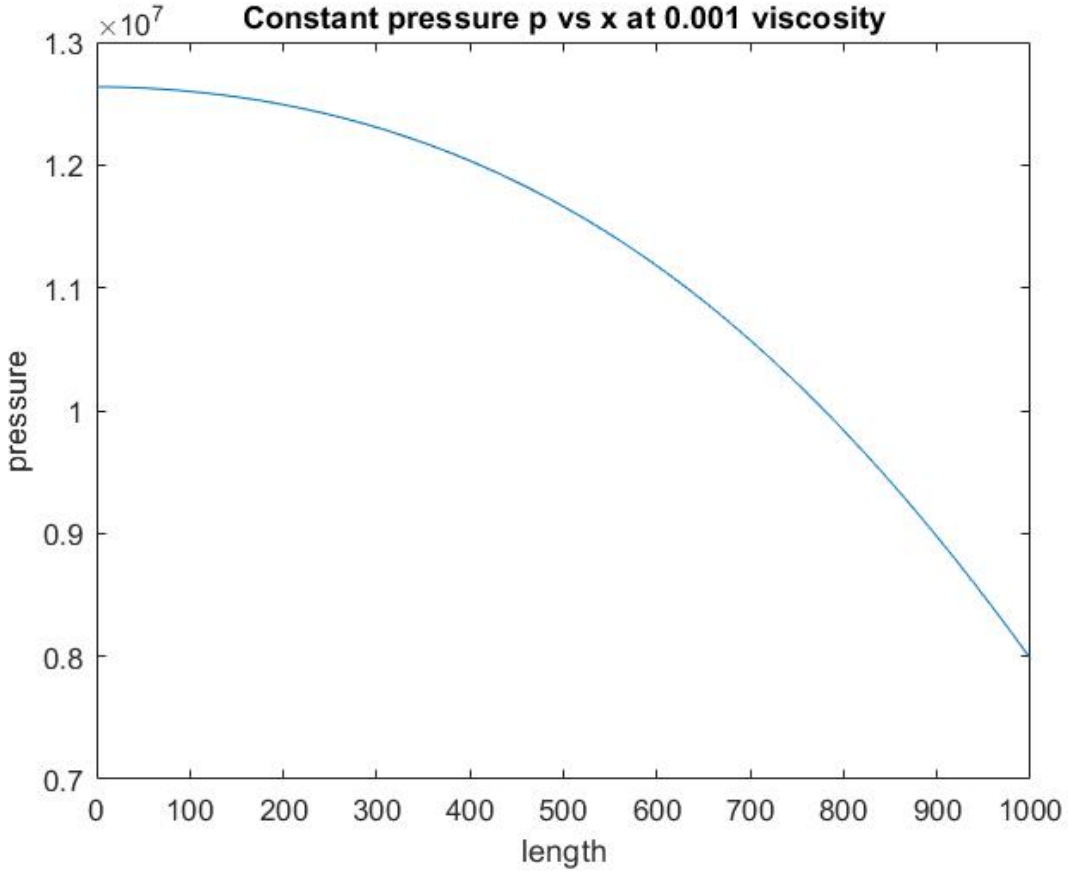
Project Report -Tejash

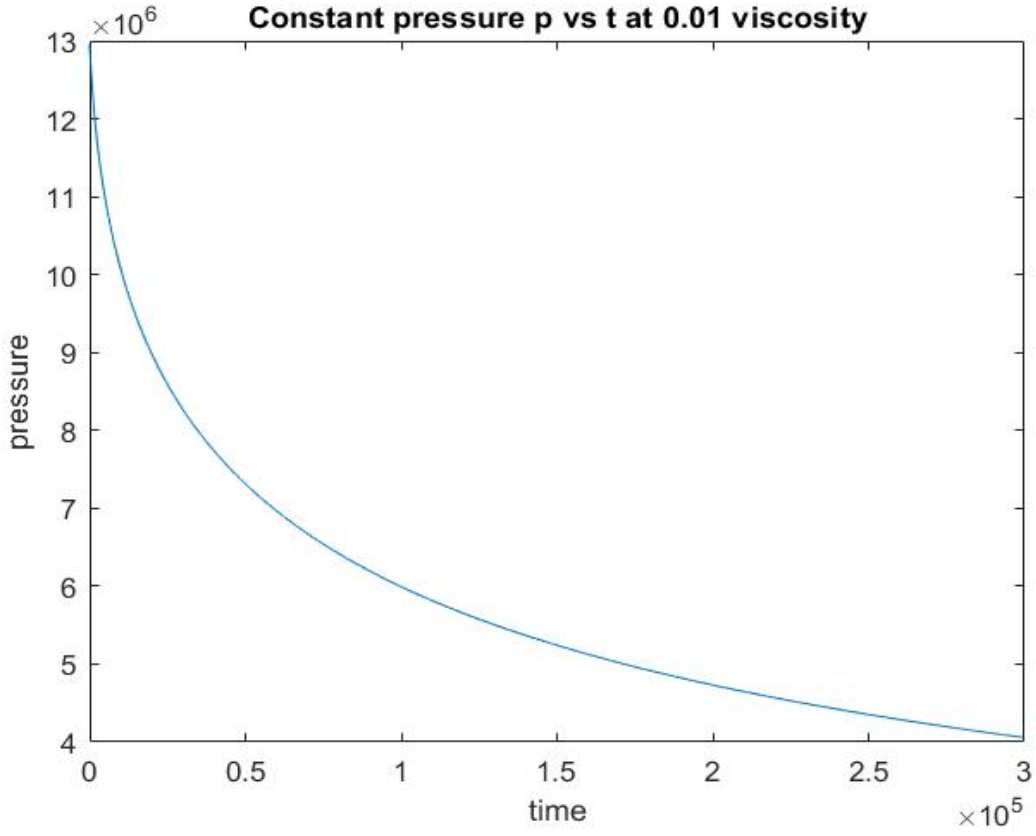
Part-A

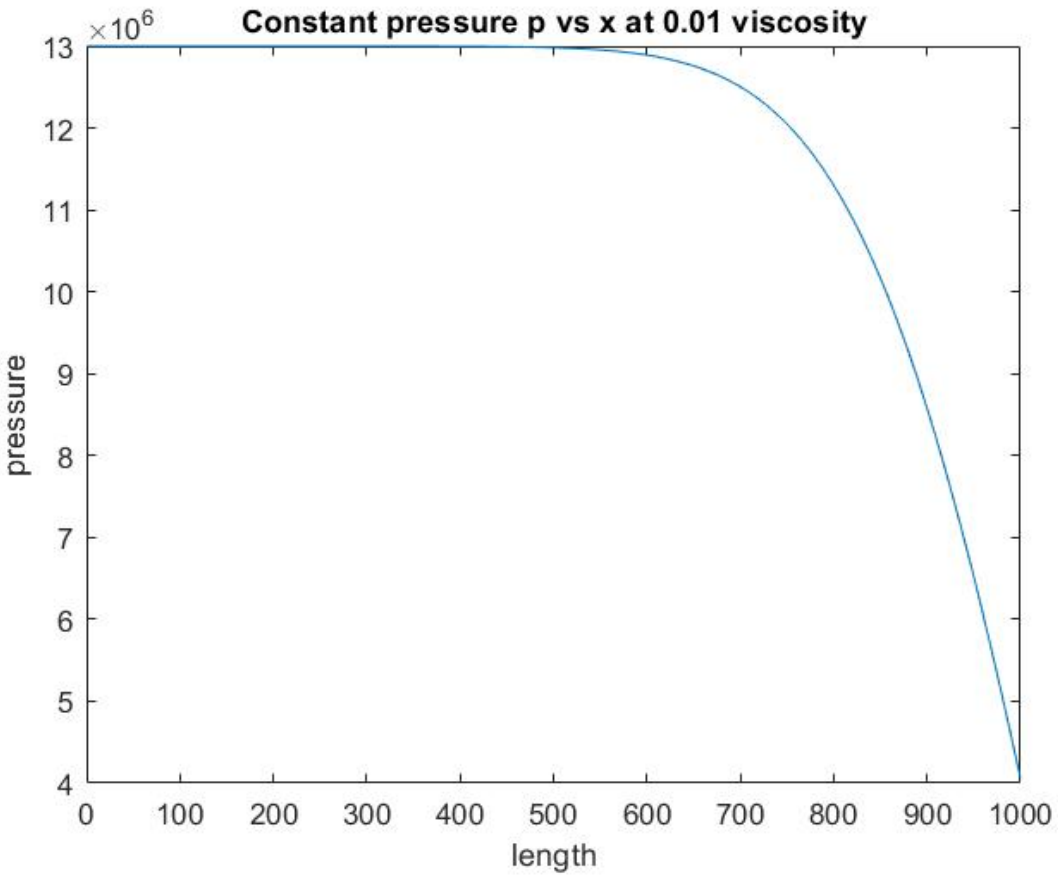
```
clear
clc
%% Define all constants
k = 9.6*10^-14;
phi = 0.1;
l = 1000;
w = 100;
th = 10;
J = 1.3*10^-10;
Ct = 2*10^-9;
pBHP = 0.1*10^6;
dt = 50;
Nx = 100;Ny = 1;
dx = l/Nx;
V = dx*w*th;
Vp = V*phi;
x = linspace(0,1000,Nx);
dy = w/Ny;
tf = 3*10^5;
ts = tf/dt;
tm = round(ts,0);
t = linspace(0,tf,tm);
p(1:Nx,1) = 13*10^6;

%% Now do calculation for 0.001 viscosity
eta_oil = 0.001;
Tx = th*dy*k/(eta_oil*dx);

%Make LHS side matrix which contains tramissibility
T = zeros(Nx,Nx);
T(1,1) = (Vp*Ct) + (dt*Tx);
T(Nx,Nx) = (Vp*Ct) + dt*(Tx + J);
for i = 2:Nx-1
    T(i,i) = (Vp*Ct) + (2*dt*Tx);
end
for i = 2:Nx
    T(i,i-1) = -dt*Tx;
end
for i = 1:Nx-1
    T(i,i+1) = -dt*Tx;
end

%Make RHS side matrix
B = zeros(Nx,1);
pt = zeros(tm,1);
for i = 1:tm
    for j = 1:Nx
        if j==Nx
            B(j,1) = (Vp*Ct*p(j)) + (dt*J*pBHP);
        else
            B(j,1) = (Vp*Ct*p(j));
        end
    end
```

