

SCAVENGER HUNT



ALTITUDES AND THE ORTHOCENTER

Which Length Is the Height?

Areas, heights and coordinates · the cards check the answers

FREE

ANSWER

24

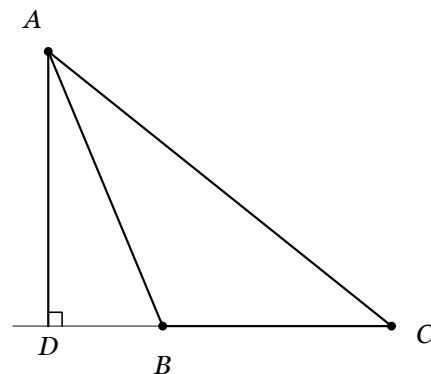
$$BC = 10$$

$$AB = 13$$

$$AD = 12$$

Find the area of $\triangle ABC$.

The height for a base is the segment with the square on that base.



H

chooseyourlesson.com

Scavenger Hunt — how to run it

a full class period

1. **Tape the 16 cards around the room**, in any order. Each card has a large letter in its bottom left corner. Start each group at a *different* one of these eight cards: *H F B D Q L G P*.
2. **Say this once:** “*The height for a base is the altitude to that base. It meets the base at a right angle. Area is base times height, divided by 2. Eight right answers bring you back to your first card.*”
3. **Each group finds the number, then walks to the card with that number at the top.** Nothing else is needed.

16 cards	pages 3–10, one copy. There are two cards on each sheet. Cut the whole stack once.
Record sheet	page 11, one per student. It shows, as small drawings, an altitude in an acute, an obtuse and a right triangle, and a median.
Answers	pages 12–13, for you only. Do not put them up in the room.

Every card asks for a number that an altitude decides. On two ring cards, the base, the height and one more length are given, and the student finds the area. The extra length is a slanted side or a median. It is not the height, because it does not meet the base at a right angle. On two, the area and the base are given, and the student finds the height: $2 \times \text{area} \div \text{base}$. On two, two sides and the height to one of them are given, and the student finds the height to the other side. The area is the same whichever side is the base. On two, one side is horizontal. The altitude to it is a vertical line through the opposite corner, so the orthocenter has that corner's x-coordinate.

Eight of the sixteen cards make the ring. A group reaches the other eight only by a wrong answer, but all the cards look the same. Each ring card has one common mistake: using a slanted side or a median as the height, forgetting the 2, using the same height for a different base, or taking the middle of a side instead of the foot of the altitude. That mistake gives the number at the top of a card off the ring. The group does that card, and its answer sends the group back to the card it got wrong. If the group goes wrong there too, it goes one more card back and still does not reach the ring.

The check is the length of the group's list. A clean run is **eight lines**. Each wrong answer adds two. Every card has a line in small type under the question. It tells a group that arrived by a wrong answer what to check. A group that arrived by a right answer skips it. If a group keeps coming back to the same cards, do not give the answer. Ask: “*Which segment has the right-angle square on this base?*”



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.

ANSWER

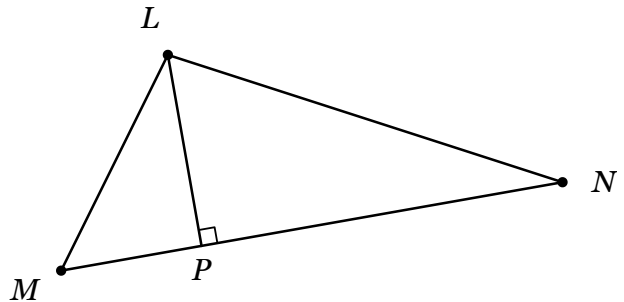
9

The area of $\triangle LMN$ is 84.

$MN = 21$

Find LP.

An altitude does not go to the middle of a side. It meets the side at a right angle.



A

chooseyourlesson.com

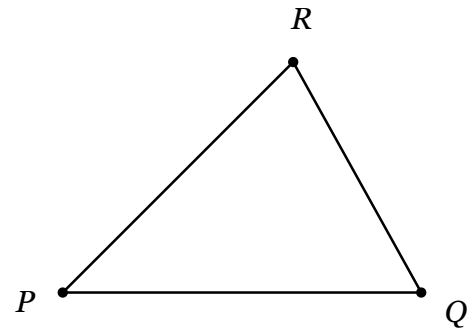
ANSWER

8

P(2, 3), Q(16, 3), R(11, 12)

What is the x-coordinate of the orthocenter of $\triangle PQR$?

