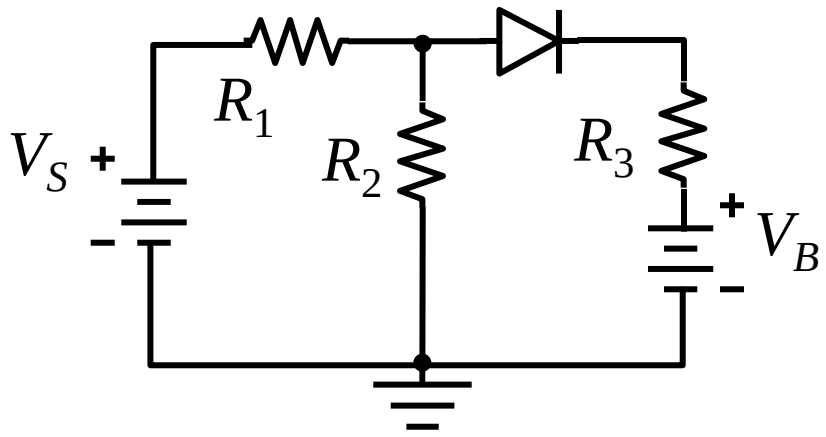
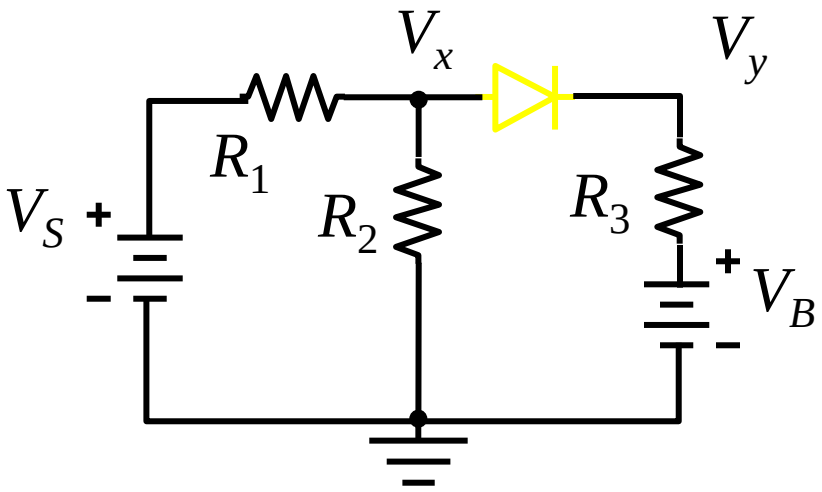
Example 4



V_S = 12 V
R_1 = 4 Ω
R_2 = 8 Ω
R_3 = 6 Ω
V_B = 9 V

Find the current through the diode and the voltage on either side of the diode.

Example 4 (Conducts?)



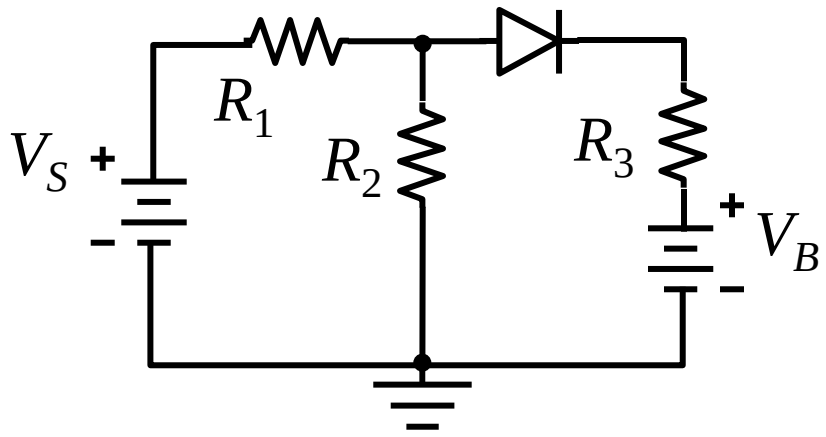
$V_S = 12$ V
$R_1 = 4\ \Omega$
$R_2 = 8\ \Omega$
$R_3 = 6\ \Omega$
$V_B = 9$ V