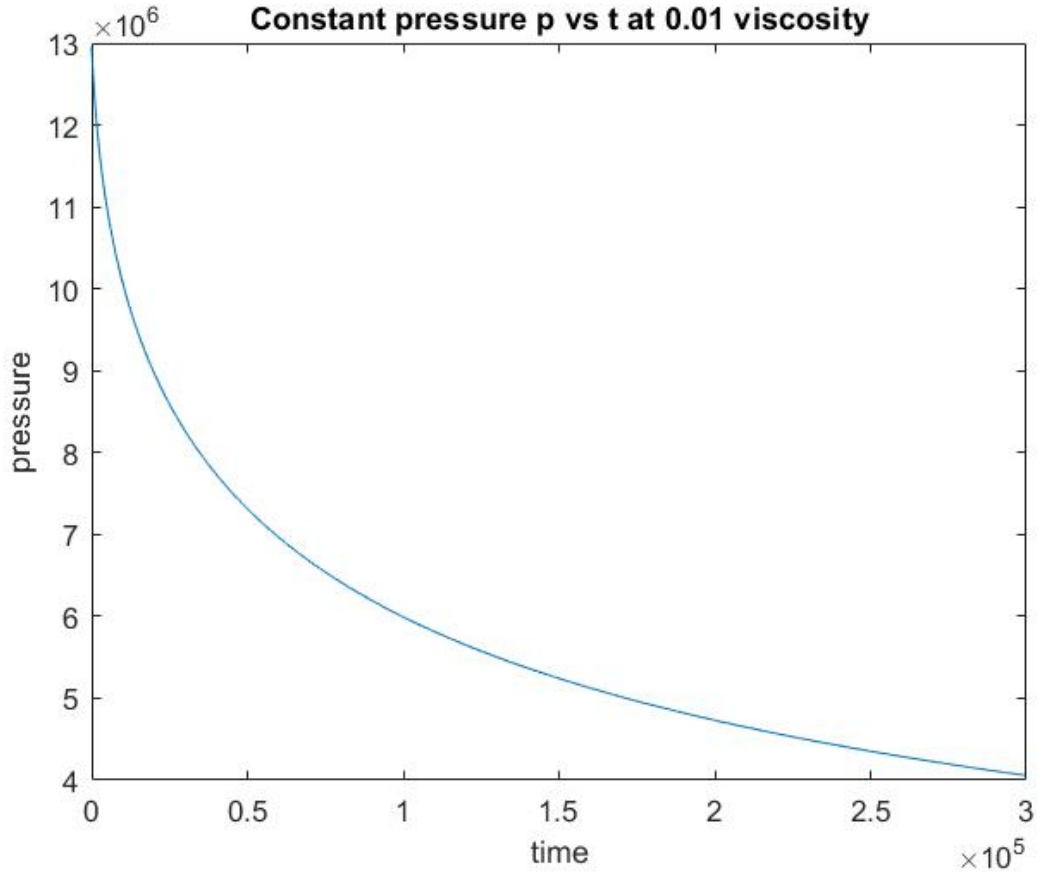
```
    %Now calculate new pressure
    p_ = T\B;
    pt(i,1) = p_(Nx,1);
    p = p_;
end

%Now plotting
figure(1)
plot(x,p_)
xlabel('length')
ylabel('pressure')
title('Constant pressure p vs x at 0.001 viscosity')
figure(2)
plot(t,pt)
xlabel('time')
ylabel('pressure')
title('Constant pressure p vs t at 0.001 viscosity')

%% Now do calculation for 0.01 viscosity
eta_new = 0.01;
Txnew = th*dy*k/(eta_new*dx);
pnew(1:Nx,1) = 13*10^6;

%Make LHS side matrix which contains tramissibility
Tnew = zeros(Nx,Nx);
Tnew(1,1) = (Vp*Ct) + (dt*Txnew);
Tnew(Nx,Nx) = (Vp*Ct) + dt*(Txnew + J);
for i = 2:Nx-1
    Tnew(i,i) = (Vp*Ct) + (2*dt*Txnew);
end
for i = 2:Nx
    Tnew(i,i-1) = -dt*Txnew;
end
for i = 1:Nx-1
    Tnew(i,i+1) = -dt*Txnew;
end


%% Make RHS side matrix
Bnew = zeros(Nx,1);
ptnew = zeros(tm,1);
for i = 1:tm
    for j = 1:Nx
        if j == Nx
            Bnew(j,1) = (Vp*Ct*pnew(j)) + (dt*J*pBHP);
        else
            Bnew(j,1) = (Vp*Ct*pnew(j));
        end
    end

    %Now calculate new pressure
    pnew_ = Tnew\Bnew;
    ptnew(i,1) = pnew_(Nx,1);
    pnew = pnew_;
end

%Now plotting
figure(3)
```

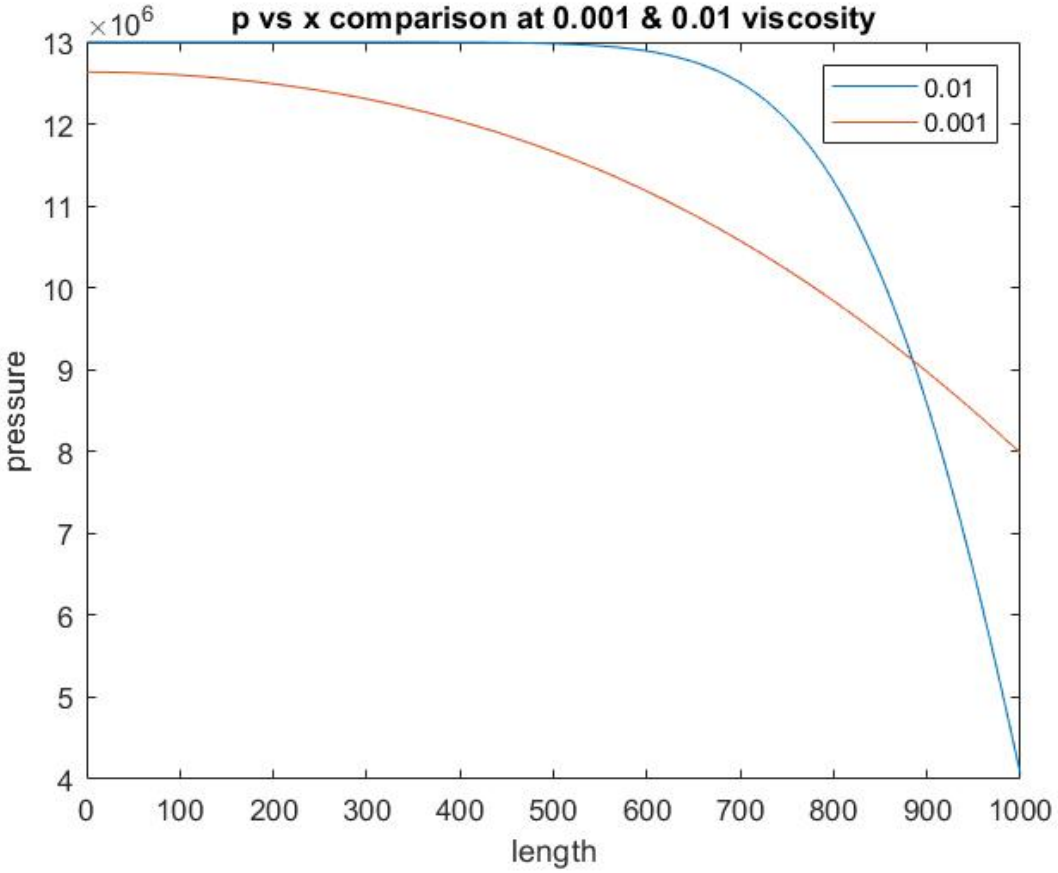
```
plot(x,transpose(pnew_))
xlabel('length')
ylabel('pressure')
title('Constant pressure p vs x at 0.01 viscosity')
figure(4)
plot(t,ptnew)
xlabel('time')
ylabel('pressure')
title('Constant pressure p vs t at 0.01 viscosity')

%% Comparing on one graph
figure(5)
plot(x,transpose(pnew_))
hold on
plot(x,p_)
legend('0.01','0.001')
xlabel('length')
ylabel('pressure')
title('p vs x comparison at 0.001 & 0.01 viscosity')
hold off

figure(6)
plot(t,ptnew)
hold on
plot(t,pt)
legend('0.01','0.001')
xlabel('time')
ylabel('pressure')
title('p vs t comparison at 0.001 & 0.01 viscosity')
hold off
```

