function Question1

xx2 = [0.001:0.001:15]; %#ok<NBRAK2>

for i = 1:length(xx2)

yy(i)=gx(xx2(i));

end

plot(xx2, yy)

ylim([-5,5])

options=optimset('Display', 'off');

sol1\_range=[4.19,4.21];

x2\_sol1=fzero(@gx, sol1\_range, options);

sol2\_range=[4.275,4.28];

x2\_sol2=fzero(@gx, sol2\_range, options);

sol3\_range=[4.3268,4.327];

x2\_sol3=fzero(@gx, sol3\_range, options);

sol4\_range=[4.356,4.358];

x2\_sol4=fzero(@gx, sol4\_range, options);

sol5\_range=[4.378,4.38];

x2\_sol5=fzero(@gx, sol5\_range, options);

xx2 = x2\_sol1;

[x13\_sol1,~]=fsolve(@fx,[1,1],options);

fprintf('Solution 1: x1 = %2.3f, x2 = %2.3f, x3 = %2.3f\n\n', x13\_sol1(1) ,x2\_sol1, x13\_sol1(2))

xx2 = x2\_sol2;

[x13\_sol2,~]=fsolve(@fx,[1,1],options);

fprintf('Solution 2: x1 = %2.3f, x2 = %2.3f, x3 = %2.3f\n\n', x13\_sol2(1), x2\_sol2, x13\_sol2(2))

xx2 = x2\_sol3;

[x13\_sol3,~]=fsolve(@fx,[1,1],options);

fprintf('Solution 3: x1 = %2.3f, x2 = %2.3f, x3 = %2.3f\n\n', x13\_sol3(1), x2\_sol3, x13\_sol3(2))

xx2 = x2\_sol4;

[x13\_sol4,~]=fsolve(@fx,[1,1],options);

fprintf('Solution 4: x1 = %2.3f, x2 = %2.3f, x3 = %2.3f\n\n', x13\_sol4(1), x2\_sol4, x13\_sol4(2))

xx2 = x2\_sol5;

[x13\_sol5,~]=fsolve(@fx,[1,1],options);

fprintf('Solution 5: x1 = %2.3f, x2 = %2.3f, x3 = %2.3f\n\n', x13\_sol5(1), x2\_sol5, x13\_sol5(2))

function ff=fx(z)

% z(1) is x1, z(2) is x3

x1 = z(1); x3 = z(2);

% These need to be equal to zero

ff(1,1)=6\*x1+x3\*log(xx2)+xx2\*x3-6;

ff(2,1)=x1+xx2+x3-5;

end

function f2=gx(x2)

options=optimset('Display', 'off');

[x\_sol,~] = fsolve(@fx,[0,0], options);

xx1 = x\_sol(1); xx3 = x\_sol(2);

f2=exp(xx1)\*sin(xx3)-5\*exp(-x2)-10;

function ff=fx(z)

% z(1) is x1, z(2) is x3

x1 = z(1); x3 = z(2);

% These need to be equal to zero

ff(1,1)=6\*x1+x3\*log(x2)+x2\*x3-6;

ff(2,1)=x1+x2+x3-5;

end

end

end

Solution 1: x1 = 4.107, x2 = 4.201, x3 = -3.308

Solution 2: x1 = 6.995, x2 = 4.279, x3 = -6.274

Solution 3: x1 = 10.098, x2 = 4.327, x3 = -9.425

Solution 4: x1 = 13.209, x2 = 4.357, x3 = -12.566

Solution 5: x1 = 16.329, x2 = 4.379, x3 = -15.708

function Question2

K1=1.93e-4;

K2=5.528;

% e1 is going to heavily favor reactants and be less than 2

e1\_guess=0.1;

% e2 will be less than e2, but the reaction will moderately favor products

e2\_guess=0.08;

options=optimset('Display', 'off');

[e\_sol,~]=fsolve(@get\_eqs,[e1\_guess, e2\_guess],options);

ee1=e\_sol(1);

ee2=e\_sol(2);

fprintf('Carbon Monoxide Fraction: %1.4f\n', (ee1-ee2)/(10+2\*ee1))

fprintf('Hydrogen Fraction: %1.4f\n', (3\*ee1+ee2)/(10+2\*ee1))

fprintf('Water Fraction: %1.4f\n', (8-ee1-ee2)/(10+2\*ee1))

fprintf('Carbon Dioxide Fraction: %1.4f\n', (ee2)/(10+2\*ee1))

fprintf('Methane Fraction: %1.4f\n', (2-ee1)/(10+2\*ee1))

function rxn\_eqs=get\_eqs(x)

% x(1) is e1, x(2) is e2

e1 = x(1); e2 = x(2);

% These need to be equal to zero

rxn\_eqs(1,1)=(e1-e2)\*(3\*e1+e2)^3-K1\*(2-e1)\*(8-e1-e2)\*(10+2\*e1)^2;

rxn\_eqs(2,1)=e2\*(3\*e1+e2)-K2\*(e1-e2)\*(8-e1-e2);

end

end

Carbon Monoxide Fraction: 0.0024

Hydrogen Fraction: 0.1881

Water Fraction: 0.6309

Carbon Dioxide Fraction: 0.0452

Methane Fraction: 0.1333