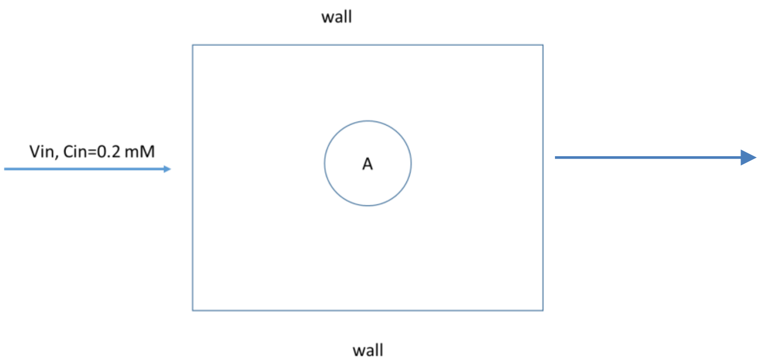
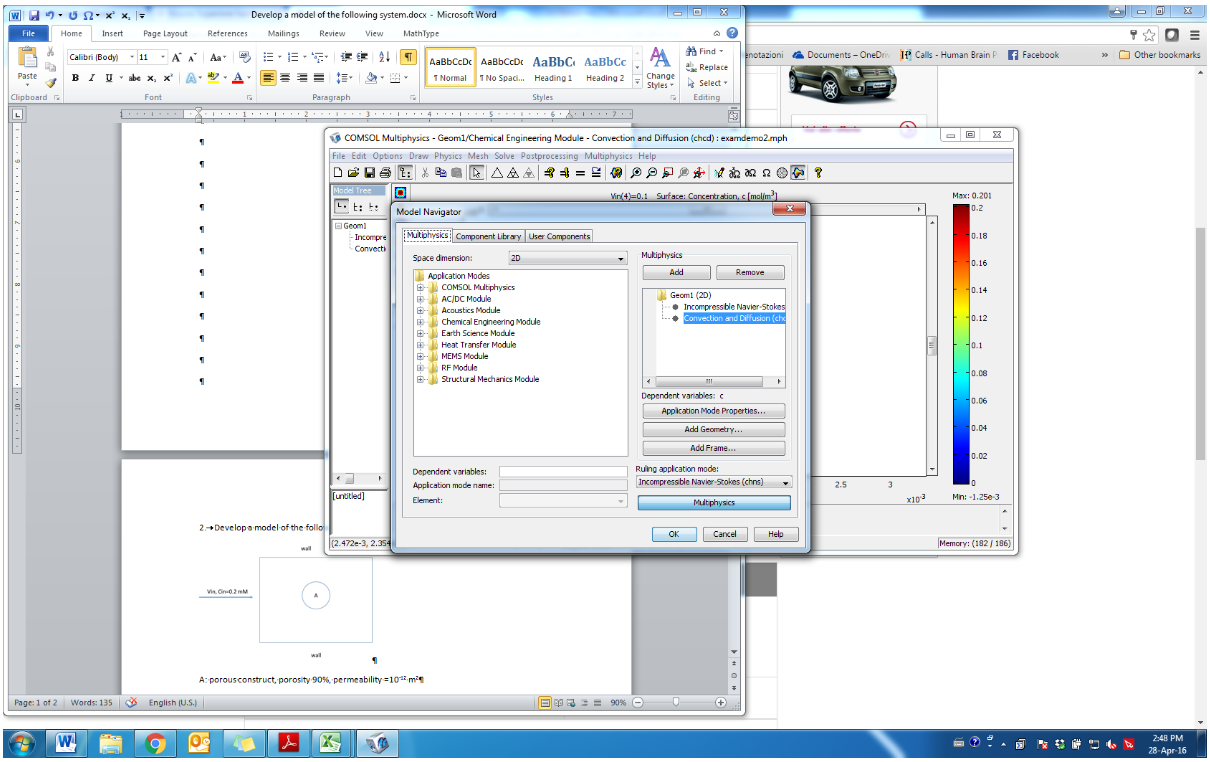
1. Develop a model of the following system in2D.



