# Geometry Unit 1 worksheet: Converses and biconditional definitions

Name _____ Date _____ Period _____

**1.** Each step below cites a definition as its reason. Name the definition, and say whether it runs **forward** (it unpacks a word you were handed into a fact) or **backward** (it earns a word once the condition is checked).

(a) $\angle K$ is a right angle, so $m\angle K = 90^\circ$.

(b) $PQ = RS$, so $\overline{PQ} \cong \overline{RS}$.

(c) $m\angle 1 + m\angle 2 = 90^\circ$, so $\angle 1$ and $\angle 2$ are complementary.

(d) $\overrightarrow{OX}$ bisects $\angle POQ$, so $\angle POX \cong \angle XOQ$.

**2.** Grace is laying out a new rectangular plot in a community garden with string lines and stakes. The corner where the two string lines meet must be a right angle. From the corner stake she measures 5 m along the first string and 12 m along the second string, and ties a marker at each spot.

(a) If the corner is a right angle, how far apart are the two markers?

(b) She swings the second string until the markers are exactly that far apart. Which statement tells her the corner is now a right angle: the Pythagorean theorem or its converse?

(c) Which of the two did you use in (a)?


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**3.** Here are two true theorems.

- **Pythagorean theorem.** In $\triangle ABC$, if $m\angle C = 90°$, then $a^2 + b^2 = c^2$.
- **Parallel lines.** If two lines cut by a transversal are parallel, then their corresponding angles are congruent.

Each conclusion below is correct. Say which theorem it rests on, and whether it uses the theorem itself, its converse, or its contrapositive.

(a) A bike frame's front triangle has a right angle where two tubes meet, and those tubes are 40 cm and 42 cm long. Isabel concludes the third tube is 58 cm long.

(b) A wall bracket is a triangle with sides 15 cm, 20 cm and 25 cm. Ben concludes it has a right angle.

(c) A straight access road crosses two rows of a vineyard. A pair of corresponding angles at the two crossings measure 63° and 63°. Sofia concludes the rows are parallel.

(d) At another pair of rows, the corresponding angles measure 63° and 61°. Sofia concludes these rows are not parallel.


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**4.** Each statement is true. Write its converse, keeping the setting. Say whether the converse is true. If it is false, give a counterexample and show that it works; if it is true, show why.

(a) If two angles are right angles, then they are congruent.

(b) For points $A$, $B$ and $M$ in a plane: if $M$ is the midpoint of $\overline{AB}$, then $AM = \frac{1}{2}AB$.

(c) For an angle with measure between 0° and 180°: if the angle is a right angle, then it is congruent to its supplement.

**5.** Let $O = (0, 0)$, and let $P = (x, y)$ be a point. Take the statement

**T.** If $x = 5$ and $y = 12$, then $OP = 13$.

(a) Show that T is true.

(b) Write the **full converse** of T, which swaps the whole hypothesis with the conclusion. Is it true?

(c) Now swap only one part: "If $x = 5$ and $OP = 13$, then $y = 12$." Is this partial converse true?

(d) Add one condition about $y$ to the hypothesis of the statement in (c) so that it becomes true, and show that it is.

**6.** Each sentence proposes a definition of a word you already know. Test both directions. If the proposal fails, give a counterexample for each direction that fails, say whether it is too loose, too tight or both, and repair it.

(a) "A triangle is equilateral if two of its sides are congruent."

(b) "Points are collinear if they all lie on the $x$-axis."

(c) "Two segments are congruent if they have the same midpoint."


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