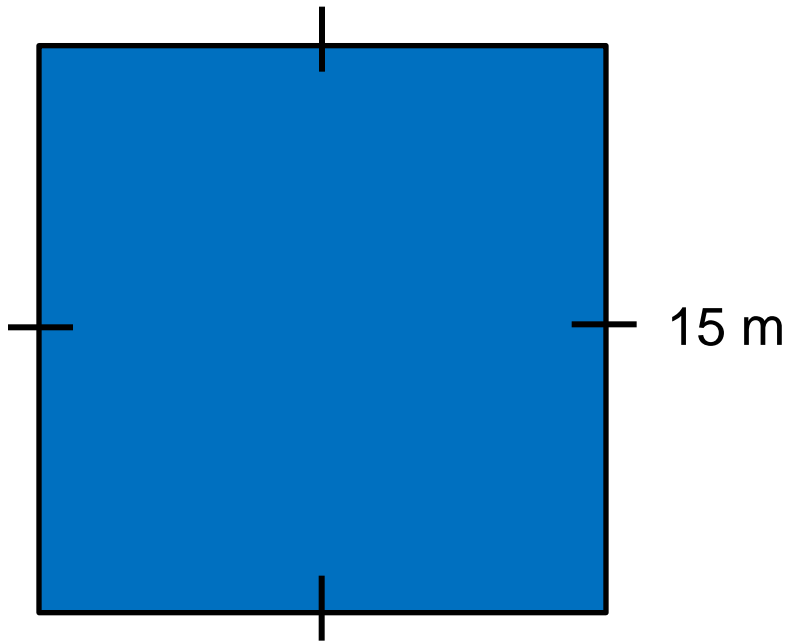# Math
Shape and Space: Perimeter

Science and Mathematics Education Research Group

Investigating Perimeters
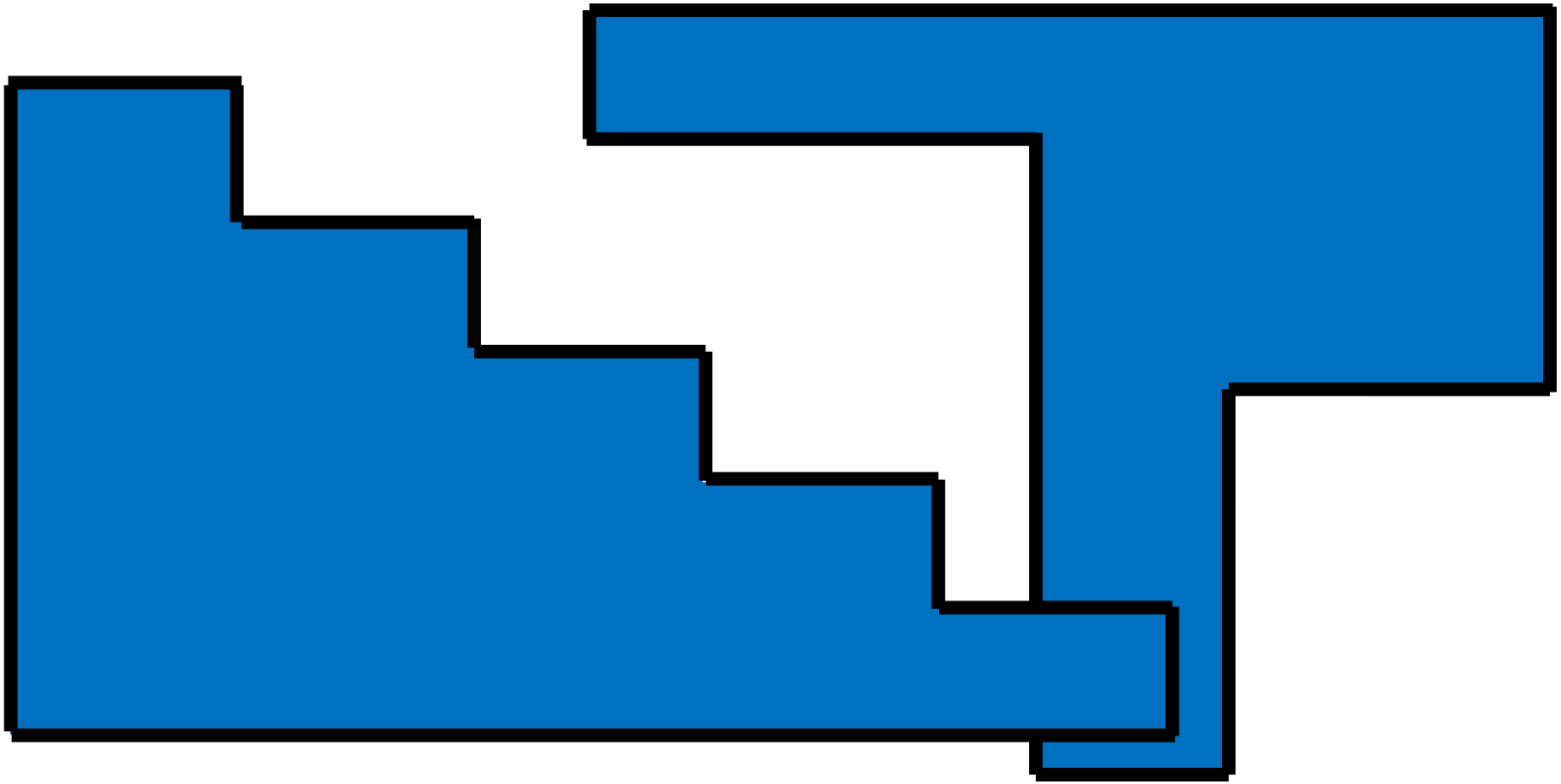
Perimeter I

What is the perimeter of the square below?

