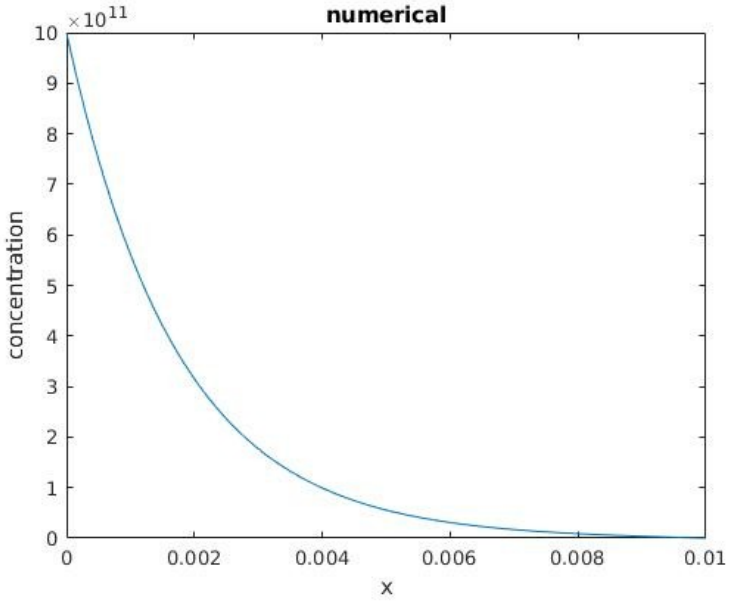
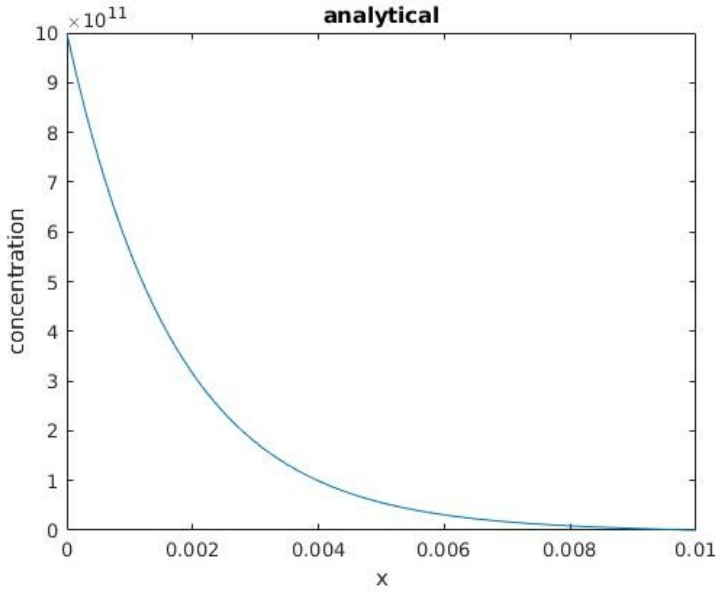
EE 735: ASSIGNMENT 4 REPORT

NAME: DIMPLE KOCHAR
ROLL NO.: 16D070010

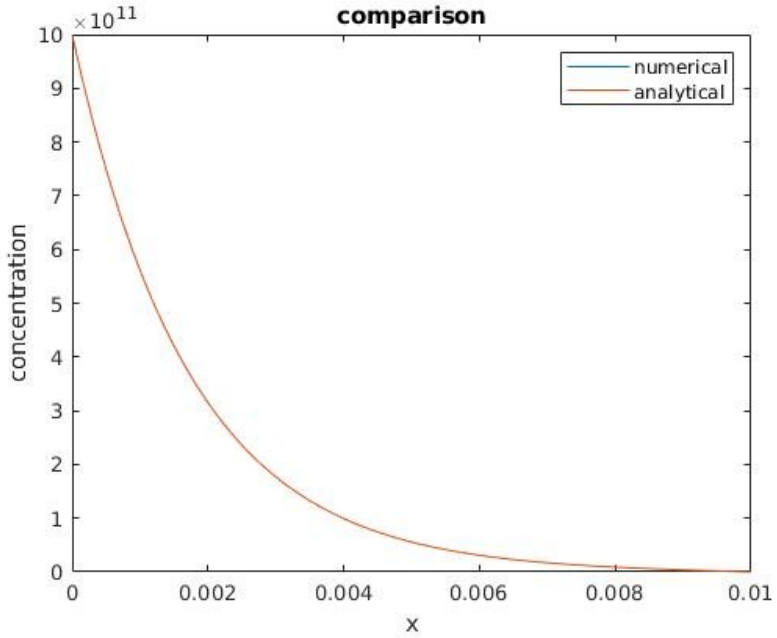
Note: Analytical solutions of all problems are at end. All concentrations (meaning density) are in cm^{-3} and x is in cm in plots.

