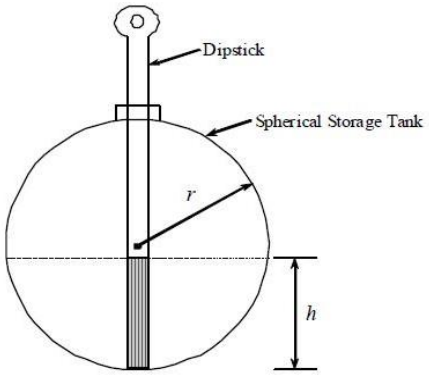
EGR 102 Introduction to Engineering Modeling

Lab 08B Homework

1. Lab Assignment (10 pts)



Part 1: A spherical storage tank containing oil has a known radius (**r**). You are tasked with calculating the height (**h**) to which the dipstick would be wet with oil when immersed in the storage tank when it contains a specified volume of oil. For a given volume **V (m^3)** of oil and tank radius **r (m)**, the following equation can be used to find the height **h (m)** of the liquid in the spherical tank.

$$f(h) = \frac{\pi}{3}h^2(3r - h) - V = 0$$

Create a MATLAB **function** to calculate the height of the oil in the tank by making use of the Newton-Raphson Method with the equation provided.

[h_final,n]=YourLastName_OilDepth(r,V,h_guess, accRelErr)

1. The function should take as **(4) inputs** the **radius** of the sphere (**r**), **volume** of oil (**V**), the initial guess for the height (**h_guess**), and the **acceptable relative percent error (accRelErr)**.

2. Use a **while loop** to repeat your calculations until the percent relative error is **below** the acceptable value. All calculations relevant to the height of the oil in the tank and the Newton-Raphson Method should be within this loop. Recall that the general form of the Newton-Raphson Method is:

$$x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$$

   Hint: The general setup for a Newton-Raphson problem doesn't change. The example from the slides can serve as a general structure for you.

3. The function should have **(2) outputs:** the converged solution for the height (**h_final**) and the number of iterations it took to reach this solution (**n**).

4. Setup a script file called YourLastName_OilDepthScript that will run your function. You will have three pairs of values to use being:

   r1 = 2.8 m and V1 = 17.1 m^3, r2 = 1.5 m and V2 = 6.2 m^3, r3 = 3.3 m and V3 = 29.6 m^3

   Use an **initial guess** of ***h=0.75 m***, and an acceptable relative percent error of ***0.001%***.

2. Reading Assignment (1 pt per question)

Read chapter 18.4 from the text in preparation for the next lab. Complete the associated assignment 8B in-lab assignment on MEL before lab 9A.

Write your name, EGR 102, Section #, Lab HW #, and Fall 2016 in your .m files.
Provide the name(s) of anyone you worked with in the comments for the dropbox.
Provide descriptive comments where appropriate in the file.
Files should be named:

YourLastName_OilDepth
YourLastName_OilDepthScript

Due Date: Before the start of Lab 9A