COLLEGE OF ENGINEERING AND TECHNOLOGIES
ALMUSTAQBAL UNIVERSITY

Electronics

CTE 207

Lecture 8

- Diode Configurations -

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Diode configuration states

- In general, a diode is in the ON state if the current established by the applied sources is such that its direction matches that of the arrow in the diode symbol, VD = 0.7 for Silicon, and VD = 0.3 for germanium.

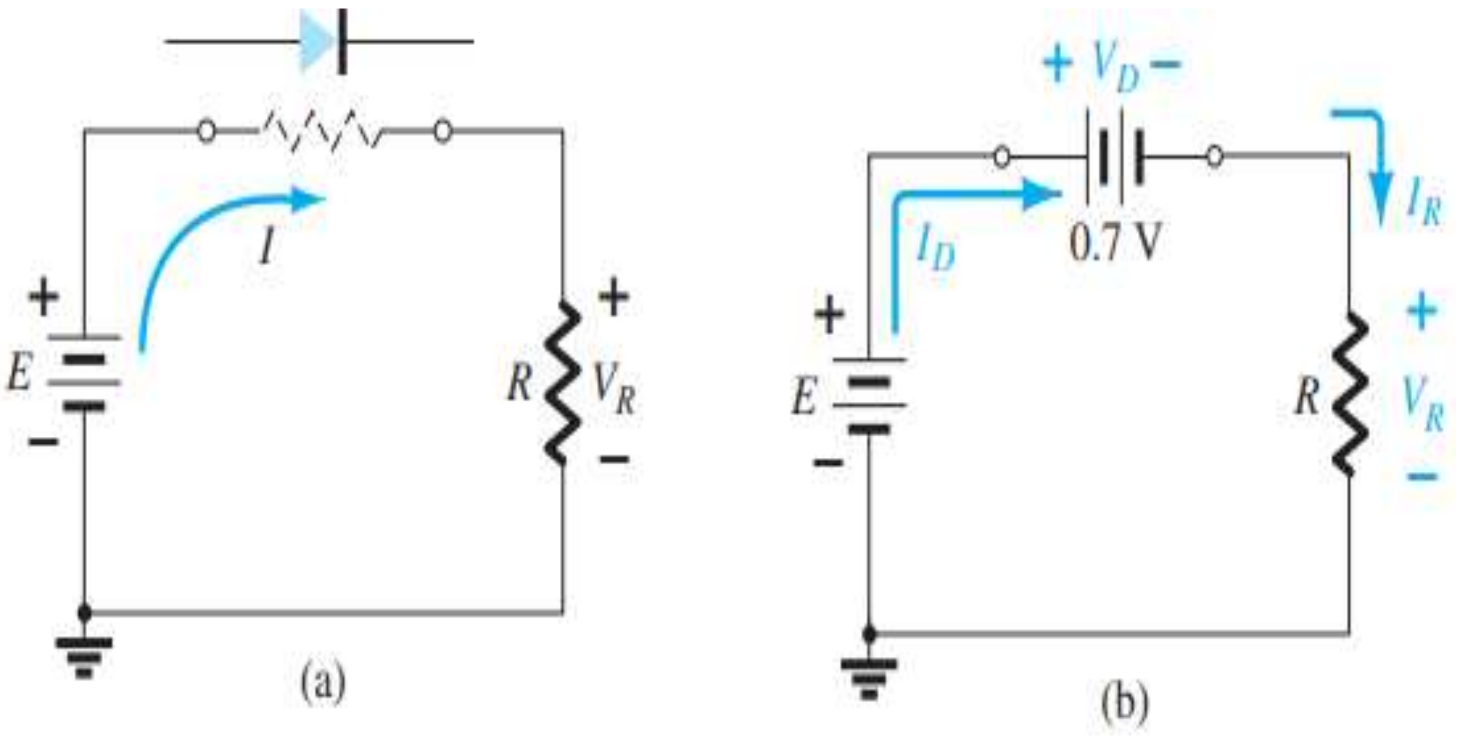
- The diode is in the "off" state resulting in the equivalent circuit.