15 m

A. 30 m

B. 45 m

C. 60 m

D. 225 m

E. Not enough information

Solution

Answer: C

Justification: A square has 4 sides with equal length. Adding up all 4 sides give:

P = 15 m + 15 m + 15 m + 15 m = 60 m
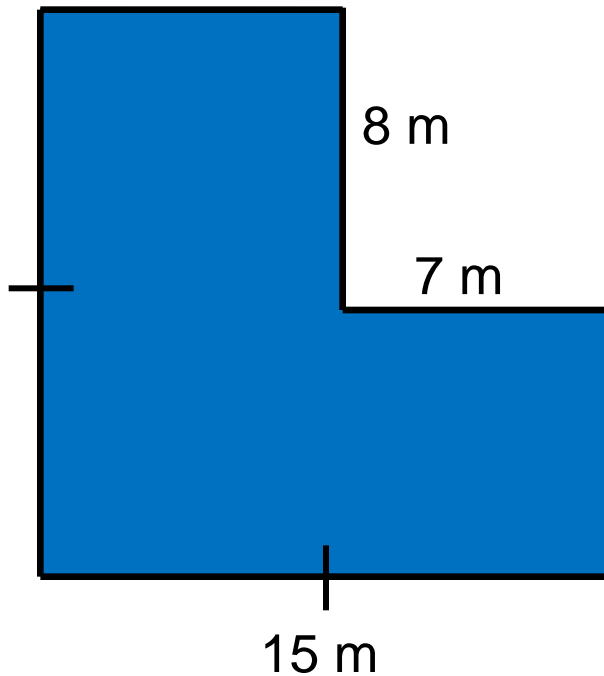
The perimeter can also be calculated using multiplication since there are 4 sides are the same:

P = 15 m × 4 = 60 m

Answer D is the area of the square: A = 15 m × 15 m

Perimeter II

What is the perimeter of the figure below?

8 m

7 m

15 m

A. 45 m

B. 52 m

C. 53 m

D. 60 m

E. Not enough information
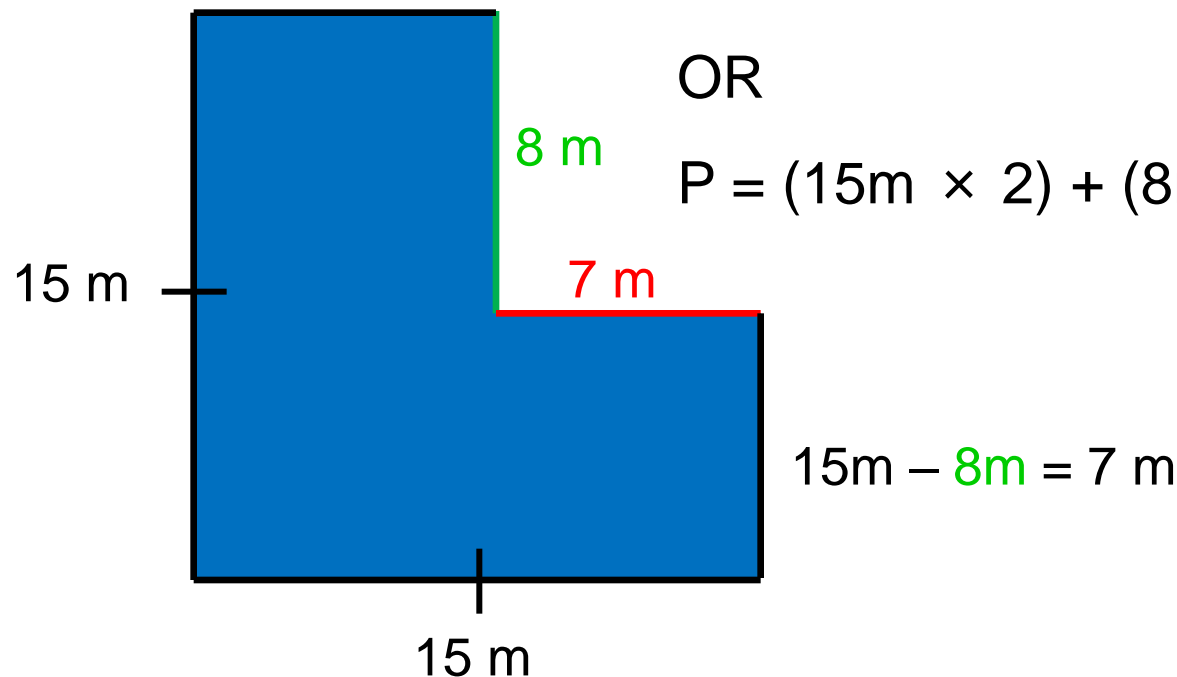
Solution

Answer: D

Justification: Even though some of the sides do not have their lengths given, they can be found as follows:

15m − 7m = 8 m

8 m

7 m

15 m

15m − 8m = 7 m

15 m

P = 15m + 15m + 8m + 8m + 7m + 7m = 60 m

OR

P = (15m × 2) + (8m × 2) + (7m × 2) = 60 m
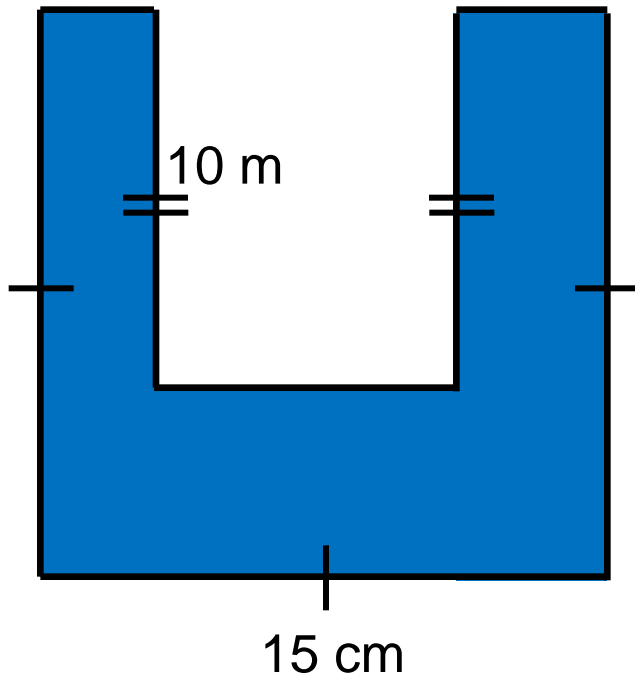
Alternate Solution