$$V_x = \frac{R_2}{R_1 + R_2} V_S \qquad V_x = \frac{8}{12} \cdot 12 = 8$$

$$V_y = 9$$

Diode does not conduct

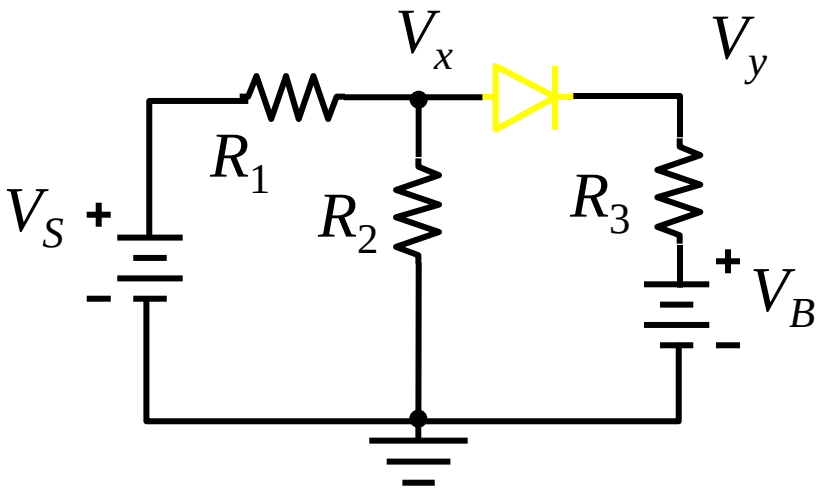
Example 5



V_S = 12 V
R_1 = 2 Ω
R_2 = 10 Ω
R_3 = 6 Ω
V_B = 9 V

Find the current through the diode and the voltage on either side of the diode.

Example 5 (Conducts?)



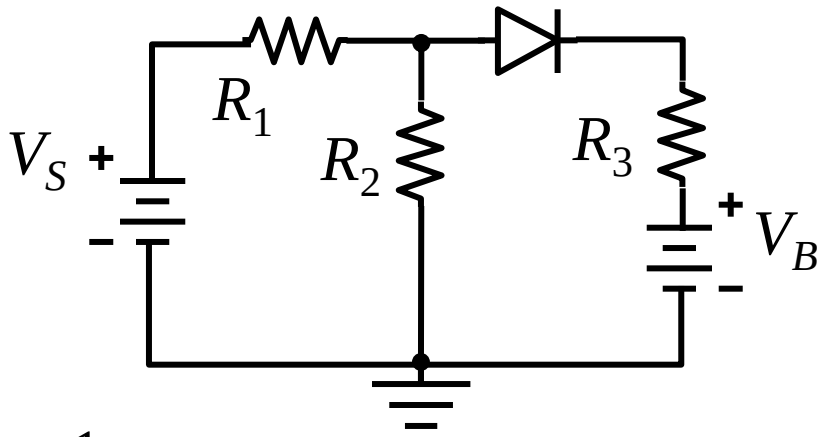
V_S = 12 V
R_1 = 2 Ω
R_2 = 10 Ω
R_3 = 6 Ω
V_B = 9 V

