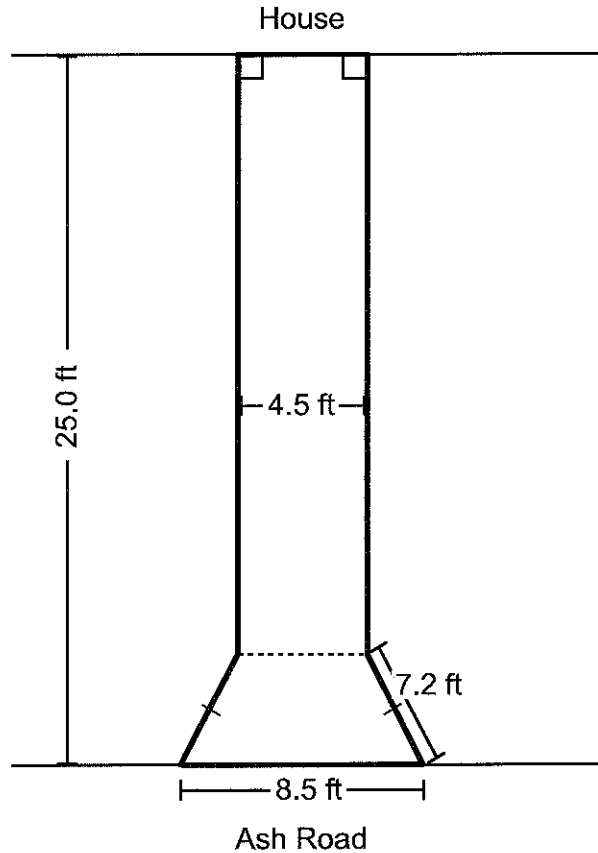


Ms. Olsen's Sidewalk

Geometry and Measurement

2. Ms. Olsen is having a new house built on Ash Road. She is designing a sidewalk from Ash Road to her front door. Ms. Olsen wants the sidewalk to have an end in the shape of an isosceles trapezoid, as shown below.



The contractor charges a fee of \$200 plus \$12 per square foot of sidewalk. Based on the diagram, what will the contractor charge Ms. Olsen for her sidewalk? Show your work or explain how you found your answer.

Remember to show your work and write your answer in your answer booklet.

Rubric for *Ms. Olsen's Sidewalk*

Sample Solution:

The height, h , of the isosceles trapezoid forms a right triangle with the base and one of the slanted sides.

The height of the trapezoid can be found using the Pythagorean Theorem as follows:

$$h = \sqrt{7.2^2 - 2.0^2} = \sqrt{47.84} \approx 6.9166 \approx 6.9 \text{ feet.}$$

The formula for the area of a trapezoid is:

$$A = \frac{h(b_1 + b_2)}{2}$$

Therefore:

$$A = \frac{6.9(8.5 + 4.5)}{2} = 44.85 \text{ square feet.}$$

The length of the rectangular section is $25 - 6.9 = 18.1$ feet.

So, the area of the rectangular section is $A = 18.1(4.5) = 81.45$ square feet.

The total area of the sidewalk is

$$A = 44.85 + 81.45 = 126.30 \text{ square feet.}$$

(Accept 126–127 square feet.)

The contractor will charge

$$200 + \$12(126.30) = \$1,715.60$$

(Accept \$1,712–\$1,724.)

Note:

Using an incorrectly calculated value of $h = 6.0$ feet, $A = 39 + 85.5 = 124.5$ square feet, and the charge will be \$1,694.

Rubric for *Ms. Olsen's Sidewalk*

3-Point Rubric:

Score 3

The response contains:

- the correct contractor charge for the sidewalk with sufficient work or explanation.

The response may contain minor errors that do not detract from a demonstration of full understanding.

Score 2

The response may contain:

- the correct charge for the sidewalk with insufficient work or explanation
OR
- an incorrect (or correct) charge due to a significant error in an otherwise correct process, with sufficient work or explanation (example: using 7.2 for the height of the triangle or trapezoid when determining the area)
OR
- the correct area of the sidewalk with sufficient work or explanation.

Score 1

The response may contain:

- the correct height of the triangular section of the trapezoid
OR
- work or explanation that shows an understanding of the problem.

Score 0

The student has demonstrated merely an acquaintance with the topic. No evidence is present to suggest that the student has the ability to solve problems of this general type.

Scored Student Responses for Ms. Olsen's Sidewalk

Question 2: Ms. Olsen's Sidewalk

Score 3

The project will cost \$1716.08 for the construction of the sidewalk.

