Geometry 2.3
Analyze statements in if-then form
Write the converse, inverse, and contrapositive of conditional statements

conditional statement hypothesis if and only if conclusion the related conditional converse inverse contrapositive and converse contrapositive

KeyConcept Conditional Statement				
Words	Symbols			
An <b>if-then statement</b> is of the form <i>if p, then q.</i>	$p \rightarrow q$ read if p then q, or p implies q			
The hypothesis of a conditional statement is the phrase immediately following the word if.	р			
The conclusion of a conditional statement is the phrase immediately following the word <i>then</i> .	q			

**Related Conditionals** There are other statements that are based on a given conditional statement. These are known as related conditionals.

KeyConcept Related Conditionals					
Words	Symbols	Examples			
A conditional statement is a statement that can be written in the form <i>if p, then q.</i>	$p \rightarrow q$	If $m \angle A$ is 35, then $\angle A$ is an acute angle.			
The converse is formed by exchanging the hypothesis and conclusion of the conditional.	$q \rightarrow p$	If $\angle A$ is an acute angle, then $m\angle A$ is 35.			
The inverse is formed by negating both the hypothesis and conclusion of the conditional.	~p → ~q	If $m \angle A$ is not 35, then $\angle A$ is not an acute angle.			
The contrapositive is formed by negating both the hypothesis and the conclusion of the converse of the conditional.	~q → ~p	If $\angle A$ is <i>not</i> an acute angle, then $m\angle A$ is <i>not</i> 35.			

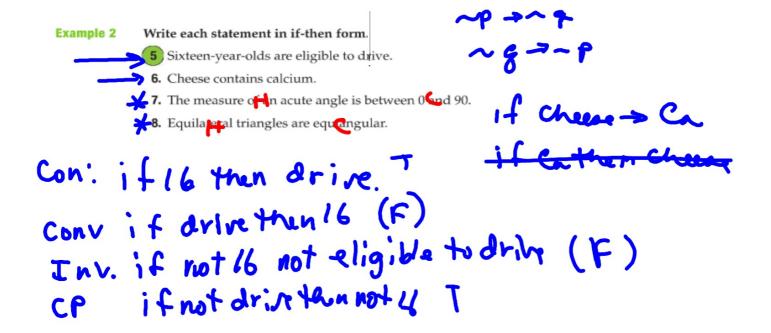
If you live in Sioux Falls, then you live in SD.

A conditional and its contrapositive are either both true or both false. Similarly, the converse and inverse of a conditional are either both true or both false. Statements with the same truth values are said to be **logically equivalent**.

## **KeyConcept** Logically Equivalent Statements

A conditional and its contrapositve are logically equivalent.

The converse and inverse of a conditional are logically equivalent.



Determine the truth value of each conditional statement. If true, explain your reasoning. Example 3 If false, give a counterexample.

**10.** If  $x^2 = 16$ , then x = 4.

11. If you live in Charlotte, then you live in North Carolina.

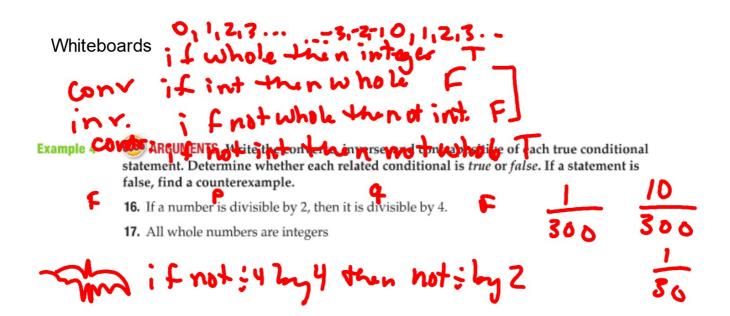
12. If tomorrow is Friday, then today is Thursday.

13. If an animal is spotted, then it is a Dalmatian.

**14.** If the measure of a right angle is 95, then bees are lizards.

**15.** If pies can fly, then 2 + 5 = 7.

Remember: benefit of the doubt...



Start by writing in if/then form.

If a triangle is equilateral, then each angle is 60 degrees. If a triangle has three 60 degree angles, then it is equilateral. 60 → €

"If and only if...iff"

## **KeyConcept** Biconditional Statement

Words A biconditional statement is the conjunction of a conditional and its converse.

Symbols  $(p \rightarrow q)$   $(q \rightarrow p)$   $\rightarrow$   $(p \leftrightarrow q)$ , read p if and only if q

If and only if can be abbreviated iff.

## **Examples**



Write each biconditional as a conditional and its converse. Then determine whether the biconditional is true or false. If talse, give a counterexample.

a. An angle is a right angle if and only if its measure is 90.

Conditional: If an angle measures 90, then the angle is right. Converse: If an angle is right, then the angle measures 90.

Both the conditional and the converse are true, so the biconditional is true.

**b.** x > -2 iff x is positive.

Conditional: If *x* is positive, then x > -2.

Let x = -1. Then -1 > -2, then x is positive. Then x > -2, but -1 is not positive. So, the biconditional is false.

Write both statement & converse. Are they both true?

## **Exercises**

Write each biconditional as a conditional and its converse. Then determine whether the biconditional is *true* or *false*. If false, give a counterexample.

1. Two angles are complements if and only if their measures have a sum of 90.

There is no school if and only if it is Saturday.

if 90 > comp if no school > 5
if comp -> 90