Q1 a)



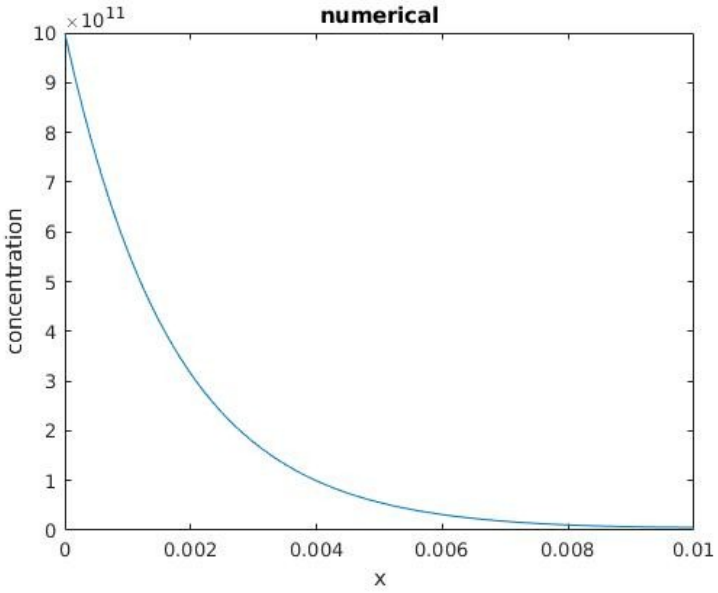


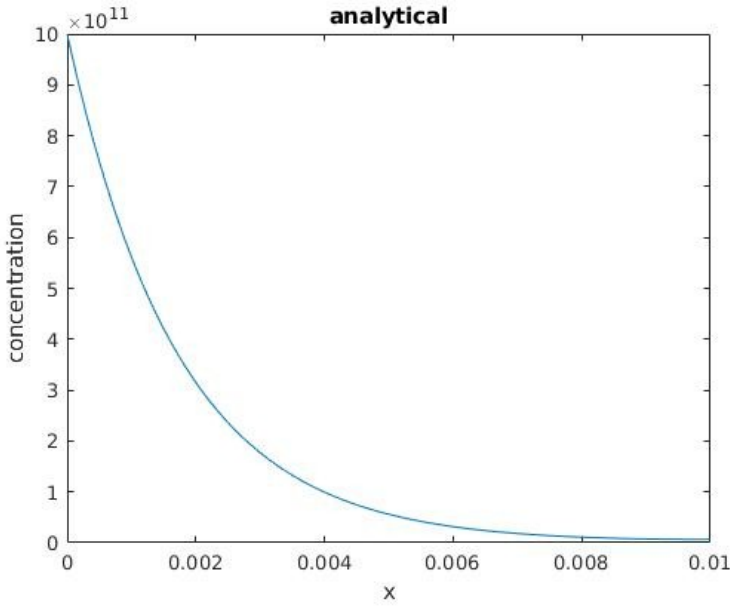
Comparing these two plots by plotting them together, we see that they superimpose each other



flux at A = $-1.72709*10^{16}$
flux at B = $-1.07696*10^{14}$
flux from A to B =
flux at B – flux at A =
$1.71632*10^{16}$

Q1 b)





