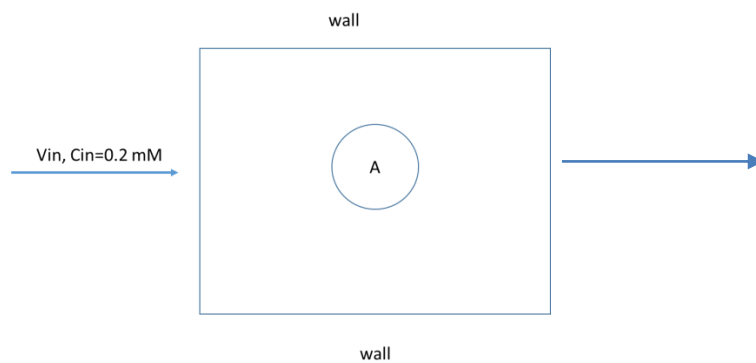


1. Develop a model of the following system in 2D.



A: gel construct with cells, no pores i.e. no flow, Doxygen=1/10 that in water. The box has sides of 2 mm. The flow is fully developed.

Using the following conditions determine the % viability as a function of V_{in} .

D oxygen in $H_2O=3.10^{-9}$ m²/s

Diameter A= 600 microns

Cell density=physiological

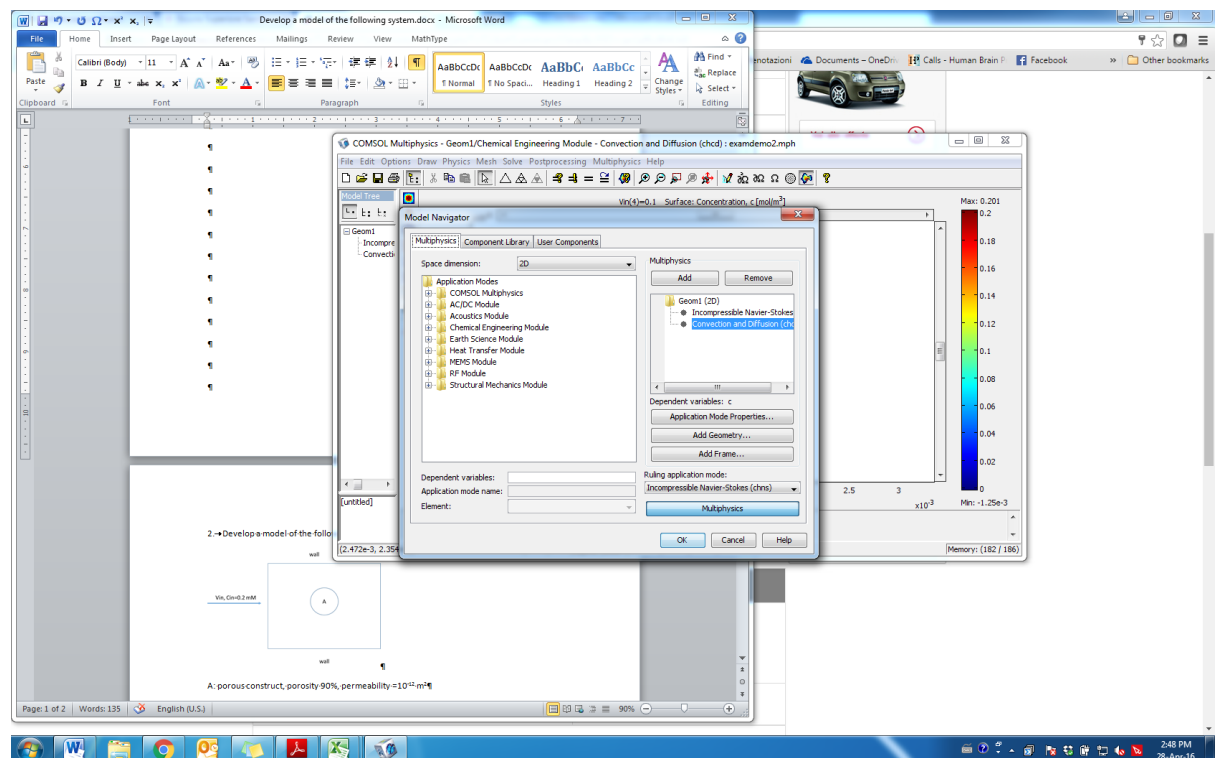
OCR= 3.10^{-17} moles/cell.s

$K_m=0.01$ mM

Critical Oxygen=0.001 mM, below this cells are dead and cannot consume oxygen

Minimum oxygen for viability=0.02 mM

OPEN 2D and add 2 modes, Navier Stokes and Convection diffusion



Add constants

The 'Constants' dialog box is open, displaying the following table:

