

## 3.2 Exercises

### ✓ CONCEPT CHECK

1. Truth tables are used to keep track of different possible \_\_\_\_\_ for a mathematical statement.
2. A conjunction of two statements  $a$  and  $b$  is true when \_\_\_\_\_.
3. A disjunction of two statements  $a$  and  $b$  is true unless \_\_\_\_\_.
4. True or False: The statement “if today is Sunday, then I will eat a sundae” is false if today is Tuesday and I eat a Sunday.
5. True or False: The statement “the snow will melt if and only if the temperature is above freezing” is true if the snow doesn’t melt and the temperature is below freezing.

### 💡 PRACTICE

Complete each truth table.

6.  $a \wedge \sim b$

Truth Table			
$a$	$b$	$\sim b$	$a \wedge \sim b$
T	T		
T	F		
F	T		
F	F		

7.  $\sim w \vee \sim z$

Truth Table				
$w$	$z$	$\sim w$	$\sim z$	$\sim w \vee \sim z$
T	T			
T	F			
F	T			
F	F			

8.  $c \Rightarrow \sim d$

Truth Table			
$c$	$d$	$\sim d$	$c \Rightarrow \sim d$
T	T		
T	F		
F	T		
F	F		

9.  $m \leftrightarrow \sim n$

**Truth Table**

$m$	$n$	$\sim n$	$m \leftrightarrow \sim n$
T	T	F	F
T	F	T	T
F	T	F	F
F	F	T	T

10.  $\sim(p \Rightarrow q)$

**Truth Table**

$p$	$q$	$p \Rightarrow q$	$\sim(p \Rightarrow q)$
T	T	T	F
T	F	F	T
F	T	T	F
F	F	T	F

11.  $\sim(s \Leftrightarrow t)$

**Truth Table**

$s$	$t$	$s \Leftrightarrow t$	$\sim(s \Leftrightarrow t)$
T	T	T	F
T	F	F	T
F	T	F	T
F	F	T	F

12.  $(a \vee b) \vee c$

**Truth Table**

$a$	$b$	$c$	$a \vee b$	$(a \vee b) \vee c$
T	T	T	T	T
T	T	F	T	T
T	F	T	T	T
T	F	F	T	T
F	T	T	T	T
F	T	F	T	T
F	F	T	F	T
F	F	F	F	F

13.  $(p \vee r) \Rightarrow q$

**Truth Table**

$p$	$r$	$q$	$p \vee r$	$(p \vee r) \Rightarrow q$
T	T	T	T	T
T	T	F	T	F
T	F	T	T	T
T	F	F	T	F
F	T	T	T	T
F	T	F	T	F
F	F	T	F	T
F	F	F	F	T

14.  $(\sim a \wedge \sim b) \wedge \sim c$

Truth Table						
$a$	$b$	$c$	$\sim a$	$\sim b$	$\sim c$	$(\sim a \wedge \sim b) \wedge \sim c$
T	T	T	F	F	F	F
T	T	F	F	F	T	F
T	F	T	F	T	F	F
T	F	F	F	T	T	F
F	T	T	T	F	F	F
F	T	F	T	F	T	F
F	F	T	T	T	F	F
F	F	F	T	T	T	F

15.  $(m \wedge n) \Leftrightarrow r$

Truth Table				
$m$	$n$	$r$	$m \wedge n$	$(m \wedge n) \Leftrightarrow r$
T	T	T	T	T
T	T	F	T	F
T	F	T	F	F
T	F	F	F	T
F	T	T	F	F
F	T	F	F	T
F	F	T	F	F
F	F	F	F	T

16.  $\sim p \Rightarrow (q \vee r)$

Truth Table					
$p$	$q$	$r$	$\sim p$	$q \vee r$	$\sim p \Rightarrow (q \vee r)$
T	T	T	F	T	T
T	T	F	F	T	T
T	F	T	F	T	T
T	F	F	F	F	F
F	T	T	T	T	T
F	T	F	T	T	T
F	F	T	T	F	F
F	F	F	T	F	F

17.  $(\sim b \leftrightarrow c) \Rightarrow \sim a$

Truth Table						
$a$	$b$	$c$	$\sim a$	$\sim b$	$\sim b \leftrightarrow c$	$(\sim b \leftrightarrow c) \Rightarrow \sim a$
T	T	T	F	F	F	T
T	T	F	F	F	T	F
T	F	T	F	T	T	F
T	F	F	F	T	F	T
F	T	T	T	F	F	T
F	T	F	T	F	T	F
F	F	T	T	T	T	F
F	F	F	T	T	F	T

Convert each compound statement into variables and then construct the truth table for the compound statement.

18. We will buy a new smartphone or we will buy a new computer.
19. I plan to go to the movies and go out to eat this weekend.
20. Ella is not on the dance team and Coleman is on the soccer team.
21. My calculator is not working correctly and I need to buy a new one if and only if it calculates that one plus one equals three.
22. If it rains and you don't put the convertible hood up, the inside of your convertible will get wet.
23. If Meg doesn't get gas, then her car will break down and she will miss her exam.

Use a truth table to determine if each statement is a tautology.

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

25.  $w \Rightarrow v$

26.  $(m \wedge n) \vee (\sim n)$

27.  $(a \wedge \sim b) \vee (a \Rightarrow b)$

Convert each compound statement into variables and create a truth table for the given statement. Then determine whether it is a tautology.

28. If I like the cake, then it is chocolate, or if the cake is chocolate, then I like the cake.
29. If the bird is blue or green, then the bird is not from here.
30. You wrote the love letter if and only if you liked her, or you did not write the love letter if and only if you did not like her.
31. The animal is a penguin implies it wears a bow tie if and only if the animal does not wear a bow tie implies it is not a penguin.