Answer: D

Justification: The highlighted sides can be moved along the perimeter of a 15 m by 15 m square.
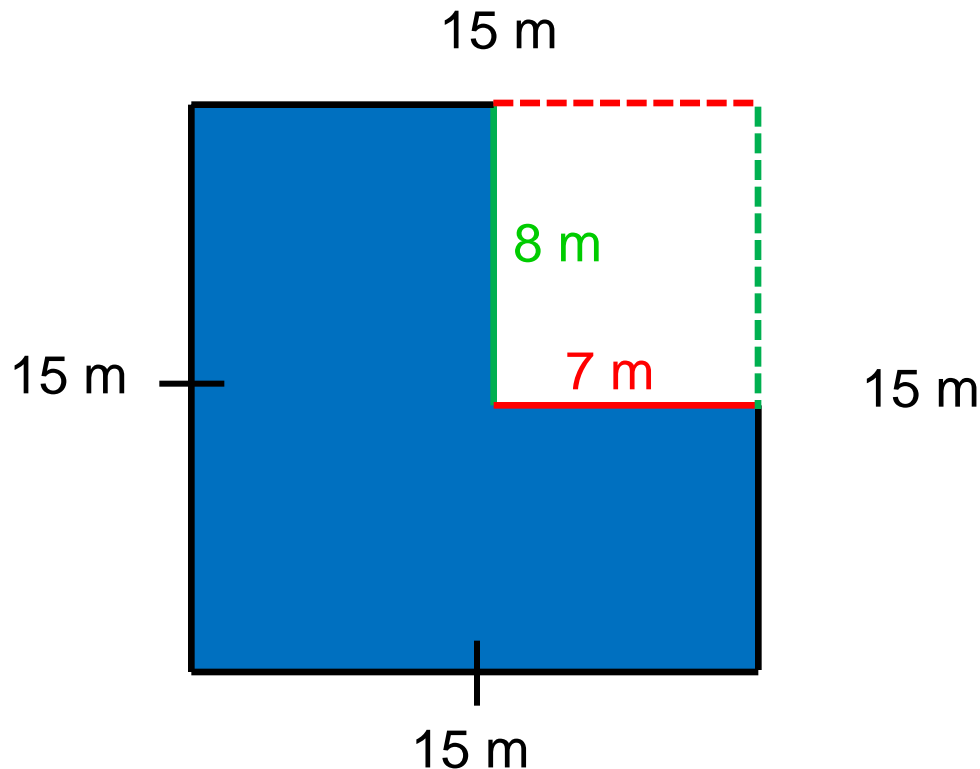
$$P = 15 \text{ m} \times 4 = 60 \text{ m}$$

Perimeter III

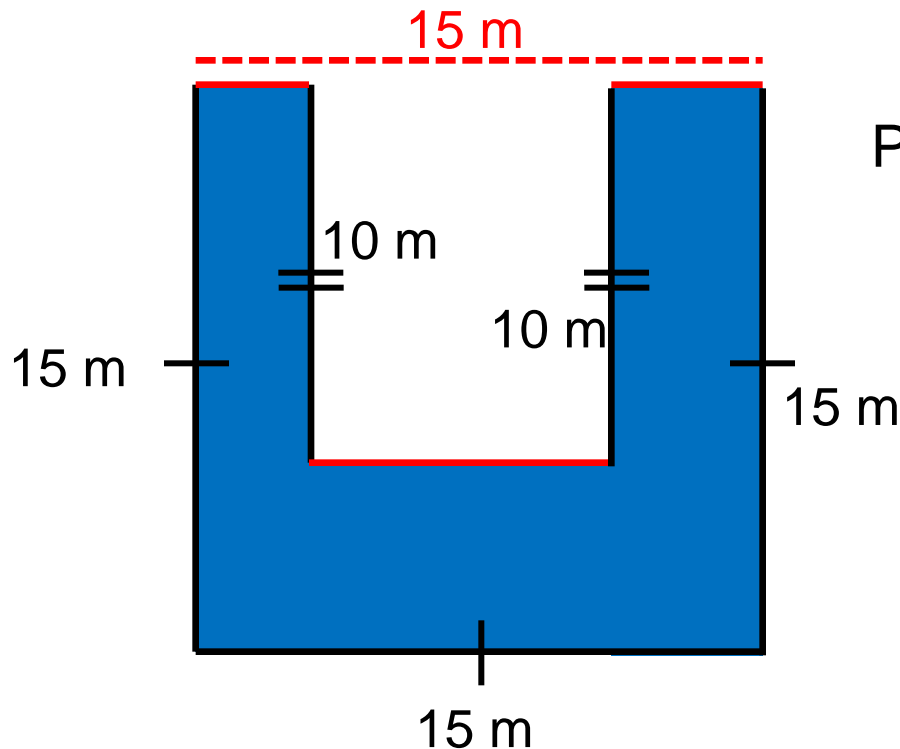What is the perimeter of the figure below?

10 m

15 cm

A. 55 m

B. 65 m
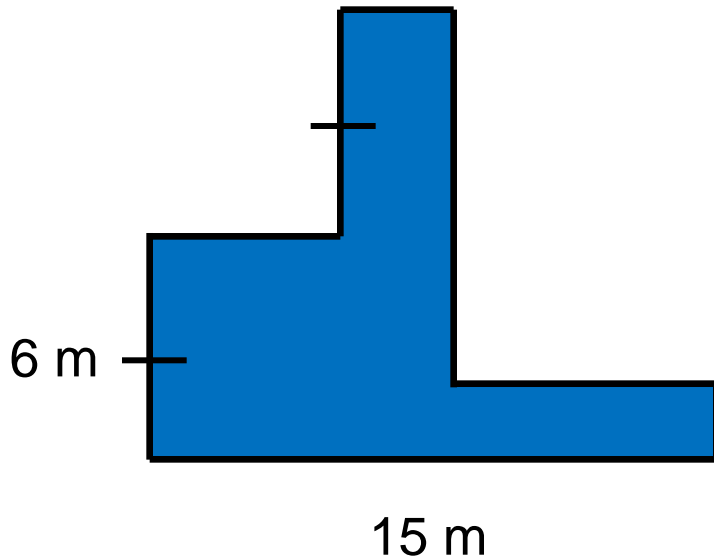
C. 75 m

D. 80 m

E. Not enough information

Solution

Answer: D

Justification: We do not know the individual lengths of the sides highlighted red, but we do know their sum must be 15 m.

15 m

10 m

10 m

15 m

15 m

15 m

$P = (15 \text{ m} \times 4) + (10 \text{ m} \times 2) = 80 \text{ m}$

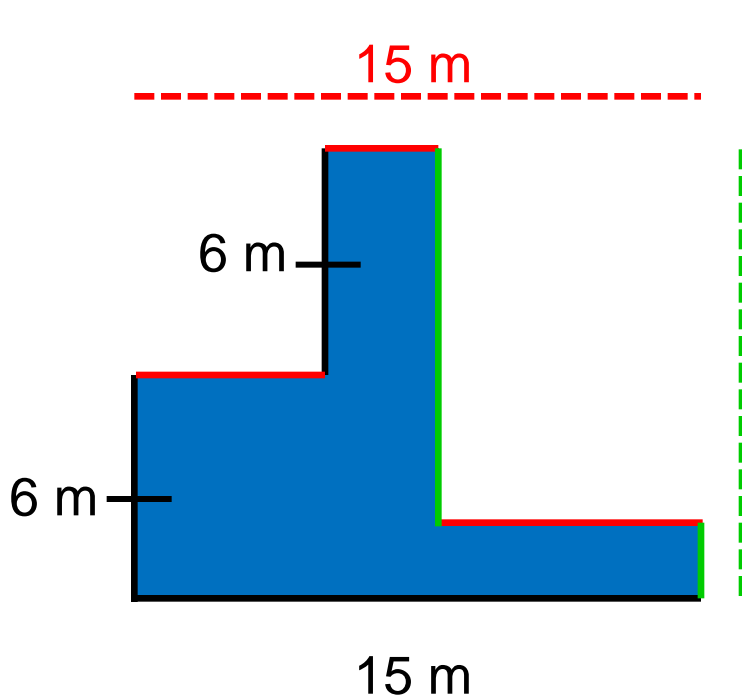What is the perimeter of the figure below?

