

Function Development Exercise 3:

A fence around a field is shaped as show in figure 1 below. It consists of a rectangle of length L and width W , and a right triangle that is symmetrical about the central horizontal axis of the rectangle. Suppose the width (W) and the enclosed area (A) are to be given (i.e., the will be the function's inputs). Write a function that calculates the length L required and the total length of fence required (i.e., the perimeter). Test your function for $W=6\text{ m}$ and $A = 80\text{ m}^2$. (Note: This building a function of the calculation you did for the last homework. You may look at the solution to that homework online.)

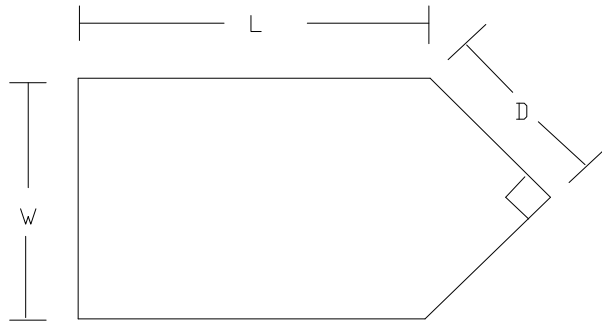


Figure 1: Area to be surrounded by a fence

Set Up/ Introduction

Type of Program: Script Function

1. Problem Statement:

2. Inputs: (full name, variable to be used, units)

Variable Name	Description	Units or Values	Input Source*

* Possible sources: command line, file, interactive input

3. Output: (full name, variable to be used, units)

Variable Name	Description	Units or Values	Output type*

* Possible types: command line, file, display

4. Solution Steps (order of these two parts may be varied):

Identify the steps/equations

Perform calculation on test case(s)

From homework we saw the area of the shape is (see PS 2 solution on class website):

$$A = L * W + \frac{1}{2} D^2$$

And the length of side D is:

$$(1) D = \frac{1}{\sqrt{2}} W$$

Substitute D into the first equation

$$L * W = A - \frac{1}{2} W (\frac{1}{2} W)$$

and solve for L

$$(2) L = \frac{A}{W} - \frac{1}{4} W$$

Now calculate perimeter

$$(3) P = W + 2L + 2D$$

Try example values of $W = 6$ m and $A = 80$ m² by hand

$$(1) D = \frac{1}{\sqrt{2}} (6) = 4.24$$

$$(2) L = \frac{80}{6} - \frac{1}{4} (6) = 11.83$$

$$(3) P = 6 + 2(11.83 + 4.34) = 38.1$$

The numbered equations represent the three steps the equations/steps the function must use.

Code: Now write a MATLAB m-file to complete this calculation (step 5).

Validate: Then Validate the resulting program (steps 6 -8).

5. Programming:

```

function [L, P]= FiveSide(A,W)
% function [L, P]= FiveSide(A,W)
% function to determine the length and perimeter of a five sided
% area that consists of a rectangle and a isosceles right triangle
% Inputs
% A = Area in square units
% W = width of the rectangle in linear units of the same type as A
% Outputs
% L = Length of the rectangle (same linear units)
% P = perimeter (same linear units)
% Internal variables
% D = length of hypotenuse of triangle (linear units)
%
% Calculate L & D
L = A./W - 1/4.*W;
D= 1/2^0.5*W;
% Now we can determine the perimeter
P=W + 2*L + 2*D;

```

Validation

6. Test Calculation

```

>> [L,P]=FiveSide(80, 6)
L = 11.8333
P = 38.1519

```

Matches

7. Reality check:

Not essential, complete calculation done in steps 4 & 6

8. Test on wider cases, if necessary

```

>> [L,P]=FiveSide([80, 80, 40, 40],[6, 4, 6, 4])
L =
11.8333 19.0000 5.1667 9.0000
P =
38.1519 47.6569 24.8186 27.6569

```

Answers look reasonable and follow an expected pattern (when the width decreases the length increases roughly proportionally, when are decreases width decreases roughly proportionally).