Homework Assignment #3

Due in class on Wednesday, September 16th.

Solve the following problems in one Excel workbook using three separate worksheets.
Email your workbook as an attachment to your TA before 8 a.m. on the due date.
There is no print-out required for this assignment.

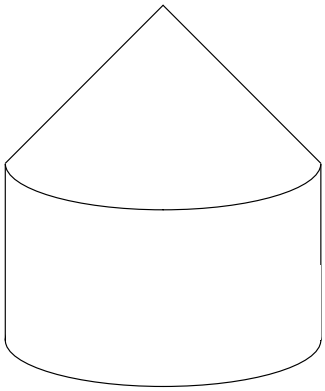
1. Problem 3.2, page 159, Excel in Engineering text.

2. Oil Storage Tank Design

   A tank is to be constructed that will hold 500 m^3 of crude oil when filled. The shape of the tank is to be a right circular cylinder, including base, with a right conical section mounted on top (see figure below) with height equal to radius. The material and labor costs to construct the cylindrical portion are \$300 per m^2, and the costs for the conical section are \$400 per m^2.

   Develop an Excel spreadsheet that starts with a given radius, calculates the height of the cylindrical section, and calculates the component and total costs for the tank.

   Investigate the dependence of cost on radius and optimize the design.



3. Designing an irrigation system

   Center-pivot irrigation systems are used on the Colorado plains to water farm fields. A typical system has a ¼-mile-long straight water pipe that pivots and rotates around a centered water source. The traditional design used one pulsating, rotating sprinkler head for each wheeled section, 120 ft long, with the sprinkler head placed high to get wide coverage. Newer designs have smaller "drop" spray nozzles, 10 ft apart, mounted below the pipe to reduce the effect of wind and evaporation on the water distribution and provide more even coverage. The typical land division is one square mile (640 acres), also called a section. There are four such irrigators per section, giving rise to the circular patterns visible from the air when flying in to or out from DIA from/to the east. Newer designs have articulated arms at the end of the main sprinkler section in order to do a better job of sprinkling into the corners of the quarter sections.

For some interesting reading, check out

http://www.zimmatic.com/#/Downloads/Literature/

If an inch of water is to be distributed on each revolution of the irrigator, and the revolution takes place over a 40-hour period, what flow rate of water, in gallons-per-minute, must be supplied by a pump to the center pivot of the system?

As you might imagine, the inner sprinklers have less ground to cover than the outer ones, so, for even distribution, the inner sprinklers need a lower flow rate. What should be the flow rates of the smaller “drop” nozzles? To simplify matters, consider setting the same flow rate for each nozzle in a 120-ft section. How do you imagine you would make these adjustments? Perhaps the literature can provide a clue. Don’t consider articulated arms here.

After solving this problem, you will never look at crop circles from an airplane the same again!