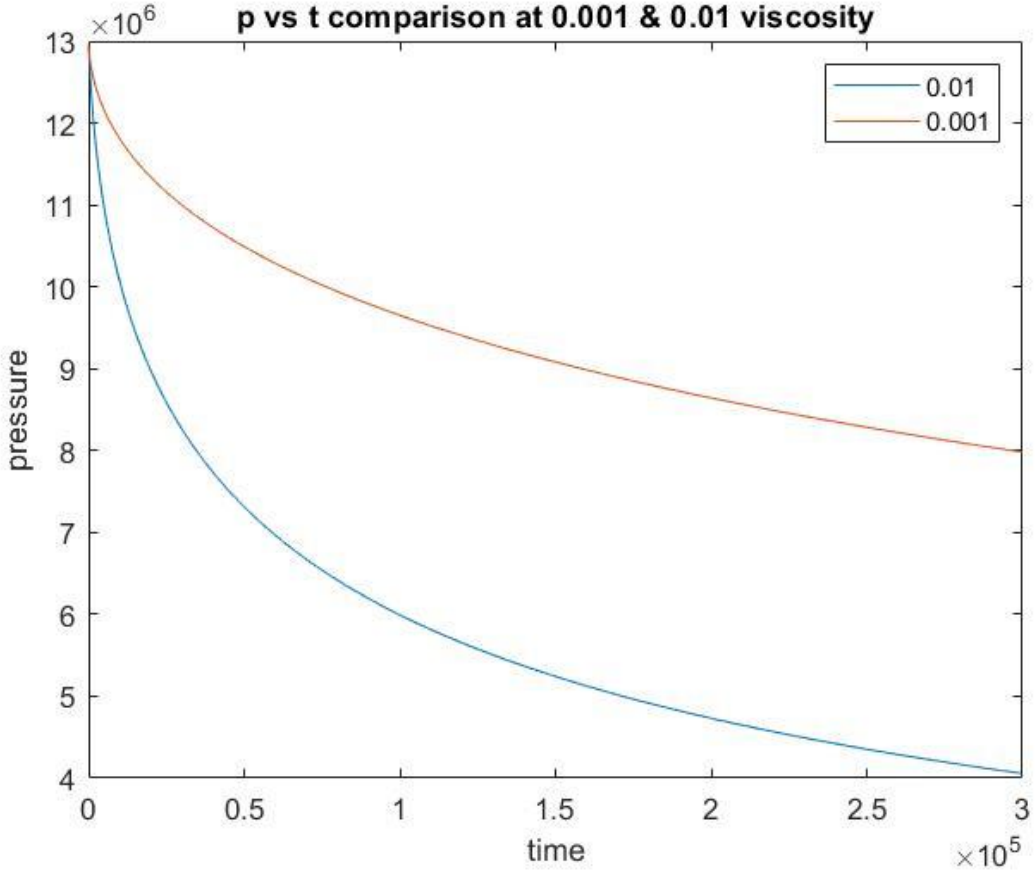

Constant pressure p vs x at 0.001 viscosity
×10^7
1.3
1.2
1.1
1
0.9
0.8
0.7
pressure
0
100
200
300
400
500
600
700
800
900
1000
length


Constant pressure p vs t at 0.01 viscosity
×10^6
13
12
11
10
9
8
7
6
5
4
pressure
0
0.5
1
1.5
2
2.5
3
time
×10^5


Constant pressure p vs x at 0.01 viscosity
×10^6
13
12
11
10
9
8
7
6
5
4
pressure
0
100
200
300
400
500
600
700
800
900
1000
length


Constant pressure p vs t at 0.01 viscosity
×10^6
13
12
11
10
9
8
7
6
5
4
pressure
0
0.5
1
1.5
2
2.5
3
time
×10^5

