



BICONDITIONALS AND DEFINITIONS

Which One Has a True Converse?

8 boxes · two true if-then sentences in each · only one can be joined with if and only if

FREE

3

Which sentence has a true converse?

- If an angle is a right angle, then it is not obtuse. **Go to box 4.**
- If an angle is a right angle, then it measures 90° . **Go to box 6.**

Hint: Test an angle of 45° on both converses.

6

Which sentence has a true converse?

- If two angles are supplementary, then their measures add to 180° . **Go to box 1.**
- If two angles form a linear pair, then they are supplementary. **Go to box 7.**

Hint: Test angles of 50° and 130° at two different vertices on both converses.

1

Which sentence has a true converse?

- If M is the midpoint of segment AB, then $AM = MB$. **Go to box 4.**
- If M is on segment AB and $AM = MB$, then M is the midpoint of segment AB. **Go to box 8.**

Hint: Test a point M off segment AB with $AM = MB$ on both converses.

8

Which sentence has a true converse?

- If two angles have the same measure, then they are congruent. **Go to box 5.**
- If two angles are vertical angles, then they have the same measure. **Go to box 7.**

Hint: Test two angles of 40° at two different vertices on both converses.

1. **Hand out page 3, one per student.** Students start at box 3. Nothing else is needed.
2. **Say this once:** *“Both sentences in a box are true. Swap the two parts of each one. Take the one that is still true.”*
3. **Students write each box number in the row at the bottom.** A clean run is 3, 6, 1, 8, 5, 2, then Finish.

Student sheet page 3, one per student.

Answers page 4: the route, the right sentence in every box, and a case that shows why the other sentence is wrong.

The wrong answer in every box is the most common mistake in this lesson. It is a true statement whose converse is false. A student who joins it with *if and only if* has not checked the converse.

Both sentences in every box are true. So a student who checks only the sentences as they are printed cannot choose. The student must swap the two parts of each sentence and check again. The hint names one case to try on the swapped sentences, but it never says which sentence to take. Every simple guessing rule, such as always taking the first answer, goes wrong within the first three steps.

No box is a dead end. The two boxes off the route (4 and 7) look like every other box. Their right answer leads back onto the route. A clean run has 6 numbers. A longer row shows that the student made a mistake and found the way back.



This is the free lesson this activity came from. The worksheet, the full answers and the lesson plan are on it, at three levels of difficulty.

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Name _____

Period _____

Date _____

Start at box 3. Both sentences in each box are true. The converse of “If A, then B” is “If B, then A.” Choose the sentence whose converse is also true. Go to the box it names. Write each box number in the row at the bottom.

1

Which sentence has a true converse?

- If M is the midpoint of segment AB, then $AM = MB$. **Go to box 4.**
- If M is on segment AB and $AM = MB$, then M is the midpoint of segment AB. **Go to box 8.**

Hint: Test a point M off segment AB with $AM = MB$ on both converses.

2

Which sentence has a true converse?

- If two lines meet to form a right angle, then they are perpendicular. **Go to Finish.**
- If two lines are perpendicular, then they intersect. **Go to box 5.**

Hint: Test two lines that meet at 60° on both converses.

3

Which sentence has a true converse?

- If an angle is a right angle, then it is not obtuse. **Go to box 4.**
- If an angle is a right angle, then it measures 90° . **Go to box 6.**

Hint: Test an angle of 45° on both converses.

4

Which sentence has a true converse?

- If two angles are complementary, then their measures add to 90° . **Go to box 6.**
- If two angles are complementary, then both of them are acute. **Go to box 3.**

Hint: Test two angles of 30° and 30° on both converses.

5

Which sentence has a true converse?

- If ray BD is the bisector of angle ABC, then angles ABD and DBC are congruent. **Go to box 1.**
- If ray BD is the bisector of angle ABC, then D is in the interior of angle ABC and angles ABD and DBC are congruent. **Go to box 2.**

Hint: Test a ray BD outside angle ABC that makes angles ABD and DBC equal, on both converses.

6

Which sentence has a true converse?

- If two angles are supplementary, then their measures add to 180° . **Go to box 1.**
- If two angles form a linear pair, then they are supplementary. **Go to box 7.**

Hint: Test angles of 50° and 130° at two different vertices on both converses.

7

Which sentence has a true converse?

- If an angle is a straight angle, then it measures more than 90° . **Go to box 6.**
- If an angle measures 180° , then it is a straight angle. **Go to box 1.**

Hint: Test an angle of 120° on both converses.

8

Which sentence has a true converse?

- If two angles have the same measure, then they are congruent. **Go to box 5.**
- If two angles are vertical angles, then they have the same measure. **Go to box 7.**

Hint: Test two angles of 40° at two different vertices on both converses.

Write the box numbers here, in order, as you go.

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Maze — answers

For the teacher

The route: $3 \rightarrow 6 \rightarrow 1 \rightarrow 8 \rightarrow 5 \rightarrow 2 \rightarrow \text{Finish}$. Boxes 4 and 7 are off the route. A student reaches them only after a wrong answer.

Box	Place on the route	The sentence to take	Next box
3	step 1	If an angle is a right angle, then it measures 90°. The converse of the other sentence is false. A case that breaks it: an angle of 45° .	Right: box 6 Wrong: box 4
6	step 2	If two angles are supplementary, then their measures add to 180°. The converse of the other sentence is false. A case that breaks it: angles of 60° and 120° , at two different vertices.	Right: box 1 Wrong: box 7
1	step 3	If M is on segment AB and $AM = MB$, then M is the midpoint of segment AB. The converse of the other sentence is false. A case that breaks it: M at (4, 3) with A at (0, 0) and B at (8, 0): $AM = 5$, $MB = 5$, not on segment AB.	Right: box 8 Wrong: box 4
8	step 4	If two angles have the same measure, then they are congruent. The converse of the other sentence is false. A case that breaks it: angles of 60° and 60° , at two different vertices.	Right: box 5 Wrong: box 7
5	step 5	If ray BD is the bisector of angle ABC, then D is in the interior of angle ABC and angles ABD and DBC are congruent. The converse of the other sentence is false. A case that breaks it: angle ABC of 100° with D outside it: angle ABD = 130° , angle DBC = 130° .	Right: box 2 Wrong: box 1
2	step 6	If two lines meet to form a right angle, then they are perpendicular. The converse of the other sentence is false. A case that breaks it: two lines that meet at 60° .	Right: Finish Wrong: box 5
4	off the route	If two angles are complementary, then their measures add to 90°. The converse of the other sentence is false. A case that breaks it: angles of 60° and 60° , at two different vertices.	Right: box 6 Wrong: box 3
7	off the route	If an angle measures 180°, then it is a straight angle. The converse of the other sentence is false. A case that breaks it: an angle of 95° .	Right: box 1 Wrong: box 6