An altitude to a horizontal side is a vertical line. Which corner is it from?



B

chooseyourlesson.com

ANSWER

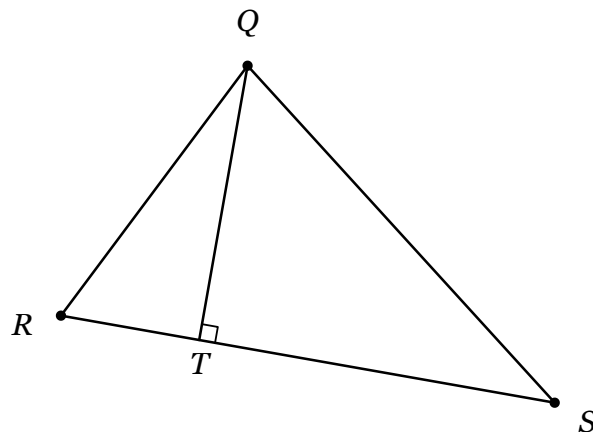
7

The area of $\triangle QRS$ is 90.

$RS = 18$

Find QT.

The foot of an altitude is often not the midpoint of the side.



C

chooseyourlesson.com

ANSWER

11

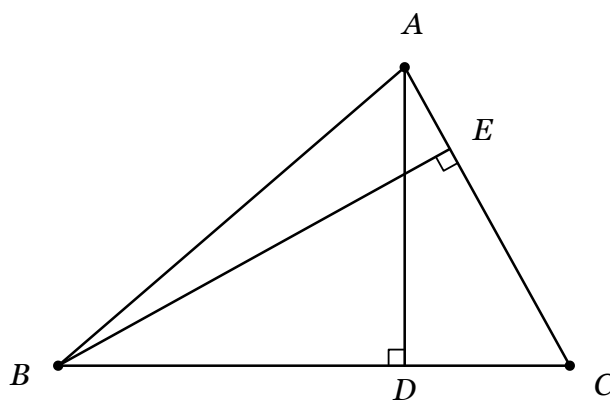
$BC = 24$

$CA = 16$

$AD = 14$

Find BE.

Each base has its own height. Find the area first, then use the other base.



D

chooseyourlesson.com

ANSWER

5

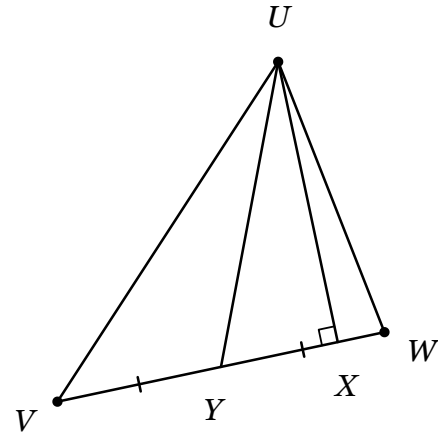
$$VW = 14$$

$$UY = 13$$

$$UX = 12$$

Find the area of $\triangle UVW$.

Is your answer half as big as it should be? Look for the 2.



E

chooseyourlesson.com

ANSWER

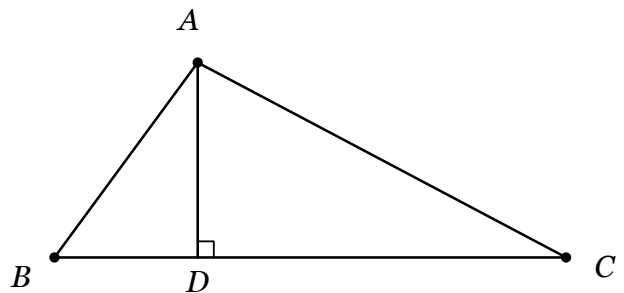
60

The area of $\triangle ABC$ is 84.

$$BC = 21$$

Find AD.

Area is half of base times height. Which of the three is missing?



