ECE 320 - Solution to Homework #1

Matlab, PartSim, Solving f(x) = 0. Due Wednesday, Jan 20th

1) Given 2 equations with 2 unknowns

$$V = 10 - 500I$$

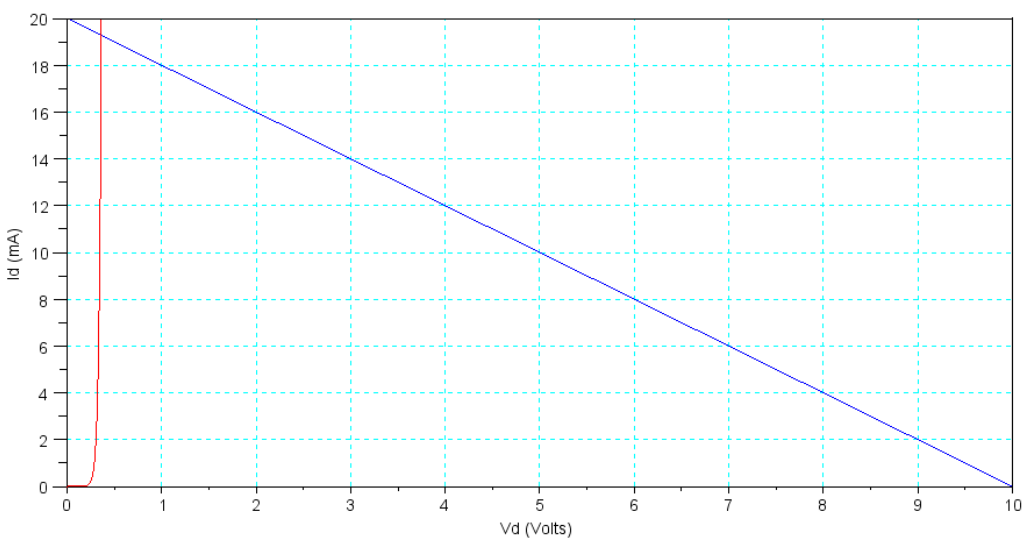
$$V = 0.052 \cdot \ln(10^8 \cdot I + 1)$$

1a) Solve in Matlab using graphical methods

```
-->10 / 500
     0.02

-->I = [0:0.001:1]' * 0.02;
-->V1 = 10 - 500*I;
-->V2 = 0.025*log(1e8 * I + 1);

-->plot(V1,I*1000,V2,I*1000);
-->xgrid(4)
-->xlabel('Vd (Volts)');
-->ylabel('Id (mA)');
```



1b) Solve numerically to find V and I (using an HP calculator)

Id = 18.4992 mA

Vd = 0.7504 V

2) Given 2 equations with 2 unknowns

$$V = 10 - 500I$$

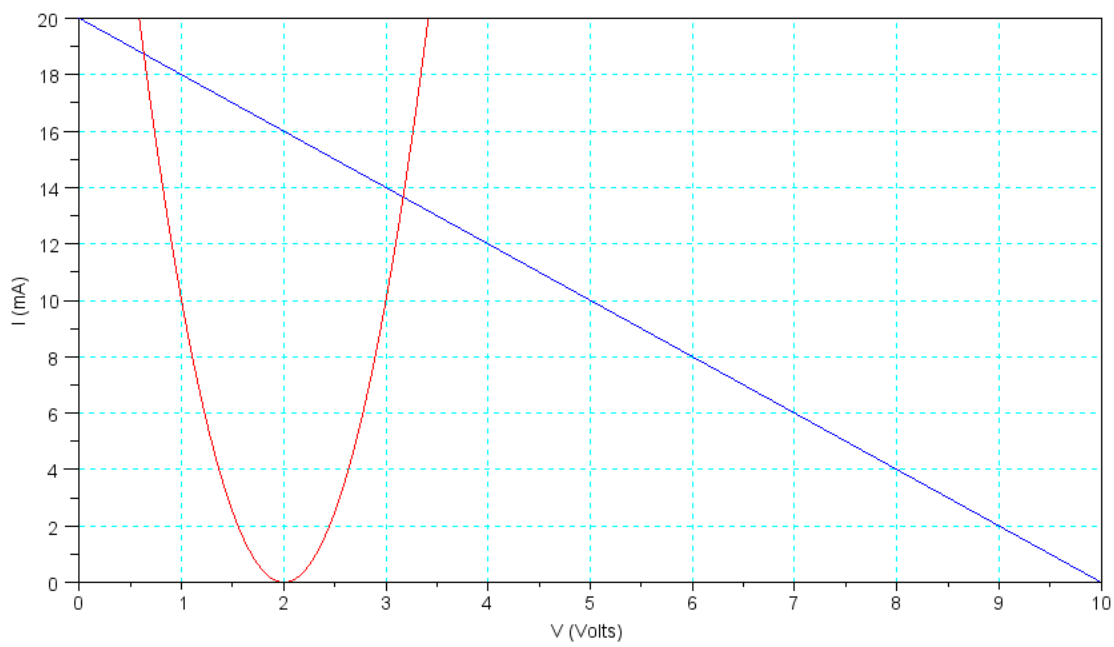
$$I = 0.01 \cdot (V - 2)^2$$

2a) Solve in Matlab using graphical methods

```
V1 = [0:0.01:10]';
I1 = (10 - V1)/500;

V2 = [0:0.01:10]';
I2 = 0.01* (V2 - 2).^2;

plot(V1,I1*1000,V2,I2*1000);
xlabel('V (Volts)');
ylabel('I (mA)');
```



2b) Solve numerically to find V and I (solved using and HP calculator)

There are two solutions

V = 0.6311V

I = 18.7377mA

and

V = 3.1689V

I = 13.6623mA

3) Solve using *fminsearch()* in Matlab

$$\left(\frac{V_1-10}{100}\right)+\left(\frac{V_1-V_2}{200}\right)+\left(\frac{V_1}{300}\right)+I_{d1}=0$$

$$I_{d1}+\left(\frac{V_1-V_2}{200}\right)=I_{d2}$$

$$I_{d1}=10^{-8}\cdot(e^{20(V_1-V_2)}-1)$$

$$I_{d2}=10^{-8}\cdot(e^{20V_2}-1)$$

The m-file

```
function [J] = Prob3(Z)
    V1 = Z(1);
    I1 = Z(2);
    V2 = Z(3);
    I2 = Z(4);

    e1 = (V1-10)/100 + (V1-V2)/200 + (V1/300) + I1;
    e2 = I1 + (V1-V2)/200 - I2;
    e3 = I1 - 1e-8 * (exp(20*(V1-V2))-1);
    e4 = I2 - 1e-8 * (exp(20*V2) - 1);

    J = e1^2 + e2^2 + e3^2 + e4^2;

end
```

The calling function

```
-->[a,b] = fminsearch('Prob3',[1.2,0,0.6,0])

 b  =

    1.585494    0.0749042    0.7940358    0.0788584
 a  =

    1.735D-20
```

The solution is

```
    V1           I1            V2           I2
1.585494    0.0749042    0.7940358    0.0788584
```

4) Input this circuit into PartSim to solve for the node votlages