

Section 2.2A Statements, Conditionals, and Biconditionals

STATEMENT: a sentence that is either true or false. The **truth value** of a statement is either true (T) or false (F). Statements are often represented using letters such as p , q , and r .

Examples

Determine the truth value of each statement.

- | | | |
|----|---|-----------------------------------|
| 1. | p : A rectangle has 4 sides. | Truth Value: TRUE or FALSE |
| 2. | q : $2 + 2 = 4$ | Truth Value: TRUE or FALSE |
| 3. | r : In Pokémon, Pikachu evolves into Charizard. | Truth Value: TRUE or FALSE |

NEGATION (NOT): making a statement negative; also has the opposite truth value.

Examples

Determine the truth value of each statement. Write the negation of each statement and then determine the truth value of each negation.

- | | | |
|----|--|-----------------------------------|
| 4. | p : January is a fall month. | Truth Value: TRUE or FALSE |
| | $\sim p$: January is not a fall month. | Truth Value: TRUE or FALSE |
| 5. | q : Mr. Lee's wife is ugly. | Truth Value: TRUE or FALSE |
| | $\sim q$: Mr. Lee's wife is not ugly. | Truth Value: TRUE or FALSE |

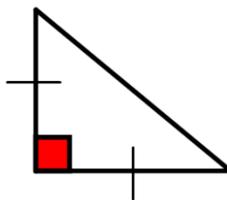
COMPOUND STATEMENT: two or more statements joined by the words *and* or *or*.

CONJUNCTION (AND): a compound statement using the word *and*. A conjunction is true only when both statements that form it are true.

Example

6. Use the following statements to write a compound statement for each conjunction. Then find its truth value.

- p : The figure is a triangle.
 q : The figure has two congruent sides.
 r : The figure has three acute angles.



$p \wedge r$: **The figure is a triangle and the figure has three acute angles.**
Truth Value: TRUE or **FALSE**

$q \wedge \sim r$: **The figure has two congruent sides AND the figure does not have three acute angles.**
Truth Value: **TRUE** or FALSE

7. Use the following statements to write a compound statement for each conjunction. Then find its truth value.

p : $-3 - 2 = -5$

q : Vertical angles are congruent.

r : $2 + 8 > 10$

$p \wedge q$: **$-3 - 2 = -5$ and vertical angles are congruent.**

Truth Value: **TRUE** or FALSE

$p \wedge r$: **$-3 - 2 = -5$ and $2 + 8 > 10$**

Truth Value: TRUE or **FALSE**

$q \wedge \sim r$: **Vertical angles are congruent and $2 + 8$ not > 10 .**

Truth Value: **TRUE** or FALSE

DISJUNCTION (OR): a compound statement using the word *or*. A disjunction is true if at least one of the statements is true.



Example

8. Use the following statements to write a compound statement for each disjunction. Then find its truth value.

p : December is a summer month.

q : December has only 30 days.

r : Christmas is on December 25th.

SUN	MON	TUE	WED	THU	FRI	SAT
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

$q \vee r$: **December has only 30 day OR Christmas is on December 25th.**

Truth Value: **TRUE** or FALSE

$p \vee q$: **December is a summer month OR December has only 30 days.**

Truth Value: TRUE or **FALSE**

$\sim p \vee \sim r$: **December is not a summer month OR Christmas is not on December 25th.**

Truth Value: **TRUE** or FALSE

9. Use the following statements to write a compound statement for each disjunction. Then find its truth value.

p : Today is Tuesday.

q : Tomorrow is not Thursday.

r : Yesterday was Monday.

$r \vee q$: **Yesterday was Monday OR tomorrow is not Thursday.**

Truth Value: **TRUE** or FALSE

$p \vee q$: **Today is Tuesday OR tomorrow is not Thursday.**

Truth Value: **TRUE** or FALSE

$\sim p \vee \sim r$: **Today is not Tuesday OR yesterday was not Monday**

Truth Value: TRUE or **FALSE**

CONDITIONAL STATEMENT: a statement that has two parts, a *hypothesis* and a *conclusion*. The conditional statement can be written in an **IF – THEN STATEMENT**. The “*if*” part contains the *hypothesis* and the “*then*” part contains the *conclusion*.

Identifying the Hypothesis and Conclusion

Identify the parts of the conditional statement (*if-then* statement) by underlining the **hypothesis** and circling the **conclusion**.

10. **If the team wins the semi-final, then the team will play in the championship.**
11. **If I don't do my homework, then I will not get credit for it.**
12. **If I am texting on my phone in class, then I will get my phone taken away.**

Writing If – Then Statements

Rewrite each statement as a conditional statement (*if-then* statement).

13. Students who eat Happy Meals are really cool.
If a student eats a Happy Meal, then they are really cool.
14. Every duck on the pond is hungry.
If there is a duck on the pond, then it is hungry.
15. I will go running if it does not rain.
If it is not raining, then I will go running.

CONVERSE: Not just a shoe, but an *if-then* statement formed by switching the hypothesis with the conclusion. Sometimes the converse is true and sometimes it's false.

Write the converse of each conditional statement. Then identify whether the conditional statement is true or false. If false, provide a counterexample.

16. Statement: If you go to Troy High School, then you live in Fullerton, CA.
Converse: **If you live in Fullerton, CA, then you go to Troy High School.**
TRUE or **FALSE** - Counterexample: **If you live in Fullerton, CA, then you may go to Fullerton High School.**
17. Statement: If $x = 6$, then $|x| = 6$.
Converse: **If $|x| = 6$, then $x = 6$.**
TRUE or **FALSE** - Counterexample: **If $x = 6$, then $|x| = -6$.**
18. Statement: If you are awesome, then you are Mr. Lee.
Converse: **If you are awesome, then you are Mr. Lee.**
TRUE or FALSE - Counterexample: _____