A. 42 m

B. 51 m

C. 54 m

D. 57 m

E. Not enough information

Solution

Answer: C

Justification: The sum of the red sides must be 15 cm, and the sum of the green sides must be 12 cm.

15 m

6 m

6 m

15 m

$P = 15m + 6m + 6m + \textcolor{red}{15m} + \textcolor{green}{12m} = 54$ m

OR

$P = (15\ m \times 2) + (12\ m \times 2) = 54$ m

6 m + 6 m = 12 m

The perimeter is the same as a 15 m by 12 m rectangle.

Perimeter V

The figure below is a 15 m by 15 m square with 3 rectangles taken away from the corners. What is the perimeter of the figure?
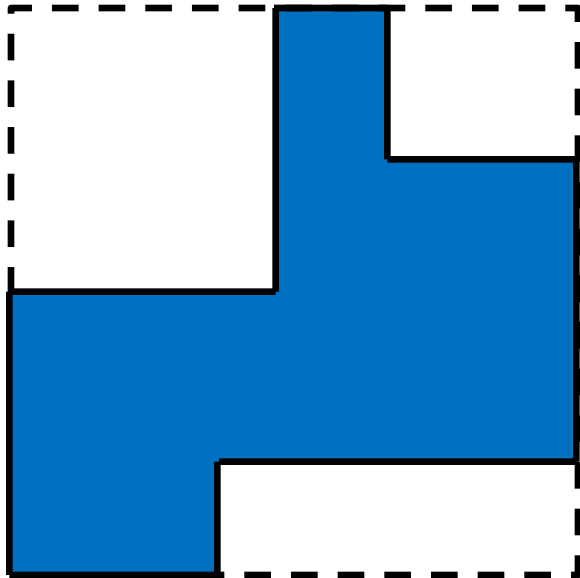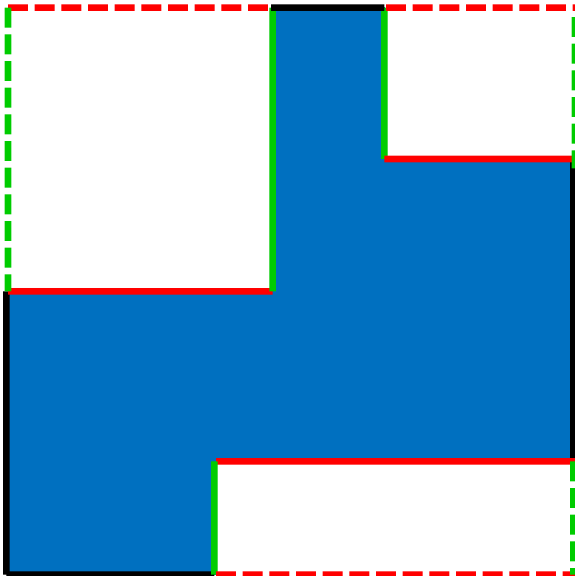

A. Less than 60 m

B. Exactly 60 m

C. Greater than 60 m

D. Not enough information

Solution

Answer: B

Justification: The inner rectangle sides can be moved to the outline of the square as shown. The perimeter then becomes the perimeter of the original square.

P = 15 m + 15 m + 15 m + 15 m = 60 m
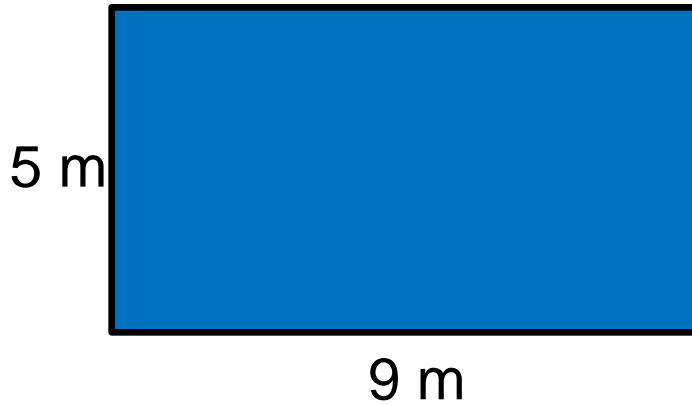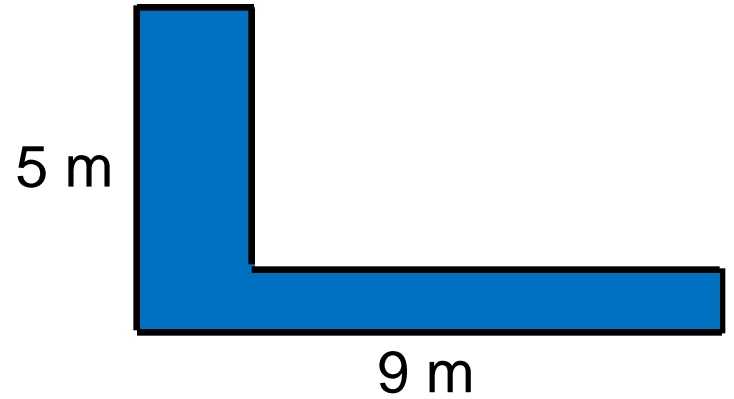
OR

P = 15 m × 4 = 60 m

Perimeter VI

Which of the following has the greatest perimeter?

A.

5 m

9 m

B.

5 m

9 m

C.

