

CUT & GLUE SORT

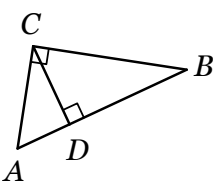
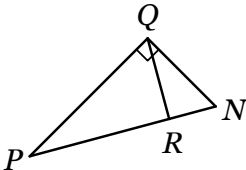
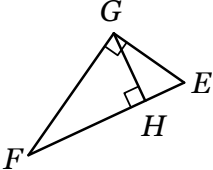
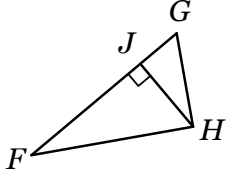


GEOMETRIC MEAN AND THE ALTITUDE TO THE HYPOTENUSE

Which Rule Finds the Length?

The altitude rule, a leg rule, or neither · decide before computing

FREE

1  AD and DB are known. Which rule finds CD?	2  NR and RP are known. Which rule finds QR?	3  EH and EF are known. Which rule finds EG?	4  FJ and JG are known. Which rule finds HJ?
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1. **Hand out pages 3 and 4**, one of each per student, with scissors and glue. Nothing else is needed.
2. **Say this once:** *“Do not compute anything. Find the altitude and the two pieces in each drawing. Then decide which rule finds the length asked for. If a right-angle square is missing, neither rule works.”*
3. **Check a sheet in ten seconds:** every row gets four pieces.

Student sheets	pages 3 and 4, one of each per student. Page 3 shows the two rules as two small drawings.
Answers	page 5.

The sheet practices one decision: which rule applies. In a right triangle, the altitude from the right angle cuts the hypotenuse into two pieces. The altitude rule: the altitude squared is one piece times the other. The leg rule: a leg squared is its own piece (the piece that touches the same end of the hypotenuse) times the whole hypotenuse. A length found from the altitude and the pieces uses the altitude rule. A length found from a leg uses the leg rule.

The leg row holds the most common wrong choice. In piece 6 the two pieces are known and a leg is asked. Students see two pieces and reach for the altitude rule. The leg rule is the right one: the two pieces are added to give the whole hypotenuse first.

The last row is the most important. Both rules are true only for the altitude from a right angle. In two pieces there is no square where the segment meets the side, so nothing says it is the altitude. In two pieces there is no square at the corner, so nothing says the triangle has a right angle there. These pieces are drawn looking square on purpose: a drawing is not a measurement. A student who counts the squares and then picks the altitude rule whenever two pieces are known gets nine of the twelve right. Other guessing rules place at most six pieces correctly.



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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Which rule finds the length?

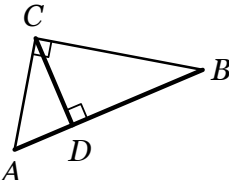
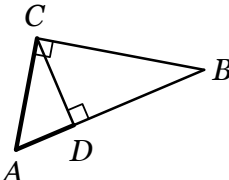
The altitude to the hypotenuse

Name _____

Period _____

Date _____

Cut out the twelve pieces on the next page. Each piece shows a triangle with a segment drawn from one corner. It names two known lengths and one length to find. **Decide which rule finds that length. Glue the piece in that row.** Do not compute anything.

 Altitude rule. The altitude squared is one piece times the other piece. $CD^2 = AD \cdot DB$, so $\frac{AD}{CD} = \frac{CD}{DB}$	 Leg rule. A leg squared is its own piece times the whole hypotenuse. $AC^2 = AD \cdot AB$, so $\frac{AD}{AC} = \frac{AC}{AB}$
The altitude CD goes from the right angle to the hypotenuse AB. It cuts AB into two pieces, AD and DB. $AD + DB = AB$. A leg's own piece is the piece that touches the same end of the hypotenuse: AD for the leg AC, DB for the leg BC.	

Both rules need two right-angle squares: one at the corner the segment starts from, and one where it meets the hypotenuse. **Only the squares count.** A corner that only looks square does not count.

