

The Water Tank Company: Using the 5 Step Process

Problem:

You work for a company that installs water tanks, customers know how many litres of water they want to be able to store, and the maximum available space they have available for the storage tank. Write a program that can calculate how high the water tank will need to be.

Note: The standard water tank in Tonga is a cylinder, so that is the type of water tank you need to make calculations on.

The Problem Resolution Plan using the 5 Step Process

1. Determine the Purpose
2. Determine the Required Data
3. Determine the Logic
4. Draft the Computer Program
5. Test & Re-test

Determine the Purpose

The program needs to calculate the height of a cylinder.

Taking a guess at how the program should look from the users perspective:

Sample Output:

Welcome to the Royal Blue Water Tank Company.
This program calculates the necessary height for installing one of our Water Tanks.
How much ground space (diameter) does the customer have : _____

With the above space, _____
we can estimate that the Water Tank will have to be _____ high

Determine the Required Data

We can already guess from the above sample, and our knowledge of mathematics:-

Mathematical Formula for calculating the volume of a cylinder:

$$Volume = \pi r^2 h$$

π we can define. We can get the Volume (amount) of water to store and space available from the customer, so we need to rewrite the formula so we can calculate the height of the water tank.

$$h = \frac{Volume}{\pi r^2}$$

π We can define, and we can use the number: **3.14159**

The Required Data from the customer will be:

Volume: The required water storage (volume)

Radius: The available land-space (which we will take as the diameter). We halve the diameter to get the *radius*.

We can modify the above "output" concept to add things we've discovered in this section.

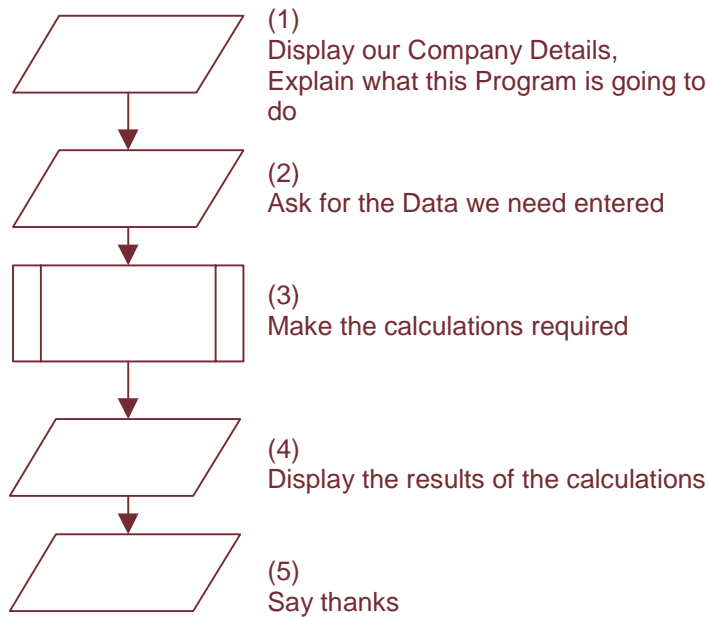
Welcome to the Royal Blue Water Tank Company.
 This program calculates the necessary height for installing one of our Water Tanks.
 How much ground space (diameter) does the customer have (meters) : _____
 How much water does the customer want to store (litres) : _____

With the above space, _____ (meters) and need for _____ (litres)
 we can estimate that the Water Tank will have to be _____ (metres) high

We specify that the user should enter the ground-space in meters, and the volume in litres. This is to minimise misunderstanding, clarify what type of values we want input and the values we output.

Determine the Logic

Using the above information, the formulas and what we have guessed to be appropriate output we can suggest the logic to possibly be:



How did I do this ?

In Microsoft Word I've used Autoshapes for the pictures on the left. You can get autoshapes from the Drawing Tools Toolbar.

Format the autoshapes to **Wrapping | Square** and text will go down the right hand side

In Microsoft Publisher draw the square, and use custom shapes for the parallelogram.

