

Your Name

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1.7-1.8 - Logic Statements

Notes

Conditional Statement

The initial statement assumed to be true

If p Then q

If  $\rightarrow$  Hypothesis (p)

Then  $\rightarrow$  Conclusion (q)

One Way Implication

If p , then q $p \rightarrow q$ p implies q
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$p \rightarrow q$   
 ~~$p \Rightarrow q$~~   
 $p \dashrightarrow q$

Two Way Implication

if and only if  
 $p \Leftrightarrow q$   
 iff

## Statements of Logic - Notation

<p>Conditional</p>	<p>If I sleep, then I have energy</p> <p><math>p \rightarrow q</math> (If p, then q)</p>
<p>Converse</p>	<p><math>q \rightarrow p</math>      <b>FLIP</b> (switch order)</p> <p>If I have energy, then I slept</p>
<p>Inverse</p>	<p><math>\sim p \rightarrow \sim q</math>      (<math>\sim</math> means NOT)      <b>NOT</b></p> <p>If I don't sleep then I don't have energy</p>
<p>Contrapositive</p>	<p><math>\sim q \rightarrow \sim p</math>      <b>FLIP + NOT</b></p> <p>If I don't have energy, then I didn't sleep</p>

## Statements of Logic - Example #1 (Definition)

<p>Conditional</p>	<p><math>p \rightarrow q</math> (If p, then q)</p> <p>If an angle is a right angle then it has a measure of 90 degrees.</p>
<p>Converse</p>	<p><math>q \rightarrow p</math></p> <p>If an angle has a measure of 90 degrees, then it is a right angle.</p>
<p>Inverse</p>	<p><math>\sim p \rightarrow \sim q</math></p> <p>If an angle is not a right angle, then it does not have a measure of 90 degrees.</p>
<p>Contrapositive</p>	<p><math>\sim q \rightarrow \sim p</math></p> <p>If an angle does not have a measure of 90 degrees, then it is not a right angle.</p>

For Definitions, the Converse is always true.



## Statements of Logic - Example #2 (Theorem)

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Conditional  $p \rightarrow q$  (If p, then q)

If two angles are right angles, then they are congruent.

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Converse  $q \rightarrow p$

If two angles are congruent, then they are right angles.

---

Inverse  $\sim p \rightarrow \sim q$

If two angles are not right angles, then they are not congruent.

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Contrapositive  $\sim q \rightarrow \sim p$

If two angles are not congruent, then they are not right angles.

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For Theorems, the Converse is Not always true. 

## Statements of Logic - Example #3 (Random)

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Conditional  $p \rightarrow q$  (If p, then q)

If my car has a flat tire, then I am late for work.

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Converse  $q \rightarrow p$

If I am late for work, then my car has a flat tire.

---

Inverse  $\sim p \rightarrow \sim q$

If my car does not have a flat tire, then I am not late for work.

---

Contrapositive  $\sim q \rightarrow \sim p$

If I am not late for work, then my car does not have a flat tire.

## Statements of Logic

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Conditional  $p \rightarrow q$  (If p, then q)

If my car has a flat tire, then I am late for work.

---

Contrapositive  $\sim q \rightarrow \sim p$

If I am not late for work, then my car does not have a flat tire.

---

The conditional and the contrapositive will always have the same truth value (true or false). If one is true, then both will be true. If one is false, both will be false.

Your Turn:

If I am rested, then I slept

Write a Conditional If  $\rightarrow$  Then statement

Write the Converse of it: <sup>Switch Order</sup> If I sleep, then I am rested

Write the Inverse of it: <sup>Negate both (Not)</sup> I don't rest, then I don't sleep

Write the Contrapositive: <sup>flip and Not</sup> I don't sleep, then I didn't rest.