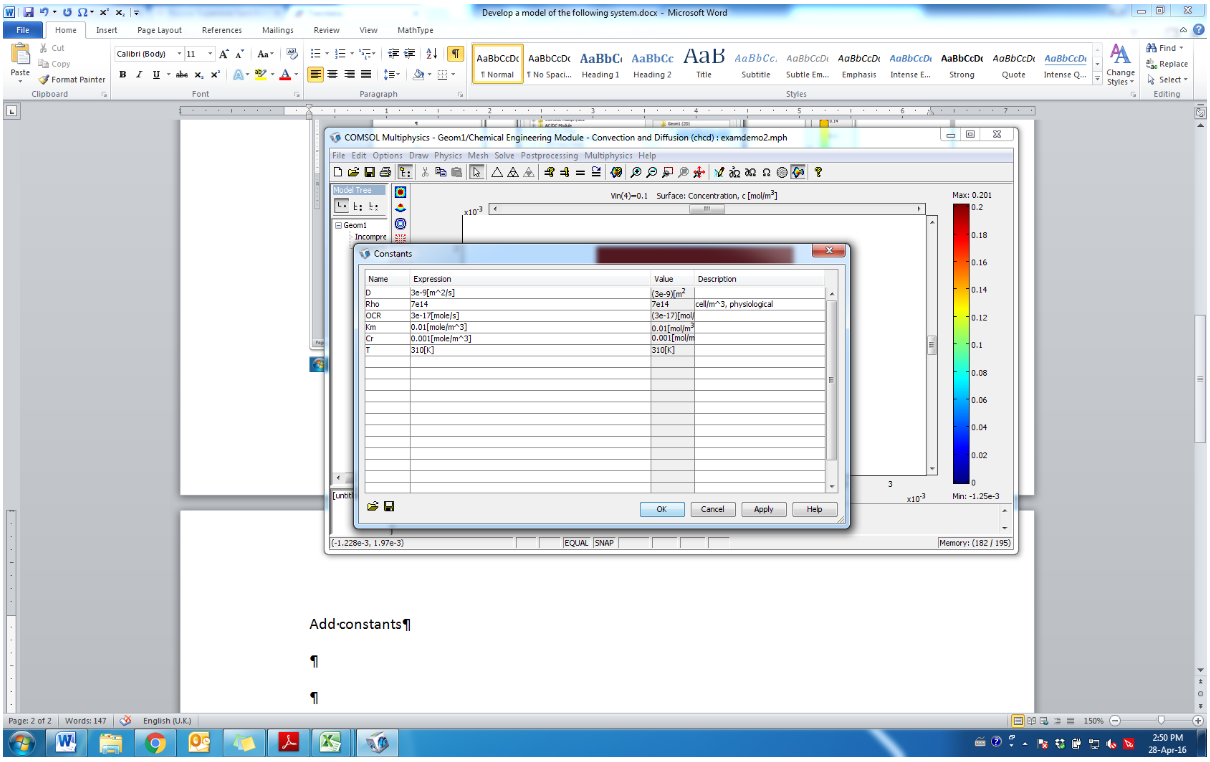
A: gel construct with cells, no pores i.e. no flow, Doxygen=1/10 that in water. The box has sides of 2 mm. The flow is fully developed.

Using the following conditions determine the % viability as a function of Vin.
D oxygen in H20=3.10^{-9} m2/s
Diameter A= 600 microns
Cell density=physiological
OCR=3.10^{-17} moles/cell.s
Km=0.01 mM
Critical Oxygen=0.001 mM, below this cells are dead and cannot consume oxygen
Minimum oxygen for viability=0.02 mM

