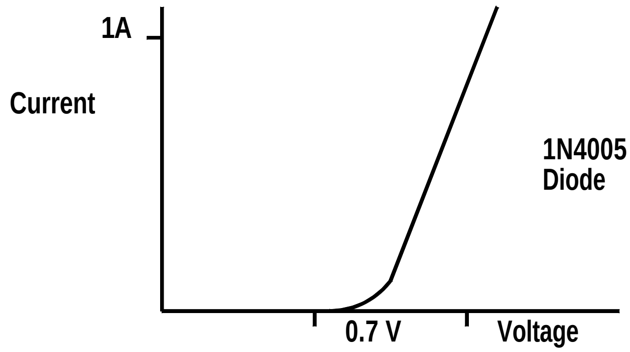
When a diode is forward biased it is found in most practical cases that:—

- For small currents, the voltage across the diode is the the knee voltage.

- For large currents, the voltage across the diode is given by:—

$$V = V_k + I \times R_B$$

where V_k is the knee voltage as given in the summary for Unit 25.



Usually the diode current is at least 1mA. From the diode characteristic curve, the expected value for the voltage across the diode is then close to the knee voltage for currents in the range from 1mA to about 100mA. This is called the "small signal region".

Rule of thumb:—
For small currents through the diode, the voltage across the diode is equal to the knee voltage.

For larger currents, such as those in rectifier circuits, we have to take into account the additional voltage drop across the diode bulk resistance of about 1Ω.
This correction is less than .4V since diodes capable of carrying high currents (eg 10A) are also designed to have low bulk resistances

The voltage across a forward biased diode is then given by:—

$$
\begin{aligned}
V &= V_k + I \times R_B \\
&\approx V_k \quad \text{for small currents}
\end{aligned}
$$

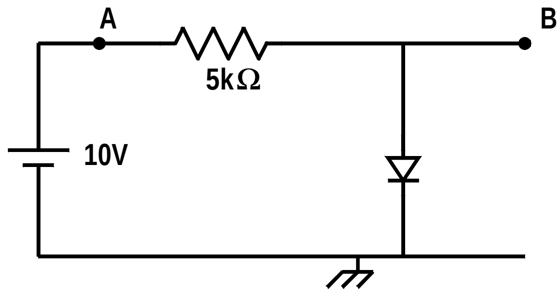
To test a diode for diode action:— Use a digital multimeter set to Ohms.

Set the range to the diode symbol on the resistance range.

Disconnect at least one lead of the diode from the circuit.

Measure the diode resistance in the forward and reverse directions.

If the resistance is infinite in one direction and small in the other direction then the diode is still functioning.



Calculate the current

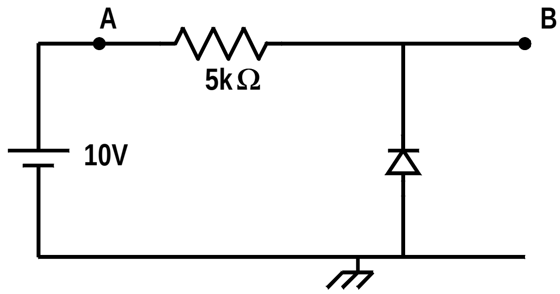
By inspection, the diode is forward biased. No large currents flow because of the $5k\Omega$ current limiting resistor
In the small signal region
Therefore expect 0.7V across the diode.

$$10\text{V} = I \times 5k\Omega + 0.7\text{V}$$

Which reduces to:—

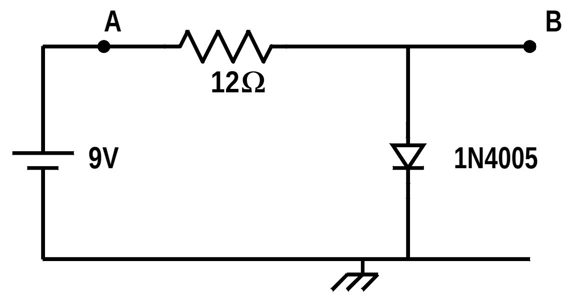
$$I = \frac{10 - 0.7}{5k\Omega} = \frac{9.3}{5k\Omega} = 1.86\text{mA}$$

The voltage at point B is +0.7V and the voltage at point A is +10V.
The voltage from B to A is 9.3V.



Calculate the current which flows in the circuit in Figure 26.2.

By inspection, the diode is reverse biased. This means that the current in the diode is about 10^{-10}A.
The voltage drop across a $5k\Omega$ resistor passing 10^{-10}A is 0.5μV which can be taken to be zero.
The voltage at one end of the $5k\Omega$ resistor is +10V. Since there is no significant voltage drop across the resistor the voltage at the other end is the same. Therefore the voltage at point B is +10V.



Replace diode by a short, the current is

$$\frac{9V}{12\Omega} \approx 0.75A$$

Use the large current approximation

$$V = V_k + I \times R_B$$

The required equation is then:—

$$9V = 0.7V + I \times R_B + I \times 12\Omega$$

$$\begin{aligned} 9V &= 0.7V + I \times (0.4\Omega + 12\Omega) \\ \text{which gives} \quad 8.3V &= I \times 12.4\Omega \\ \text{and a current} \quad I &= 0.67A \end{aligned}$$