5 m

9 m
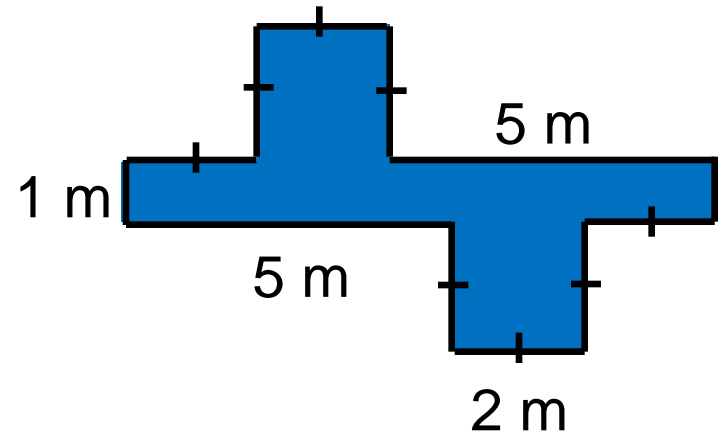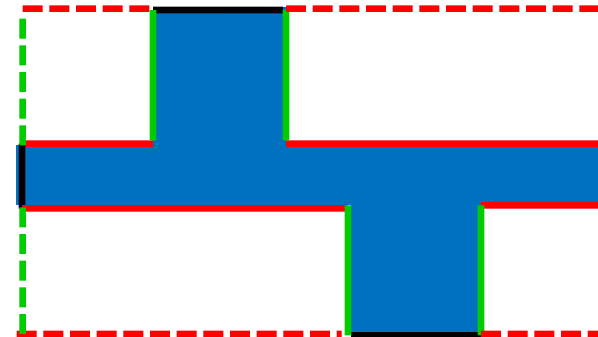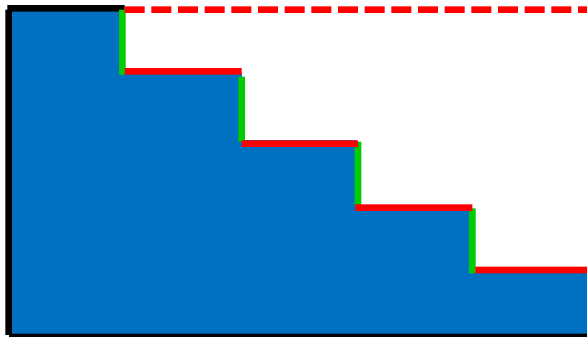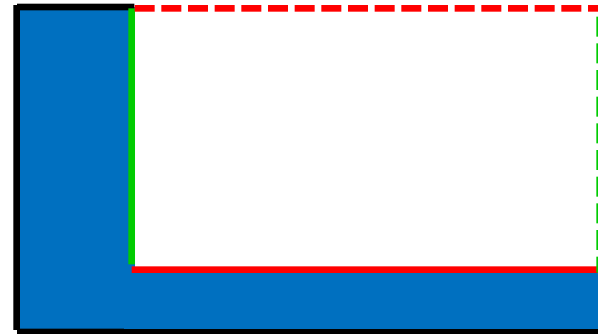
D.

5 m

1 m

5 m

2 m
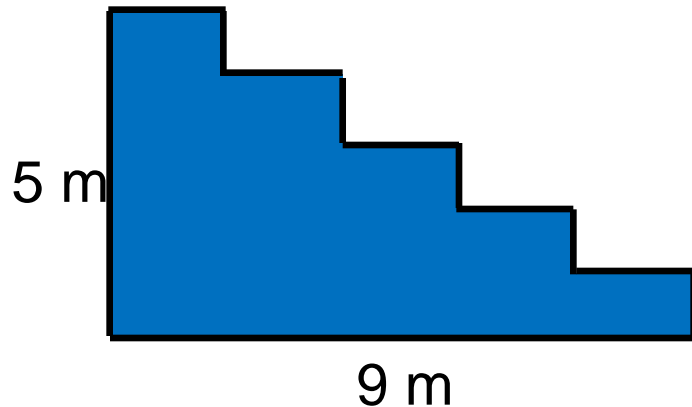
E.   They all have the same perimeter

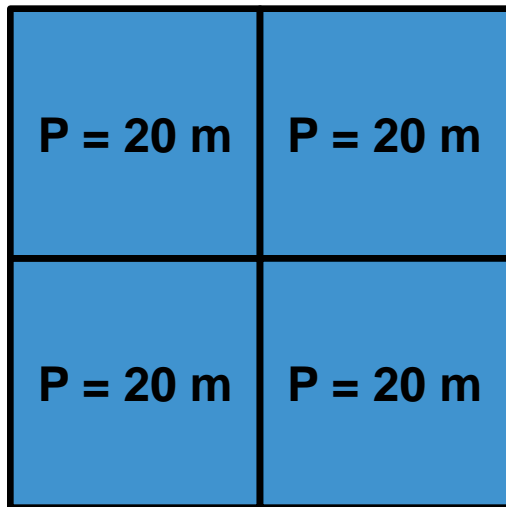# Solution

Answer: E

Justification: All of the highlighted sides can be moved to form the 5 m by 9 m rectangle.

Perimeter VII

Four squares with a perimeter of 20 m each are arranged as shown to form a larger square. What is the perimeter of the larger square?
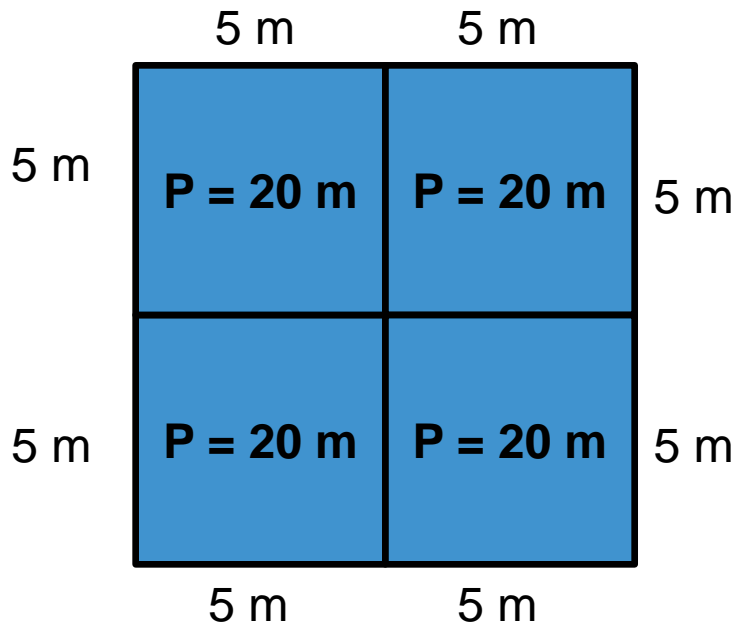
P = 20 m	P = 20 m
P = 20 m	P = 20 m

A. 20 m

B. 40 m

C. 60 m

D. 80 m

E. Not enough information

Solution

Answer: B

Justification: The small squares with P = 20 m must have side length 5 m since 5 m + 5 m + 5 m + 5 m = 20 m.