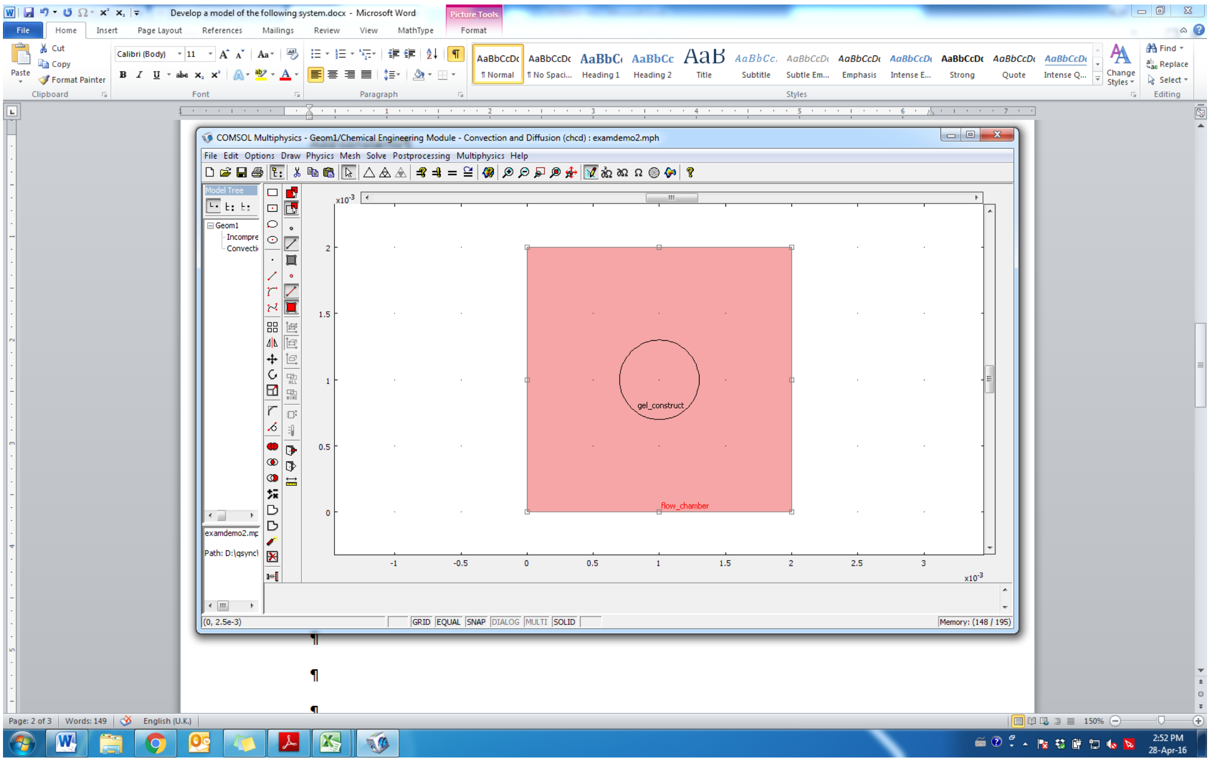
OPEN 2D and add 2 modes, Navier Stokes and Convection diffusion



