Measure and record the actual value of the series resistance used in the circuit using the DVM as an Ohmmeter. For each of the three types of diodes—1N4148 signal diode, 1N5226 3.3V Zener diode, and red LED—determine the diode parameters the emission coefficient (SPICE parameter N) and the reverse saturation or scale current (SPICE parameter IS). Measure and record using the DVM as a DC voltmeter the value of the voltage across R and the voltage across the diode. Do this by changing the DC power supply voltage from 12 V to 4 V in steps of 2 V. Use this set of diode current as a function of diode voltage to plot the $\ln(I_D)$ versus V_D where I_D is the diode current (voltage across R divided by R) and the V_D is the diode voltage. The slope of the plot is $1/(NV_T)$ where V_T is the thermal voltage $V_T = 26.59\,\text{mV}$. The y intercept is $\ln(I_S)$. Any plotting program can be used.

11.4.3 Measurement of Diode Parameters

Assemble the circuit shown in Fig. 11.18.

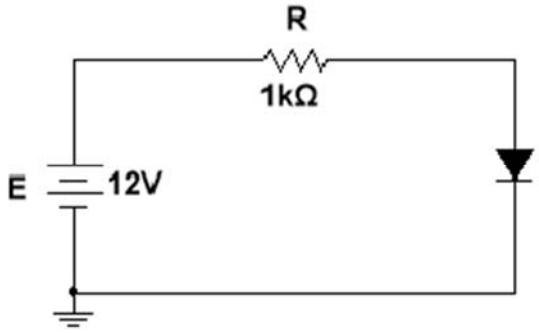


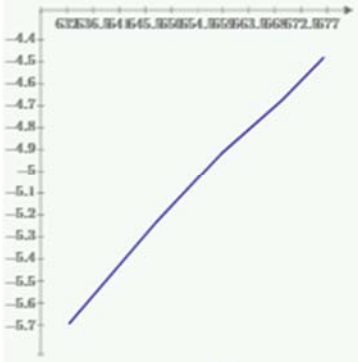
Figure 11.18: Circuit for Determining Diode Parameters.

#

Diode *Parameter* *Measurement* $R := 1\ k\Omega$ *Mathcad* *Prime*

$$I_D = I_s \cdot \left(exp\left(\frac{V_D}{N \cdot V_T} \right) - 1 \right)$$

$$I_D := \begin{bmatrix} 11.324 \\ 9.332 \\ 7.341 \\ 5.353 \\ 3.368 \end{bmatrix} \left(\frac{1\ V}{R} \right) \qquad V_D := \begin{bmatrix} 676.432 \\ 669.241 \\ 658.851 \\ 647.498 \\ 632.338 \end{bmatrix} \cdot 1\ mV$$



$$\ln\left(\frac{I_D}{1\ A} \right) \ (1)$$

$V_D\ (mV)$

$$m := \text{slope}\left(V_D, \ln\left(\frac{I_D}{1\ A} \right) \right) \qquad b := \text{intercept}\left(V_D, \ln\left(\frac{I_D}{1\ A} \right) \right) \qquad V_T := 25.9\ mV$$

$$I_s := 1\ A \cdot \exp(b) = 112.114\ pA \qquad N := \frac{1}{m \cdot V_T} = 1.416$$

$I_s = 112.114\ pA$ $N = 1.416$

#

```
%diodepara;Matlab;
I=[11.324,9.332,7.341,5.353,3.368];R=1000;I=I/R;
V=[676.432,669.241,658.851,647.498,632.338];V=V/1000;
y=log(I);VT=25.9*0.001;
plot(V,y);title('ln(ID) Current vs V');xlabel('VD');ylabel('ln(ID)');
p=polyfit(V,y,1);m=p(1,1);b=p(1,2);
IS=exp(b)
N=1/(m*VT)
```

#

```
IS =

   1.1211e-10


N =

    1.4158
```

#