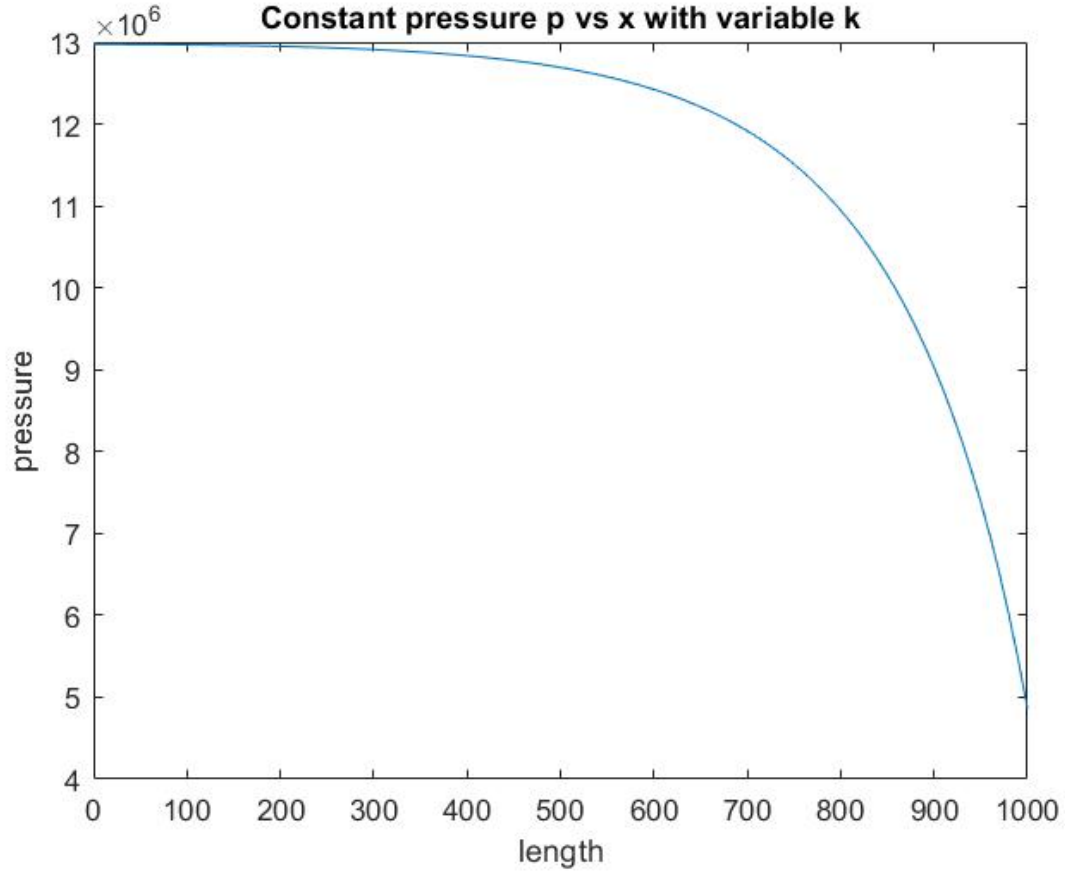

p vs x comparison at 0.001 & 0.01 viscosity
×10^6
13
12
11
10
9
8
7
6
5
4
pressure
0
100
200
300
400
500
600
700
800
900
1000
length
0.01
0.001

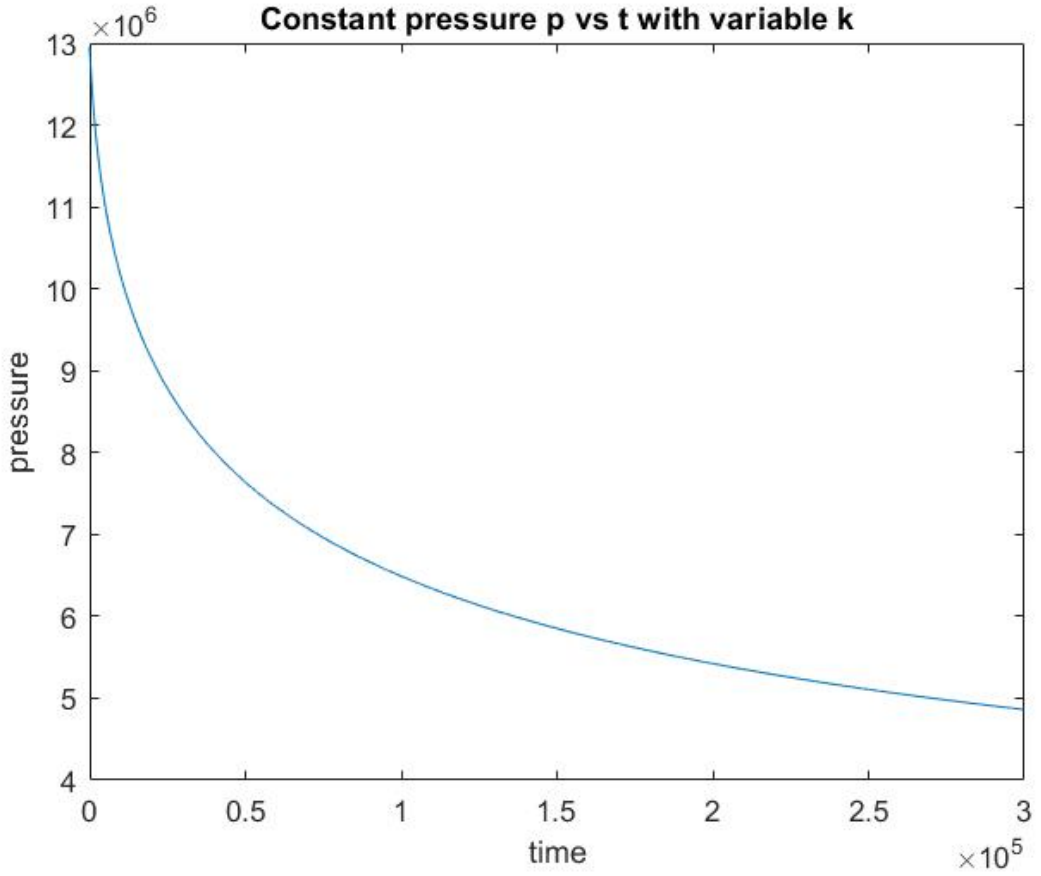

p vs t comparison at 0.001 & 0.01 viscosity
×10^6
13
12
11
10
9
8
7
6
5
4
pressure
0
0.5
1
1.5
2
2.5
3
time
×10^5
0.01
0.001

Part-B

```
clear
clc
%% Define all constants
phi = 0.1;
l = 1000;
w = 100;
th = 10;
eta_oil = 0.001;
J = 1.3*10^-10;
Ct = 2*10^-9;
pBHP = 0.1*10^6;
dt = 50;
Nx = 100;Ny = 1;
dx = l/Nx;
V = dx*w*th;
Vp = V*phi;
x = linspace(0,1000,Nx);
dy = w/Ny;
tf = 3*10^5;
ts = tf/dt;
tm = round(ts,0);
t = linspace(0,tf,tm);
p(1:Nx,1) = 13*10^6;

%% Make permiability matrix
k0 =  9.6 * 10^-14;
k = zeros(Nx,1);
for i = 1:Nx
    k(i,1) = k0*(1-(0.9*i/Nx));
end

%% Make transmissibility matrix
Tx = zeros(Nx+1,1);
Tx(1,1) = 0;
Tx(Nx+1,1) = 0;
for i = 2:Nx
    Tx(i) = 2*th*dy*k(i-1)*k(i)/(eta_oil*dx*(k(i-1) + k(i)));
end

%% Make LHS matrix
T = zeros(Nx,Nx);
T(1,1) = (Vp*Ct) + dt*(Tx(2) + Tx(1));
T(Nx,Nx) = (Vp*Ct) + dt*(Tx(Nx+1) + Tx(Nx) + J);
for i = 2:Nx-1
    T(i,i) = (Vp*Ct) + dt*(Tx(i+1) + Tx(i));
end
for i = 2:Nx
    T(i,i-1) = -dt*Tx(i);
end
for i = 1:Nx-1
    T(i,i+1) = -dt*Tx(i+1);
end

%% Make RHS matrix & calculate pressure
B = zeros(Nx,1);
pt = zeros(tm,1);
```

```
for i = 1:tm
    for j = 1:Nx
        if j == Nx
            B(j,1) = (Vp*Ct*p(j)) + (dt*J*pBHP);
        else
            B(j,1) = (Vp*Ct*p(j));
        end
    end

    p_ = T\B;
    pt(i,1) = p_(Nx,1);
    p = p_;
end

%% Now plotting
figure(1)
plot(x,transpose(p_))
xlabel('length')
ylabel('pressure')
title('Constant pressure p vs x with variable k')
figure(2)
plot(t,pt)
xlabel('time')
ylabel('pressure')
title('Constant pressure p vs t with variable k')
```