F

chooseyourlesson.com

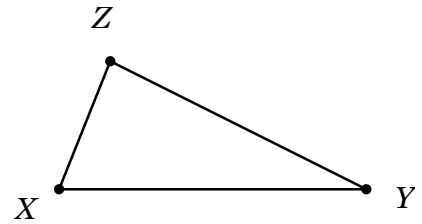
ANSWER

10

$X(1, 3), Y(13, 3), Z(3, 8)$

What is the x-coordinate of the orthocenter of $\triangle XYZ$?

Sketch the triangle. Where is the corner across from the horizontal side?



G

chooseyourlesson.com

ANSWER

24

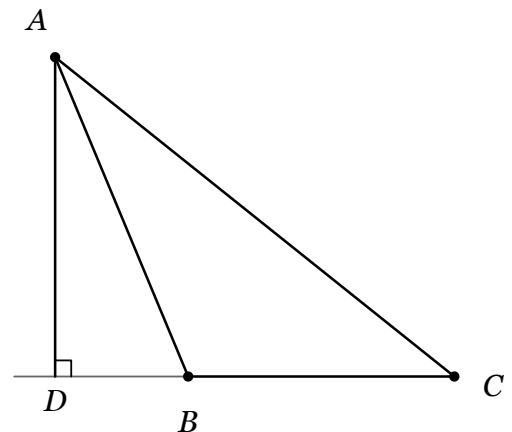
$BC = 10$

$AB = 13$

$AD = 12$

Find the area of $\triangle ABC$.

The height for a base is the segment with the square on that base.



H

chooseyourlesson.com

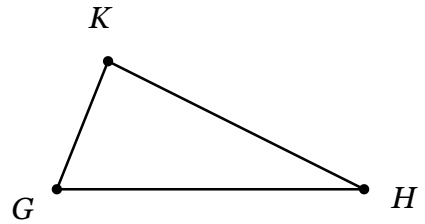
ANSWER

12

$G(1, 3)$, $H(13, 3)$, $K(3, 8)$

What is the x-coordinate of the orthocenter of $\triangle GHK$?

Each height goes with one base. Which base does your height meet?



J

chooseyourlesson.com

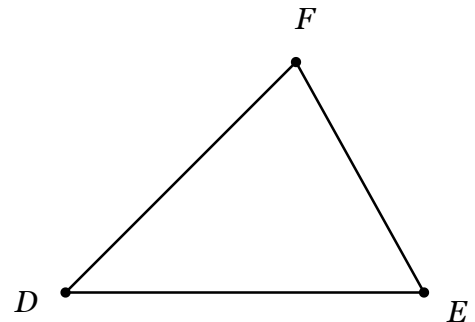
ANSWER

14

$D(2, 3)$, $E(16, 3)$, $F(11, 12)$

What is the x-coordinate of the orthocenter of $\triangle DEF$?

A new base needs a new height. The area is the same for both.



K

chooseyourlesson.com

ANSWER

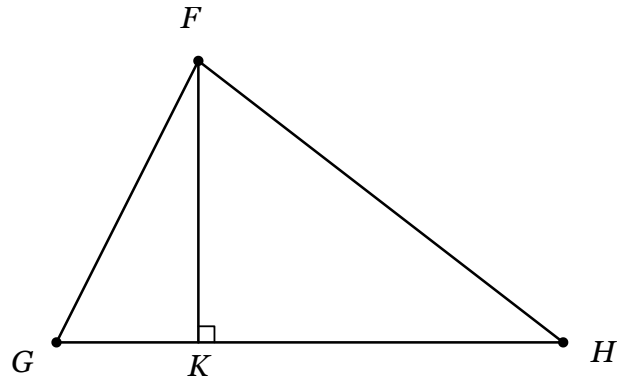
84

The area of $\triangle FGH$ is 90.

$GH = 18$

Find FK.

Two times the area, then divide by the base. Check the order of the steps.



