TRUTH TABLES HOMEWORK

TEXT: 2.3, 2.4

LAST NAME	FIRST NAME	DATE

1. 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?

2. Consider the statement

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

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

3. Construct the truth table for the following statement: fill out the answer column completely, and box it.

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

4. Construct a formal statement such that a corresponding truth table has 4 rows.

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

5. $(x \vee y) \rightarrow (y \wedge x)$

Tautology Contradiction Neither

6. $(\sim q) \vee (\sim p)$

Tautology Contradiction Neither

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

Tautology Contradiction Neither

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

Tautology Contradiction Neither

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

Tautology Contradiction Neither

10. $\big(\sim (g \rightarrow h)\big) \leftrightarrow h$

Tautology Contradiction Neither

11. $\big(a \wedge (\sim b)\big) \vee (a \to b)$

Tautology Contradiction Neither

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

Tautology Contradiction Neither

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

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

14 (†)**.** 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.

Answers

1. 16

3.

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

5. 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	

7. 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	

9. 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

11. 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