

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

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

1. _____ Any valid argument with a false conclusion must have a false premise.
2. _____ Some wffs are both conditionals and disjunctions.
3. _____ If a wff does not contain any parentheses, then it is atomic.
4. _____ Every denial is a negation.
5. _____ Every invalid argument has only one invalidating assignment.

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

1. The conclusion of a valid argument ...
 - (a) _____ cannot be true unless all the premises are true.
 - (b) _____ cannot be false 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 false.

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

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3. $((P \leftrightarrow Q) \rightarrow \sim (R \& S)) \vee T$ is a ...
- (a) _____ biconditional
 - (b) _____ conditional
 - (c) _____ negation
 - (d) _____ conjunction
 - (e) _____ disjunction
4. $(P \rightarrow Q) \leftrightarrow \sim (R \vee T)$ is a ...
- (a) _____ conditional
 - (b) _____ biconditional
 - (c) _____ negation
 - (d) _____ not a WFF
 - (e) _____ disjunction
5. $(D \rightarrow (B \& \sim C))$ could be used as a translation of ...
- (a) _____ I can have my dessert and not eat my brussels sprouts if I complain.
 - (b) _____ I can have my dessert only if I eat my brussels sprouts and do not complain about it.
 - (c) _____ If I have my dessert and eat my brussels sprouts, then I have nothing to complain about.
 - (d) _____ I can not have my dessert if I eat my brussels sprouts and complain.
 - (e) _____ none of the above.

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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, then Brazil will protest to the UN only if Chile calls 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

2. Neither Bill nor Fred will attend if both Mary and Jane do not attend.

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

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

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

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4. Rick will win the election if and only if he is the best candidate and outspends his opponent in advertising.

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

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

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

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

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

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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.

$$\sim(P \rightarrow Q) \mid\text{-} (P \ \& \ (Q \rightarrow P))$$

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

$$((\sim R \vee M) \rightarrow N), \sim N \mid\text{-} \sim R$$

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

$$(((A \rightarrow B) \rightarrow C) \rightarrow D), (D \rightarrow (C \rightarrow (B \rightarrow A))) \vdash (A \leftrightarrow D)$$