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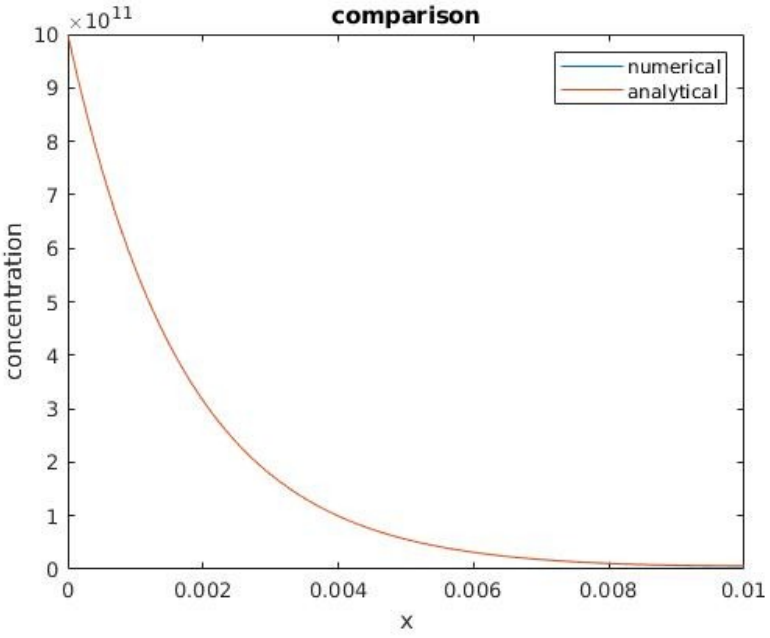
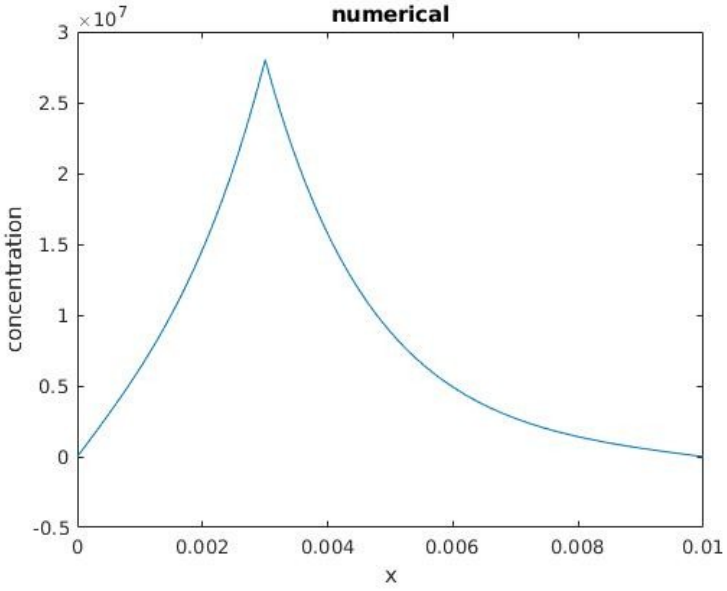
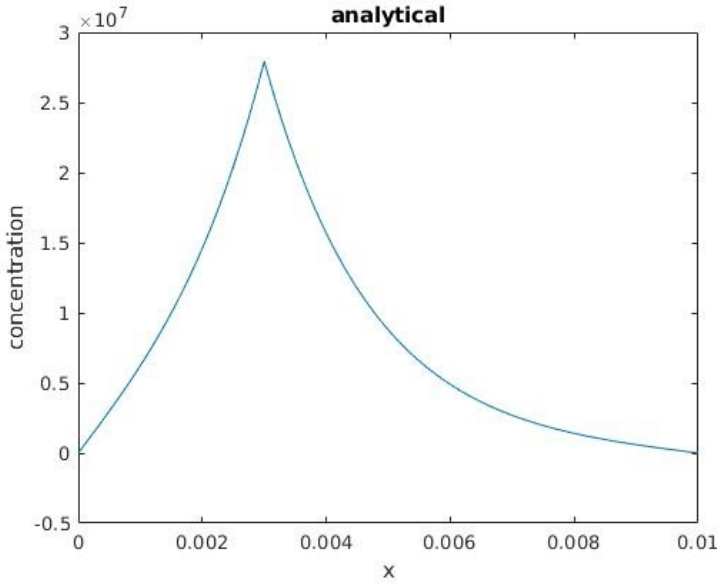


flux at A = $-1.7270*10^{16}$
flux at B = $-5.8944*10^{12}$
flux from A to B =
flux at B – flux at A =
$1.72643*10^{16}$

Using this boundary results in nearly same flux at A and same flux from A to B. However, flux at B changes due to this boundary condition as outgoing flux becomes a function of density at B.

Q1 c)





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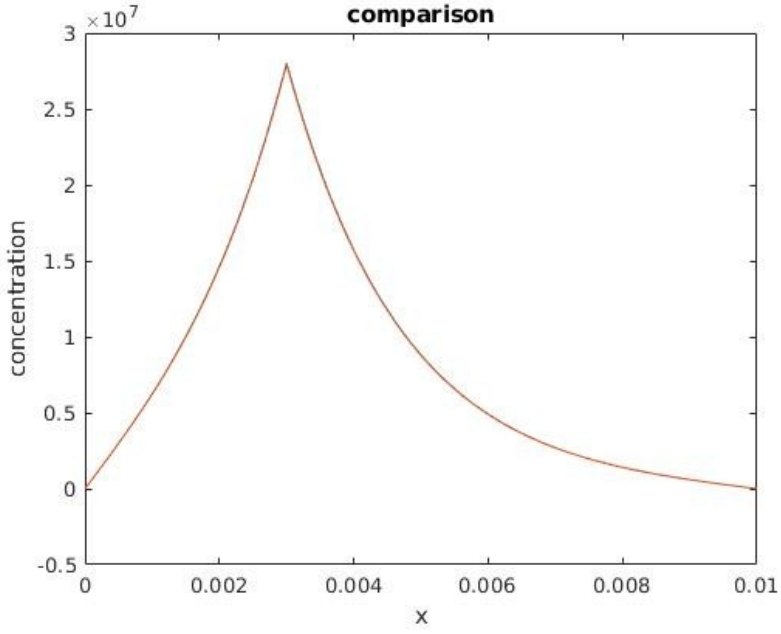


