

Cluster 8.7: Expressions, Equations, and Relationships

8.7C: Geometry and Formulas: Laptop Stand

Focusing TEKS

8.7C Expressions, Equations, and Relationships. The student applies mathematical process standards to use geometry to solve problems. The student is expected to use the Pythagorean Theorem and its converse to solve problems. **Readiness Standard**

Additional TEKS:

8.2B Approximate the value of an irrational number, including π and square roots of numbers less than 225, and locate that rational number approximation on a number line. **Supporting Standard**

7.11A Model and solve one-variable, two-step equations and inequalities. **Readiness Standard**

Focusing Mathematical Process

8.1A Apply mathematics to problems arising in everyday life, society, and the workplace.

8.1B Use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution.

8.1E Create and use representations to organize, record, and communicate mathematical ideas.

▲ Performance Task

Doug has a laptop stand with a fan inside to keep the laptop cool when it is on his desk. The laptop fits perfectly on the top of the stand. The side of the stand forms a right angle as shown in the sketch below.



The stand is 1.5 inches high putting the laptop on a slight incline. The laptop is 9.5 inches long from top to bottom. About how deep from front to back is the bottom of the laptop stand that sits along the desk's surface? Justify your reasoning.

Answer: About 9 inches deep, since $\sqrt{88} \approx 9.4$.

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Mathematically Speaking...

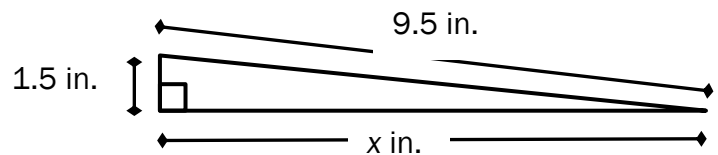
In this task, students apply the Pythagorean Theorem to solve a problem involving a laptop stand. The stand height and laptop length are provided. Students will represent the situation and determine which measurements relate to each side of the right triangle. Students need to not only understand how the parts of the triangle relate to the Pythagorean Theorem formula, but also to be able to work backwards through the formula when given the hypotenuse and one of the legs rather than both legs.



Prior to solving this task, students should have familiarity with square numbers and finding square roots. These are necessary skills to use in solving problems related to the Pythagorean Theorem. In addition, this problem asks students to also approximate the value of a square root that is not a perfect square, which is another concept built early in the grade 8 expectations.

Possible Solution

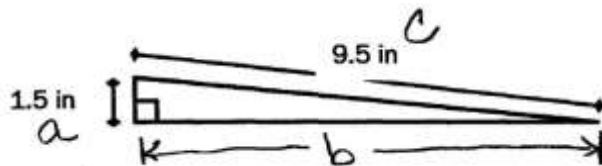
The stand forms a right angle with the desk. Use a drawing to represent the problem and the given measurements.



Since the problem asks for a missing side measurement in a right triangle, the problem can be solved using the Pythagorean Theorem.

The Pythagorean Theorem is $a^2 + b^2 = c^2$ where a and b represent the legs of the right triangle and c represents the hypotenuse.

In this case, the information in the problem gives the height of the triangle, which is one leg. Label this side of the triangle side a . The problem also gives the hypotenuse of the triangle using the incline edge. Label the hypotenuse side c . Label the missing side, the depth of the stand, as side b .



Since the measures of one leg and the hypotenuse are provided in the problem, the Pythagorean equation should be rearranged to find the missing leg measurement. This is done by subtracting the square of the known leg from the square of the hypotenuse to find the square of the missing leg, which will be the depth of the laptop stand.

$$a^2 + b^2 = c^2$$

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$$a^2 - a^2 + b^2 = c^2 - a^2$$

$$c^2 - a^2 = b^2$$

In this case, the problem to solve is $9.5^2 - 1.5^2 = b^2$

$$9.5^2 = 9.5 \times 9.5 = 90.25$$

$$1.5^2 = 1.5 \times 1.5 = 2.25$$

$$90.25 - 2.25 = b^2$$

$$b^2 = 88$$

Since $b^2 = 88$, find the square root of b in order to find the depth of the stand. The number 88 is not a perfect square, meaning there is not a whole number that when squared (multiplied times itself) results in 88. Therefore, determine the approximate value of $\sqrt{88}$.

A calculator can be used to determine the approximate square root of 88. The answer from the calculator is 9.38083152. Since the problem uses the word “about” in the question, a rounded approximate answer is appropriate.

The depth of the laptop stand is closest to, or about, 9.4 inches or 9 inches.

Reasonableness



The square of the number 9 is 81, because $9 \times 9 = 81$. The value 81 is a little smaller than the target of $\sqrt{88}$.