$$V_x = \frac{R_2}{R_1 + R_2} V_S \qquad V_x = \frac{10}{12} \cdot 12 = 10$$

$$V_y = 9$$

Diode conducts

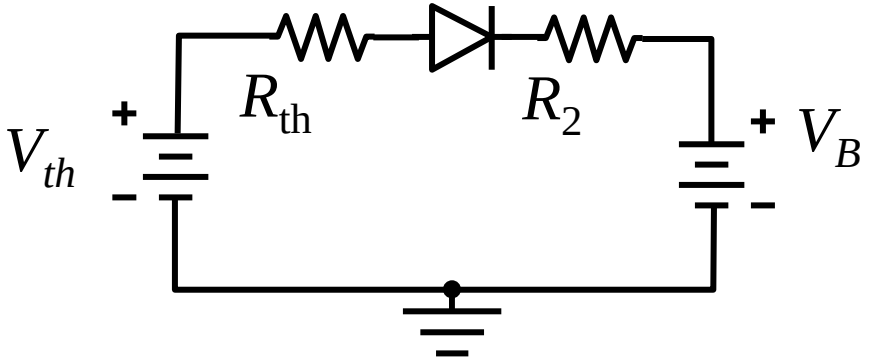
Example 5 (Thévenin Solution)



$V_S = 12$ V
$R_1 = 2\ \Omega$
$R_2 = 10\ \Omega$
$R_3 = 6\ \Omega$
$V_B = 9$ V

$$\frac{1}{R_{th}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_{th}} = \frac{1}{2} + \frac{1}{10} = \frac{6}{10} = \frac{3}{5}$$



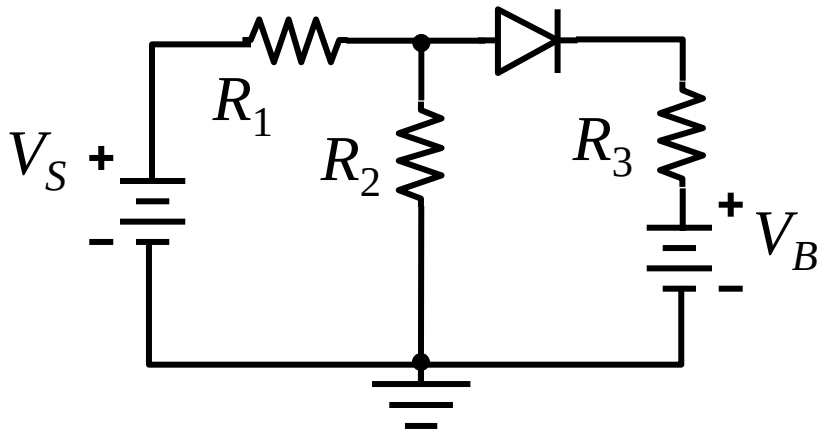
$$V_{th} = \frac{R_2}{R_1 + R_2} V_S$$

$$V_{th} = \frac{10}{12} 12 = 10$$

$$i_D = \frac{V_{th} - 0.7 - V_B}{R_{th} + R_3}$$

$$i_D = \frac{10 - 0.7 - 9}{5/3 + 6} = \frac{3}{23} 0.3 = 39.13\,\text{mA}$$

Example 5 (Node Analysis Solution)



$V_S = 12$ V
$R_1 = 2\ \Omega$
$R_2 = 10\ \Omega$
$R_3 = 6\ \Omega$
$V_B = 9$ V

$$i_1 = i_2 + i_3$$

$$\frac{V_S - V_x}{R_1} = \frac{V_x}{R_2} + \frac{V_x - 0.7 - V_B}{R_3}$$

$$V_x\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right) = \frac{V_S}{R_1} + \frac{0.7 + V_B}{R_3}$$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

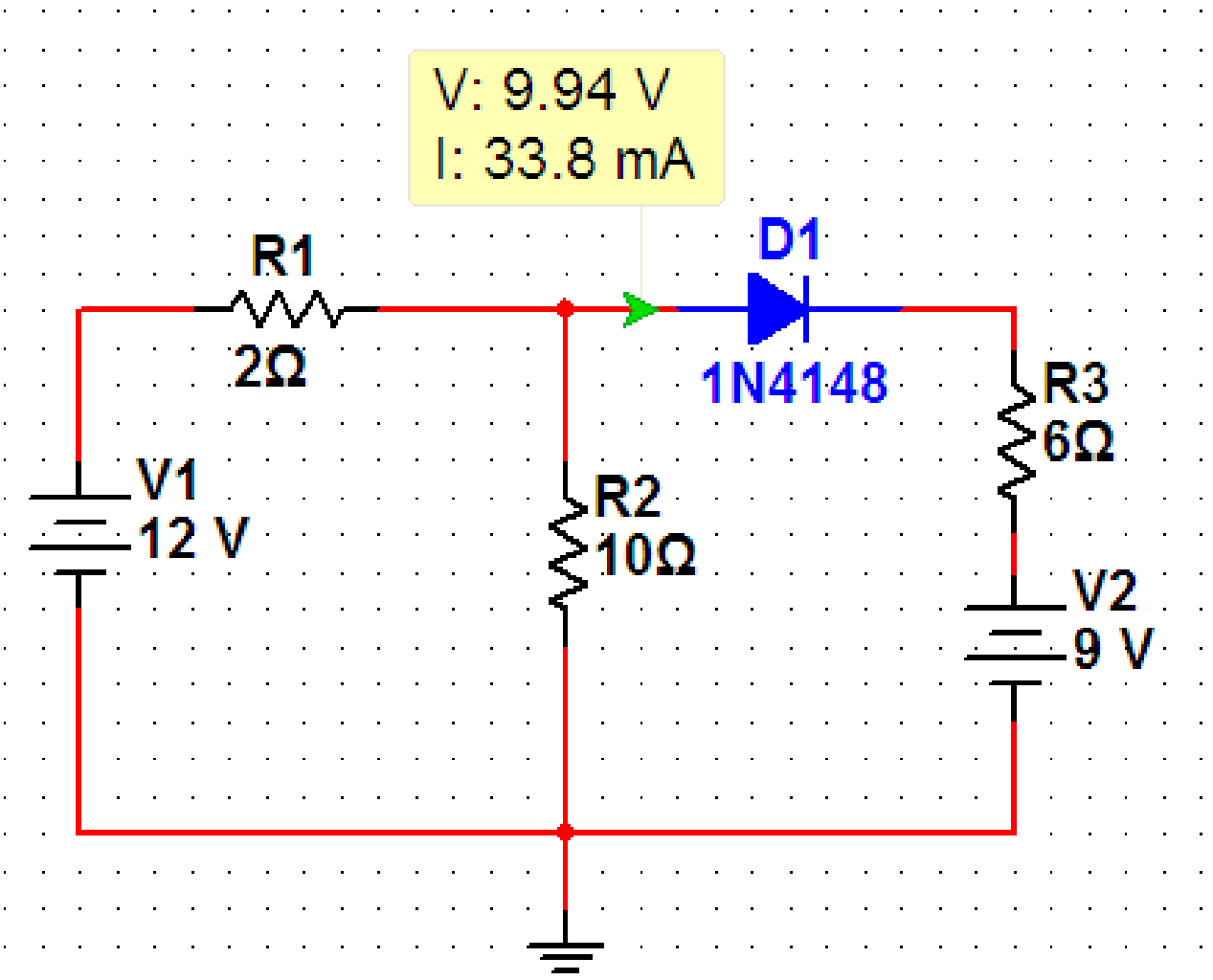
$$\frac{1}{R_p} = \frac{1}{2} + \frac{1}{10} + \frac{1}{6} = \frac{15+3+5}{30} = \frac{23}{30}$$

$$V_x = \frac{30}{23} \cdot \left(\frac{12}{2} + \frac{9.7}{6}\right) = 9.9348$$

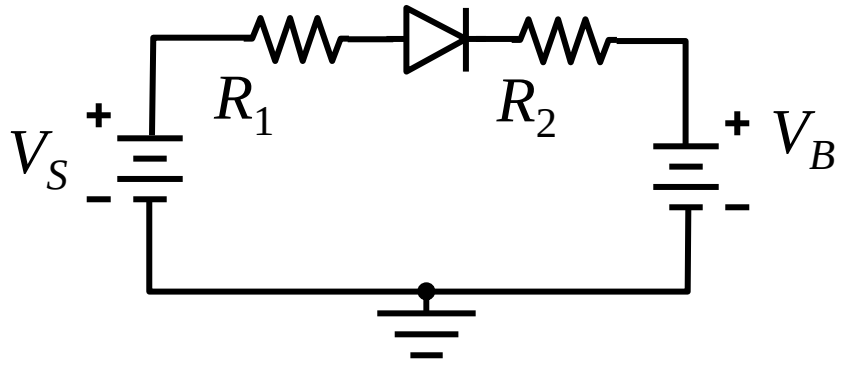
$$V_y = V_x - 0.7$$

$$i_3 = \frac{V_x - 0.7 - V_B}{R_3} = \frac{9.93 - 9.7}{6} = 39.13\,\text{mA}$$

Example 5 (Multisim)



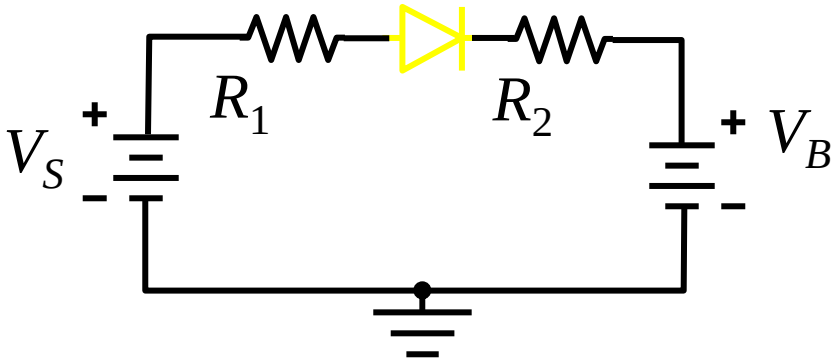
Example 6



V_S = 12 V
R_1 = 5 Ω
R_2 = 8 Ω
V_B = 10 V

Find the current through the diode and the voltage on either side of the diode.

Example 6 (Conducts?)

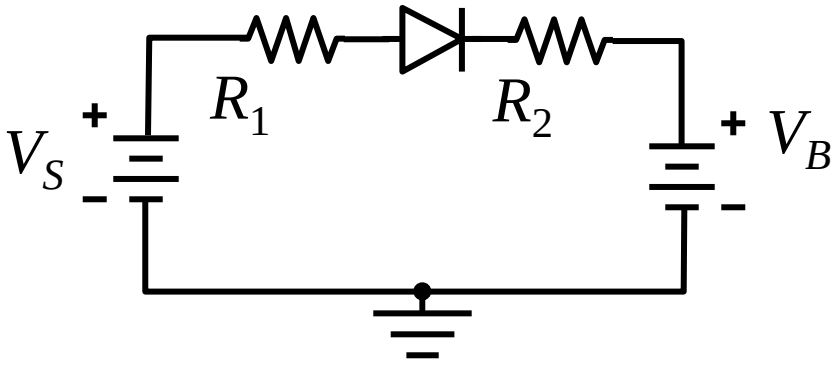


V_S = 12 V
R_1 = 5 Ω
R_2 = 8 Ω
V_B = 10 V

$V_x = 12$ $V_y = 10$

Diode conducts

Example 6



$V_S = 12$ V
$R_1 = 5\ \Omega$
$R_2 = 8\ \Omega$
$V_B = 10$ V

KVL $\quad V_S = i_D R_1 + 0.7 + i_D R_2 + V_B$

$$i_D = \frac{V_S - 0.7 - V_B}{R_1 + R_2}$$

$$i_D = \frac{12 - 0.7 - 10}{13} = 100\ \text{mA}$$

$$V_x = V_S - i_D R_1 = 12 - 0.5 = 11.5$$

$$V_y = V_B + i_D R_2 = 10 + 0.8 = 10.8;$$