flux at A = $1.7736*10^{11}$
flux at B = $-1.7067*10^{10}$

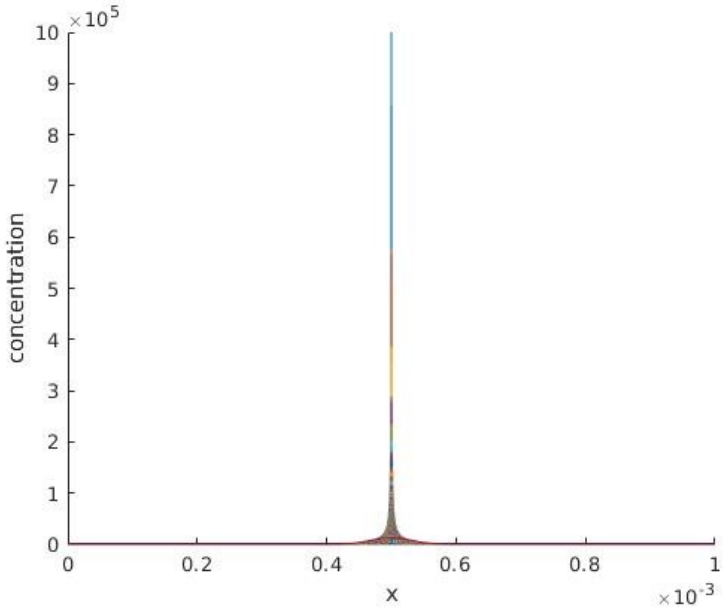
Q2

We take N = 1001 gridpoints from x = 0 to 10^{-3} cm. So, h = 10^{-6} cm

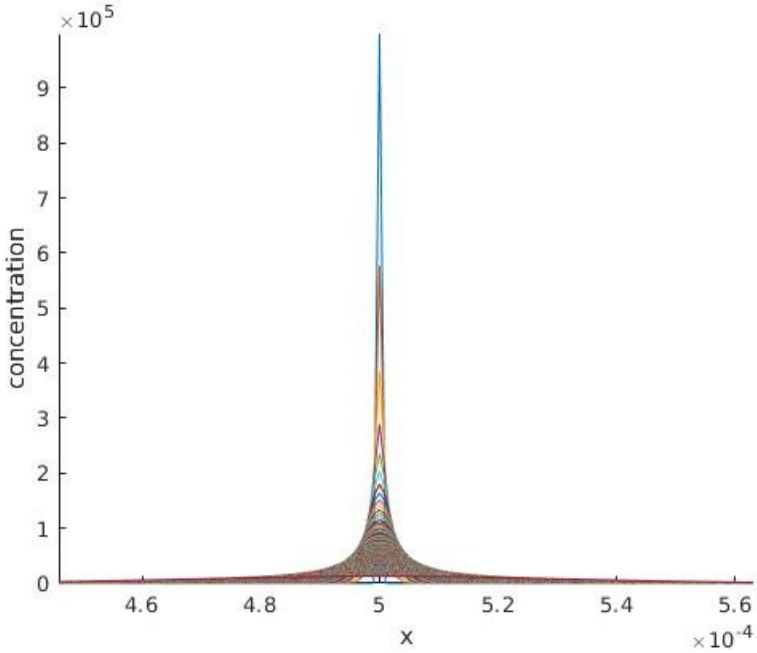
This gives us p = $5*10^{-9}$ sec

Running for 1000 such time steps, means we run till = $5*10^{-6}$ sec

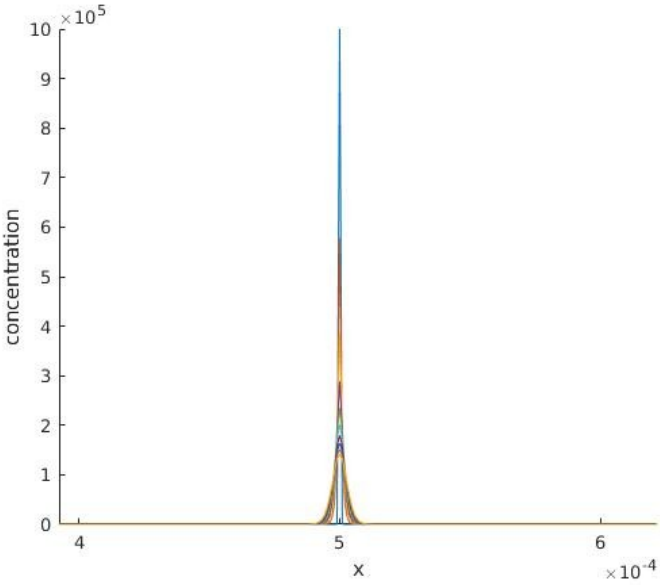
All 1001 graphs:



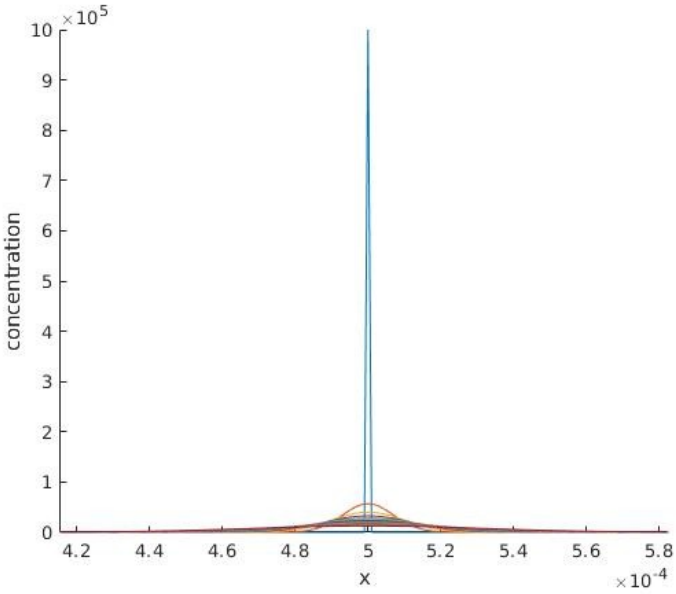
Zoomed plot:



