Conditional Statements in Geometry

Geometry Worksheet · Grade 8–10

Name: ________________________________ Date: __________________

Learning Objectives

- Write and identify the hypothesis and conclusion of a conditional statement in if-then form
- Form the converse, inverse, and contrapositive of a given conditional statement
- Use symbolic notation (p, q, \sim p, \sim q) to represent and manipulate conditional statements

Problems

1. Identify the hypothesis and conclusion in the following conditional statement: 'If a figure is a square, then it is a quadrilateral.'

$p \to q$

2. Write the negation of the statement: 'The angle is a right angle.'

$\sim p$

3. Rewrite the following statement in if-then form: 'All rectangles have four right angles.'

$p \to q$

4. Given p: 'It is raining' and q: 'The ground is wet,' write the conditional statement in symbolic form and in sentence form.

$p \to q$

5. Write the converse of the conditional statement: 'If a figure is a square, then it is a quadrilateral.'

$q \to p$

6. Write the inverse of the conditional statement: 'If a figure is a square, then it is a quadrilateral.'

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$\sim p \rightarrow \sim q$

7. Write the contrapositive of the conditional statement: 'If a figure is a square, then it is a quadrilateral.'

$\sim q \rightarrow \sim p$

8. Given the conditional statement 'If two angles are supplementary, then their measures add up to 180°,' determine which related statement — converse, inverse, or contrapositive — is: 'If two angles do not add up to 180°, then they are not supplementary.'

$\sim q \rightarrow \sim p$

9. Given p: 'Two lines are parallel' and q: 'They do not intersect,' write all four forms — conditional, converse, inverse, and contrapositive — in symbolic notation.

$p \rightarrow q,\ q \rightarrow p,\ \sim p \rightarrow \sim q,\ \sim q \rightarrow \sim p$

10. Analyze the statement 'If a polygon has exactly three sides, then it is a triangle.' Determine whether its converse and contrapositive are also true, and explain why the contrapositive always shares the same truth value as the original conditional statement.

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Conditional Statements in Geometry — Answer Key

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Answer Key

1. Answer: Hypothesis: a figure is a square; Conclusion: it is a quadrilateral

- The hypothesis follows 'if' and the conclusion follows 'then'.
- Hypothesis (p): 'a figure is a square'; Conclusion (q): 'it is a quadrilateral'.

2. Answer: The angle is not a right angle.

- To negate a statement, insert the word 'not' to reverse its meaning.
- Negation: 'The angle is not a right angle.'

3. Answer: If a figure is a rectangle, then it has four right angles.

- Identify the subject as the hypothesis and the property as the conclusion.
- If-then form: 'If a figure is a rectangle, then it has four right angles.'

4. Answer: Symbolic: $p \rightarrow q$; Sentence: If it is raining, then the ground is wet.

- A conditional statement connects hypothesis p to conclusion q using 'if...then'.
- Symbolic: $p \rightarrow q$; Sentence: 'If it is raining, then the ground is wet.'

5. Answer: If a figure is a quadrilateral, then it is a square.

- The converse is formed by switching the hypothesis and conclusion.
- Converse: 'If a figure is a quadrilateral, then it is a square.'

6. Answer: If a figure is not a square, then it is not a quadrilateral.

- The inverse is formed by negating both the hypothesis and the conclusion.
- Inverse: 'If a figure is not a square, then it is not a quadrilateral.'

7. Answer: If a figure is not a quadrilateral, then it is not a square.

- The contrapositive negates both p and q and then switches their positions.
- Contrapositive: 'If a figure is not a quadrilateral, then it is not a square.'

8. Answer: Contrapositive

- Check the structure: both parts are negated and the hypothesis and conclusion are switched.
- This matches the form $\sim q \rightarrow \sim p$, which is the contrapositive.

9. Answer: Conditional: $p \rightarrow q$; Converse: $q \rightarrow p$; Inverse: $\sim p \rightarrow \sim q$; Contrapositive: $\sim q \rightarrow \sim p$

- Conditional ($p \rightarrow q$): If two lines are parallel, then they do not intersect.
- Converse ($q \rightarrow p$): If they do not intersect, then two lines are parallel. Inverse ($\sim p \rightarrow \sim q$): If two lines are not parallel, then they intersect. Contrapositive ($\sim q \rightarrow \sim p$): If two lines intersect, then they are not parallel.

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10. Answer: Converse is true here; the contrapositive is always logically equivalent to the original (both true or both false).

- Original ($p \to q$): 'If a polygon has exactly three sides, then it is a triangle.' — True.
- Converse ($q \to p$): 'If it is a triangle, then it has exactly three sides.' — Also true in this case, but not always.
- Contrapositive ($\sim q \to \sim p$): 'If it is not a triangle, then it does not have exactly three sides.' — True, because the contrapositive is logically equivalent to the original by the law of contraposition ($p \to q \leftrightarrow \sim q \to \sim p$).

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