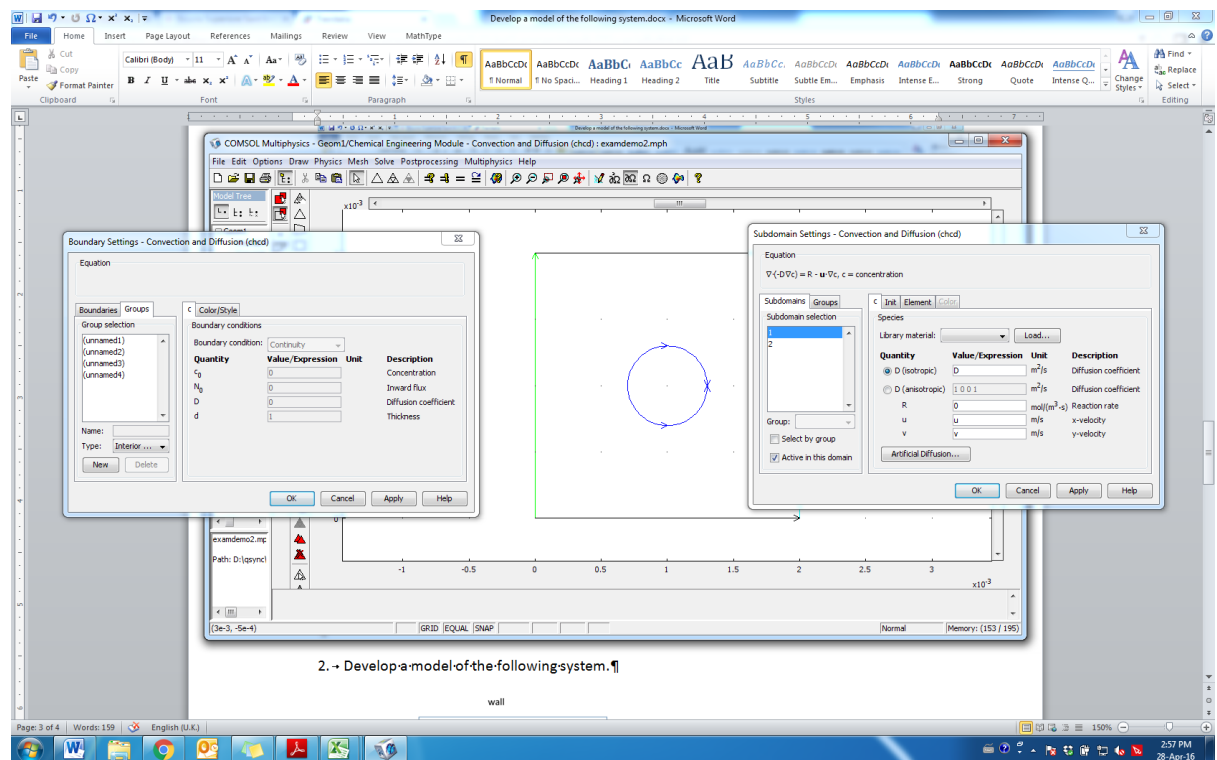
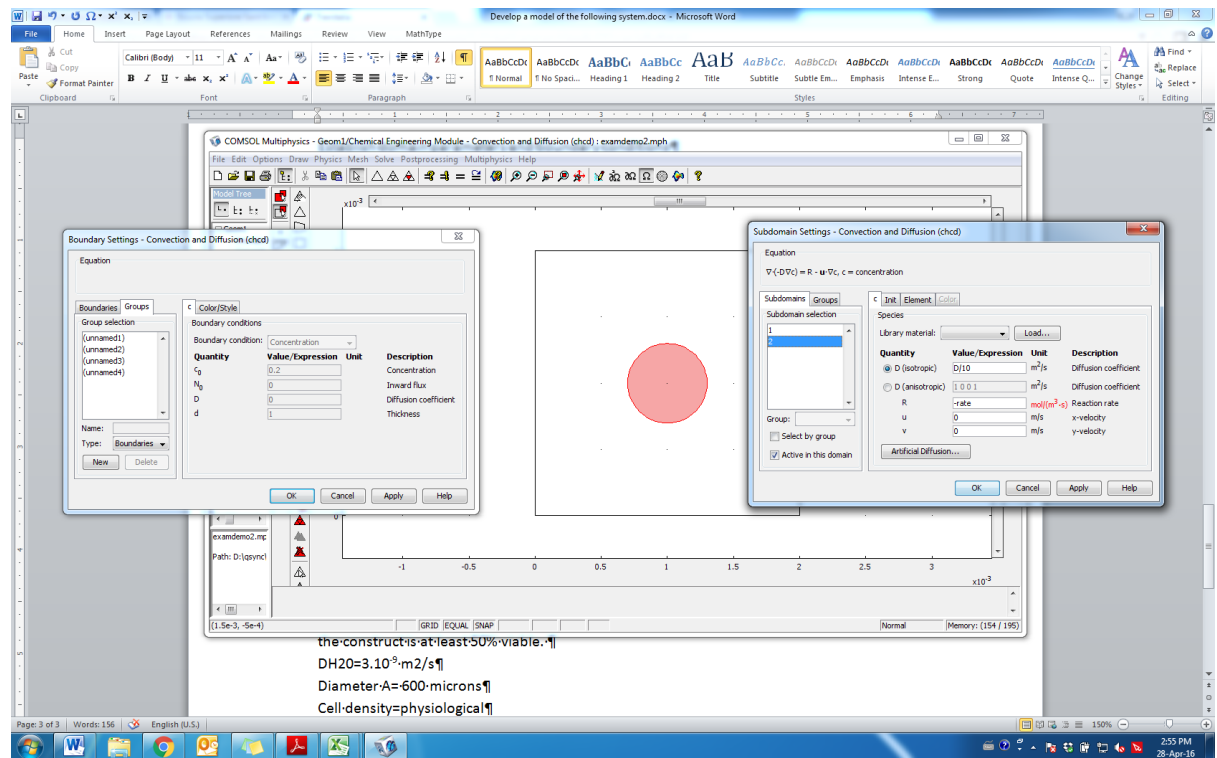
Name	Expression	Value	Description
D	$3e-9[m^2/s]$	$3e-9[m^2]$	
Rho	7144	7144	kg/m^3 , physiological
OCR	$3e-17[mole/s]$	$3e-17[mol]$	
Km	$0.01[mole/m^3]$	$0.01[mol/m^3]$	
Q	$0.001[mole/m^3]$	$0.001[mol/m^3]$	
T	$310[K]$	$310[K]$	

Below the dialog, the text 'Add-constants' is visible on the page.

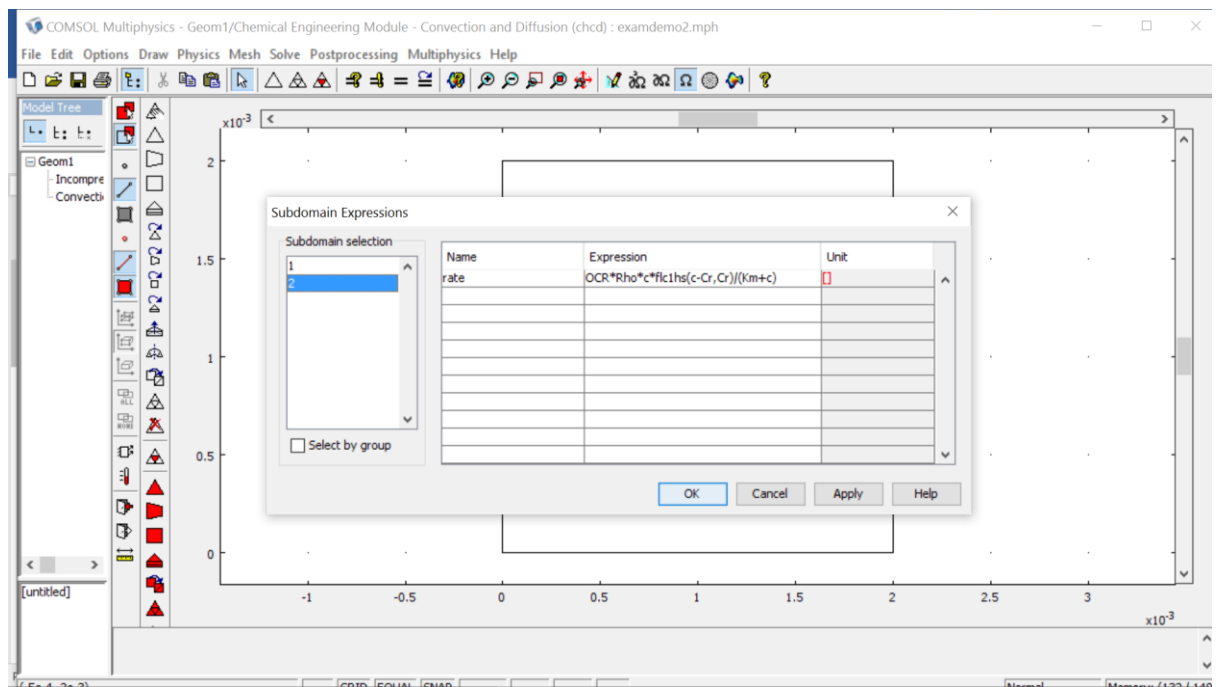
Draw domains

The 'Draw' domain tool is active, showing a 2D plot with a grid. A red rectangular domain is labeled 'flow_chamber' and a circular domain is labeled 'gel_construct'. The axes are labeled $x10^3$ and $x10^2$.

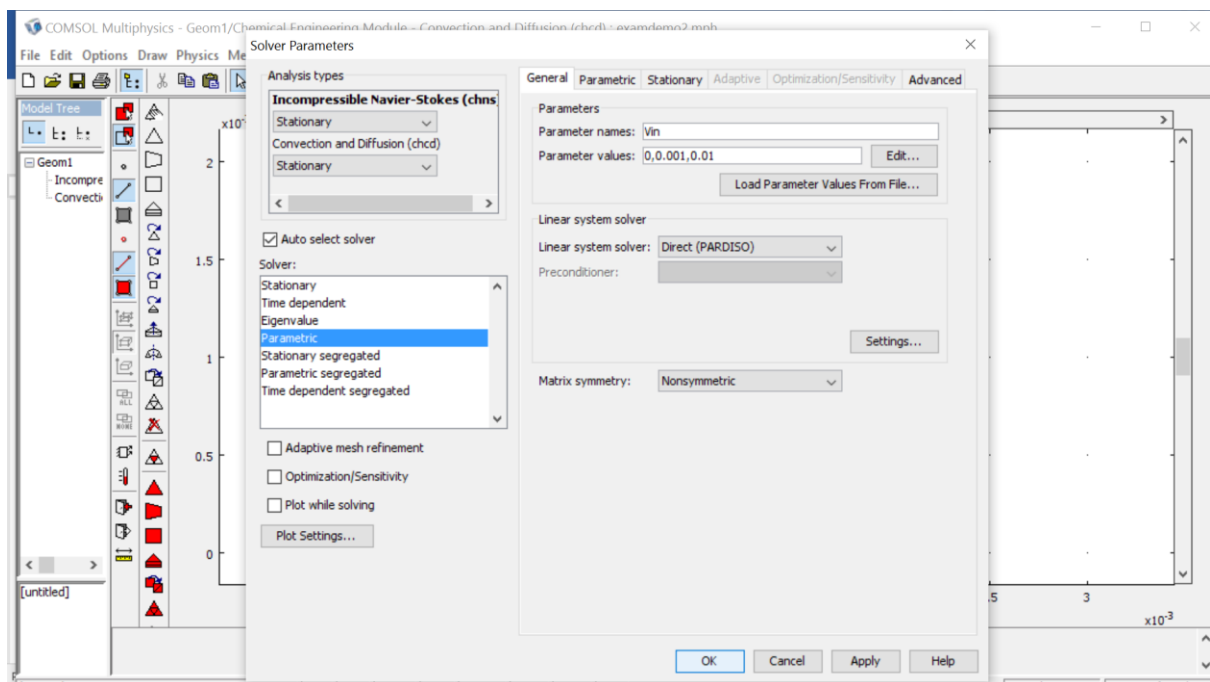
Establish domain parameters and boundary conditions, convection and diffusion and Navier Stokes



Establish the rate expression in the construct subdomain

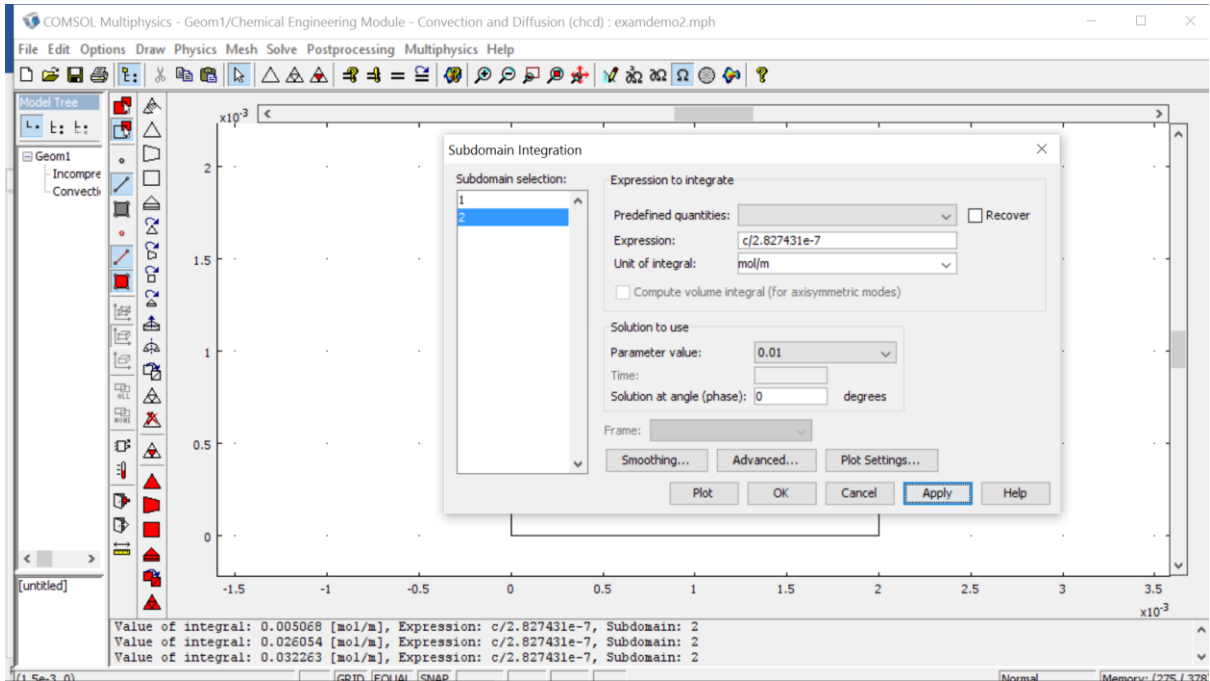


Implement the parametric solver

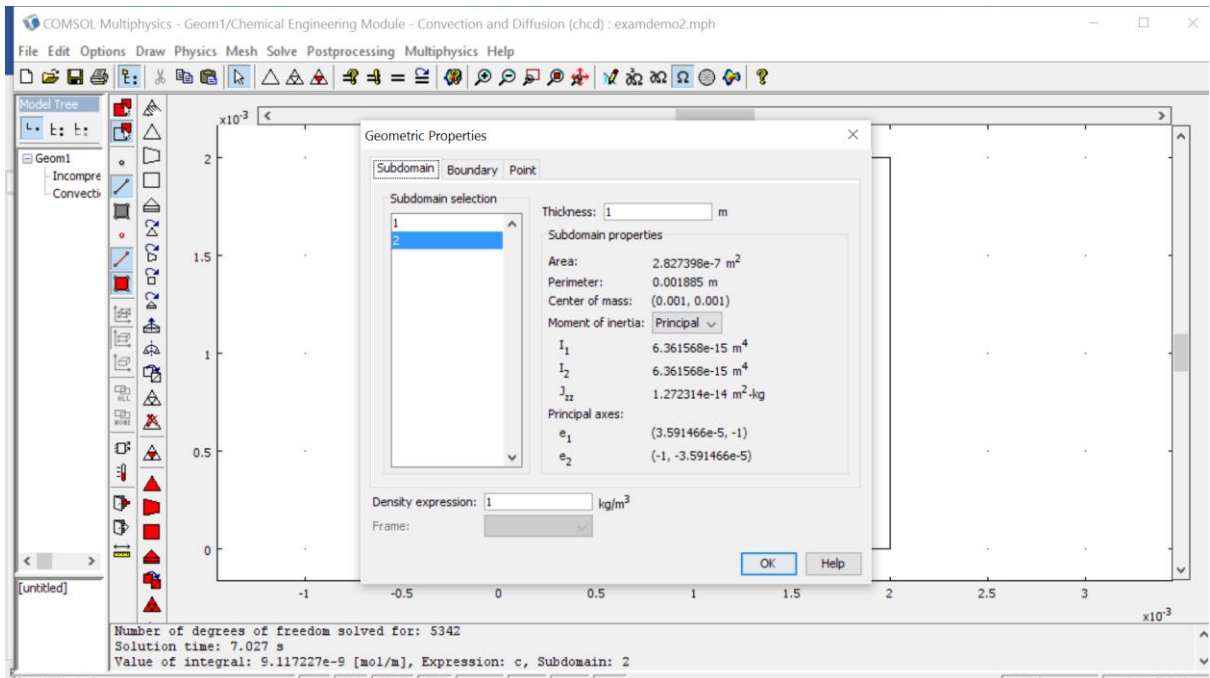


Mesh and solve.

To calculate the % viability for the construct, use the postprocessing menu. In particular, subdomain integration of the concentration in 2D is the integration of concentration over area (moles/m³ *m²=moles/m). To convert this into an average concentration in the construct you need to multiply by its surface area. I have done this below for the 3 velocities.



The surface area is also available on the post processing menu (Geometric properties)



To determine the fraction of the construct which has a concentration above 0.02 mM we can integrate only for C>0.02 mM. Below the result: for Vin=0 m/s, the fraction above 0.02 mM is 0.07,

and increases to 0.36 (36%) for $V_{in}=0.01$ m/s. The calculation can be verified by working out the integral of c and then $c>0.2$ and dividing the former by the latter.