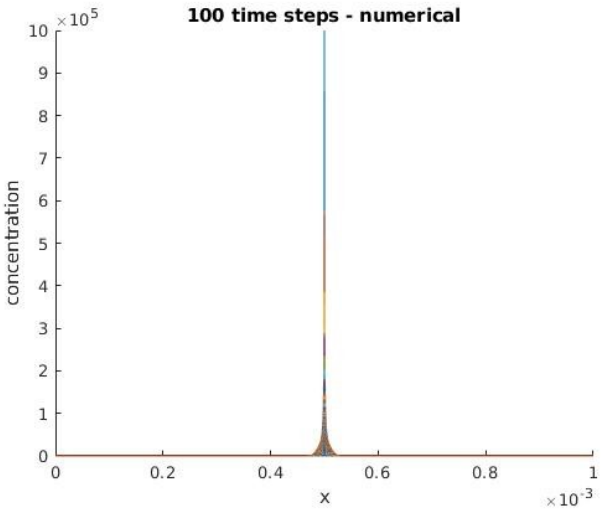
1st 10 plots:

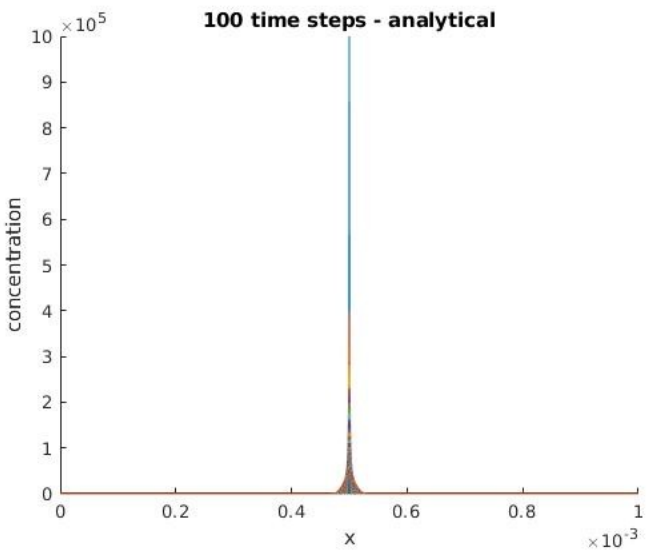


plots after 0.25us intervals (21 plots)



Comparison with analytical:





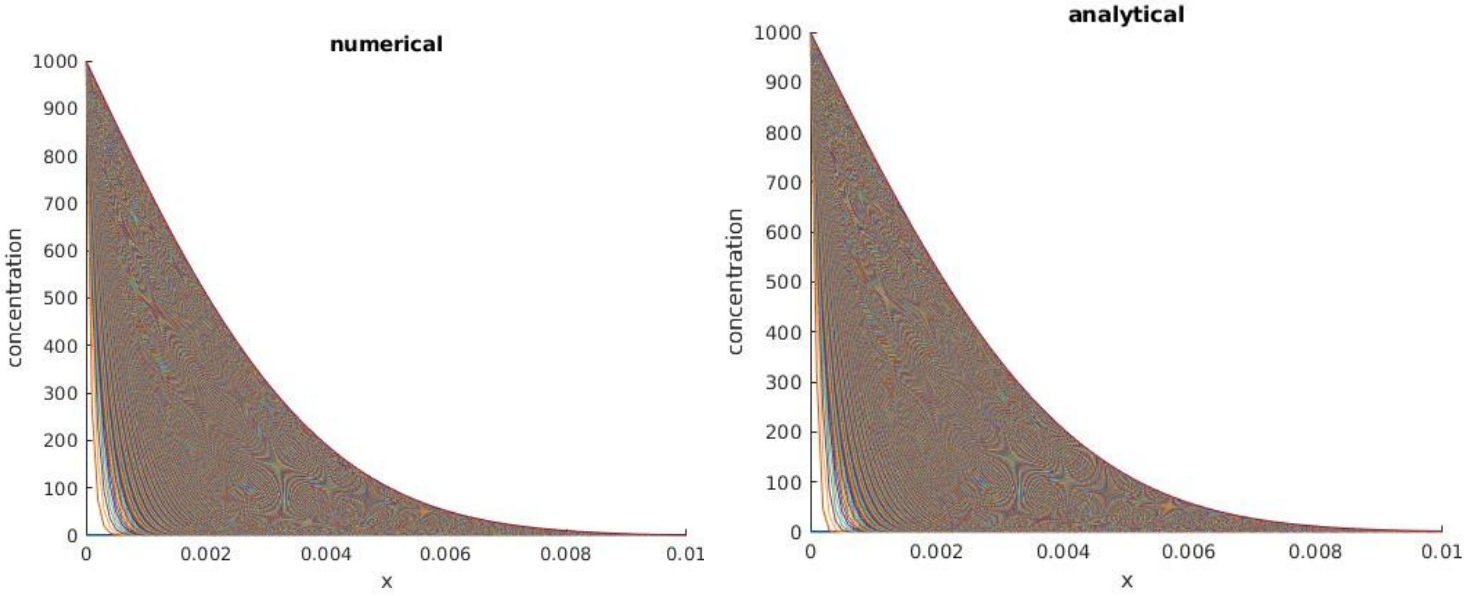
I don’t get exactly matched numbers, but their order is same as that of analytical.

