MEE 340 Wet Lab Experiment (Team 10)

In [3]:
```
import numpy as np
import math

def grouptask2(maxh=0.675,minh=0.03,dh=0.015,
               height=0.75,top=1.5,bottom=0.8,
               g=9.81,nu=1.05*(10**-6),
               L=[8.00,12.00],D=[0.05,0.03],eps=[0,0],
               alpha=0.05):

    #Default Values are set to solve Problem 1 in Group Task #2

    minh = minh - 0.0000000001                     #correction for np.arange to include endpoint
    h = np.arange(maxh,minh,-dh)            #Define array to contain all values of height (h) given dh

    deltaRMax = (top-bottom)/2              #Define array to contain radii toward finding volume in each subdiv
    radii = []

    for i in h:
        radii.append((bottom/2)+((deltaRMax/height)*i))


    Vol = []                                #Calculate Volume for each height division

    for i in radii:
        Vol.append(math.pi*(i**2)*dh)


    #Find Vave (Velocity at exit of piping) for each volume division
    #Note that major losses and pipe dimensions are only coming from the problems
    #May need adjustments for actual lab

    Vave = []

    #Calculate major losses and select Vave for each h and volume division
    #Calculate total minor losses beforehand:

    minorLossContraction = float(input("Enter total minor loss from area contractions: "))
    minorLossTurnsConnections = float(input("Enter total minor loss from turns and connections: "))

    minorLoss=minorLossContraction + minorLossTurnsConnections + 0.5 + 1000*0.05/9.81
    #0.5 from sharp entry
    #last term from ball valve

    for x in h:
        Vguess = math.sqrt(2*g*x)   #start off with an ideal jet exit velocity
        flag = 1

        while (flag == 1):
            Re=[]
            F=[]
            Ratios=[]

            for a in D:
                Re.append(Vguess*a/nu)

            #For the purposes of shortening time for final calculation, the Haaland Equation will be used.

            i=0 #index counter
            for b in Re:
                F.append((1/(-1.8*math.log10(((eps[i]/(3.7*D[i]))**1.11)+(6.9/b)))**2))
                i=i+1

            i=0 #index counter
            for c in F:
                Ratios.append(c*L[i]/D[i])
                i=i+1


            Vresult = math.sqrt((2*g*x)/(1+sum(Ratios)+minorLoss))  #Update new V for error testing
            errorTest = (Vguess-Vresult)/(Vresult)

            if (errorTest > -alpha and errorTest < alpha):  #error estimation: if change in height is sufficien
                #use current V as Vave for the height
                Vave.append(Vresult)
                flag = 0
            else:
                Vguess = Vresult #Reset/Update Vguess


    #Obtain deltaT array to compute time to deplete each division

    area = (math.pi/4)*(D[len(D)-1]**2)

    #Evaluate area at final pipe
```

```
    deltaT = []
    i = 0  #index counter

    for j in Vave:
        deltaT.append(Vol[i]/(j*area))
        i = i+1


    #Find total time (in seconds) to deplete tank by summing elements in deltaT

    total = sum(deltaT)
    print(total)
```

The function above takes the following inputs:

> **maxh,minh,dh**: establishes range of heights for which volume flow rates are considered
>
> **height**: maximum height of tank; radii of disks for which volume flow rates are considered are dependent on this height.
>
> **top,bottom**: top and bottom diameters of rounded tank; radii of disks are also dependent on these measurements.
>
> **g,nu**: parameters of experiment setting, namely gravitational accel. and kinematic viscosity of fluid in tank (water)
>
> **L,D,eps**: arrays/vectors containing all pipe lengths, diameters, surface roughness as fluid flows down an outlet channel
>
> **alpha**: Used for error testing when iteratively determining velocities in each height division

Before the function predicts a time, the following intermediate input is needed from user:

> **Total minor losses from area contractions** (refer to area contraction graphs in Lecture Notes)
>
> **Total minor losses from turns/connections** (refer to Lecture Notes; Homework 16)
>
> **Other minor losses can be adjusted directly in function body** (e.g. different valves, reservoir entrance/exit conditions, etc.

The output of this function represents the **time it takes for the tank to deplete from a start height to an end height in seconds**, where volume flow rates are assumed to remain constant over a certain percentage of change in height (**dh**).

In [4]:
```
grouptask2()
```

```
Enter total minor loss from area contractions: 0.4096
Enter total minor loss from turns and connections: 0
1894.5898504144388
```

In [ ]: