SLE - 002

```
%Insert creative name here
clear
clc
close all
%System of Eqns for Refference
% Lt = (L1 + x1 + W) + (L2 + x2 + W) + (L3 + x3 + W) + (L4 + x4)
% k1*x1 = k2*x2 = k3*x3 = k4*x4
%  -k1*x1 + k2*x2 = 0
%  -k2*x2 + k3*x3 = 0
%  -k3*x3 + k4*x4 = 0
%Create solution vector and initalise
Solutions = zeros(2, 4);
%Write as an Augmented Matrix to make a function from
function Sols = Solveforcase(k1,k2,k3,k4,Lt,Li,W)
Coefs = [-k1 k2 0 0;0 -k2 k3 0;0 0 -k3 k4;1 1 1 1];
value4 = (Lt -(4*Li) -(4*W));
Values = [0;0;0;value4];
Sols = Coefs\Values;
end
%Case 1
W =0.2;
Lt =8;
Li =1;
k1 = 2;
k2 = 2;
k3 = 2;
k4 = 2;
Solutions(1,:) = Solveforcase(k1,k2,k3,k4,Lt,Li,W);
%Case 2
W =0.2;
Lt =8;
Li =1;
k1 = 1;
k2 = 2;
k3 = 3;
k4 = 4;
Solutions(2,:)  = Solveforcase(k1,k2,k3,k4,Lt,Li,W);
%Display Results
fprintf('Case 1:');
fprintf('x1 = %g', Solutions(1, 1));
fprintf('x2 = %g', Solutions(1, 2));
fprintf('x3 = %g', Solutions(1, 3));
fprintf('x4 = %g', Solutions(1, 4));


fprintf('Case 2:');
```

```
fprintf('x1 = %g', Solutions(2, 1));
fprintf('x2 = %g', Solutions(2, 2));
fprintf('x3 = %g', Solutions(2, 3));
fprintf('x4 = %g', Solutions(2, 4));
```

```
Case 1:
x1 = 0.8
x2 = 0.8
x3 = 0.8
x4 = 0.8
Case 2:
x1 = 1.536
x2 = 0.768
x3 = 0.512
x4 = 0.384
```

SLE – 004

```
%Perform the magic ritual
clear
clc
close all
%System of Eqns for Refference
% 1500 = x4 + x1
% 1200 = x1 + x2
% 1000 = x2 + x3
% 1300 = x3 + x4
%Write as 4x4 augmented matrix
Coefs = [1 0 0 1;1 1 0 0;0 1 1 0;0 0 1 1];
Values = [1500;1200;1000;1300];
%Apply RRef
System_total = [Coefs, Values];
System_Reduced = rref(System_total);
%Reform into augmented
Reduced_Coefs = System_Reduced(1:3 , 1:4);
Reduced_Values = System_Reduced(1:3 , 5);
%Solve Augmented
Sols = Reduced_Coefs\Reduced_Values;
%Display Findings
fprintf('Original Solutions')
fprintf('x1 = %g', Sols(1));
fprintf('x2 = %g', Sols(2));
```

```
fprintf('x3 = %g', Sols(3));
fprintf('x4 = %g', Sols(4));
fprintf('Answer for Part b:')
fprintf('Max vehicles travling in specified area is given by x4')
%Rewrite for x4 = 1000
New_Coefs = [1 0 0 1;1 1 0 0;0 1 1 0;0 0 1 1;0 0 0 1];
New_Values = [1500;1200;1000;1300;1000];
New_Sols = New_Coefs\New_Values;
%Display New x values
fprintf('New (Part C) Solutions')
fprintf('x1 = %g', New_Sols(1));
fprintf('x2 = %g', New_Sols(2));
fprintf('x3 = %g', New_Sols(3));
fprintf('x4 = %g', New_Sols(4));
```

```
Original Solutions
x1 = 0
x2 = 1200
x3 = -200
x4 = 1500
Answer for Part b:
Max vehicles travling in specified area is given by x4



New (Part C) Solutions
x1 = 500
x2 = 700
x3 = 300
x4 = 1000
```