As we see in our analytical solution, we have a gaussian profile with $sigma^2 = 2*D*t$, i.e. profile has a variance which is time dependent. As time passes and variance increases, we see the graph has flattened more which is expected due to diffusion. Increasing D too results in faster flattening as compared to this graph.

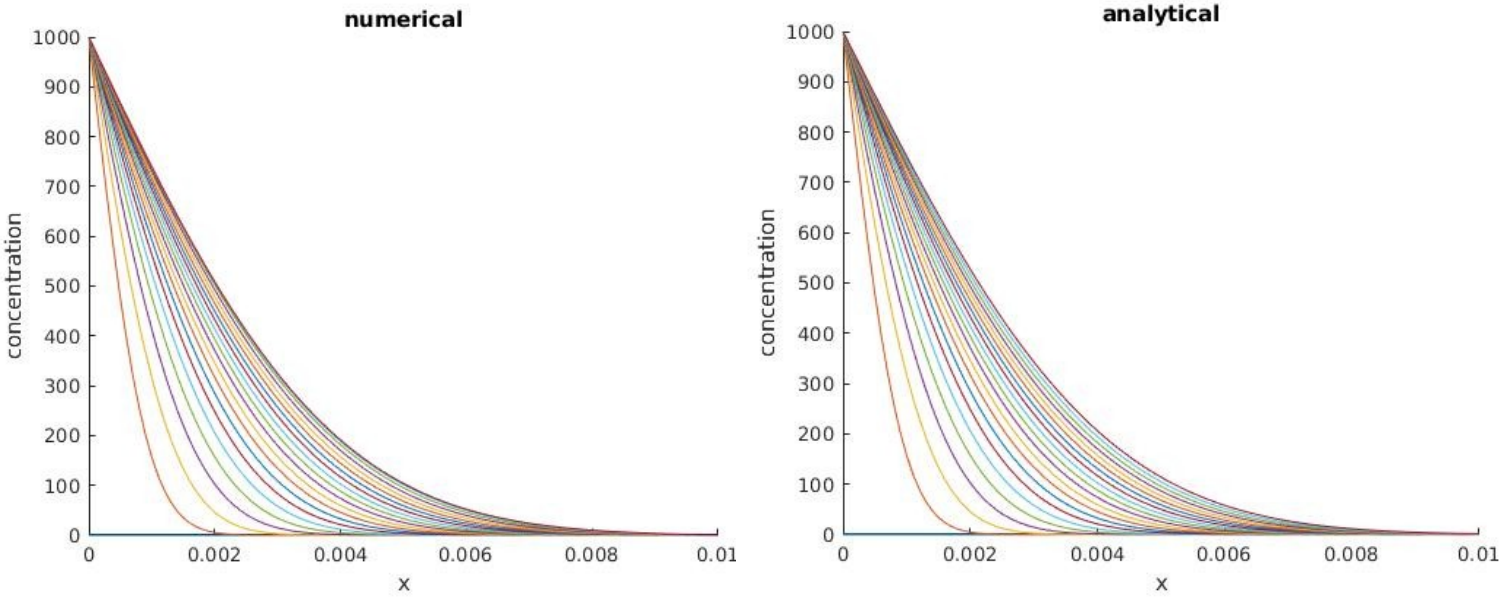
Q3.

We take N = 101 gridpoints from x = 0 to 10^{-2} cm. So, h = 10^{-4} cm
This gives us p = $1.6667*10^{-10}$ sec
Running for 1000 such time steps, means we run till = $1.6667*10^{-7}$ sec

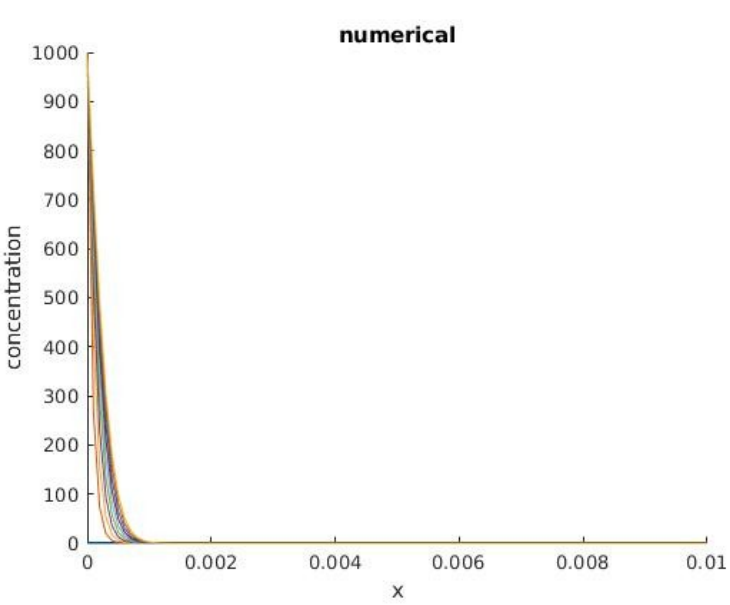
Plotting all 1001 plots and comparing with analytical:(1st plot all 0-inital)