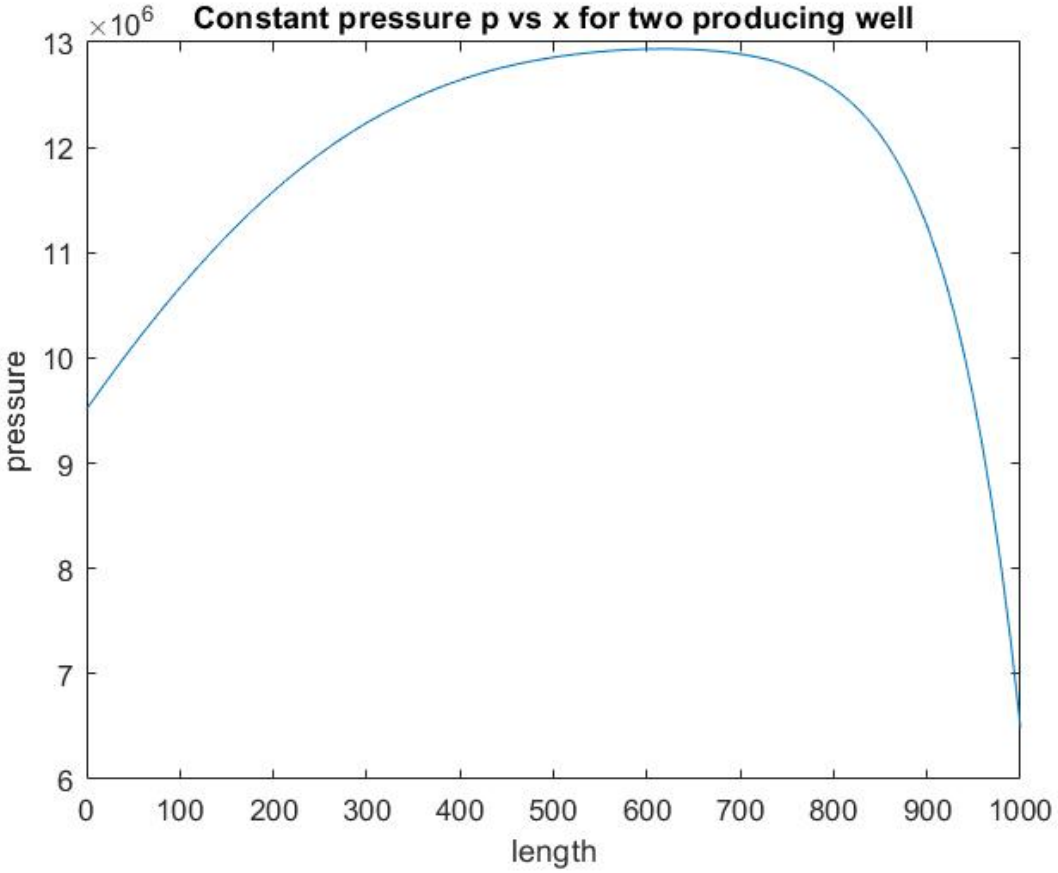

Constant pressure p vs x with variable k
×10^6
13
12
11
10
9
8
7
6
5
4
pressure
0
100
200
300
400
500
600
700
800
900
1000
length

