

1. (20 points) Use an indirect method of proof for the following and if invalid, provide the counterexample.

$a \vee s$ $w \rightarrow (p \rightarrow a)$ <p>a. $\sim s \vee (p \wedge w)$</p> <p style="text-align: center;">-----</p> a	$p \wedge q$ $s \rightarrow (\sim q \vee r)$ <p>b. $p \vee s$</p> <p style="text-align: center;">-----</p> $\sim s$
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2. (20 points) Use the conditional proof and if invalid, provide a counterexample.

$a \rightarrow d$ $\sim d \vee p$ <p>a. $p \rightarrow \sim c$</p> <p style="text-align: center;">-----</p> $(a \wedge b) \rightarrow c$	$(p \vee q) \rightarrow r$ $\sim r \vee s$ <p>b. $\sim p \rightarrow w$</p> <p style="text-align: center;">-----</p> $s \rightarrow w$
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3. (20 points) Using a truth table, determine if the following arguments are valid or invalid. If invalid, provide a counterexample.

$p \rightarrow q$ $\sim s \vee q$ <p>a. p</p> <p style="text-align: center;">-----</p> s	$p \rightarrow q$ $q \rightarrow r$ <p>b. r</p> <p style="text-align: center;">-----</p> p
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4. (30 points) Using the Equivalence Laws on page 53, show the following are equivalent.

- a. $(p \rightarrow r) \rightarrow s \Leftrightarrow (p \wedge \sim r) \vee s$
- b. $A \wedge (B \rightarrow C) \Leftrightarrow (A \wedge \sim B) \vee (A \wedge C)$
- c. $s \rightarrow (p \vee \sim r) \Leftrightarrow (\sim p \wedge r) \rightarrow \sim s$

7. (10 points) Using the Boolean algebra notation (\wedge , \vee , \sim) or the words (*and*, *or*, *not*) write a database search for the following queries. You must use quotes for strings and if necessary, parentheses where needed or assign letters to the words and/or phrases. Do not assume any precedence of operators.

- a) *You like to collect used concert tickets. Although these stubs have little value, you find it interesting. Write a search to find this stubs in a fictional database.*
- b) *You discover that an auction site also sells these used stubs. You decide you want some Beatles concert stubs. Often, you can find an excellent deal by taking into account typos such as Beetles. Add this to the search in part a.*