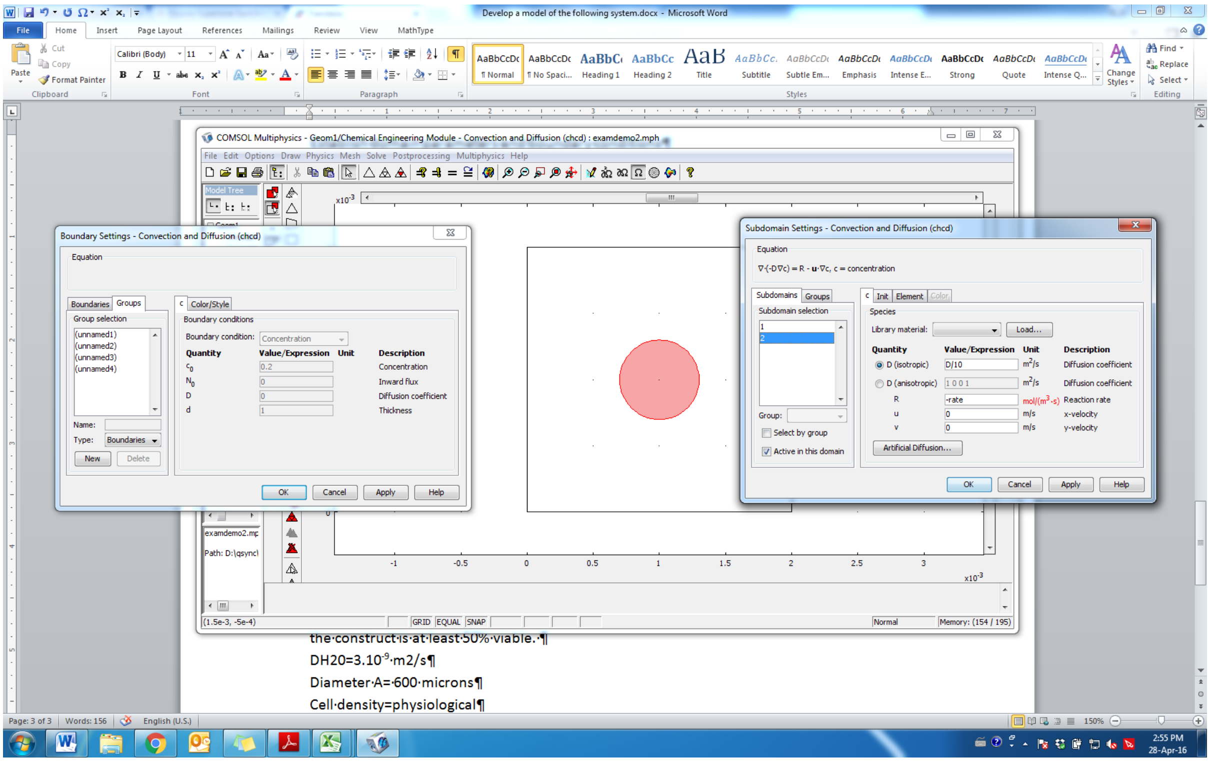
Add constants

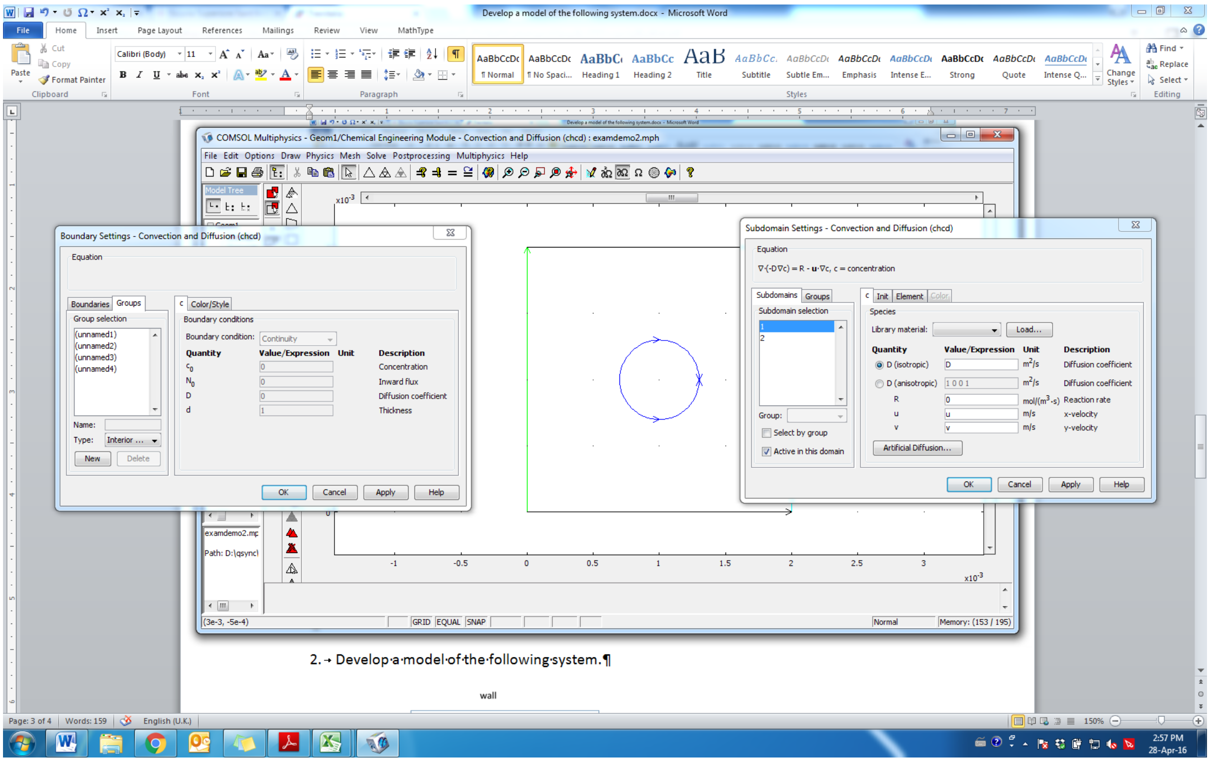


Draw domains

