Integrated EXCITE Problem I

1. A constant area tank of 15 cm diameter is filled with water to an initial height of 24 cm. At time t = 0 a plug in a diameter is removed. The experiment can be viewed by linking to the EXCITE 1 Draining Tank module on the su details are also found in the module.

Analysis:

2. Perform an analysis from fundamental concepts that predicts a) the draining time of the tank; b) the water heig drains.

3. Input the results from you analysis into columns D and E of the EXCITE 1 module. You may either hand input y formula feature of the EXCEL spreadsheet. Your analysis results will be automatically plotted on the graph in the spreadsheet.

Experiment:

4. In the EXCITE 1 module, click on the photo of the draining tank in the lower left quadrant. This will allow you to tank experiment. Using the embedded digital clock and close-up view of the water height scale in the video, take water height vs . time as the experiment proceeds.
Input this data into columns B and C of the EXCITE 1 module. The data will again be presented in the graph.

Write a short discussion that compares the analysis and experiment results. Does the predicted drain time match not, what effects in the experiment might lead to differences between
analysis and experiment results?

Parametric Variation:

5. Link to the EXCITE 2 – Draining Tank Variations module. In the lower left hand quadrant are several photos of the draining tank experiment labeled 'Initial Height = 20 cm', etc. Click on these photos to view draining tank vi height is varied. Again, collect total drain time data for each draining tank experiment and input the data into colu module. The variation of total drain time vs. initial fluid height will be automatically plotted.

6. Discuss the observed variation in drain time. Does it match your physical intuition? What happens to the drain doubled? Use the parametric variation section in the EXCITE module (below the graph) to vary the initial drain he analysis. Does the analysis also predict the variation in drain time observed in the experiments?

) a plug in a drain hole of 0.95 cm
ıle on the supplemental DVD. Additional

e water height vs. time as the tank

hand input your results or use the
graph in the lower right quadrant of the

allow you to view a video of the draining
video, take experimental data for the

e graph.

time match that from the experiment? If

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ata into columns B-E in the EXCITE 2

to the drain time if the water height is
itial drain height in your previous

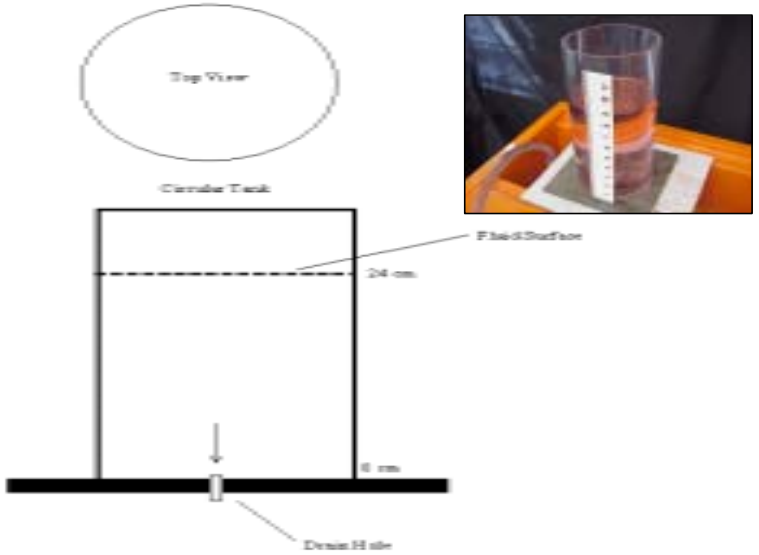
EXCITE 1

Principles of Fluid Mechanics

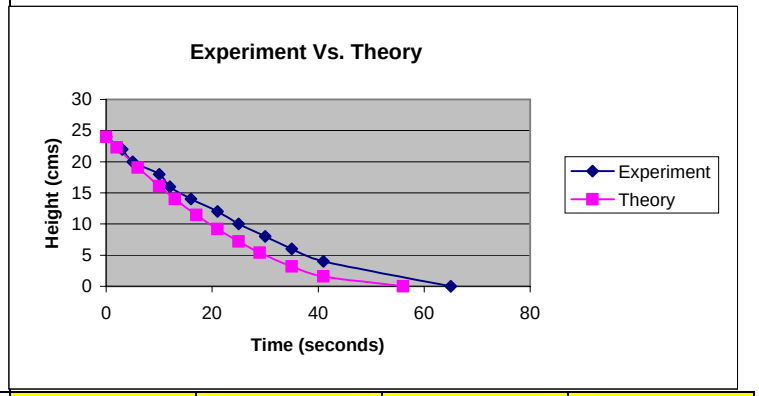
CHAPTER 3

DRAINING TANK PROBLEM

A tank of circular area is filled with a fluid to some intital height. At time t = 0 a drain hole in the bottom of the tank is unplugged. How long does it take the tank to drain? What is the height of the water as a function of time?
See Problem Description tab below for more details.



EXPERIMENTAL		ANALYTIC MODELING	
Time (seconds)	Height (cms)	Time (seconds)	Height (cms)
0	24	0	24
3	22	2	22.29
5	20	6	19.06
10	18	10	16.09
12	16	13	14.02
16	14	17	11.48
21	12	21	9.2
25	10	25	7.17
30	8	29	5.4
35	6	35	3.2
41	4	41	1.58
65	0	56	0.01



PARAMETRIC VARIATION SECTION →

Initial Fluid Height	Tank Diameter	Drain Hole Diam.	Fluid Density
24	15	0.95	998

Questions to guide your discussions in parts 3 and 5:

3.

What property of the fluid is not accounted for in your analysis?

Where in the flow does this fluid property have the greatest effect?

If this fluid property is accounted for in your analysis, would it drive your result for the total draining time closer to the result for the experiment?

5. If you had two tanks with identical geometry and working fluid, but Tank 1 was filled to 2x the height of Tank 2. Which would drain faster?