L

chooseyourlesson.com

ANSWER

65

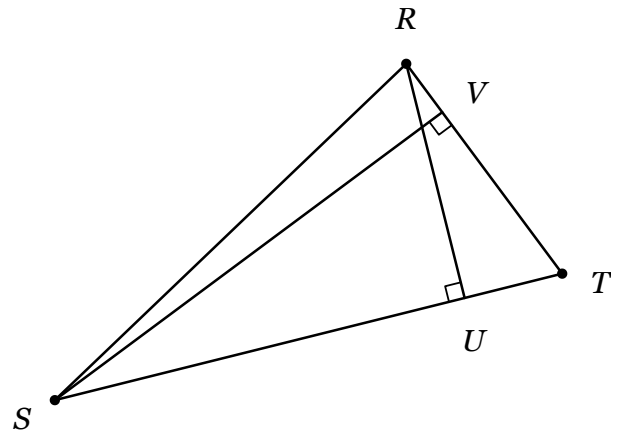
$ST = 26$

$TR = 13$

$RU = 12$

Find SV.

A slanting side is not the height. The height meets the base at a right angle.



M

chooseyourlesson.com

ANSWER

91

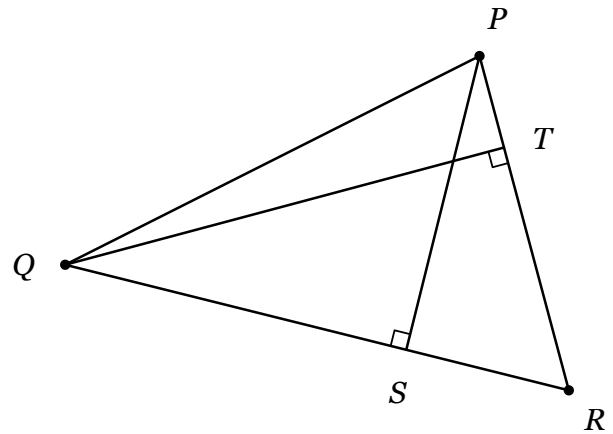
$$QR = 24$$

$$RP = 16$$

$$PS = 14$$

Find QT.

A segment to the middle of a side is a median. Is it the height?



N

chooseyourlesson.com

ANSWER

3

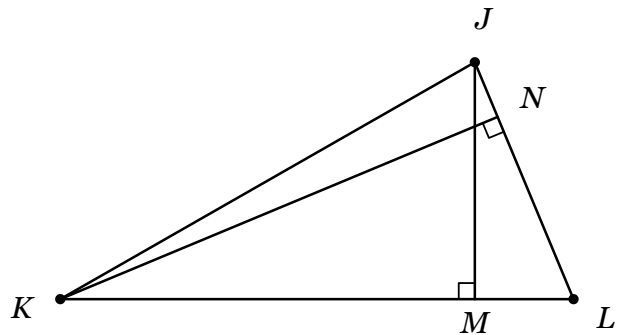
$$KL = 26$$

$$LJ = 13$$

$$JM = 12$$

Find KN.

Does your height meet this base at a right angle?



P

chooseyourlesson.com

ANSWER

21

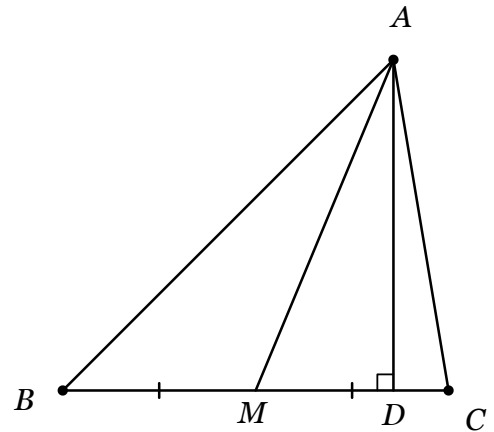
$$BC = 14$$

$$AM = 13$$

$$AD = 12$$

Find the area of $\triangle ABC$.

Which segment meets the base at a right angle? Only that one is the height.



chooseyourlesson.com

Q

ANSWER

4

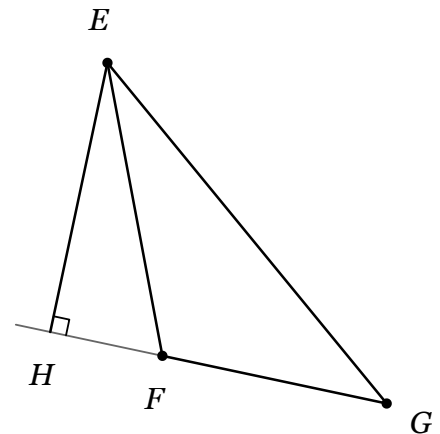
$$FG = 10$$

$$EF = 13$$

$$EH = 12$$

Find the area of $\triangle EFG$.

Height = $2 \times \text{area} \div \text{base}$. Is the 2 in your work?



chooseyourlesson.com

R

Scavenger Hunt — where I went

Altitudes and heights

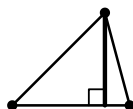
Name _____

Period _____

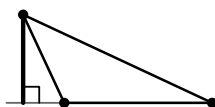
Date _____

Do the card you are at. Fill in one line. Then find the card with your answer at the top. A clean run is eight lines. Each card has a line in small type under the question. **If you are on a card because you went wrong, its line says what to check. If you were right, skip it.**

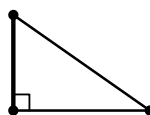
An **altitude** is a segment from a corner to the line of the opposite side. The right-angle square shows it meets that line at a right angle. In each drawing below, the thick segment is the one named.



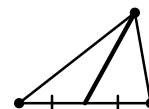
An **altitude** goes from a corner and meets the opposite side at a right angle.



It may meet the **line** of the side, outside the triangle (dashed).



In a right triangle, a **leg** is an altitude.



A **median** goes to the middle of the side (ticks). It is not an altitude.

Card letter

My work

My answer

1

2

3

4

5

6

7

8

9

10

How does an altitude always meet the opposite side?

Every number stands for a letter. Write the letter for each of your answers in the box above that number. Leave the other boxes empty. Then read the boxes you filled, left to right. **If they do not spell a word, one answer is wrong.**

3 = S 4 = Y 5 = L 7 = Q 8 = Q 9 = S 10 = U 11 = A 12 = A 14 = U 21 = R 24 = E 60 = L 65 = R 84 = Y 91 = E

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

3

4

5

7

8

9

10

11

12

14

21

24

60

65

84

91



135 free geometry lessons — worksheets, worked answers and lesson plans.
chooseyourlesson.com

Scavenger Hunt — answers

For the teacher

The ring in order. A group may begin anywhere on it. Wherever it begins, eight right answers bring it back to that card.

H → F → B → D → Q → L → G → P → H

How does an altitude always meet the opposite side? The answer is *SQUARELY*. The ring's answers, in the order of the boxes on the record sheet (smallest number first), with their letters: **3 S • 8 Q • 10 U • 11 A • 21 R • 24 E • 60 L • 84 Y**.

	Card	The card	Answer, and why	The common wrong answer	Joke letter for the number at its top
1	H	BC = 10 AB = 13 AD = 12 Find the area of $\triangle ABC$.	60. AD has the right-angle square on BC, so it is the height for base BC. Area = $10 \times 12 \div 2 = 60$. AB is a slanted side, not the height.	65, from using the slanted side as the height	E
2	F	The area of $\triangle ABC$ is 84. BC = 21 Find AD.	8. Area = base $\times$ height $\div 2$, so height = $2 \times \text{area} \div \text{base} = 2 \times 84 \div 21 = 8$.	4, from dividing the area by the base and forgetting the 2	L
3	B	P(2, 3), Q(16, 3), R(11, 12) What is the x-coordinate of the orthocenter of $\triangle PQR$?	11. PQ is horizontal (both y-coordinates are 3). The altitude from R is the vertical line $x = 11$, and the orthocenter is on it. So its x-coordinate is 11.	9, from taking the middle of the horizontal side instead of the foot of the altitude	Q
4	D	BC = 24 CA = 16 AD = 14 Find BE.	21. AD has the square on BC, so area = $24 \times 14 \div 2 = 168$. BE has the square on CA, so it is the height for base CA = 16: $BE = 2 \times 168 \div 16 = 21$.	14, from copying the given height, as if every base had the same height	A
5	Q	BC = 14 AM = 13 AD = 12 Find the area of $\triangle ABC$.	84. AD has the right-angle square on BC, so it is the height. Area = $14 \times 12 \div 2 = 84$. AM goes to the middle of BC (the ticks), so it is the median.	91, from using the median as the height	R
6	L	The area of $\triangle FGH$ is 90. GH = 18 Find FK.	10. Area = base $\times$ height $\div 2$, so height = $2 \times \text{area} \div \text{base} = 2 \times 90 \div 18 = 10$.	5, from dividing the area by the base and forgetting the 2	Y
7	G	X(1, 3), Y(13, 3), Z(3, 8) What is the x-coordinate of the orthocenter of $\triangle XYZ$?	3. XY is horizontal (both y-coordinates are 3). The altitude from Z is the vertical line $x = 3$, and the orthocenter is on it. So its x-coordinate is 3.	7, from taking the middle of the horizontal side instead of the foot of the altitude	U
8	P	KL = 26 LJ = 13 JM = 12 Find KN.	24. JM has the square on KL, so area = $26 \times 12 \div 2 = 156$. KN has the square on LJ, so it is the height for base LJ = 13: $KN = 2 \times 156 \div 13 = 24$.	12, from copying the given height, as if every base had the same height	S