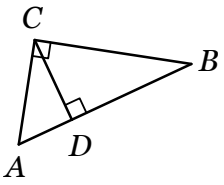
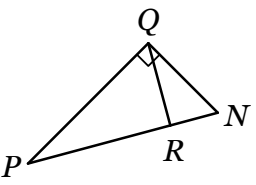
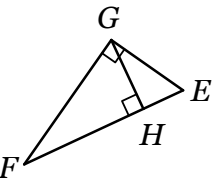
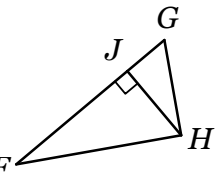
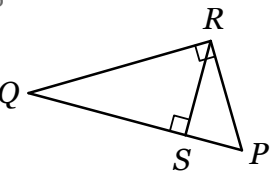
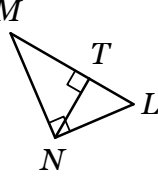
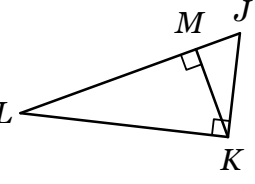
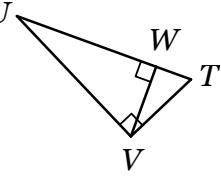
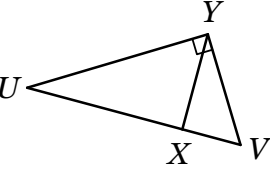
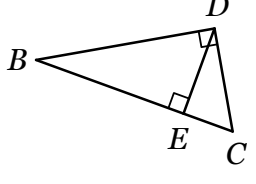
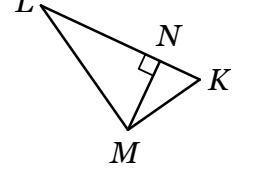
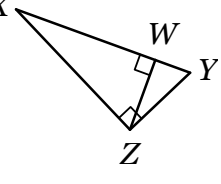
The altitude rule: the altitude squared is one piece times the other piece.

A leg rule: a leg squared is its own piece times the whole hypotenuse.

Neither rule: a right-angle square is missing, at the corner or where the segment meets the side.

The twelve pieces

Cut along the dotted lines

1  AD and DB are known. Which rule finds CD?	2  NR and RP are known. Which rule finds QR?	3  EH and EF are known. Which rule finds EG?	4  FJ and JG are known. Which rule finds HJ?
5  RS and PS are known. Which rule finds SQ?	6  LT and TM are known. Which rule finds LN?	7  KM and ML are known. Which rule finds JM?	8  TV and TU are known. Which rule finds TW?
9  UY and UV are known. Which rule finds UX?	10  CD and EC are known. Which rule finds BC?	11  KN and KL are known. Which rule finds KM?	12  XW and WY are known. Which rule finds ZW?



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Cut & Glue Sort — answers

For the teacher

Altitude rule	1 · AD and DB are known. Which rule finds CD? CD is the altitude, and AD and DB are the two pieces. AD and DB are known, so $CD^2 = AD \cdot DB$ gives CD.	5 · RS and PS are known. Which rule finds SQ? RS is the altitude, and PS and SQ are the two pieces. RS and PS are known, so $RS^2 = PS \cdot SQ$ gives SQ.	7 · KM and ML are known. Which rule finds JM? KM is the altitude, and JM and ML are the two pieces. KM and ML are known, so $KM^2 = JM \cdot ML$ gives JM.	12 · XW and WY are known. Which rule finds ZW? ZW is the altitude, and XW and WY are the two pieces. XW and WY are known, so $ZW^2 = XW \cdot WY$ gives ZW.
Leg rule	3 · EH and EF are known. Which rule finds EG? EG is a leg, and its own piece is EH. EF is the whole hypotenuse, not a piece of it. $EG^2 = EH \cdot EF$ gives EG.	6 · LT and TM are known. Which rule finds LN? LN is a leg, and its own piece is LT. The whole hypotenuse is LT + TM. $LN^2 = LT \cdot LM$ gives LN.	8 · TV and TU are known. Which rule finds TW? TV is a leg, and its own piece is TW. TU is the whole hypotenuse, not a piece of it. $TV^2 = TW \cdot TU$ gives TW.	10 · CD and EC are known. Which rule finds BC? CD is a leg, and its own piece is EC. BC is the whole hypotenuse, not a piece of it. $CD^2 = EC \cdot BC$ gives BC.
Neither rule	2 · NR and RP are known. Which rule finds QR? No square at R: nothing says QR is perpendicular to NP, so QR may not be the altitude. It looks square, but a drawing is not a measurement. NR and RP do not fix QR.	4 · FJ and JG are known. Which rule finds HJ? No square at H: nothing says the angle at H is a right angle. It looks square, but a drawing is not a measurement. Both rules need a right angle there, and FJ and JG do not fix HJ.	9 · UY and UV are known. Which rule finds UX? No square at X: nothing says YX is perpendicular to UV, so YX may not be the altitude. It looks square, but a drawing is not a measurement. UY and UV do not fix UX.	11 · KN and KL are known. Which rule finds KM? No square at M: nothing says the angle at M is a right angle. It looks square, but a drawing is not a measurement. Both rules need a right angle there, and KN and KL do not fix KM.

Every row holds four pieces. A piece goes in the altitude row when the altitude and the two pieces are the three lengths involved. It goes in the leg row when a leg is one of them, with its own piece and the whole hypotenuse. It goes in the last row when a right-angle square is missing, at the corner or where the segment meets the side.

To check a piece with a student, ask: “Where are the two squares? Which segment is the altitude? Is the asked length the altitude, a piece, a leg, or the hypotenuse?”