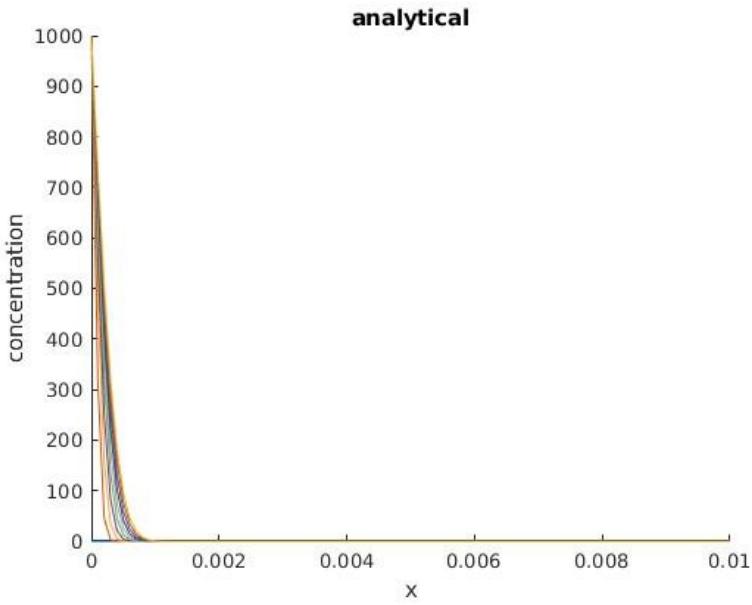


plots after 2.5ms intervals (21 plots) (1st plot all 0-inital)



1st 10 plots:

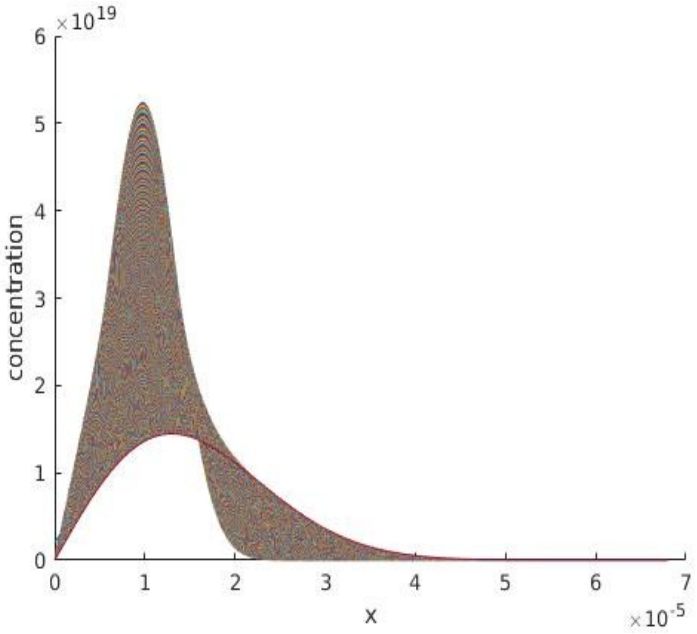


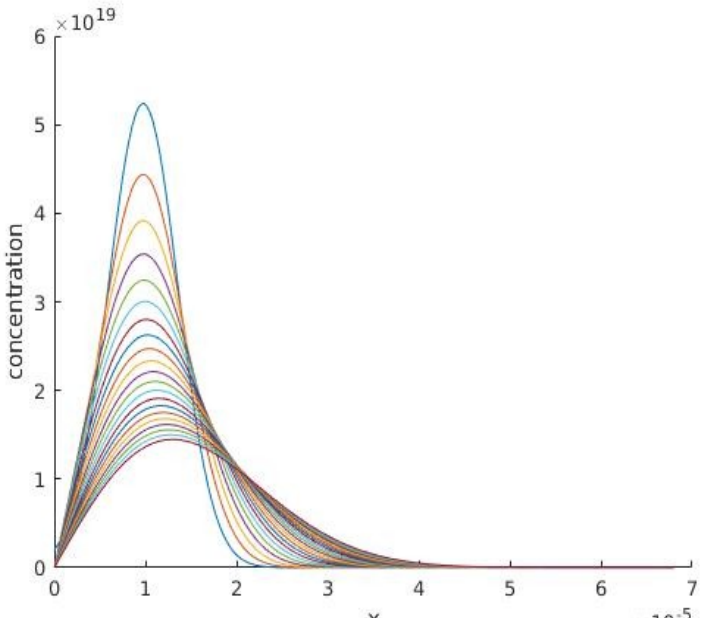


Q4.

