6) Build this curcuit on your breadboard and measure Vd. From this, compute Id

- Include a photo to receive credit for this problem

Vd = 0.757V

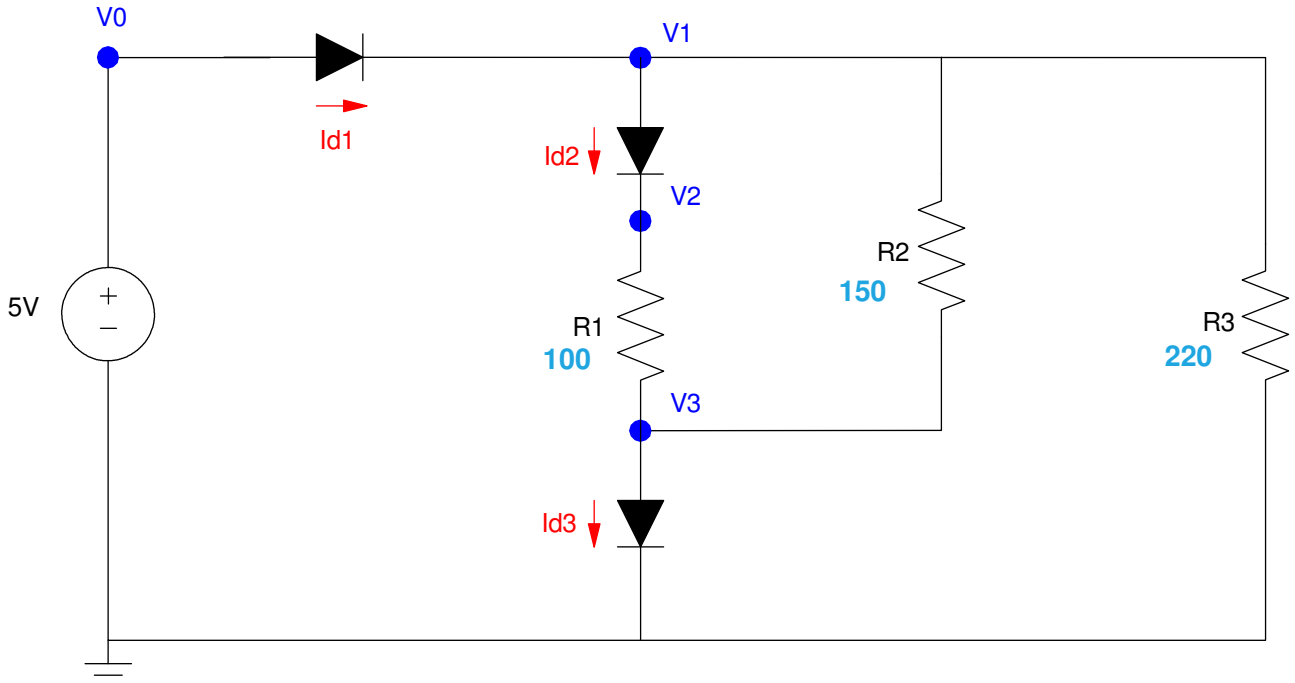
$$I_d = \left(\frac{5.00V - 0.757V}{51\Omega}\right) = 83.20mA$$

	Vd	Id
4a) Graphical solution	800mV	85mA
4b) Numeric Solution	821.1mV	83.58mA
5) Simulation (CircuitLab)	779.1mV	84.42mA
6) Lab (experimental)	757mV	83.20mA

Problem 4 to 6

Problem 8 - 10: Pick three resistors for R1, R2, R3 in the range of 100 Ohms to 330 Ohms. They can all be the same.

