

Construct truth tables for the statement forms in [5](#) [6](#) [7](#) [8](#), [9](#), [10](#), and [11](#).

5.  $\sim p \vee q \rightarrow \sim q$

Answer ↓

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

7.  $p \wedge \sim q \rightarrow r$

Answer ↓

		conclusion		hypothesis	
$p$	$q$	$r$	$\sim q$	$p \wedge \sim q$	$p \wedge \sim q \rightarrow r$
T	T	T	F	F	T
T	T	F	F	F	T
T	F	T	T	T	T
T	F	F	T	T	F
F	T	T	F	F	T
F	T	F	F	F	T
F	F	T	T	F	T
F	F	F	T	F	T

9.  $p \wedge \sim r \leftrightarrow q \vee r$

Answer ↓

$p$	$q$	$r$	$\sim r$	$p \wedge \sim r$	$q \vee r$	$p \wedge \sim r \leftrightarrow q \vee r$
T	T	T	F	F	T	F
T	T	F	T	T	T	T
T	F	T	F	F	T	F
T	F	F	T	T	F	F
F	T	T	F	F	T	F
F	T	F	T	F	T	F
F	F	T	F	F	T	F
F	F	F	T	F	F	T

In [16](#) and [17](#), write each of the two statements in symbolic form and determine whether they are logically equivalent. Include a truth table and a few words of explanation to show that you understand what it means for statements to be logically equivalent.

16. If you paid full price, you didn't buy it at Crown Books. You didn't buy it at Crown Books or you paid full price.

Answer ↓

Let  $p$  represent "You paid full price" and  $q$  represent "You didn't buy it at Crown Books." Thus, "If you paid full price, you didn't buy it at Crown Books" has the form  $p \rightarrow q$ . And "You didn't buy it at Crown Books or you paid full price" has the form  $q \vee p$ .

$p$	$q$	$p \rightarrow q$	$q \vee p$
T	T	T	T
T	F	F	T
F	T	T	T
F	F	T	F

These two statements are not logically equivalent because their forms have different truth values in rows 2 and 4.

(An alternative representation for the forms of the two statements is  $p \rightarrow \sim q$  and  $\sim q \vee p$ . In this case, the truth values differ in rows 1 and 3.)

20. Write negations for each of the following statements. (Assume that all variables represent fixed quantities or entities, as appropriate.)

a. If  $P$  is a square, then  $P$  is a rectangle.

Answer ↓

$P$  is a square and  $P$  is not a rectangle.

b. If today is New Year's Eve, then tomorrow is January.

c. If the decimal expansion of  $r$  is terminating, then  $r$  is rational.

d. If  $n$  is prime, then  $n$  is odd or  $n$  is 2.

Answer ↓

$n$  is prime and both  $n$  is not odd and  $n$  is not 2. Or:  $n$  is prime and  $n$  is neither odd nor 2.

e. If  $x$  is nonnegative, then  $x$  is positive or  $x$  is 0.

f. If Tom is Ann's father, then Jim is her uncle and Sue is her aunt.

Answer ↓

Tom is Ann's father and either Jim is not her uncle or Sue is not her aunt.

Rewrite each of the statements in [32](#) and [33](#) as a conjunction of two if-then statements.

32. This quadratic equation has two distinct real roots if, and only if, its discriminant is greater than zero.

Answer ↓

If this quadratic equation has two distinct real roots, then its discriminant is greater than zero, and if the discriminant of this quadratic equation is greater than zero, then the equation has two real roots.

Rewrite the statements in [40](#) and [41](#) in if-then form.

40. Catching the 8:05 bus is a sufficient condition for my being on time for work.

Answer ↓

If I catch the 8:05 bus, then I am on time for work.

44. A sufficient condition for Jon's team to win the championship is that it win the rest of its games.

Answer ↓

If Jon's team wins the rest of its games, then it will win the championship.