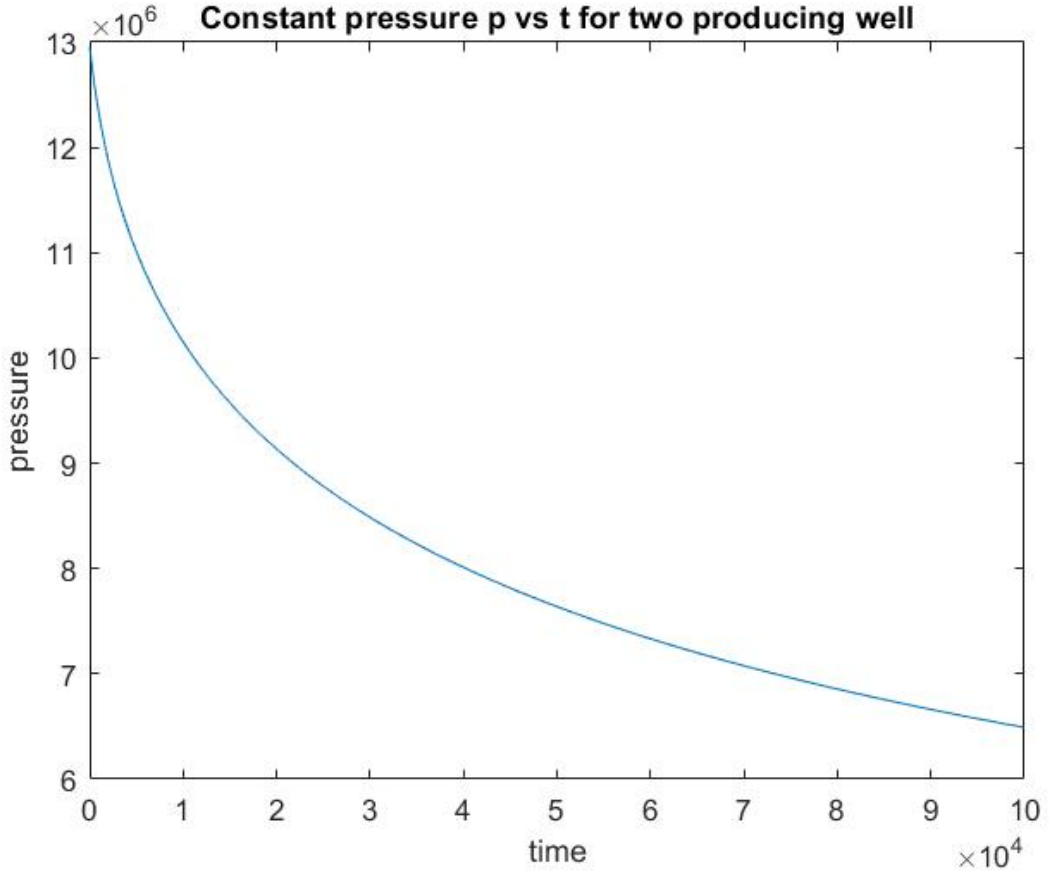

Constant pressure p vs t with variable k
×10^6
13
12
11
10
9
8
7
6
5
4
pressure
0
0.5
1
1.5
2
2.5
3
time
×10^5

Part-C

```
clear
clc
%% Define all constants
phi = 0.1;
l = 1000;
w = 100;
th = 10;
eta_oil = 0.001;
J = 1.3*10^-10;
Ct = 2*10^-9;
pBHP = 0.1*10^6;
dt = 50;
Nx = 100;Ny = 1;
dx = l/Nx;
V = dx*w*th;
Vp = V*phi;
x = linspace(0,1000,Nx);
dy = w/Ny;
tf = 1*10^5;
ts = tf/dt;
tm = round(ts,0);
t = linspace(0,tf,tm);
p(1:Nx,1) = 13*10^6;

%% Make permiability matrix
k0 =  9.6 * 10^-14;
k = zeros(Nx,1);
for i = 1:Nx
    k(i,1) = k0*(1-(0.9*i/Nx));
end

%% Make transmissibility matrix
Tx = zeros(Nx+1,1);
Tx(1,1) = 0;
Tx(Nx+1,1) = 0;
for i = 2:Nx
    Tx(i) = 2*th*dy*k(i-1)*k(i)/(eta_oil*dx*(k(i-1) + k(i)));
end

%% Make LHS matrix
T = zeros(Nx,Nx);
T(1,1) = (Vp*Ct) + dt*(Tx(2) + Tx(1) + J);
T(Nx,Nx) = (Vp*Ct) + dt*(Tx(Nx+1) + Tx(Nx) + J);
for i = 2:Nx-1
    T(i,i) = (Vp*Ct) + dt*(Tx(i+1) + Tx(i));
end
for i = 2:Nx
    T(i,i-1) = -dt*Tx(i);
end
for i = 1:Nx-1
    T(i,i+1) = -dt*Tx(i+1);
end

%% Make RHS matrix & calculate pressure
B = zeros(Nx,1);
pt = zeros(tm,1);
```

```
for i = 1:tm
    B(1,1) = (Vp*Ct*p(1)) + (dt*J*pBHP);
    for j = 2:Nx-1
            B(j,1) = (Vp*Ct*p(j));
    end
    B(Nx,1) = (Vp*Ct*p(Nx)) + (dt*J*pBHP);

    p_ = T\B;
    pt(i,1) = p_(Nx,1);
    p = p_;
end

%% Now plotting
figure(1)
plot(x,transpose(p_))
xlabel('length')
ylabel('pressure')
title('Constant pressure p vs x for two producing well')
figure(2)
plot(t,pt)
xlabel('time')
ylabel('pressure')
title('Constant pressure p vs t for two producing well')
```

