



Instructions: Complete the following problems as directed. Type your name. Type your answers. Staple or paper clip multiple pages. If you turn this in by e-mail, type the date and time you sent it on the hardcopy. Each problem is worth 2 pt. 10 pts. total.

Prove 1-3 using basic rules only.

1. $(p \& (q \rightarrow \neg r)); (s \leftrightarrow p); (s \rightarrow r) \therefore \neg q$

1. $(p \& (q \rightarrow \neg r))$	A
2. $(s \leftrightarrow p)$	A
3. $(s \rightarrow r)$	A
4. Show: $\neg q$	
5. q	AIP
6. $(q \rightarrow \neg r)$	&E, 1
7. $\neg r$	$\rightarrow$ E, 5,6
8. p	&E, 1
9. s	$\rightarrow$ E, 8,2
10. r	$\rightarrow$ E, 3,9
11. $\neg r$	R, 7

2. Prove from no assumptions: $(p \rightarrow ((s \vee r) \rightarrow (p \vee (s \& r))))$

1. Show $(p \rightarrow ((s \vee r) \rightarrow (p \vee (s \& r))))$	
2. p	ACP
3. Show $((s \vee r) \rightarrow (p \vee (s \& r)))$	
4. $(s \vee r)$	ACP
5. $p \vee (s \& r)$	$\vee$ I, 4

3. $(p \ \& \ q); (r \vee \neg q) \therefore (\neg r \rightarrow \neg s)$

1.	$p \ \& \ q$	A
2.	$r \vee \neg q$	A
3.	Show $\neg r \rightarrow \neg s$	
4.	$\neg r$	ACP
5.	Show $r \rightarrow \neg s$	
6.	r	ACP
7.	Show $\neg s$	
8.	s	AIP
9.	r	R, 6
10.	$\neg r$	R, 4
11.	Show $\neg q \rightarrow \neg s$	
12.	$\neg q$	ACP
13.	Show $\neg s$	
14.	s	AIP
15.	q	&E, 1
16.	$\neg q$	R, 12
18.	$\neg s$	$\vee E, 2, 5, 11$

Note: This is the corrected version.

Prove 4-5 using basic or derived rules.

4. $(\neg(p \vee q) \leftrightarrow \neg(s \vee \neg m)), m \therefore (\neg s \rightarrow (\neg p \& \neg q))$

1.	$(\neg(p \vee q) \leftrightarrow \neg(s \vee \neg m))$	A
2.	m	
3.	Show $(\neg s \rightarrow (\neg p \& \neg q))$	A
4.	$\neg s$	ACP
5.	$\neg m$	$\neg \neg, 2$
6.	$(\neg s \& \neg m)$	$\&I, 4, 5$
7.	$\neg(s \vee \neg m)$	$\neg \vee, 5$
8.	$\neg(p \vee q)$	$\leftrightarrow E, 1, 7$
9.	$(\neg p \& \neg q)$	$\neg \vee, 8$

5. $(p \& (q \rightarrow \neg r)); (s \leftrightarrow \neg p); (\neg s \rightarrow r) \therefore \neg q$

1.	$(p \& (q \rightarrow \neg r))$	A
2.	$(s \leftrightarrow \neg p)$	A
3.	$(\neg s \rightarrow r)$	A
4.	Show $\neg q$	
5.	p	$\&E, 1$
6.	$\neg \neg p$	$\neg \neg, 5$
7.	$\neg s$	$2, 6 \leftrightarrow E^*$
8.	r	$\rightarrow E, 3, 7$
9.	$\neg \neg r$	$\neg \neg, 8$
10.	$(q \rightarrow \neg r)$	$\&E, 1$
11.	$\neg q$	$\neg E^* 9, 10$