5 m   5 m

5 m

| P = 20 m | P = 20 m | 5 m |
| P = 20 m | P = 20 m | 5 m |

5 m   5 m

5 m   5 m
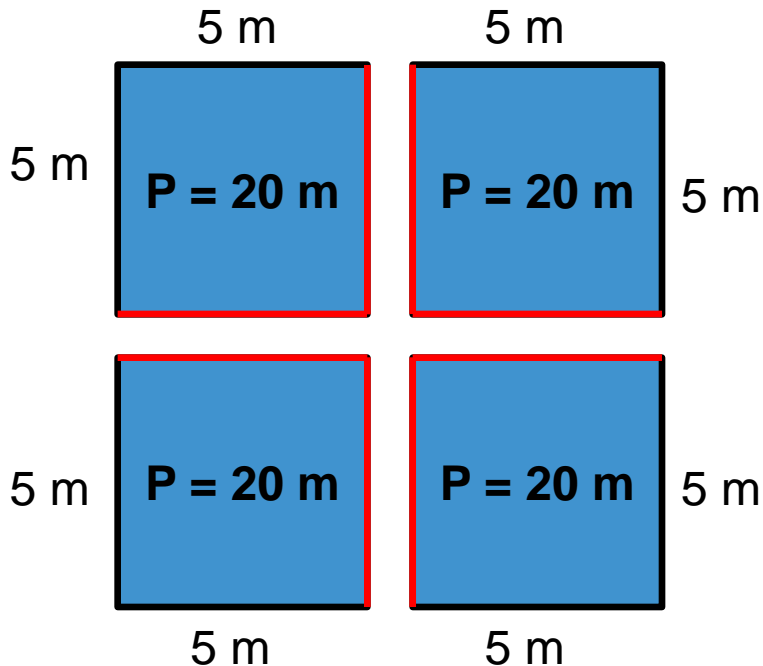
P = 5 m × 8 = 40 m

Alternative Solution

Answer: B

Justification: The total perimeter of 4 separate squares is 80 m. When joined together, the highlighted sides will be glued together.

5 m   5 m

5 m   P = 20 m   P = 20 m   5 m

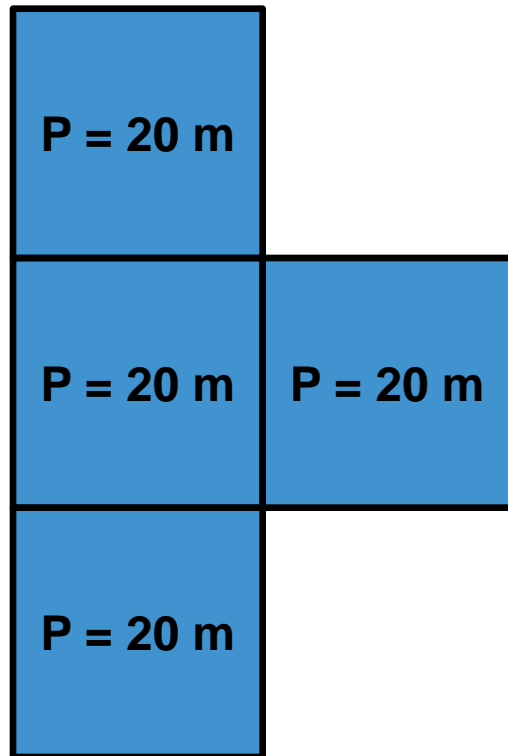5 m   P = 20 m   P = 20 m   5 m

5 m   5 m

Instead of summing the exterior sides, the interior sides can be subtracted from the total perimeter.

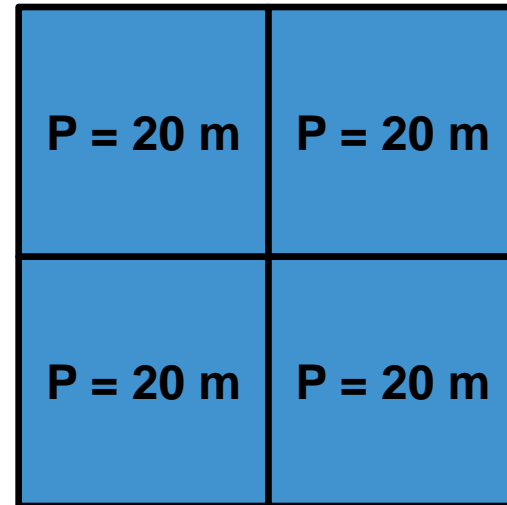$$P = 80 \text{ m} - 5 \text{ m} \times 8 = 40 \text{ m}$$

Perimeter VIII

Four squares with a perimeter of 20 m are arranged in two different ways as shown. Which has the greater perimeter?
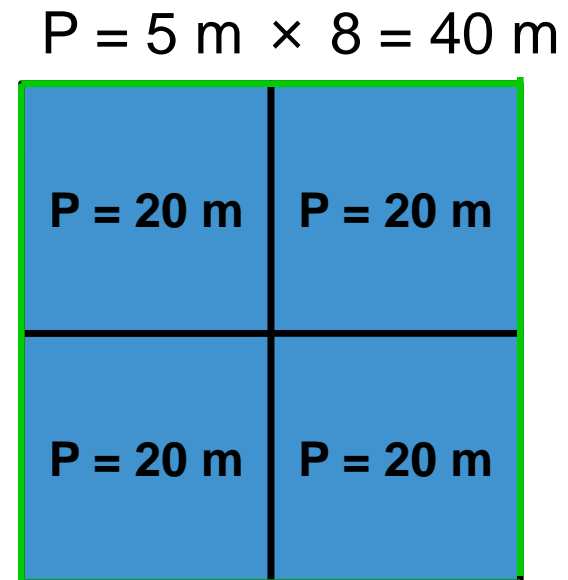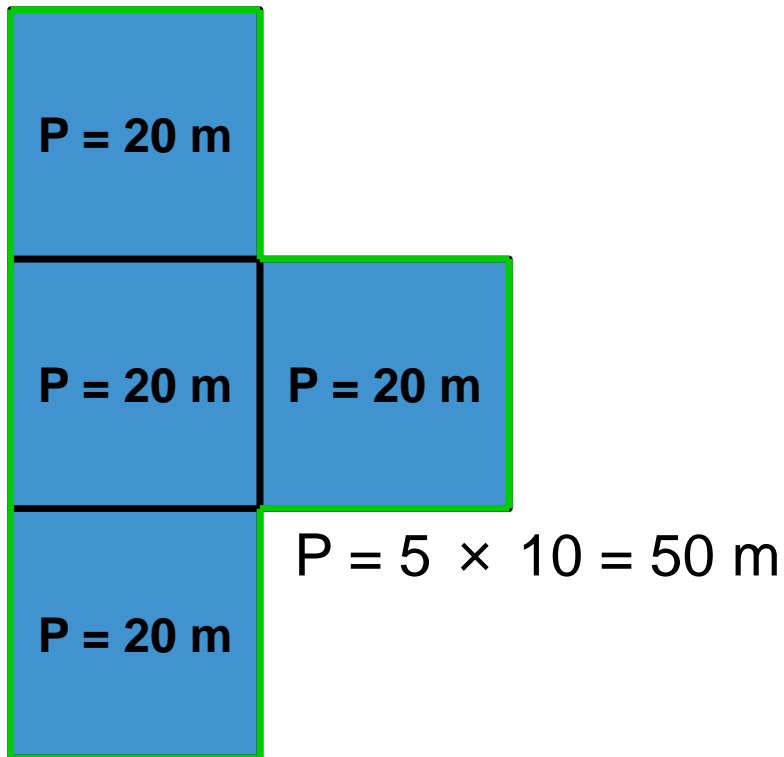
A.