Each wrong answer in the table is the number at the top of a card off the ring. Those cards are on the next page.

Scavenger Hunt — the cards off the ring

For the teacher

A group reaches these eight cards only by a wrong answer. The number at the top of each one is the wrong answer from one ring card. Its right answer is the number at the top of that ring card, so the group goes back to the card it got wrong. If the group makes the same kind of mistake there, it goes to another card off the ring. So a second wrong answer never moves a group forward.

Card	The card	Answer, and why	The common wrong answer	Joke letter for the number at its top
M	ST = 26 TR = 13 RU = 12 Find SV.	24. RU has the square on ST, so area = $26 \times 12 \div 2 = 156$. SV has the square on TR, so it is the height for base TR = 13: $SV = 2 \times 156 \div 13 = 24$.	12, from copying the given height, as if every base had the same height	R
R	FG = 10 EF = 13 EH = 12 Find the area of $\triangle EFG$.	60. EH has the right-angle square on FG, so it is the height for base FG. Area = $10 \times 12 \div 2 = 60$. EF is a slanted side, not the height.	65, from using the slanted side as the height	Y
A	The area of $\triangle LMN$ is 84. MN = 21 Find LP.	8. Area = base $\times$ height $\div 2$, so height = $2 \times \text{area} \div \text{base} = 2 \times 84 \div 21 = 8$.	4, from dividing the area by the base and forgetting the 2	S
K	D(2, 3), E(16, 3), F(11, 12) What is the x-coordinate of the orthocenter of $\triangle DEF$?	11. DE is horizontal (both y-coordinates are 3). The altitude from F is the vertical line $x = 11$, and the orthocenter is on it. So its x-coordinate is 11.	9, from taking the middle of the horizontal side instead of the foot of the altitude	U
N	QR = 24 RP = 16 PS = 14 Find QT.	21. PS has the square on QR, so area = $24 \times 14 \div 2 = 168$. QT has the square on RP, so it is the height for base RP = 16: $QT = 2 \times 168 \div 16 = 21$.	14, from copying the given height, as if every base had the same height	E
E	VW = 14 UY = 13 UX = 12 Find the area of $\triangle UVW$.	84. UX has the right-angle square on VW, so it is the height. Area = $14 \times 12 \div 2 = 84$. UY goes to the middle of VW (the ticks), so it is the median.	91, from using the median as the height	L
C	The area of $\triangle QRS$ is 90. RS = 18 Find QT.	10. Area = base $\times$ height $\div 2$, so height = $2 \times \text{area} \div \text{base} = 2 \times 90 \div 18 = 10$.	5, from dividing the area by the base and forgetting the 2	Q
J	G(1, 3), H(13, 3), K(3, 8) What is the x-coordinate of the orthocenter of $\triangle GHK$?	3. GH is horizontal (both y-coordinates are 3). The altitude from K is the vertical line $x = 3$, and the orthocenter is on it. So its x-coordinate is 3.	7, from taking the middle of the horizontal side instead of the foot of the altitude	A

Other mistakes lead to no ring card. For example, a group might forget to halve base $\times$ height, stop at the area, or use the x-coordinate of a corner on the horizontal side. Its answer is then not the number at the top of any ring card.

Guessing does not work. Every simple rule that uses only the printed numbers, such as copying the first number, answers at most two of the sixteen cards correctly.