Discrete Mathematics with Applications, 4th edition
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Supplementary Exercises: Chapter 2

1. **Section 2.1**: Suppose x is a particular real number, and let p, q, and r symbolize "$-1 < x$," "$-1 = x$," and "$x < 5$," respectively. Write the following inequalities symbolically:

   (a) $-1 \le x$

   (b) $-1 < x < 5$

   (c) $-1 \le x < 5$

2. **Section 2.2**: Show that the statement forms $p \rightarrow\, \sim q$ and $\sim p \vee \sim q$ are logically equivalent. Include a truth table and a few words of explanation that show your understanding of the meaning of logical equivalence.

3. **Section 2.2**: Write each of the following statements in symbolic form, and determine whether they are logically equivalent. Include a truth table and a few words of explanation that show your understanding of the meaning of logical equivalence.

   If Tom likes celebrating, then he enjoys the annual gala.

   Tom enjoys the annual gala or he likes celebrating.

4. **Section 2.2**: Write negations for the following statements:

   (a) $-3 < x \le 2$ (Assume x is a particular real number.)

   (b) The moon was shining or the light was on.

   (c) If the DNA matches, then Mia was at the scene of the crime.

5. **Section 2.2**: Write the converse, contrapositive, and inverse for the following statement: If Lou got an A, then Lou's score was at least 88.

6. **Section 2.2**: Write the following statement in if-then form without using the word "necessary": Doing all her chores is a necessary condition for Cinderella to be allowed to go to the ball.

7. **Section 2.3**: Use symbols to write the logical form of the following argument. Then use a truth table to test the argument for validity. Indicate which columns represent the premises and which represent the conclusion, and include a few words of explanation showing that you understand the meaning of validity.

   If line 10 is correct, then the variable is declared.
   The variable is declared or line 10 is not correct.

   Therefore, line 10 is correct or the variable is declared.

8. **Section 2.3**: Use symbols to write the logical form of the following argument. Then use a truth table to test the argument for validity. Indicate which columns represent the premises and which represent the conclusion, and include a few words of explanation showing that you understand the meaning of validity.

   Tom is guilty or Sue is guilty.
   If Ana is guilty or Sue is guilty, then Tom is not guilty.

   $\therefore$ Tom is not guilty or Sue is not guilty.

9. **Section 2.4**: What is the output of the circuit corresponding to the logical expression $(P \vee \sim Q) \wedge (Q \vee R)$ when $P = 1$, $Q = 0$, and $R = 1$?

10. **Section 2.4**: Write the logical expression for the circuit that corresponds to the following input/output table:

P	Q	R	S
1	1	1	0
1	1	0	0
1	0	1	1
1	0	0	0
0	1	1	0
0	1	0	0
0	0	1	1
0	0	0	0

11. **Section 2.5**

   (a) Write the following binary number in decimal notation: 101011_2.

   (b) Write 86 in binary notation.

   (c) Perform the following binary addition:

$$\begin{array}{r} 110011_2 \\ + \quad 11011_2 \\ \hline \end{array}$$