

Open Comsol Multiphysics 3.2, Select the Model Library tab, Then select any model within the chemical engineering Module library as shown below. Then press the documentation button.

Then select Go to the Chemical Engineering Module Overview
 A First Example
 as shown below

The image shows two overlapping windows. On the left is the 'Model Navigator' window in Comsol Multiphysics. The 'Model Library' tab is active, showing a tree view of modules. The 'Chemical Engineering Module' is expanded, and 'Reaction Engineering' is selected. Under 'Reaction Engineering', 'boat reactor' is highlighted. A callout box points to this selection with the text 'Select an example'. Below the tree, the 'Documentation' button is highlighted with a callout box that says 'Select Documentation'. On the right is a Microsoft Internet Explorer browser window displaying the documentation page for 'A First Example'. The page title is 'A First Example' and it contains introductory text about modeling a mass balance. A callout box points to the 'Overview, A First Example' section of the table of contents with the text 'Overview, A First Example'. Below the browser window, there are two diagrams: a 3D perspective view of a cylindrical reactor with an 'outlet' and 'porous catalyst' region, and a 2D cross-sectional diagram showing the 'outlet' and 'catalyst' subdomains with their respective boundaries $\partial\Omega_{outlet}$ and $\partial\Omega_{catalyst}$.

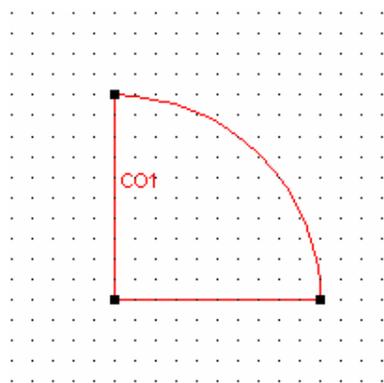


Figure 1: The first shape that you draw

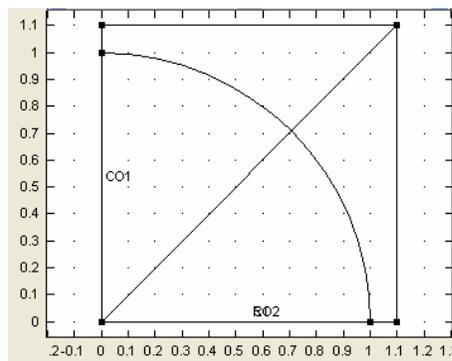
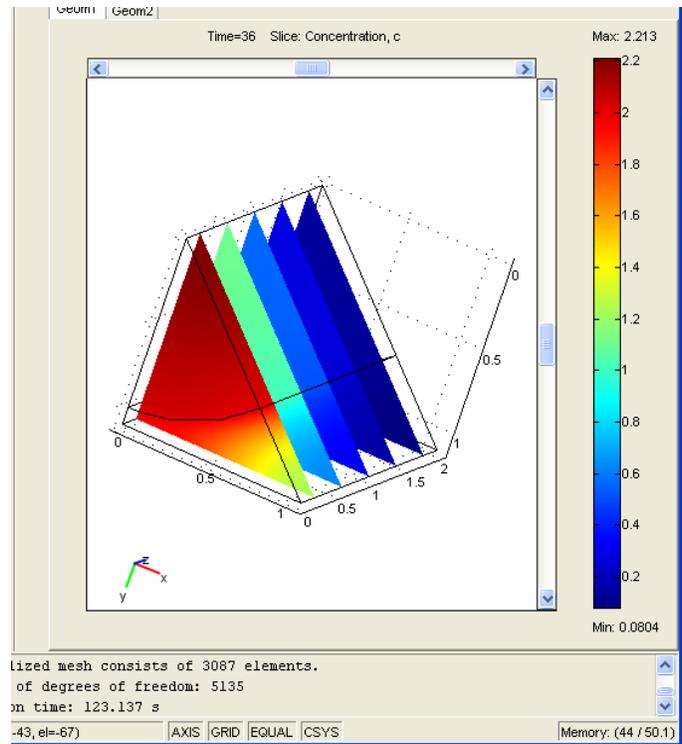
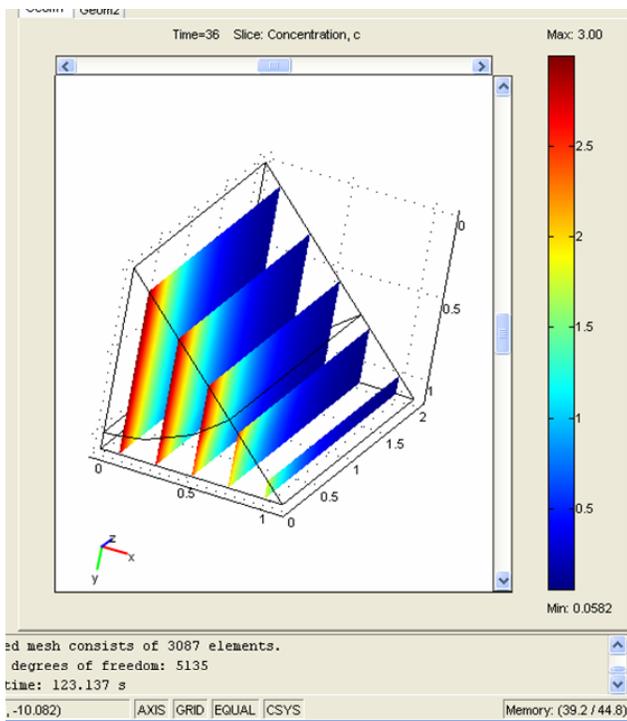


Figure 2: All 3 shapes together



Submit at the end of the period:

1. Turn in 3-D slice plot with 5 z-level slices
2. Compute the average concentration at the inlet and outlet boundaries. The average concentration is given by

$$\bar{c} = \frac{\iint (c * w_{vel}) dx dy}{\iint w_{vel} dx dy}$$

To do this

first calculate the average velocity and then calculate the integral of $c * w_{vel}$. Dividing these two numbers gives you the average velocity at a surface. Try the inlet surface first to make sure that you get $c_{in} = 3 \text{ mol/m}^3$. Use Postprocessing, boundary integration. Surface 3 should be your inlet and 4 should be your outlet.

(e.g. for the inlet I get the average velocity as 0.098175m/s and the average concentration $c * w_{vel} / 0.098175 = 2.9999$) From these values of average concentration you will be able to calculate a conversion (assume dilute gas).

3. Increase the flowrate by a factor of 2 and 10 times the initial flowrate. Describe what happens giving the minimum outlet concentration, average outlet concentration, and conversion for each of the three cases.
4. Compute the average concentration
5. Vary the reaction rate constant, k , as suggested in the tutorial. Use values of the base case, 1 and 10 s^{-1} . Explain what happens to the outlet concentration.