The square of the number 10 is 100, because $10 \times 10 = 100$. The value 100 is a little more than the target of $\sqrt{88}$.

This means the value of $\sqrt{88}$ is between 9 and 10 on the number line. Since 88 is closer to 81 than it is to 100, the closest whole number is 9. A more specific approximation can also be estimated as needed.

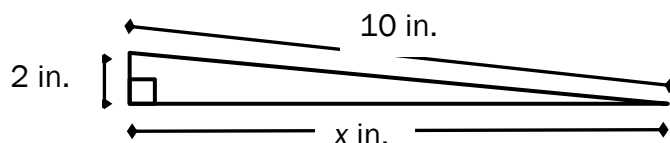
Look For...

- a drawing or representation of the problem with given measurements
- the use of the Pythagorean theorem applied in the solution
- appropriate strategy to approximate the square root of 88 as the solution
- an approximate answer about 9 inches or in the accepted range (about 9.4)
- student justification of choices of solution strategy

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● Differentiation: Simplified Task

Doug has a laptop stand with a fan inside to keep the laptop cool when it is on his desk. The laptop fits perfectly on the top of the stand. The side of the stand forms a right angle as shown in the sketch below.



The stand is 2 inches high at the back so that it puts the laptop on a slight incline. The laptop rests along the incline, which is 10 inches long. About how deep from front to back is the bottom of the laptop stand that sits along the desk's surface? Give your answer to the nearest whole number and justify your reasoning.

Answer: About 10 inches deep ($\sqrt{96} \approx 9.8$)

■ Differentiation: Enriching Task

Doug has a laptop stand with a fan inside to keep the laptop cool when it is on his desk. The laptop fits perfectly on the top of the stand. The side of the stand forms a right angle as shown in the sketch below.



The stand is 1.5 inches high putting the laptop on a slight incline. The laptop is 9.5 inches long from top to bottom. About how deep from front to back is the bottom of the laptop stand that sits along the desk's surface?

If the width of the laptop stand is 9 inches across, how much area does the laptop stand cover on the desk's surface? Justify your reasoning.

Answer: About 9 inches deep ($\sqrt{88} \approx 9.4$). The area would be 9.4 in. \times 9 in. or about 84.6 in².

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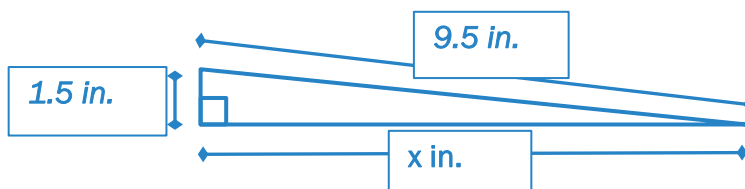
Scaffolded Task with Answers

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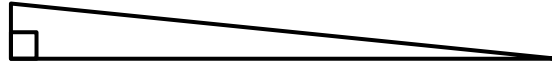
1. Use the information in the problem to label the drawing for the stand including measurements.



2. What formula can be used to find the missing side length?
The Pythagorean theorem: $a^2 + b^2 = c^2$
3. Identify which variables in the formula represent each of the measurements given in the problem. Write the equation to be solved.
 $1.5^2 + x^2 = 9.5^2$
4. Use an appropriate strategy to solve for the missing side length.
 $1.5^2 + x^2 = 9.5^2$
 $2.25 + x^2 = 90.25$
 $2.25 - 2.25 + x^2 = 90.25 - 2.25$
 $x^2 = 88$
 $x = \sqrt{88}$
 $x \approx 9.4$
5. About how deep is the bottom of the laptop stand?
About 9.4 inches

Performance Task: 8.7C
Geometry and Formulas: Laptop Stand

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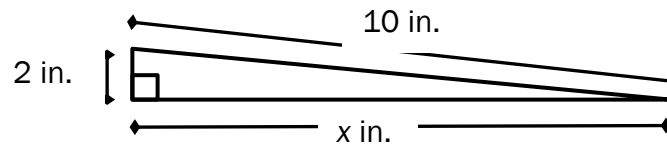
Procedural	0	1	2
Conceptual	0	1	2
Communication	0	1	2

Total points: _____



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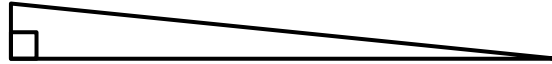
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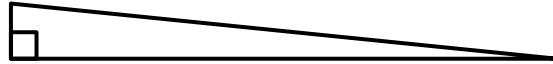
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2. What formula can be used to find the missing side length?
3. Identify which variables in the formula represent each of the measurements given in the problem. Write the equation to be solved.
4. Use an appropriate strategy to solve for the missing side length.
5. About how deep is the bottom of the laptop stand?