Ea = 3.69 eV, D_0 = 10.5 cm^2/sec

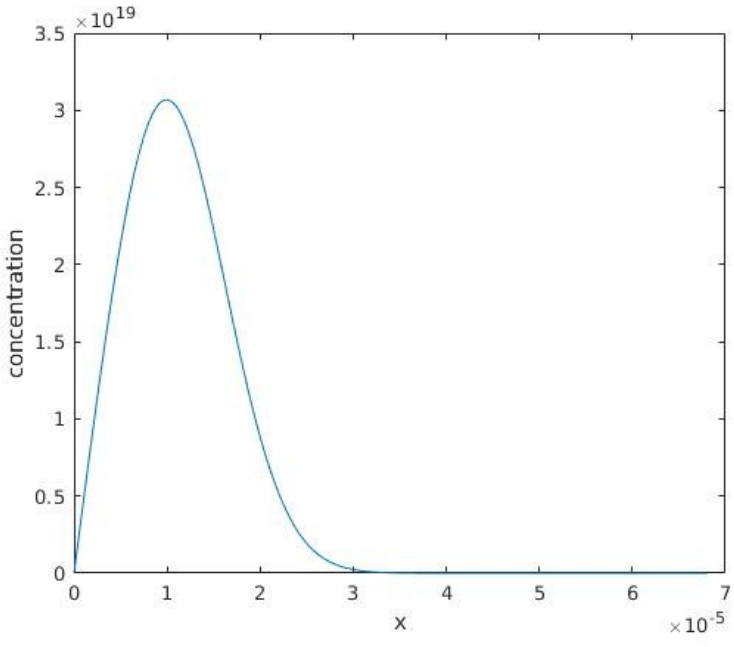
Keeping neumann boundary conditions at right boundary and keeping left boundary at n=0 (using neumann boundary at left boundary also doesn't change thermal budget

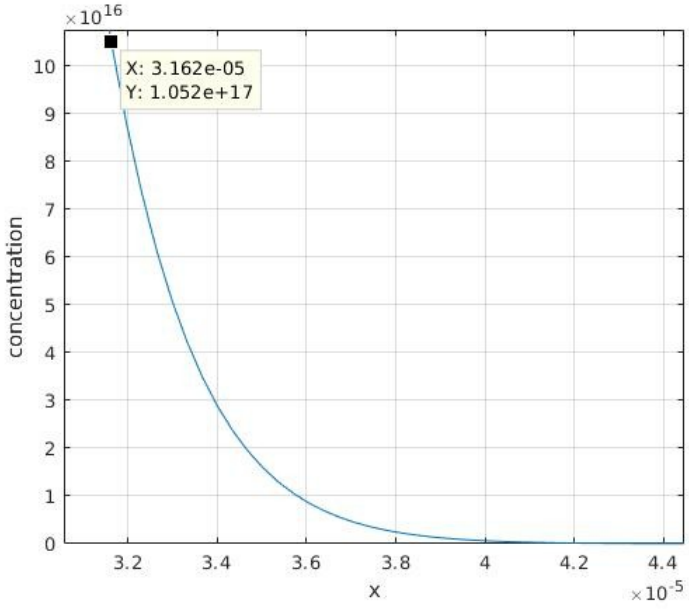


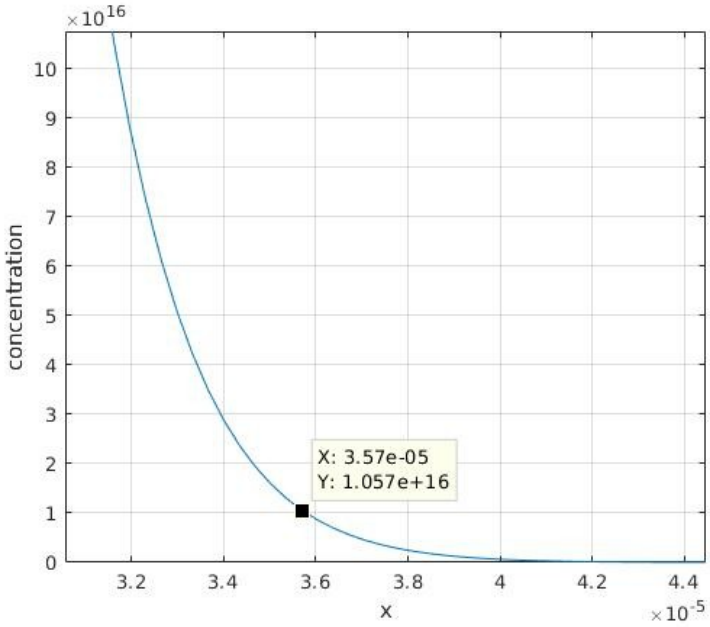


Thermal Budget = $1.36408*10^{-11}$ cm^2

At 1000 degrees celsius, when slope roll off is 40nm/decade at junction depth:







(slight error in answer due to numerical inaccuracies)

time (sec)	D (cm^2/sec)	Temperacture (celsius)
512.0253	$2.6641*10^{-14}$	1000
$1.4132*10^{12}$	$9.6526*10^{-24}$	500
0.0392	$3.4804*10^{-10}$	1500