

1. Name and define this symbol, $\Leftrightarrow$, used in the Boolean Logic system we studied. (4 points)

2. Define the inverse, converse, and contrapositive of $R \rightarrow S$. (6 points)

Inverse:

Converse:

Contrapositive:

For the following true/false questions construct a truth table if needed. (1 point)

3. T or F: A conditional statement and the contrapositive of the same statement are logically equivalent.
4. T or F: The inverse of a conditional statement and the converse of the same statement are logically equivalent.
5. T or F: The inverse of a conditional statement and the contrapositive of the same statement are logically equivalent.

6. Fill in the following truth table. (6 points)

p	q	$p \vee q$	$\sim(p \vee q)$	$p \rightarrow q$	$\sim(p \vee q) \otimes (p \rightarrow q)$

7. Define **tautology** and give an example with a truth table of a **tautology**. (4 points)

8. Construct a truth table for $(\sim p \leftrightarrow q) \vee \sim (\sim p \wedge q)$ (8 points)

Matching: match a statement on the left with a statement on the right that are form a logical equivalence. A choice may be used more than once or not at all. (2 points each)

9. $\sim p \rightarrow \sim q$ _____

10. $\sim (p \otimes q)$ _____

11. $\sim p \vee q$ _____

12. $\sim (p \vee q)$ _____

13. $\sim (p \wedge q)$ _____

A. $\sim p \otimes \sim q$

B. $\sim p \vee \sim q$

C. $\sim p \wedge \sim q$

D. $p \rightarrow q$

E. $q \rightarrow p$

F. $p \leftrightarrow q$

14. Draw a logic gate diagram for each of the following statements (3 points each)

a. $(\sim p \wedge q) \vee \sim (p \wedge q)$

b. $p \vee (\sim p \wedge \sim (q \vee (p \wedge q)))$

c. $\left(((p \vee q) \wedge (p \vee \sim q)) \vee ((p \otimes q) \wedge (p \otimes \sim q)) \right)$

15. Rewrite the statement to a logically equivalent statement that eliminates the use of the conditional and biconditional. (4 points each)

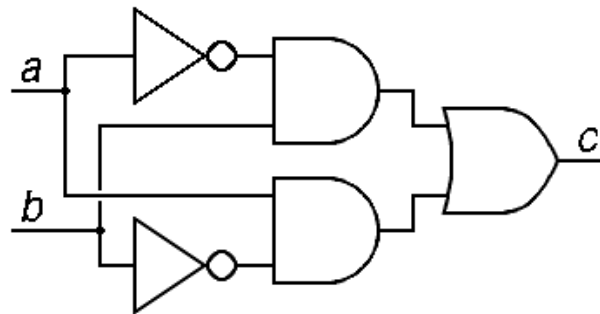
a. $p \rightarrow \sim(p \wedge q)$

b. $(p \otimes q) \leftrightarrow q$

16. Simplify $(p \otimes q) \leftrightarrow (p \vee q)$ using logical equivalences or a truth table and then draw a logic gate diagram of the simplified statement. (8 points)

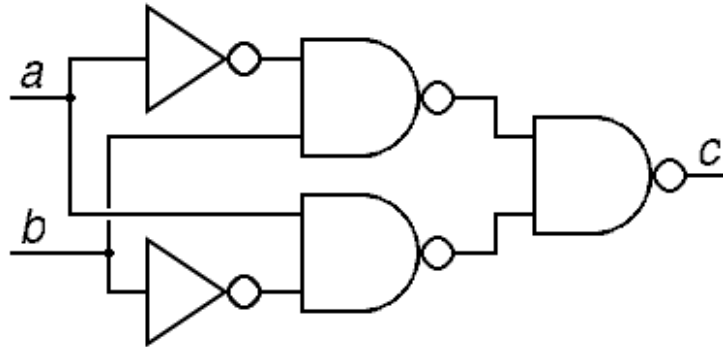
Simplified statement:

Circuit Diagram:



17. Write the logic statement for the following logic gate diagram. (6 points)

18. Use this logic gate diagram to answer the following questions. (4 points each)



- Write the logic statement the circuit represents.
- Create a truth table for the statement.
- Find a simpler statement that is logically equivalent to the statement in part a.
- Draw a logic gate diagram of the statement in part c.