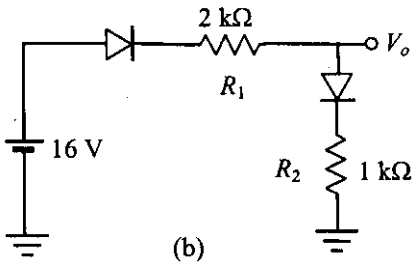
Diode Circuits

Example

Calculate V_0



$V = 0.7 + I_D R_1 + 0.7 + I_D R_2$

$V - 0.7 - 0.7 = I_D(R_1 + R_2)$

$I_D = [V - (0.7 + 0.7)] / (R_1 + R_2)$

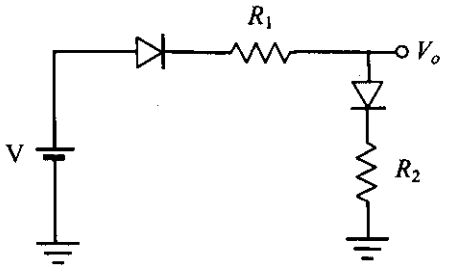
$I_D = 14.6 / (2000 + 1000)$

$I_D = 4.9$ mA

$V_0 = 0.7 + I_D R_2$

$V_0 = 0.7 + 0.0049 \times 1000 = 0.7 + 4.9 = 5.6$ V

Exercise

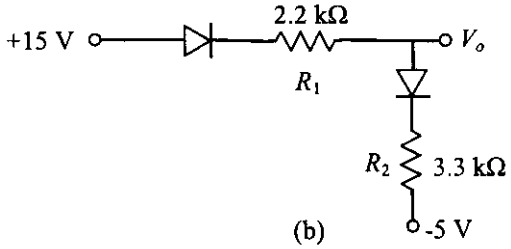


Calculate V_0 for V = 15 V, R1 = 2200 Ω, R2 = 3300 Ω

Answer: $I_D = 2.5$ mA $V_0 = 8.9$ V

Example

Calculate V_0



$+15 = 0.7 + I_D R_1 + 0.7 + I_D R_2 - 5$

$20 - 0.7 - 0.7 = I_D(R_1 + R_2)$

$I_D = 18.6 / (R_1 + R_2)$

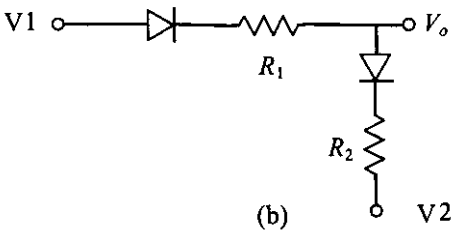
$I_D = 18.6 / (2200 + 3300)$

$I_D = 3.38$ mA

$V_0 = 0.7 + I_D R_2 - 5.0$

$V_0 = 0.7 + 0.00338 \times 3300 - 5.0 = 0.7 + 11.2 - 5.0 = 6.9$ V

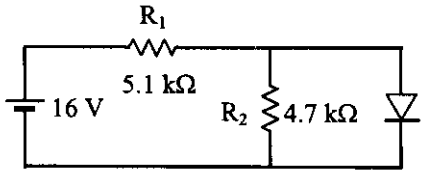
Exercise



Calculate V_0 for V1 = +10 V V2 = -5 V
R1 = 1100 Ω R2 = 2200 Ω

Answer: $I_D = 4.1$ mA $V_0 = 4.8$ V

Example (Refer to the Diode Circuit Lecture Notes)



Calculate the Current I_D

1. Remove Diode (Replace by V_{TH})

   For Voltage Divider $V_{TH} = V [R_2 / (R_1 + R_2)]$

   $V_{TH} = 16 [4700 / (5100 + 4700)] = 7.67$ V

2. Short V_{source} (R_1 in parallel with R_2)

   $R_{EQ} = (R_1 \times R_2) / (R_1 + R_2)$

   $R_{EQ} = (5100 \times 4700) / (5100 + 4700) = 2446\ \Omega$

3. Redraw with V_{TH}, R_{EQ}, Diode

   $V_{TH} = I_D R_{EQ} + V_D$ $\qquad$ $I_D = (V_{TH} - V_D) / R_{EQ}$

   $I_D = (7.67 - 0.7) / 2446 = 2.85$ mA

Alternative Solution Method

$V_{R2} = V_D = 0.7$ V

$I_{R2} = V_{R2} / R_2 = 0.7 / 4700 = 0.15$ mA

$I_{R1} = (V - V_{R2}) / R_1 = (16.0 - 0.7) / 5100 = 3.0$ mA

$I_{Total} = I_{R1}$

$I_D = I_{Total} - I_{R2} = 3.00 - 0.15 = 2.85$ mA

Exercise

Calculate the Current I_D

Answer: $I_D = 4.9$ mA $\quad V_D = 0.7$ V