R1	R2	R3
100 Ohms brown - black - brown	150 Ohms brown - green - brown	220 Ohms red - red - brown



8) Write the voltage node equations assuming nonlinear diodes. Solve for {V1, V2, and V3} using Matlab.

$$I_{d1} = 7.69 \cdot 10^{-11}\left(\exp\left(\frac{V_0 - V_1}{0.0377}\right) - 1\right)$$

$$I_{d2} = 7.69 \cdot 10^{-11}\left(\exp\left(\frac{V_1 - V_2}{0.0377}\right) - 1\right)$$

$$I_{d3} = 7.69 \cdot 10^{-11}\left(\exp\left(\frac{V_3}{0.0377}\right) - 1\right)$$

Node Equations

$$-I_{d1} + I_{d2} + \left(\frac{V_1 - V_3}{150}\right) + \left(\frac{V_1}{220}\right) = 0$$

$$-I_{d2} + \left(\frac{V_2 - V_3}{100}\right) = 0$$

$$\left(\frac{V_3 - V_2}{100}\right) + \left(\frac{V_3 - V_1}{150}\right) + I_{d3} = 0$$

Create an m-file which

- Receives your gues for V1, V2, V3, and
- Computes the sum-squared error in the current equations

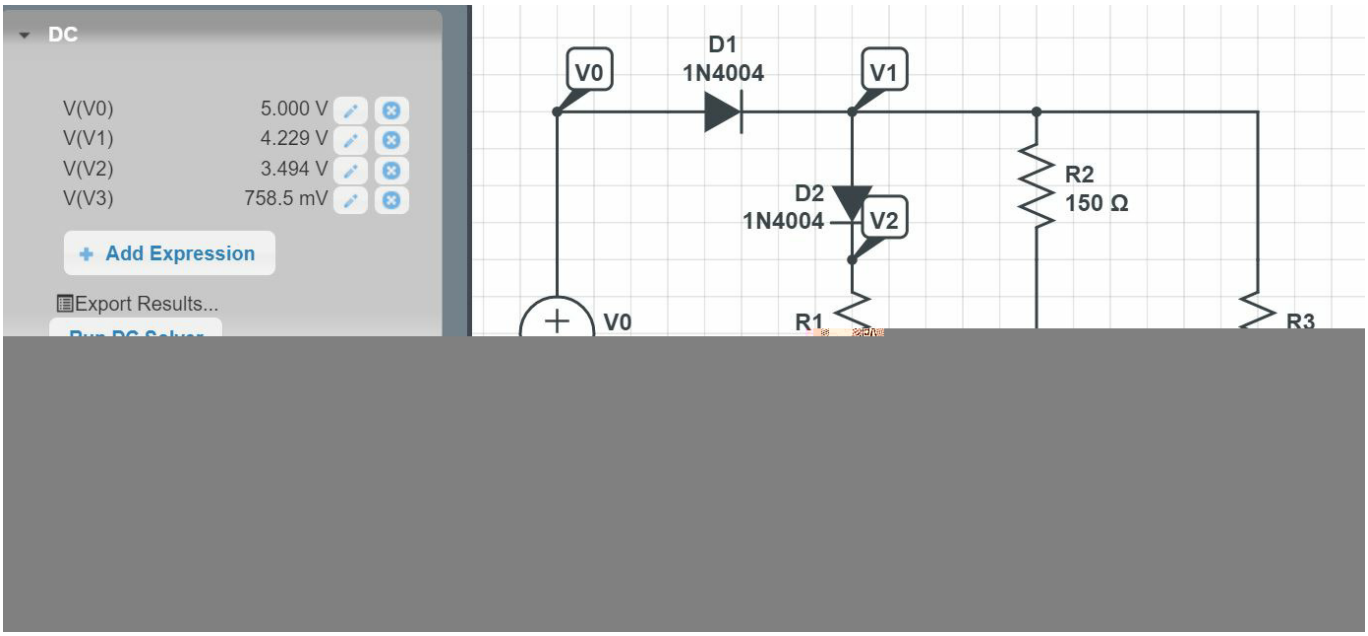
Matlab Code:

```
function [ J ] = Diode1( z )

 V0 = 5;
 V1 = z(1);
 V2 = z(2);
 V3 = z(3);

 Idss = 7.69e-11;
 nVt = 0.0377;

 Id1 = Idss* exp( (V0-V1)/nVt - 1 );
 Id2 = Idss* exp( (V1-V2)/nVt - 1 );
 Id3 = Idss* exp( (V3)/nVt - 1 );

 e1 = -Id1 + Id2 + (V1-V3)/150 + (V3)/220;
 e2 = -Id2 + (V2-V3)/100;
 e3 = (V3-V2)/100 + (V3-V1)/150 + Id3;

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

 disp([z, log10(J)])
 pause(0.1);
end
```