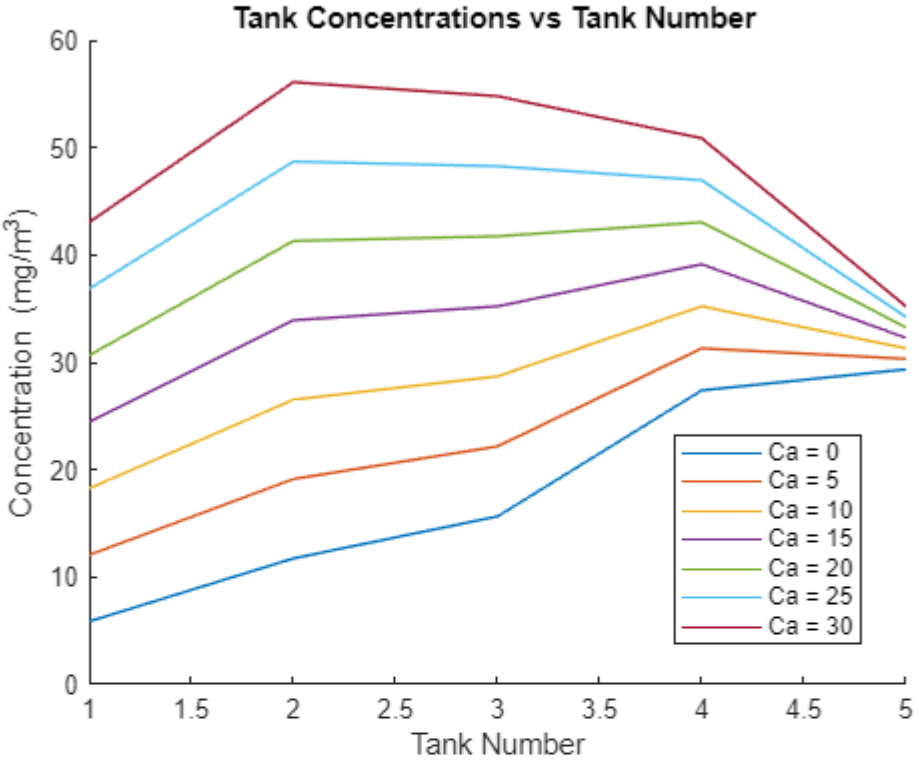
SLE – 006

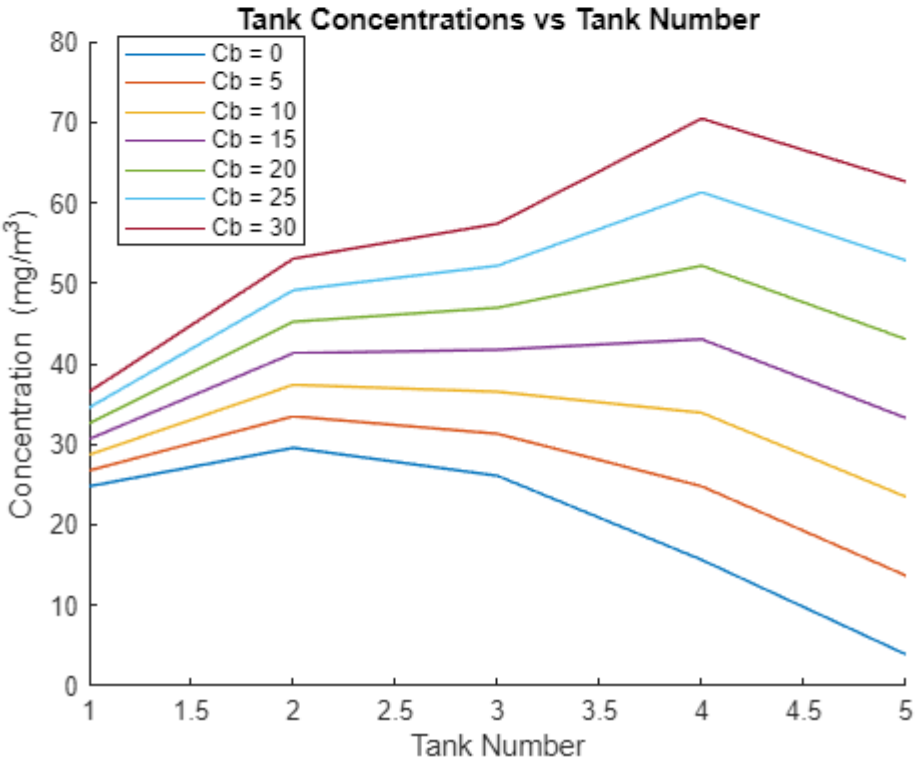
```
%Sacrifice to the code gods
```

```
clear
clc
close all
% System of Eqns for the Mixing Tanks
% 4Ca + 4C2 = 8C1
% 8C1 + 6C3 = 12C2
% 6C2 + 2C4 = 8C3
% 3C3 + 4C5 = 6C4
% 2C4 + 12Cb = 8C5
% Given values
Ca = 20;
Cb = 15;
% Write as 5x5 augmented matrix
Coefs = [-8 4 0 0 0; 8 -12 6 0 0; 0 6 -8 2 0; 0 0 3 -6 4; 0 0 0 2 -8];
Value1 = (-4 * Ca);
Value5 = (-12 * Cb);
Values = [Value1; 0; 0; 0; Value5];
% Solve Augmented
Sols = Coefs \ Values;
% Display
fprintf('Answer for Part b:');
fprintf('C1 = %g', Sols(1));
fprintf('C2 = %g', Sols(2));
fprintf('C3 = %g', Sols(3));
fprintf('C4 = %g', Sols(4));
fprintf('C5 = %g', Sols(5));
% Part c: Varying Ca (Cb = 15) and plotting
Ca_values = [0, 5, 10, 15, 20, 25, 30];
Cb_fixed = 15;
C_values_Ca = zeros(5, length(Ca_values));
for i = 1:length(Ca_values)
    Values = [-4 * Ca_values(i); 0; 0; 0; -12 * Cb_fixed];
    New_Sols = Coefs \ Values;
    C_values_Ca(:, i) = New_Sols;
end
figure;
hold on;
colors_Ca = lines(length(Ca_values)); %
for i = 1:length(Ca_values)
    plot(1:5, C_values_Ca(:, i), 'Color', colors_Ca(i, :), 'DisplayName',
sprintf('Ca = %g', Ca_values(i)));
end
title('Tank Concentrations vs Tank Number ');
xlabel('Tank Number');
ylabel('Concentration (mg/m^3)');
legend('show');
hold off;
```

```
legend(["Ca = 0", "Ca = 5", "Ca = 10", "Ca = 15", "Ca = 20", "Ca = 25", "Ca =
30"], "Position", [0.6856 0.1603 0.1784, 0.2658])
% Part c: Varying Cb (Ca = 20) and plotting
Cb_values = [0, 5, 10, 15, 20, 25, 30];
Ca_fixed = 20;
C_values_Cb = zeros(5, length(Cb_values));
for i = 1:length(Cb_values)
