# TRUTH TABLES

TEXT: 2.3, 2.4

| LAST NAME | FIRST NAME | DATE |
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**1** (1 point). Find the truth value of the given statement if $s =$ false:

$$\sim (s \vee (\sim s))$$

**2** (1 point). Find the truth value of the given statement, if $a =$ true and $b =$ false:

$$(a \wedge b) \rightarrow (a \vee b)$$

**3** (1 point). Find the truth value of the given statement, if $p =$ false, $q =$ false, and $r =$ true:

$$((\sim p) \vee q) \leftrightarrow ((\sim q) \wedge r)$$

**4** (1 point). Find the truth value of the given statement, if $x =$ true, $y =$ true, and $z =$ false:

$$(x \rightarrow y) \wedge ((\sim y) \rightarrow z)$$

**5** (6 points)**.** For each statement, construct the truth table, fill out the answer column completely, and box it. Determine whether each statement is a tautology, a contradiction, or neither.

(a) $A \leftrightarrow (\sim A)$

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Tautology Contradiction Neither

(b) $B \rightarrow (B \wedge (\sim B))$

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Tautology Contradiction Neither

(c) $(A \wedge B) \rightarrow (A \vee B)$

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Tautology Contradiction Neither

**6** (1 point). Consider the statement

$$(X \wedge Y) \vee (X \wedge Z) \vee (X \wedge W)$$

How many rows would a truth table for this statement have?

**7** (1 point). Consider the statement

$$(a \vee b) \vee (b \rightarrow c) \vee \big(d \wedge (\sim e)\big) \leftrightarrow (a \wedge f \wedge g)$$

How many rows would a truth table for this statement have?

**8** (3 points). Construct the truth table for the following statement: fill out the answer column completely, and box it.

$$\big((\sim a) \wedge b\big) \rightarrow \big(b \leftrightarrow (a \vee c)\big)$$

**9.** Consder the following statement:

*Useful shapes are not printable,*
*printable shapes are against the law,*
*and legal shapes are not useful.*

Let $A =$ "Shapes are useful", $B =$ "Shapes are printable", and $C =$ "Shapes are legal". Translate the compound statement above into the formal language of logic.

Hint: it's a conjunction of three conditional statements.
For example, *Useful shapes are not printable* is $A \to (\sim B)$.

Construct the truth table for the formal statement above. Fill out the answer column completely, and box it.

**10.** Construct the truth table for the formal statement below. Fill out the answer column completely, and box it.

$$\Big(\big(X \to (\sim X)\big) \to \big((\sim X) \to X\big)\Big) \to (\sim X)$$

## Problems With Answers.

For each given statement, construct a truth table and determine whether the statement is a tautology, a contradiction, or neither.

**1.** $(x \vee y) \rightarrow (y \wedge x)$

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Tautology Contradiction Neither

**2.** $(\sim q) \vee (\sim p)$

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Tautology Contradiction Neither

**3.** $(a \wedge b) \vee \big(a \wedge (\sim b)\big)$

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Tautology Contradiction Neither

**4.** $(\sim x) \wedge \big( \sim (x \vee y)\big)$

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Tautology Contradiction Neither

**5.** $\Big( \sim \big(c \vee (\sim b)\big)\Big) \rightarrow \big((\sim a) \wedge b\big)$

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Tautology Contradiction Neither

**6.** $\big( \sim (g \rightarrow h)\big) \leftrightarrow h$

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Tautology Contradiction Neither

**7.** $\big(a \wedge (\sim b)\big) \vee (a \rightarrow b)$

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Tautology Contradiction Neither

**8.** $y \vee \big((\sim z) \vee (x \wedge z)\big)$

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Tautology Contradiction Neither

## ANSWERS.

**1.** Neither tautology nor contradiction

| $x$ | $y$ | $(x \vee y)$ | $\rightarrow$ | $(y \wedge x)$ |
|---|---|---|---|---|
| T | T | | T | |
| T | F | | F | |
| F | T | | F | |
| F | F | | T | |

**3.** Neither tautology nor contradiction

| $a$ | $b$ | $(a \wedge b)$ | $\vee$ | $\big(a \wedge (\sim b)\big)$ |
|---|---|---|---|---|
| T | T | | T | |
| T | F | | T | |
| F | T | | F | |
| F | F | | F | |

**5.** Neither tautology nor contradiction

| $a$ | $b$ | $c$ | $\Big(\sim\big(c \vee (\sim b)\big)\Big)$ | $\rightarrow$ | $\big((\sim a) \wedge b\big)$ |
|---|---|---|---|---|---|
| T | T | T | | T | |
| T | T | F | | F | |
| T | F | T | | T | |
| T | F | F | | T | |
| F | T | T | | T | |
| F | T | F | | T | |
| F | F | T | | T | |
| F | F | F | | T | |

**7.** Tautology

| $a$ | $b$ | $\big(a \wedge (\sim b)\big)$ | $\vee$ | $(a \rightarrow b)$ |
|---|---|---|---|---|
| T | T | | T | |
| T | F | | T | |
| F | T | | T | |
| F | F | | T | |