

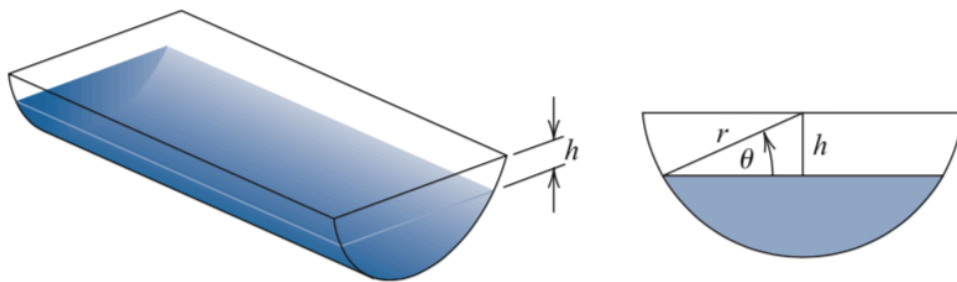
HOMEWORK WEEK 2

Please solve the following problem using Bisection, Newton's and Secant method in using google colab.

Problem 1

A trough of length L has a cross section in the shape of a semicircle with radius r . (See the accompanying figure.) When filled with water to within a distance h of the top, the volume V of water is

$$V = L \left[0.5\pi r^2 - r^2 \arcsin(h/r) - h(r^2 - h^2)^{1/2} \right].$$



Suppose $L = 10$ ft, $r = 1$ ft, and $V = 12.4$ ft³. Find the depth of water in the trough to within 0.01 ft.

Problem 2

In the design of all-terrain vehicles, it is necessary to consider the failure of the vehicle when attempting to negotiate two types of obstacles. One type of failure is called *hang-up failure* and occurs when the vehicle attempts to cross an obstacle that causes the bottom of the vehicle to touch the ground. The other type of failure is called *nose-in failure* and occurs when the vehicle descends into a ditch and its nose touches the ground.

The accompanying figure, adapted from [Bek], shows the components associated with the nose-in failure of a vehicle. In that reference it is shown that the maximum angle α that can be negotiated by a vehicle when β is the maximum angle at which hang-up failure does *not* occur satisfies the equation

$$A \sin \alpha \cos \alpha + B \sin^2 \alpha - C \cos \alpha - E \sin \alpha = 0,$$

where

$$A = l \sin \beta_1, \quad B = l \cos \beta_1, \quad C = (h + 0.5D) \sin \beta_1 - 0.5D \tan \beta_1,$$

$$\text{and } E = (h + 0.5D) \cos \beta_1 - 0.5D.$$

- a. It is stated that when $l = 89$ in., $h = 49$ in., $D = 55$ in., and $\beta_1 = 11.5^\circ$, angle α is approximately 33° . Verify this result.
- b. Find α for the situation when l , h , and β_1 are the same as in part (a) but $D = 30$ in.