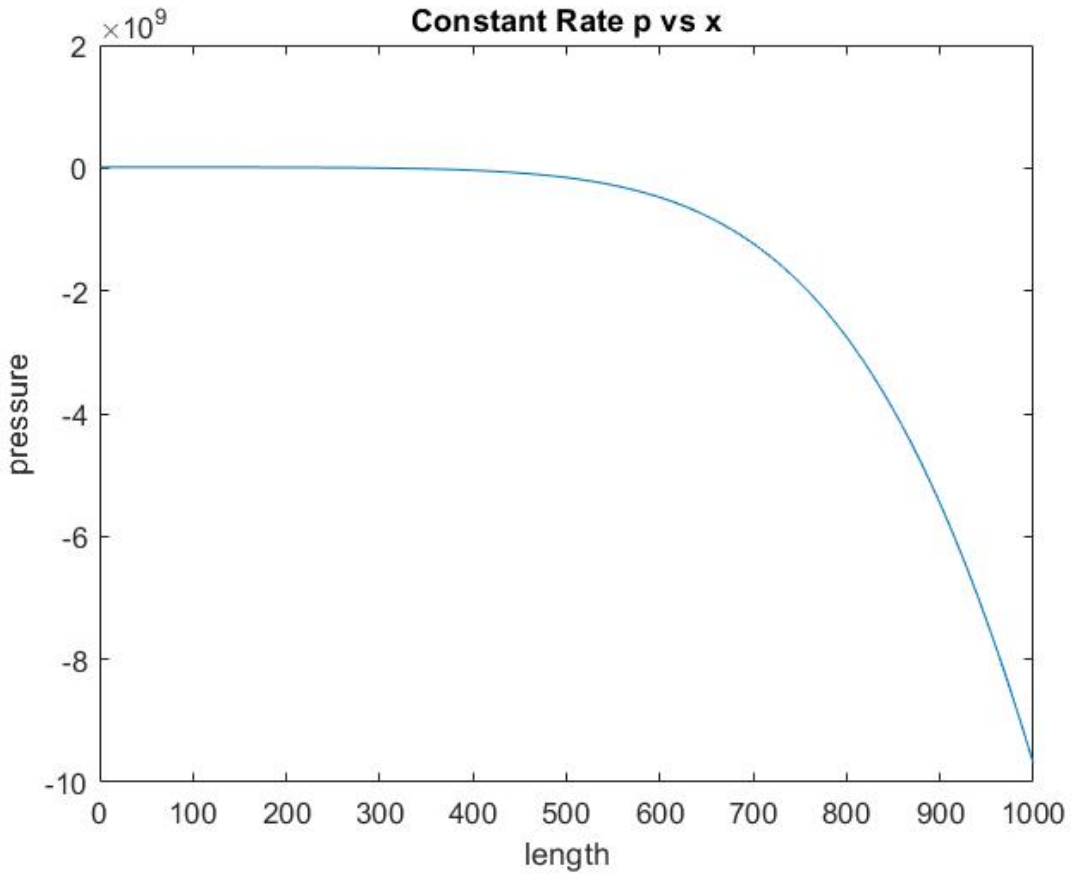

Constant pressure p vs x for two producing well
×10^6
13
12
11
10
9
8
7
6
pressure
0
100
200
300
400
500
600
700
800
900
1000
length

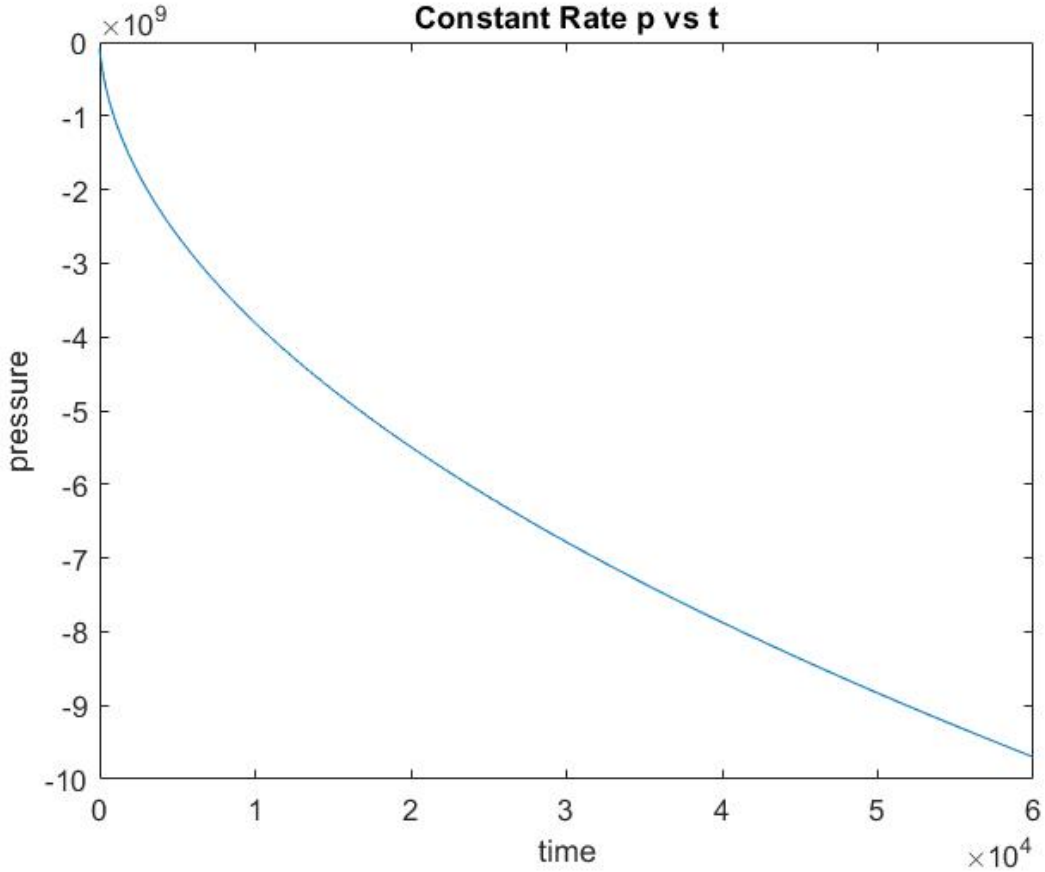

Constant pressure p vs t for two producing well
×10^6
13
12
11
10
9
8
7
6
pressure
0
1
2
3
4
5
6
7
8
9
10
time
×10^4

Part-D

```
clear
clc
%% Define all constants
k = 9.6*10^-14;
phi = 0.1;
l = 1000;
w = 100;
th = 10;
eta_oil = 0.001;
J = 1.3*10^-10;
Ct = 2*10^-9;
dt = 50;
Nx = 100;Ny = 1;
dx = l/Nx;
V = dx*w*th;
Vp = V*phi;
x = linspace(0,1000,Nx);
dy = w/Ny;
tf = 6*10^4;
ts = tf/dt;
tm = round(ts,0);
t = linspace(0,tf,tm);
p(1:Nx,1) = 13*10^6;
pBHP = 0.1*10^6;
Tx = th*dy*k/(eta_oil*dx);

%% Make LHS matrix
T = zeros(Nx,Nx);
T(1,1) = (Vp*Ct) + (dt*Tx);
T(Nx,Nx) = (Vp*Ct) + (dt*Tx);
for i = 2:Nx-1
    T(i,i) = (Vp*Ct) + (2*dt*Tx);
end
for i = 2:Nx
    T(i,i-1) = -(dt*Tx);
end
for i = 1:Nx-1
    T(i,i+1) = -(dt*Tx);
end

%% Make RHS matrix & calculate pressure
B = zeros(Nx,1);
pt = zeros(tm,1);
Q = 5;
for i = 1:tm

    for j = 1:Nx
        if j == Nx
            B(j,1) = (Vp*Ct*p(j)) - (dt*Q);
        else
            B(j,1) = (Vp*Ct*p(j));
        end
    end
    p_ = T\B;
    pt(i,1) = p_(Nx,1);
    p = p_;
```

```
end

%% Now plotting
figure(1)
plot(x,transpose(p_))
xlabel('length')
ylabel('pressure')
title('Constant Rate p vs x')
figure(2)
plot(t,pt)
xlabel('time')
ylabel('pressure')
title('Constant Rate p vs t')
```




Constant Rate p vs t
×10^9
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
pressure
0
1
2
3
4
5
6
time
×10^4