

ANSWER KEY

Name (5 points): _____ **Section** (5 points): _____

Section I: True / False questions (4 points each)

1. F If the conclusion of an argument is true, then that argument is valid.
2. F Some wffs are both conditionals and disjunctions.
3. F Every WFF contains at least one connective.
4. T Every negation is a denial.
5. T Every invalid argument has an invalidating assignment.

Section II: Mark the correct completion (4 points each)

1. The conclusion of a valid argument ...
 - (a) X must be true if all the premises are true.
 - (b) _____ cannot be true unless at least one of the premises is false.
 - (c) _____ cannot be false unless all the persimmons are false.
 - (d) _____ cannot be false unless all the premises are false.
 - (e) _____ cannot be true if all the premises are true.

2. The main connective of $((R \leftrightarrow Q) \rightarrow \sim S) \vee (T \& \sim U)$ is ...
 - (a) X the wedge
 - (b) _____ the hedge
 - (c) _____ the arrow
 - (d) _____ the double-arrow
 - (e) _____ the ampersand

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3. $((P \rightarrow Q) \leftrightarrow \sim (R \& S)) \vee T$ is a ...

(a) _____ biconditional

(b) _____ conditional

(c) _____ negation

(d) _____ conjunction

(e) X disjunction

4. $\sim((P \rightarrow Q) \& \sim (R \vee T))$ is a ...

(a) _____ conditional

(b) _____ biconditional

(c) X negation

(d) _____ not a WFF

(e) _____ disjunction

5. $(D \rightarrow (B \& \sim C))$ is a ...

(a) X conditional

(b) _____ conjunction

(c) _____ negation

(d) _____ disjunction

(e) _____ not a WFF

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Section III Translations (5 points each)

Using the provided translation schemes, construct a strictly correct translation that includes all parentheses.

1. If Argentina mobilizes and Brazil protests to the UN, Chile will call for a meeting of all Latin American states.

A - Argentina mobilizes
B - Brazil protests to the UN
C - Chile calls for a meeting of all Latin American states

$((A \ \& \ B) \rightarrow C)$

2. Bill and Fred will attend only if not both Mary and Jane attend.

B - Bill attends
F - Fred attends
J - Jane attends
M- Mary attends

$((B \ \& \ F) \rightarrow \sim (M \ \& \ J))$

3. Bob cannot attend unless he doesn't have to work, and Nancy can attend only if Bob attends.

B - Bob attends
N - Nancy attends
W - Bob has to work

$((\sim B \vee \sim W) \ \& \ (N \rightarrow B))$

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4. If Rick is neither the best candidate nor outspends his opponent, then he will not win the election.

B - Rick is the best candidate
O - Rick outspends his opponent
W - Rick wins the election

$$(\sim(B \vee O) \rightarrow \sim W)$$

Section IV Proofs (5 points each)

Give a proof for each of the following sequents. Unless otherwise indicated, use only the primitive rules, (that is, no derived rules).

1. $(\sim P \ \& \ R), (P \vee Q), (Q \rightarrow S) \vdash (R \ \& \ S)$

1	(1)	$(\sim P \ \& \ R)$	A	
2	(2)	$(P \vee Q)$	A	
3	(3)	$(Q \rightarrow S)$	A	$\vdash (R \ \& \ S)$
1	(4)	$\sim P$	1 &E	
1,2	(5)	Q	2,4 \vee E	
1,2,3	(6)	S	3,5 \rightarrow E	
1	(7)	R	1 &E	
1,2,3	(8)	$(R \ \& \ S)$	6,7 &I	

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2. $(P \rightarrow R), (\sim R \vee Q), (Q \rightarrow S) \vdash (P \rightarrow S)$

1	(1)	$(P \rightarrow R)$	A
2	(2)	$(\sim R \vee Q)$	A
3	(3)	$(Q \rightarrow S)$	A $\vdash (P \rightarrow S)$
4	(4)	P	A (for \rightarrow I)
1,4	(5)	R	1,4 \rightarrow E
1,2,4	(6)	Q	2,5 \vee E
1,2,3,4	(7)	S	3,6 \rightarrow E
1,2,3	(8)	$(P \rightarrow S)$	7 \rightarrow I (4)

3. $(P \rightarrow R), (Q \rightarrow S), \sim(S \vee R) \vdash \sim(P \& Q)$

(For this one you may use the derived rules if you wish)

1	(1)	$(P \rightarrow R)$	A
2	(2)	$(Q \rightarrow S)$	A
3	(3)	$\sim(S \vee R)$	A $\vdash \sim(P \& Q)$
4	(4)	$(P \& Q)$	A (for RAA)
4	(5)	P	4 &E
1,4	(6)	R	1,5 \rightarrow E
1,4	(7)	$(S \vee R)$	6 \vee I
1,3	(8)	$\sim(P \& Q)$	3,7 RAA (4)

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Section V Truth Tables (5 points each)

Answer each question using truth tables. You may use either direct or indirect truth tables, but if you choose to use an indirect truth table, sufficient work must be shown to indicate how you reached your answer.

1. Is the following sequent valid? Provide an invalidating assignment if it is not.

$$\sim(P \rightarrow Q) \vdash (P \leftrightarrow \sim Q)$$

P	Q	\sim	(P	\rightarrow	Q)	\vdash	(P	\leftrightarrow	\sim	Q)
T	T	F		T				F	F	
T	F	T		F				T	T	
F	T	F		T				T	F	
F	F	F		T				F	T	

VALID

2. Is the following sequent valid? Provide an invalidating assignment if it is not.

$$((P \vee Q) \rightarrow R), \sim R \vdash (Q \vee R)$$

P	Q	R	((P	\vee	Q)	\rightarrow	R),	\sim	R	\vdash	(Q	\vee	R)
F	F	F		F		T		T				F	

Invalid when P = F, Q = F, R = F

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3. Is the following sequent valid? Provide an invalidating assignment if it is not.

$$(P \leftrightarrow Q), (Q \vee R), (R \rightarrow S) \vdash (P \rightarrow S)$$

P	Q	R	S	(P	\leftrightarrow	Q),	(Q	\vee	R),	(R	\rightarrow	S)	\vdash	(P	\rightarrow	S)
T	T	F	F		T			T			T				F	

Invalid when P = T, Q = T, R = F, S = F