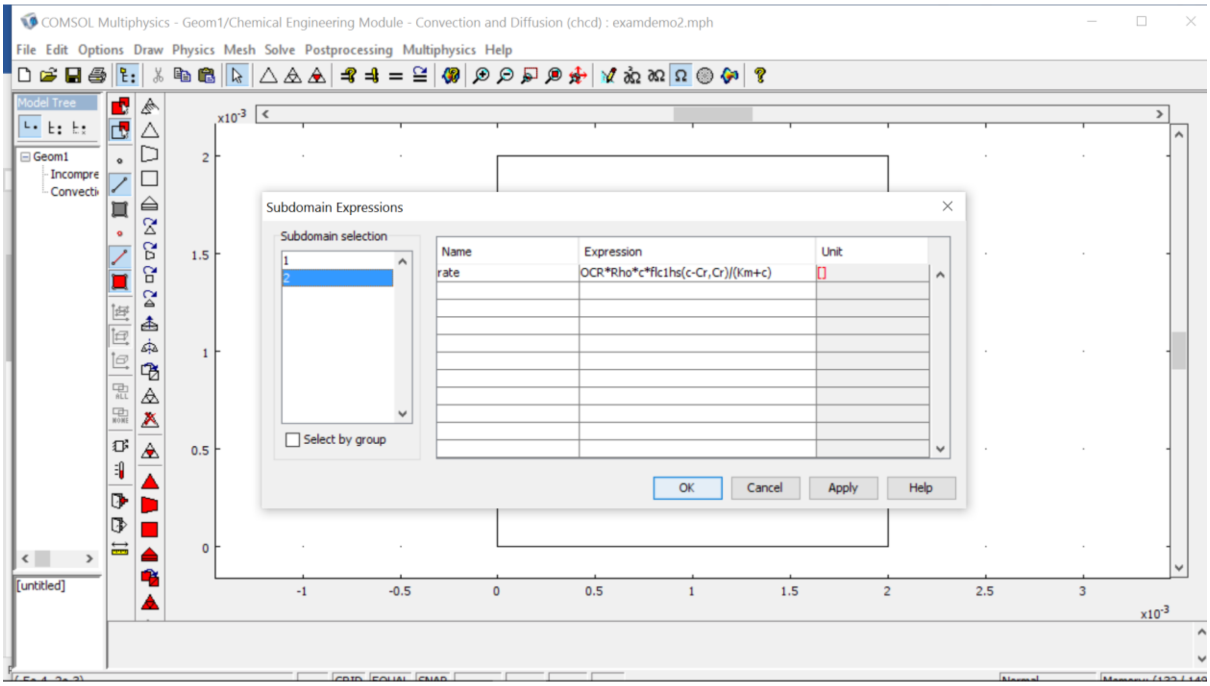


Establish domain parameters and boundary conditions, convection and diffusion and Navier Stokes