Show Calculations

$$\text{trapezoid} = A = \frac{1}{2}(b_1 + b_2)h$$

$$\frac{1}{2}(4.5 + 8.5)6.92$$

$$\frac{1}{2}(13)6.92$$

$$44.98 = A$$

$$\text{rectangle} = L \times W$$

$$25 - 6.92 = 18.08 = L$$

$$4.5 = W$$

$$18.08$$

$$\times 4.5$$

$$\hline 81.36$$

$$+ 44.98$$

$$\hline 126.34 \text{ sq. ft}$$

$$\times 12$$

$$\hline 1,516.08$$

$$\$200$$

$$\$1,516.08$$

$$\hline \$1,716.08$$

$$8.5 - 4.5 = 4/2 = 2$$

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

$$2^2 + b^2 = 7.2^2$$

$$4 + b^2 = 51.84$$

$$\hline -4 \quad -4$$

$$b^2 = 47.84$$

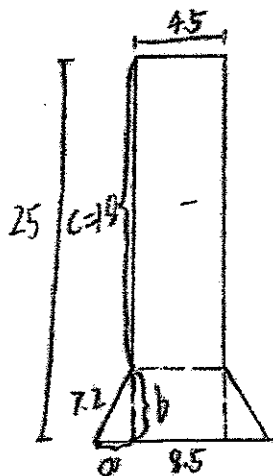
$$b = 6.92$$

The response demonstrates a full and complete understanding of the concepts and processes essential to the task. The student applies the Pythagorean Theorem to find the height of the trapezoid, which is used in the appropriate formula to find the area of the trapezoidal portion of the sidewalk. The student then correctly calculates the area of the rectangular portion of the sidewalk, finds the total area, multiplies by \$12, and adds \$200 to find the contractor's charge for the sidewalk.

Scored Student Responses for Ms. Olsen's Sidewalk

Question 2: Ms. Olsen's Sidewalk

Score 3



Show Calculations

$$12 \left[4.5(18) + \frac{4.5+8.5}{2} \cdot 7 \right] + 200 = 1718.5$$

$$a = \frac{8.5 - 4.5}{2} = 2.$$

$$b = \sqrt{7.2^2 - 2^2} \approx 7.$$

$$c = 25 - b = 18.$$

This response demonstrates a full and complete understanding of the concepts and processes essential to the task. The student correctly calculates the height of the trapezoid, which is rounded up to 7, and correctly determines the total area of the sidewalk. The total area is multiplied by \$12, and the contractor's fee of \$200 is added to find the total charge for the sidewalk. All work is clearly shown.

Scored Student Responses for Ms. Olsen's Sidewalk

Question 2: Ms. Olsen's Sidewalk

Score 2

Show Calculations



$$A = \frac{1}{2}(b_1 + b_2)h$$

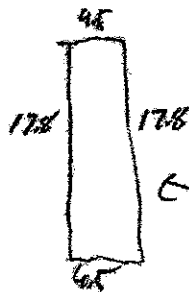
$$A = \frac{1}{2}(8.5 - 4.5)7.2$$

$$A = \frac{1}{2}(4)7.2$$

$$A = \frac{1}{2}(28.8)$$

$$A = 14.4$$

$$\begin{array}{r} 25 \\ -7.2 \\ \hline 17.8 \end{array}$$



$$17.8(4.5) = 80.1$$

$$A = 80.1$$

$$\begin{array}{r} 20.1 \\ + 4.4 \\ \hline \end{array}$$

$$89.5(12) = 1,074$$

$$+ 200$$

$$\boxed{\$1334}$$

The response demonstrates a reasonable understanding of the task. The student uses 7.2 for the height of the trapezoid, thus arriving at an incorrect area for the trapezoidal portion of the sidewalk. The student then applies a reasonable process, which includes a minor calculation error (subtracting 4.5 from 8.5 instead of adding), to find the total area of the sidewalk. The total area is correctly multiplied by \$12, and the contractor's fee is then added.

Scored Student Responses for Ms. Olsen's Sidewalk

Question 2: Ms. Olsen's Sidewalk

Score 2

I drew lines into the trapezoid to make the larger rectangle and found its area. ($b \cdot h = 28.0 \times 4.5 = 126 \text{ ft}^2$) That leaves me with two triangles remaining in the trapezoid. To find area ($\frac{1}{2}bh$) I first subtracted 4.5 from 8.5 to find the length of the Δ . Then by using Pythagorean theorem, I found the remaining side (height) and then found area. Then added both areas up to $\approx 126.5 \text{ ft}^2$

Show Calculations

$12 \times 200 = \text{price}$

Area of Rect. $4.5 \times 28 = \text{area} = 126 \text{ ft}^2$

Whole Sidewalk $126 + 14 \text{ ft}^2 = 140 \text{ ft}^2$

Area of Δ

$$2^2 + b^2 = 7.2^2$$

$$4 + b^2 = 51.84$$

$$-4$$

$$\sqrt{b^2} = 47.84$$

$b = 6.9$

$b \approx 7$ ← rounded

$$\frac{1}{2} (6.9)(2) = \frac{1}{2} (13.8) = 6.9$$

7 ft^2

total $\Delta = 14 \text{ ft}^2$

This response demonstrates a reasonable understanding of the task. The student correctly calculates the height of the triangular portion of the trapezoid, which is rounded up to 7, and correctly determines the total area of the sidewalk. Conversion to money to determine the contractor's fee, however, is not accounted for in the student's calculations.