P = 20 m

P = 20 m   P = 20 m

P = 20 m

B.

P = 20 m   P = 20 m

P = 20 m   P = 20 m

C. Both have the same perimeter

D. Not enough information

Solution

Answer: A

Justification: Even though both shapes are made up of the same blocks, the arrangement on the left has 2 more revealed sides.

P = 20 m

P = 20 m

P = 20 m

P = 20 m

P = 5 × 10 = 50 m

P = 5 m × 8 = 40 m

P = 20 m

P = 20 m

P = 20 m

P = 20 m

Alternative Solution

Answer: A

Justification: The arrangement with the fewest interior sides will have the largest perimeter. Interior sides do not add to perimeter.

P = 20 m

P = 20 m   P = 20 m

P = 20 m

6 interior sides

8 interior sides

P = 20 m   P = 20 m

P = 20 m   P = 20 m
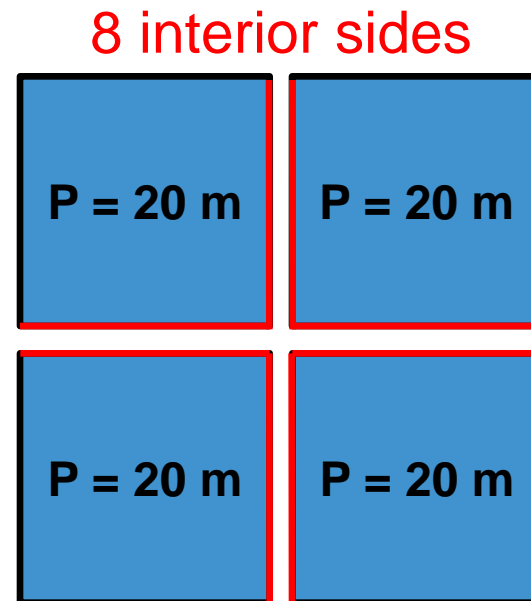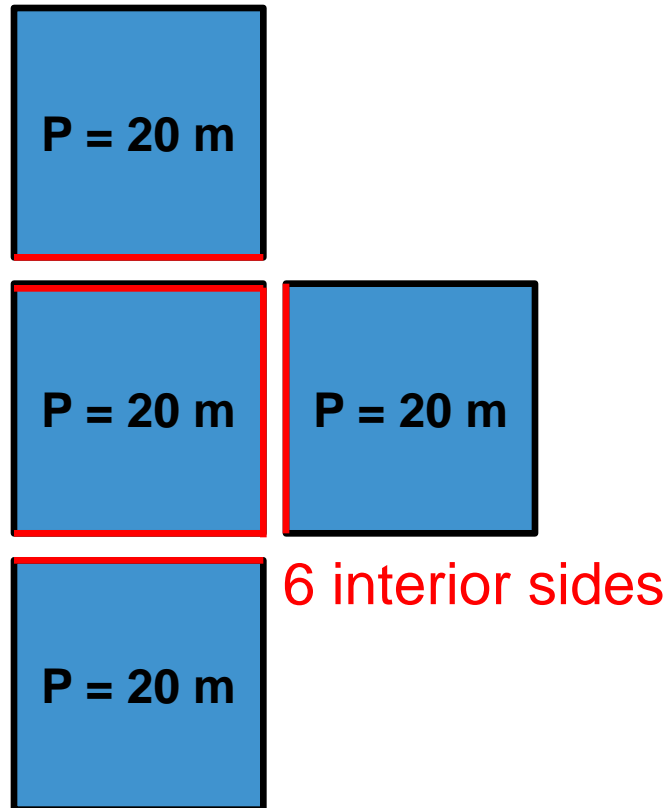
Perimeter IX

Can four squares with a perimeter of 20 m be arranged to give a perimeter greater than 50 m? Squares can only be glued together such that at least 1 side is completely touching the side of a different square
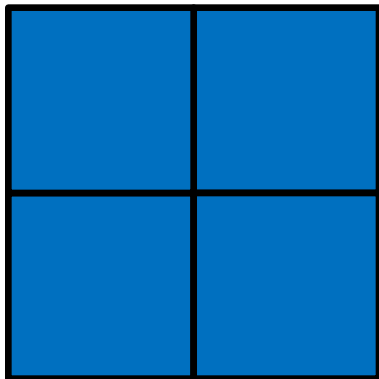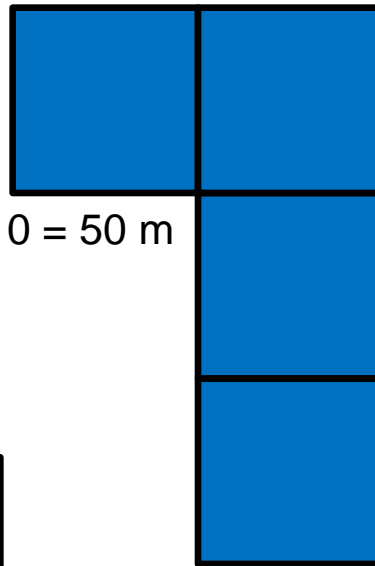
| P = 20 m | P = 20 m |

| P = 20 m | P = 20 m |
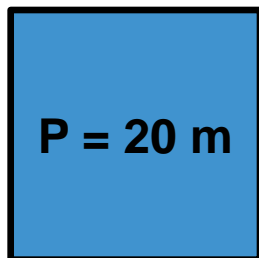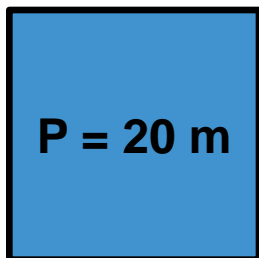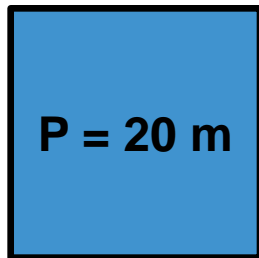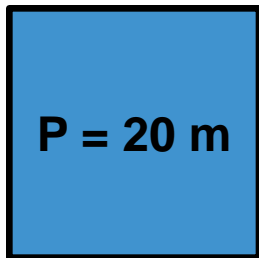
A. Yes