If I get a puppy, then my house is NOT quiet

$p \rightarrow \neg q$

NAME \_\_\_\_\_ DATE \_\_\_\_\_  
 GEOMETRY  
 Logic Worksheet : CONDITIONALS

In 1-4, write the converse, inverse, and contrapositive of the statement in symbolic form.  
 1)  $p \rightarrow q$       2)  $\neg p \rightarrow \neg q$       3)  $m \rightarrow p$       4)  $\neg p \rightarrow \neg q$

Flip order  
 Converse:  $q \rightarrow p$   
 Inverse:  $\neg p \rightarrow \neg q$   
 Contrapositive:  $\neg q \rightarrow \neg p$

In 5-6, write the converse of the statement in words.

5) If you buy Goal toothpaste, then your children will brush longer.  
 Converse: **Flip** If your children brush longer, then you buy Goal toothpaste

In 7-8, write the inverse of the statement in words.

7) If you live to an old age, then you eat Nano yogurt.  
 Inverse: **Not** If you did not live to an old age, then you did not eat Nano yogurt

In 9-10, write the contrapositive of the statement in words.

9) If you brush with Brite then your teeth will be pearly white.  
 Contrapositive: **Flip & Not** If your teeth are not pearly white then you did not brush with Brite

In 11-16, circle the correct answer.

11) When  $p \rightarrow q$  is true, which related conditional must be true?  
 (1)  $q \rightarrow p$   
 (2)  $\neg p \rightarrow \neg q$   
 (3)  $p \rightarrow \neg q$   
 (4)  $\neg q \rightarrow \neg p$   
**Contrapositive will be true**

12) Which is the contrapositive of "If winter comes, then spring is not far behind"?

- (1) If spring is not far behind, then winter comes.
- (2) If spring is far behind, then winter comes.
- (3) If spring is not far behind, then winter does not come.
- (4) If spring is far behind, then winter does not come.

13) Which is the converse of "If a polygon is a rectangle, then its area does not equal  $l \cdot w \cdot h$ ."

- (1) If a polygon is not a rectangle, then its area does not equal  $l \cdot w \cdot h$ .
- (2) If a polygon has area that equals  $l \cdot w \cdot h$ , then it is a rectangle.
- (3) If a polygon has an area that does not equal  $l \cdot w \cdot h$ , then it is not a rectangle.
- (4) If the area of a rectangle is  $l \cdot w \cdot h$ , then it is a polygon.

14. Which statement has the same truth value as  $\neg m \rightarrow \neg p$ ?

- (1)  $m \rightarrow \neg p$
- (2)  $p \rightarrow m$
- (3)  $\neg p \rightarrow m$
- (4)  $\neg p \rightarrow \neg m$

15. If  $p \rightarrow q$  is true, then  $\neg q \rightarrow \neg p$  is

- (1) sometimes true
- (2) always true
- (3) truth value cannot be determined
- (4) never true

16. The inverse of  $p \rightarrow \neg q$  is

- (1)  $\neg p \rightarrow \neg q$
- (2)  $\neg p \rightarrow q$
- (3)  $\neg q \rightarrow p$
- (4)  $q \rightarrow p$

In 17-20, Write the Converse and then determine the truth value. Give a counter example if it is not always true.

17. Definition: If a triangle is an isosceles triangle, then it has exactly two sides and their opposite angles are congruent. The Converse is...  
**for Definition converse true**  
 (1) true  
 (2) false  
 (3) sometimes true  
 (4) cannot be determined  
**If a shape has exactly two sides and their opposite are congruent, then it is an isosceles triangle**

18. Theorem: If two angles are right angles, then the two angles are congruent. The Converse is...

- (1) true
  - (2) false
  - (3) sometimes true
  - (4) cannot be determined
- If the two angles are congruent then the two angles are right**

19. Theorem: If a shape is a square, then it has 4 right angles. The Converse is...

- (1) true
  - (2) false
  - (3) sometimes true
  - (4) cannot be determined
- Counter Example both could be 20**

20. Definition: If a two triangles have two congruent angles and side in between, then the two triangles are congruent. The Converse is...

- (1) true
- (2) false
- (3) sometimes true
- (4) cannot be determined