
 \hline
 \therefore u
 \end{array}$$

$$\begin{array}{l}
 \textcircled{ii} \quad \sim P \leftrightarrow Q \\
 Q \rightarrow \sigma \\
 \sim \sigma \\
 \hline
 \therefore P
 \end{array}$$

$$\begin{array}{l}
 \textcircled{iii} \quad P \rightarrow (Q \rightarrow \sigma) \\
 \sim Q \rightarrow \sim P \\
 P \\
 \hline
 \therefore \sigma
 \end{array}$$

$$\begin{array}{l}
 \textcircled{iv} \quad P \rightarrow (Q \rightarrow \sigma) \\
 P \vee s \\
 t \rightarrow Q \\
 \sim s \\
 \hline
 \therefore \sim \sigma \rightarrow \sim t
 \end{array}$$

3. Show that the argument form with premises $(p \wedge t) \rightarrow (\sigma \vee s)$, $q \rightarrow (\sim t)$, $u \rightarrow p$ and $\sim s$ with the conclusion $q \rightarrow \sigma$ is valid.