

ANSWER MAZE



ALTITUDES AND THE ORTHOCENTER

Where Do the Altitudes Meet?

One page · 10–15 minutes · nothing to prepare

FREE

4

In triangle ABC, side $BC = 12$. The altitude from A to BC is 7. The median from A to BC is 9. What is the area of triangle ABC?

54 → go to 2

42 → go to 7

Which of the two segments meets BC at a right angle?

7

Triangle STU has angles of 25° , 45° and 110° . Where do its three altitudes meet?

Outside the triangle. → go to 1

Inside the triangle. → go to 5

Find the largest angle. Compare it with a right angle.

1. **Hand out page 3**, one per student. Nothing else is needed.
2. **Say this once:** *“Start at box 4. An altitude meets the opposite side, or its line, at a right angle. Write every box number in the row at the bottom as you go.”*
3. **Check a sheet quickly.** A student with no mistakes writes **4 7 1 8 3 6**: six boxes, then out.

Student sheet page 3, one per student. At the top it shows where the three altitudes meet in an acute, a right and an obtuse triangle, as small drawings.

Answers page 4.

Every wrong answer comes from one of two mistakes. The first mistake is about the height. The height for a base is the altitude to that base, the segment that meets it at a right angle. Students often use a slanted side or a median instead, or forget the 2 when they find a height from an area. These wrong answers send the student to box 2, which asks for the height to a second side.

The second mistake is about where things are. Many students think the altitudes always meet inside the triangle. They meet inside an acute triangle, at the right-angle corner of a right triangle, and outside an obtuse triangle. Some students also believe an obtuse triangle has no altitude to a side next to its obtuse angle. It does: the altitude meets the line of that side, outside the triangle. These wrong answers send the student to box 5. Boxes 2 and 5 both lead back to the route.

The row at the bottom is the check. A clean run is six numbers. Each wrong answer adds at least one more. Guessing does not get a student out: every simple guessing rule, such as always taking the first answer, goes wrong within the first three boxes.



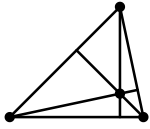
This is the free lesson this activity came from. The worksheet, the full answers and the lesson plan are on it, at three levels of difficulty.
chooseyourlesson.com — 135 free geometry lessons.

Name _____

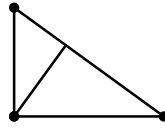
Period _____

Date _____

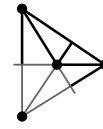
The three **altitudes** of a triangle (or the lines they lie on) meet at one point, the **orthocenter** (the dot).



Acute triangle: the orthocenter is **inside**.



Right triangle: it is **at the right-angle corner**.



Obtuse triangle: it is **outside**.

Answer the question in the box. Choose an answer, and go to the box it names. Write each box number in the row at the bottom as you reach it. The height for a base is the altitude to that base. Area = base $\times$ height $\div$ 2.

1

The area of triangle DEF is 60. Side EF = 15. How long is the altitude to EF?

4 $\rightarrow$ go to 2

8 $\rightarrow$ go to 8

Write the area rule first. Then put in the area and the base.

2

In triangle PQR, side QR = 18 and side PR = 12. The altitude to QR is 8. How long is the altitude to PR?

12 $\rightarrow$ go to 7

8 $\rightarrow$ go to 4

Find the area first. Then use the other base.

3

In triangle JKL, side KL = 20. The altitude from J to KL is 9. Side JK = 15. What is the area of triangle JKL?

90 $\rightarrow$ go to 6

150 $\rightarrow$ go to 2

Which length meets KL at a right angle?

4

In triangle ABC, side BC = 12. The altitude from A to BC is 7. The median from A to BC is 9. What is the area of triangle ABC?

54 $\rightarrow$ go to 2

42 $\rightarrow$ go to 7

Which of the two segments meets BC at a right angle?

5

A triangle has corners A(4, 9), B(1, 2) and C(11, 2). Where does the altitude from A meet side BC?

(6, 2) $\rightarrow$ go to 7

(4, 2) $\rightarrow$ go to 1

Plot the points. Which way does a line perpendicular to BC go?

6

In triangle ABC, the angle at B is 120° . Draw the altitude from A to side BC. Where does it meet the line through B and C?

Nowhere. There is no altitude to BC. $\rightarrow$ go to 5

It meets the line past B. $\rightarrow$ you are out

Sketch it. Extend side BC in both directions.

7

Triangle STU has angles of 25° , 45° and 110° . Where do its three altitudes meet?

Outside the triangle. $\rightarrow$ go to 1

Inside the triangle. $\rightarrow$ go to 5

Find the largest angle. Compare it with a right angle.

8

Triangle VWX has a right angle at X. Where is its orthocenter?

At corner X. $\rightarrow$ go to 3

Inside the triangle. $\rightarrow$ go to 5

Where do the two legs meet?

Write each box number as you reach it:

--	--	--	--	--	--	--	--	--



135 free geometry lessons
chooseyourlesson.com

The route, in order. Boxes 2 and 5 are not on it. A student reaches them only by a wrong answer. They are the last two rows of the table.

4 → 7 → 1 → 8 → 3 → 6 → out

	Box	Right answer, and why	Wrong answer, and why a student picks it
1	Box 4	42 The altitude meets BC at a right angle, so it is the height for base BC. Area = $12 \times 7 \div 2 = 42$. The median goes to the middle of BC and is not the height.	“54” goes to box 2. A student who uses the median, 9, as the height picks this.
2	Box 7	Outside the triangle. The 110° angle is obtuse, so the triangle is obtuse. The altitudes of an obtuse triangle (carried on as lines) meet outside it.	“Inside the triangle.” goes to box 5. A student who thinks every center of a triangle is inside it picks this.
3	Box 1	8 Area = base $\times$ height $\div 2$, so height = $2 \times$ area $\div$ base = $2 \times 60 \div 15 = 8$.	“4” goes to box 2. A student who divides 60 by 15 and forgets the 2 picks this.
4	Box 8	At corner X. In a right triangle the two legs are altitudes: each one meets the other leg at a right angle. They meet at the right-angle corner, X. So the orthocenter is X.	“Inside the triangle.” goes to box 5. A student who thinks an altitude cannot be a side, or that the point must be inside, picks this.
5	Box 3	90 The altitude from J meets KL at a right angle, so it is the height for base KL. Area = $20 \times 9 \div 2 = 90$. JK is a slanted side, not the height.	“150” goes to box 2. A student who uses the slanted side JK as the height picks this.
6	Box 6	It meets the line past B. Angle B is obtuse, so the foot of the altitude from A lands on the line through B and C, beyond B. Every triangle has an altitude to every side.	“Nowhere. There is no altitude to BC.” goes to box 5. A student who believes an altitude must stay inside the triangle picks this.
	Box 2	12 Area = $18 \times 8 \div 2 = 72$. With base PR = 12, the height is $2 \times 72 \div 12 = 12$. Each base has its own height.	“8” goes to box 4. A student who uses the same height for every base picks this.
	Box 5	(4, 2) BC is horizontal, so the altitude from A is the vertical line through A, $x = 4$. It meets BC at (4, 2). The point (6, 2) is the middle of BC.	“(6, 2)” goes to box 7. A student who goes to the middle of BC, as a median does, picks this.

How to check any box. For an area or a height: find the segment that meets the base at a right angle. That one is the height for that base, and area = base $\times$ height $\div 2$. For a place: find the largest angle. Less than 90° means the altitudes meet inside, exactly 90° means at the right-angle corner, and more than 90° means outside.

A student can find the last four boxes of the route by following the arrows backward from “you are out.” So ask a student with a clean row to explain one box.