**Engineering Application I – Water Discharge from a Reservoir**

This review will help you understand and complete the assignment described in the R script “Engineering\_problem\_I.R”.

You will find what you will have to turn in at the end of the R script:

# 5) Turn in the following !! ####

# \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

# (A) Create a single plot with all the three functions

# i) Add a main title for the plot

# ii) Add your name as "sub title"

# (B) Include the exact solution:

# "What is the value of "h" to for achieving a velocity of 10 m/sec?"

# (C) Upload your document as a single PDF file to Canvas

## Water Discharge from a Reservoir

Water is discharged from a water supply reservoir through a pipe as shown in Figure 1. As a designer, there are multiple factors we need consider including (i) water level drop with discharge, (ii) pressure loss in the pipe due to water level drop and (iii) resistance due to friction in the pipe.

Diagram

Description automatically generated

Figure

If we neglect all these, the velocity at the outlet of the pipe can be expressed as,

|  |  |
| --- | --- |
|  | Equation |

Where, is the height of water level in the reservoir, is the length of the pipe, is acceleration due to gravity, and is the time since the beginning of the flow.

If the velocity m/sec, measured at the outlet at seconds, estimate the water level in the reservoir. The length of the pipe is 10 m and is 9.81 m/sec2.

### Solution

First, we need to recognize that we have been asked to find , i.e., the roots of a function .

We can substitute the given values (, , and ) and simplify Equation 1.

|  |  |
| --- | --- |
| which deduces to  Thus, the function with the independent variable can be described as | Equation  Equation |

As we reviewed earlier (see Figure 8 in handout “Equations of Single Variable” and related discussion), Equation 10 can be written as , where,

|  |  |
| --- | --- |
|  | Equation |
|  | Equation |

The graphs of (red) and (blue) are given below. The combined function (black) shows the root, i.e., value of when .

Chart, line chart

Description automatically generated

Figure

The value of at the intersection of both functions is . Therefore, the answer to the question “What is reservoir water level at sec, and the velocity m/sec?” is 5.098 m.