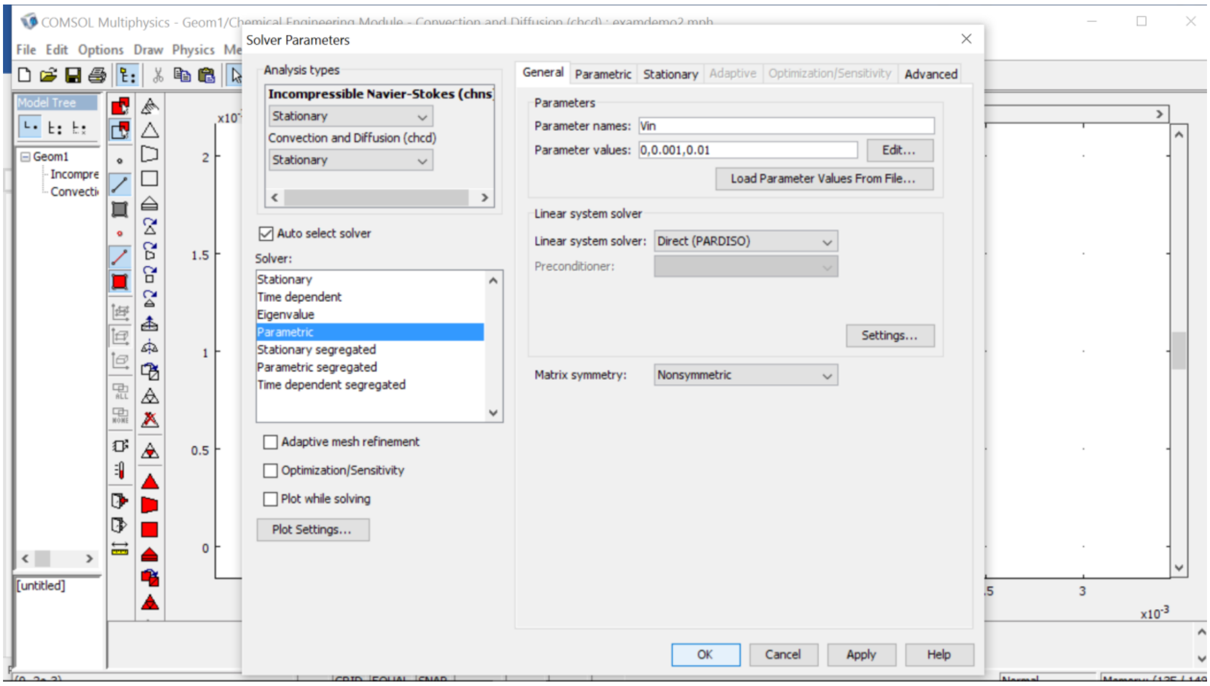




Establish the rate expression in the construct subdomain

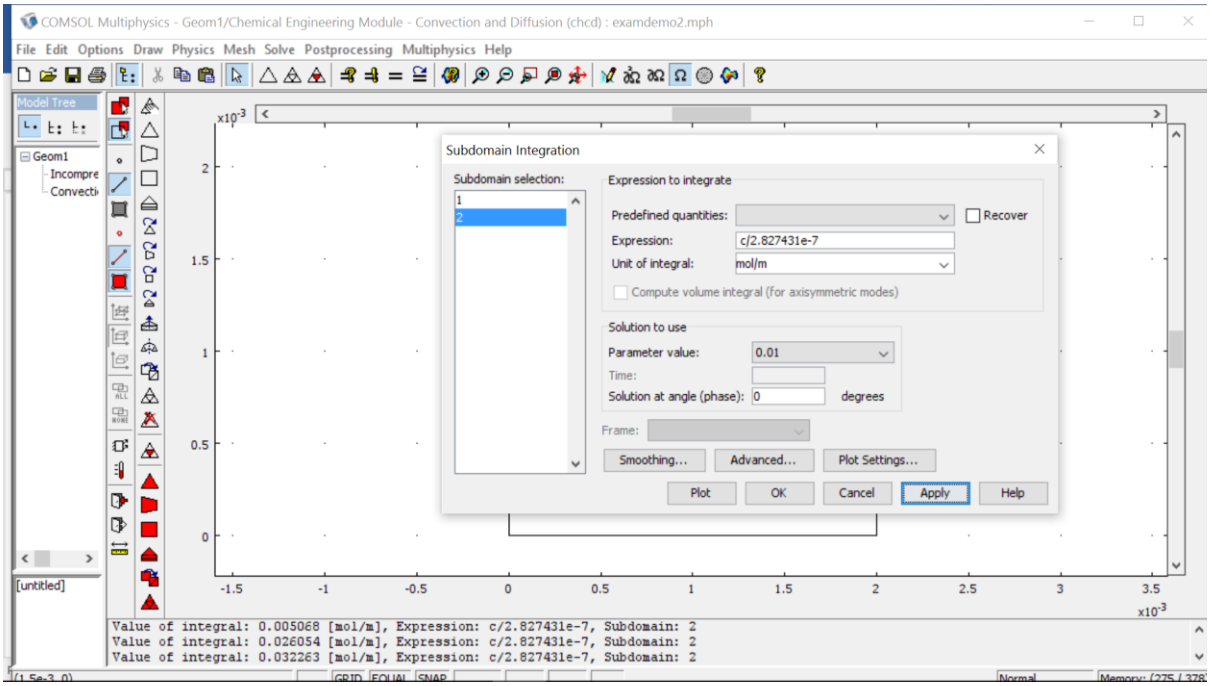


Implement the parametric solver

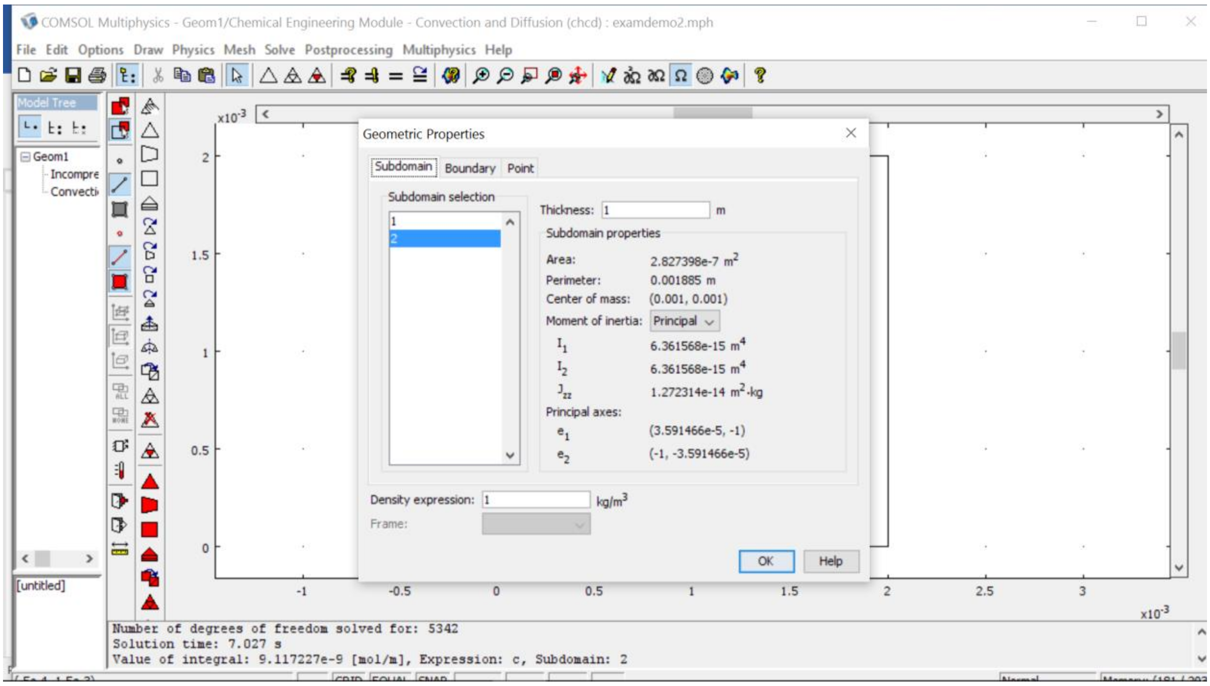


Mesh and solve.

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/m^3 *m^2=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 Vin=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.