B. No

Solution

Answer: B

Justification: The 4 blocks can only be arranged as follows:

P = 5 m x 8 = 40 m

P = 5 m x 10 = 50 m

P = 5 m x 10 = 50 m

P = 5 m x 10 = 50 m

P = 5 m x 10 = 50 m
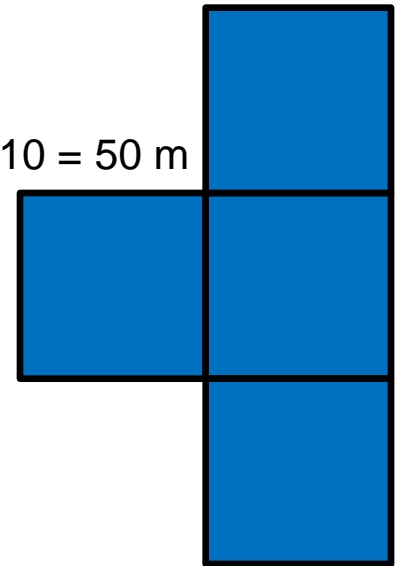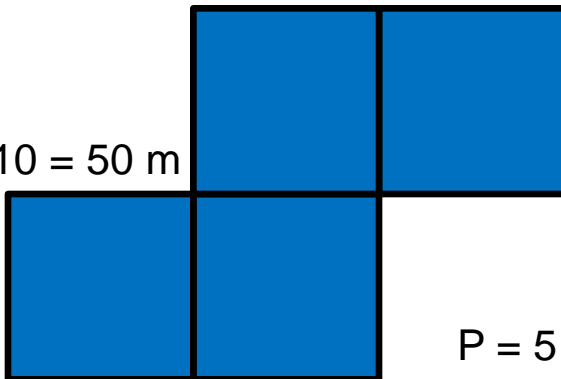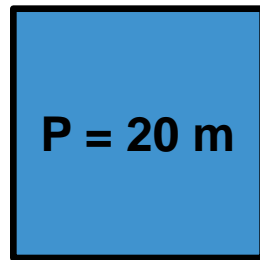
P = 5 m x 10 = 50 m

Perimeter X (Hard)

You are now given 100 squares with a perimeter of 20 m to arrange like before. What is the _maximum_ perimeter you can have?

$$\text{P = 20 m} \times \textbf{100}$$

A. Less than 1000 m

B. Exactly 1000 m

C. Greater than 1000 m

Solution

Answer: C

Justification: The first 2 blocks must be arranged like so:

P = 5 m x 6 = 30 m

In order to get the largest perimeter possible, the next square should only cover 1 side, but add 3 more exterior sides.

(Increase P by 10 m)

P = 30 m + 15 m – 5 m = 40 m

The first two squares give a perimeter of 30 m. There are 98 remaining squares that will each add 10 m to the final shape.

P = 30 m + (10 m x 98) = 1010 m
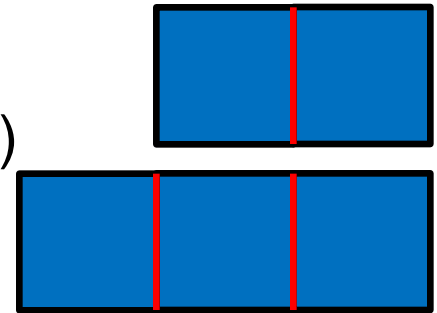
Alternative Solution

Answer: C

Justification: Notice the following pattern:

2 blocks: 2 interior sides (1 from each block)

3 blocks: (3 – 1)(2) = 4 interior sides

100 blocks: (100 – 1)(2) = 198 interior sides

Each time a new block is added, the minimum number of interior sides added is 2 sides since each block must be glued to another block.

The total perimeter of 100 separate blocks is P = 20 m × 100 = 2000 m. Subtracting the interior sides from the total perimeter gives:

P = 2000 m – (198 m × 5) = 1010 m

Perimeter XI (Hard)

You are now given 100 squares with a perimeter of 20 m to arrange like before. What is the _minimum_ perimeter you can have?
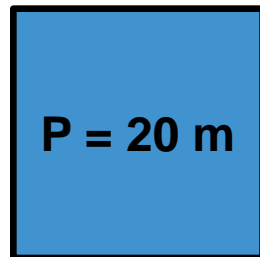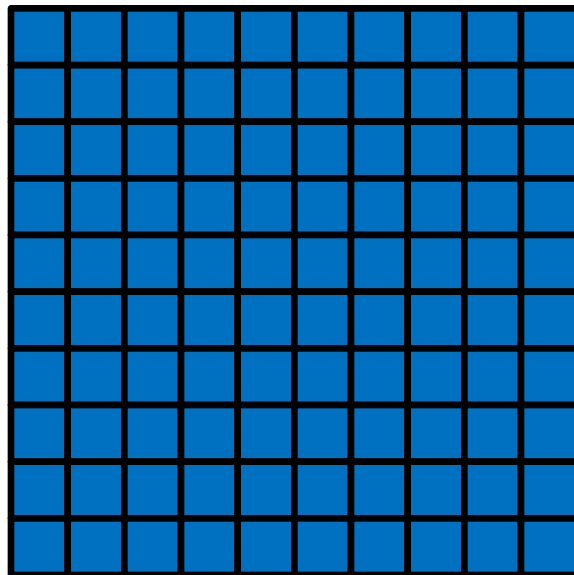
P = 20 m × 100

A. Less than 200 m

B. Exactly 200 m

C. Greater than 200 m

Solution

Answer: B

Justification: The perimeter can be minimized by arranging the squares to form a larger square. In this arrangement, only the squares on the outside contribute to the perimeter of the shape.

50 m

5 m x 10 = 50 m

P = 50 m x 4 = 200 m