    Values = [-4 * Ca_fixed; 0; 0; 0; -12 * Cb_values(i)];
    New_Sols = Coefs \ Values;
    C_values_Cb(:, i) = New_Sols;
end
figure;
hold on;
colors_Cb = lines(length(Cb_values));
for i = 1:length(Cb_values)
    plot(1:5, C_values_Cb(:, i), 'Color', colors_Cb(i, :), 'DisplayName',
sprintf('Cb = %g', Cb_values(i)));
end
title('Tank Concentrations vs Tank Number');
xlabel('Tank Number');
ylabel('Concentration (mg/m^3)');
legend('show');
hold off;
legend(["Cb = 0", "Cb = 5", "Cb = 10", "Cb = 15", "Cb = 20", "Cb = 25", "Cb =
30"], "Position", [0.1581 0.6667 0.1784, 0.2658])
%Interp of part c
fprintf('Part C interpretation')
fprintf('As seen the effect of increasing the inflow rate for ca or cb ')
fprintf('is that on average each tank will have a greater concentration within it
')
% Part d: Change in both initial concentrations
Ca_new = 15;
Cb_new = 25;
Value1n = (-4 * Ca_new);
Value5n = (-12 * Cb_new);
New_Values = [Value1n; 0; 0; 0;Value5n];
New_Sols = Coefs \ New_Values;
delta_Sols = New_Sols - Sols;
fprintf('\nAnswer for Part d');
fprintf('Delta C1 = %g ', delta_Sols(1));
fprintf('Delta C2 = %g ', delta_Sols(2));
fprintf('Delta C3 = %g ', delta_Sols(3));
fprintf('Delta C4 = %g ', delta_Sols(4));
fprintf('Delta C5 = %g ', delta_Sols(5));
```

```
Answer for Part b:
C1 = 30.6522
C2 = 41.3043
C3 = 41.7391
C4 = 43.0435
C5 = 33.2609
```





Part C interpretation

As seen the effect of increasing the inflow rate for ca or cb

is that on average each tank will have a greater concentration within it

Answer for Part d

Delta C1 = -2.28261

Delta C2 = 0.434783

Delta C3 = 3.91304

Delta C4 = 14.3478

Delta C5 = 18.587