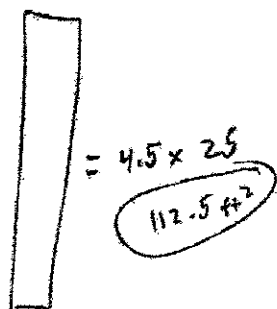
Scored Student Responses for Ms. Olsen's Sidewalk

Question 2: Ms. Olsen's Sidewalk

Score 1

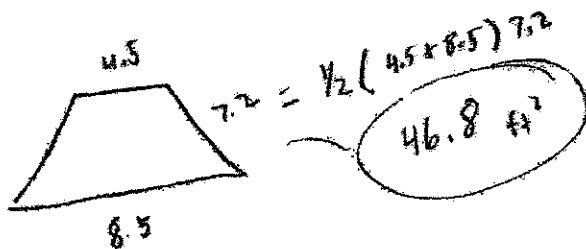
The Contractor will charge her 2111.6 dollars because
 it was 12 dollars per square foot plus 200 dollar fee.

Show Calculations



$$\begin{array}{r}
 112.5 \\
 + 46.8 \\
 \hline
 159.3
 \end{array}
 \quad
 \begin{array}{r}
 1911.6 \\
 + 200 \\
 \hline
 \$ 2111.6
 \end{array}$$

$\$ 200 + 12 = 159.3$



The response demonstrates a partial understanding of the task. The student uses 7.2 for the height of the trapezoid, thus arriving at an incorrect area for the trapezoid. The student then uses the entire length of the sidewalk to arrive at an incorrect area for the rectangle. The student correctly applies the incorrect areas for the trapezoid and rectangle to find a total area, multiplies by \$12, and adds the \$200 contractor's fee.

Scored Student Responses for Ms. Olsen's Sidewalk

Question 2: Ms. Olsen's Sidewalk

Score 1

The contractor will charge Ms. Olsen \$761.60 for her sidewalk because the contractor has a fee of \$200 no matter what the length is and Ms. Olsen had 46.8 square feet of sidewalk and I multiplied that by the \$12 that is charged per square foot and added the rate of \$200 to determine my answer of \$761.60.

Show Calculations

\$200

$$(12) 46.8 \text{ft}^2$$

$$\$561.6 + 200$$

$$\$761.60$$

Area
of
Trapezoid

$$A = \frac{1}{2} (b_1 + b_2) h$$

$$A = \frac{1}{2} (8.5 + 4.5) 7.2$$

$$A = \frac{1}{2} (93.6)$$

$$A = 46.8 \text{ft}^2$$

This response demonstrates a partial understanding of the task. The student provides an appropriate strategy for finding the area of the trapezoid; however, 7.2 is used for the height of the trapezoid. No attempt is made to find the area of the rectangle. Subsequent procedures (multiplying by \$12 and adding the \$200 contractor's fee) fail to advance the response toward completion of the task.

Scored Student Responses for Ms. Olsen's Sidewalk

Question 2: Ms. Olsen's Sidewalk

Score 0

Based on my answer the contractor will charge \$ 2711 to Ms. Olsen for her side walk.

What I did was that find the area of the trapezoid and multiply for the the square foot of side walk plus \$200 Per fee.

Show Calculations

$$\$ 200 \times 8.5 \text{ ft} = \$1700$$

$$8.5 \text{ ft} - 4.5 \text{ ft} = 4 \text{ ft}$$

$$\frac{1011}{\text{Charge}} \rightarrow 2711$$

$$7.2^2 + x^2 = 7^2$$

$$\frac{51.84}{4} + x = \frac{49}{4}$$

$$x = 12.96$$

$$\text{Triangle} = 12.96 \text{ A} \times 2 = 25.92 = 2 \text{ Triangles}$$

$$\text{Square} = 58.32 \text{ A.}$$

$$\text{isosceles trapezoid} = 84.25 = \text{A}$$

$$\$12 \times 84.25^2 \text{ square feet} = \$ 1011$$

The response contains merely an acquaintance with the topic. The student incorrectly applies the Pythagorean Theorem to find the height of the trapezoid. All subsequent work is also incorrect. No evidence is present to suggest that the student has the ability to solve problems of this general type.

Scored Student Responses for *Ms. Olsen's Sidewalk*

Question 2: Ms. Olsen's Sidewalk

Score 0

The contractor is going to charge Mrs. Olsen \$742.40 dollars for the sidewalk. I got this after I added up all the money it is going to cost for each square foot.

Show Calculations

$$\begin{array}{r} 200 \\ + 215.6 \\ + 102 \\ + 54 \\ + 86.4 \\ 86.4 \\ \hline 742.40 \end{array}$$

$$12 \sqrt{25} = 300$$

$$\sqrt{8.5} \times 12 = 62$$

$$4.5 \times 12 = 54$$

$$7.2 \times 12 = 86.4$$

$$7.2 \times 12 = 86.4$$

The response demonstrates merely an acquaintance with the topic. The student states a fee for the contractor's charge, but no work is present to demonstrate understanding of any aspect of the required mathematical processes.