Draw the text box to the right of the shapes.

House Cleaning:

Define The Variables:

- Volume will store the volume required by the buyer, this is an integer since we don't store half litres.
- Diameter will store the available space for the water-tank, this is a single since we may need to calculate using decimal values. (eg. 9.8 meters)
- Radius will store the radius of the water-tank, this is a single since we need to make calculations based on the Diameter which is already a single (eg. $9.8 / 2 = 4.9$)
- Height will store the height of the water-tank, this is a single since we will make calculations using decimal values.
- Pi will store the definition for Pi since there is no Pi symbol on the keyboard, this is a single since we will use decimal values. We will also set this to 3.14159

Draft the Computer Program

Welcome to the Royal Blue Water Tank Company.
This program calculates the necessary height for installing one of our Water Tanks.
How much ground space (diameter) does the customer have (meters) : _____
How much water does the customer want to store (litres) : _____

With the above space, _____ (meters) and need for _____ (litres)
we can estimate that the Water Tank will have to be _____ (metres) high

(a) Start with Comments:

```
REM Author:  
REM Class:  
REM  
REM Project Sample. This is a sample for showing how the 5 decision steps can be used
```

(b) Define / Declare Variables

```
DIM Volume AS INTEGER  
DIM Diameter, Radius, Height AS SINGLE  
DIM PI AS SINGLE  
  
PI = 3.14159
```

(c) (1) & (2) Show who we are, and find out what the variables are

```
PRINT "Welcome to the Royal Blue Water Tank Company"  
PRINT "This program calculates the necessary height for installing one of our Water Tanks"  
PRINT "How much ground space (diameter) does the customer have (meters):";  
INPUT "", Diameter  
PRINT "How much water does the customer want to store (litres):";  
INPUT "", Volume
```

(d) (3) Make the calculations

```
Radius = Diameter / 2  
Height = Volume / (PI * Radius * Radius)
```

(e) (4) & (5) Display the output

```
PRINT "With the above space"; Diameter;"(meters) and need for "; Volume;"(liters)"  
PRINT "we can estimate that the Water Tank will have to be "; Height;"(meters) high"  
PRINT  
PRINT "Thank-you for shopping with us."
```

(f) Stop

Welcome to the Royal Blue Water Tank Company.
 This program calculates the necessary height for installing one of our Water Tanks.
 How much ground space (diameter) does the customer have (meters) : _____
 How much water does the customer want to store (litres) : _____

With the above space, _____ (meters) and need for _____ (litres)
 we can estimate that the Water Tank will have to be _____ (meters) high

Test and Re-Test

We use a calculator to make the following sample test numbers, and expected results from the formula.
 (or we can use Excel):

PI	3.14159				
Diameter	Volume	Expected height	Program Calculation	Working ?	
10	500	6.37	<i>6.3662</i>	<input checked="" type="checkbox"/>	
15	500	2.83	<i>2.829</i>	<input checked="" type="checkbox"/>	
17.5	500	2.08	<i>2.078</i>	<input checked="" type="checkbox"/>	
20	500	1.59	<i>1.591</i>	<input checked="" type="checkbox"/>	
10	800	10.19	<i>10.185</i>	<input checked="" type="checkbox"/>	
15	800	4.53	<i>4.527</i>	<input checked="" type="checkbox"/>	
17.5	800	3.33	<i>3.326</i>	<input checked="" type="checkbox"/>	
20	800	2.55	<i>2.546</i>	<input checked="" type="checkbox"/>	
10	1000	12.73	<i>12.732</i>	<input checked="" type="checkbox"/>	
15	1000	5.66	<i>5.658</i>	<input checked="" type="checkbox"/>	
17.5	1000	4.16	<i>4.157</i>	<input checked="" type="checkbox"/>	
20	1000	3.18	<i>3.183</i>	<input checked="" type="checkbox"/>	

Reference:

Watertk1.bas : The above code entered into QBasic

Watertk2 ~ 4 : includes minor modifications to the code