Solving using fminsearch()

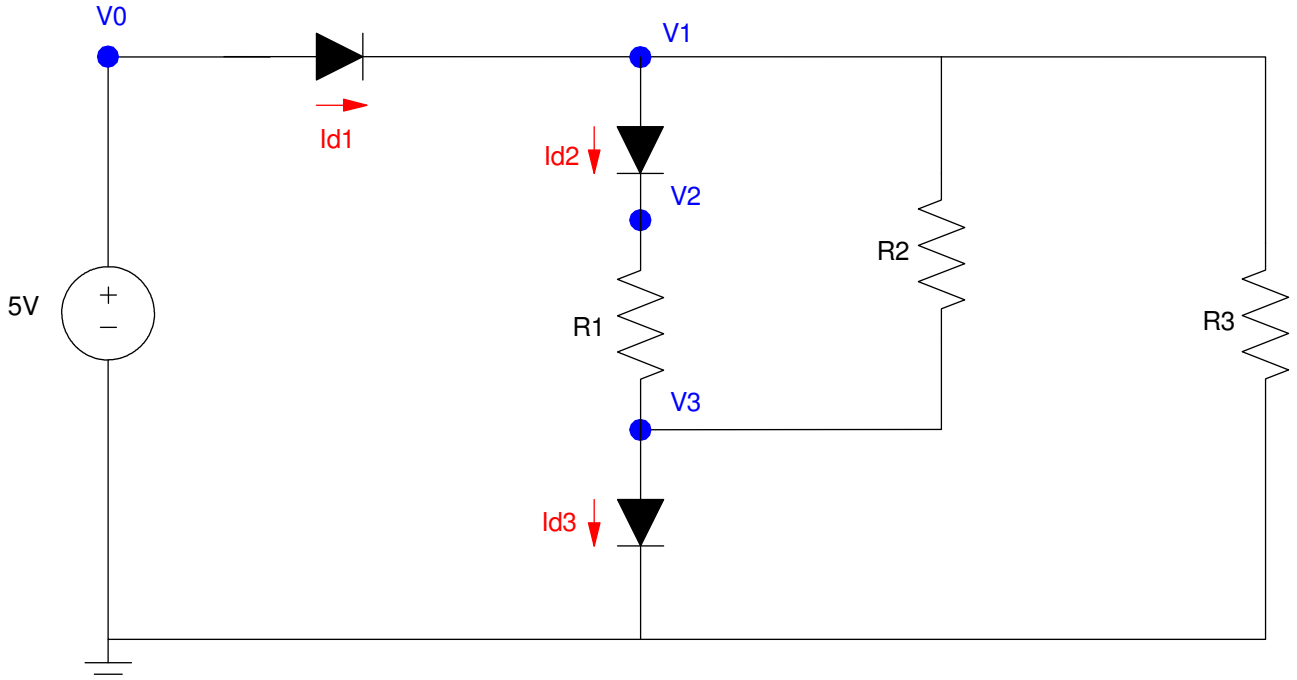
```
>> [V,e] = fminsearch('Diode3', [3,2,1])

          V1        V2        V3
V =    4.1955    3.4172    0.8018

e =  5.5499e-010
```

9) Simulate this circuit in CircuitLab to determine {V1, V2, and V3}



10) Build this circuit with your breadboard and measure {V1, V2, V3}

	V0	V1	V2	V3
8) Numeric Solution	5.00V	4.1955V	3.4172V	801.8mV
9) Simulation (CircuitLab)	5.00V	4.229V	3.494V	758.5mV
10) Lab (experimental)	4.92V	4.14V	3.40V	755mV



Problem 8-10. R1, R2, and R3 are in the range of 100-330 Ohms (your pick)