

$$\begin{array}{lcl}
m & | & X \vee Y \\
n & | & \neg X \\
k & | & \begin{array}{l} X \\ \hline \end{array} \\
k+1 & | & \begin{array}{l} \neg Y \\ \hline \end{array} \\
k+2 & | & \begin{array}{l} X \\ \hline \end{array} \quad \text{R } k \\
k+3 & | & \neg X \quad \text{R } n \\
k+4 & | & Y \quad \neg\text{E } k+1-k+3 \\
k+5 & | & \begin{array}{l} Y \\ \hline \end{array} \\
k+6 & | & Y \quad \text{R } k+5 \\
k+7 & | & Y \quad \vee\text{E } m, k-k+4, k+5-k+6
\end{array}$$

$$\begin{array}{lcl}
m & | & \neg(X \wedge Y) \\
j & | & X \vee \neg X \quad \text{LEM} \\
k & | & \begin{array}{l} X \\ \hline \end{array} \\
k+1 & | & \begin{array}{l} Y \\ \hline \end{array} \\
k+2 & | & \begin{array}{l} X \wedge Y \\ \hline \end{array} \quad \wedge\text{I } k, k+1 \\
k+3 & | & \neg(X \wedge Y) \quad \text{R } m \\
k+4 & | & \neg Y \quad \neg\text{I } k+1-k+3 \\
k+5 & | & \neg X \vee \neg Y \quad \vee\text{I } k+4 \\
k+6 & | & \neg X \\
k+7 & | & \neg X \vee \neg Y \quad \vee\text{I } k+6 \\
k+8 & | & \neg X \vee \neg Y \quad \vee\text{E } j, k-k+5, k+6-k+7
\end{array}$$

m	$\neg X \vee \neg Y$	
$m+1$	$\neg X$	
k	$X \wedge Y$	
$k+1$	X	$\wedge E\ k$
$k+2$	$\neg X$	$R\ m+1$
$k+3$	$\neg(X \wedge Y)$	$\neg I\ k-k+2$
$k+4$	$\neg Y$	
l	$X \wedge Y$	
$l+1$	Y	$\wedge E\ k$
$l+2$	$\neg Y$	$R\ k+4$
$l+3$	$\neg(X \wedge Y)$	$\neg I\ l-l+2$
$l+4$	$\neg(X \wedge Y)$	$\vee E\ m, m+1-k+3, k+4-l+3$

- The following ‘proofs’ are *incorrect*. Explain the mistakes they make.

1	$\neg L \rightarrow (A \wedge L)$	
2	$L \vee \neg L$	LEM
3	$\neg L$	
4	A	$\rightarrow E\ 1, 3$
5	L	
6	\perp	$\perp I\ 5, 3$
7	A	$\perp E\ 6$
8	A	$\vee E\ 2, 3-4, 5-7$

- The following three proofs are missing their citations (rule and line numbers). Add them, to turn them into *bona fide* proofs. Additionally, write down the argument that corresponds to each proof.

1		$\neg L \rightarrow (J \vee L)$
2		$\neg L$
3		$J \vee L$
4		J
5		J
6		$J \rightarrow J$
7		L
8		\perp
9		J
10		$L \rightarrow J$
11		J

FOL:

	1		$\forall x \neg Ax$	
	2		$\exists x Ax$	
	3		Ac	
•	4		$\neg Ac$	$\forall E$ 1
	5		\perp	$\perp I$ 3, 4
	6		\perp	$\exists E$ 2, 3-5
	7		$\neg \exists x Ax$	$\neg I$ 2-6

	1		$\exists x \neg Ax$	
	2		$\forall x Ax$	
	3		$\neg Ac$	
•	4		Ac	$\forall E$ 2
	5		\perp	$\perp I$ 4, 3
	6		\perp	$\exists E$ 1, 3-5
	7		$\neg \forall x Ax$	$\neg I$ 2-6

Not bothering to fix in modal logic or metatheory sections