- Due to the open circuit, the diode current is (0)A, and the voltage across the resistor R is as the following:

$$V_R = I_R R = I_D R = (0\text{ A})R = \mathbf{0\ V}$$

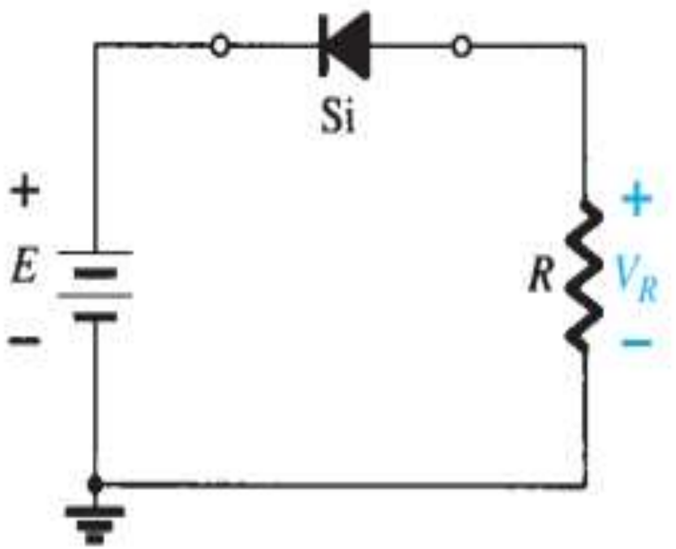
$$I_D = I_R = \frac{V_R}{R}$$

Diode configuration states

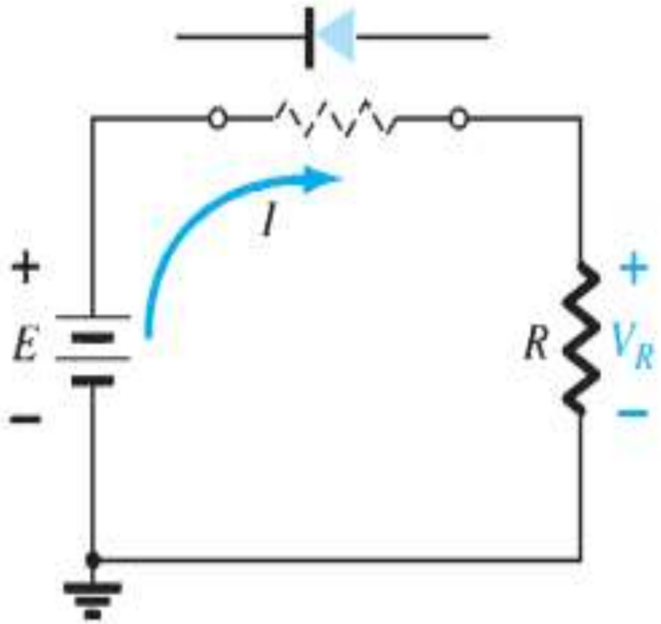


(a) State of the diode (b) Equivalent model for the “on” diode

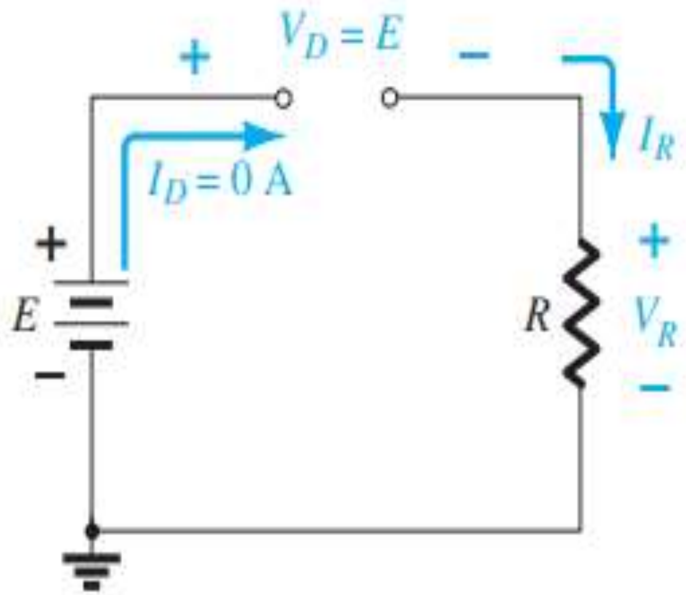
Diode configuration states



Reversing the diode



State of the diode



Equivalent model for the “off” diode

Diode configuration states

- The fact that VR = 0V will establish E volts across the open circuit as defined by Kirchhoff's voltage law.

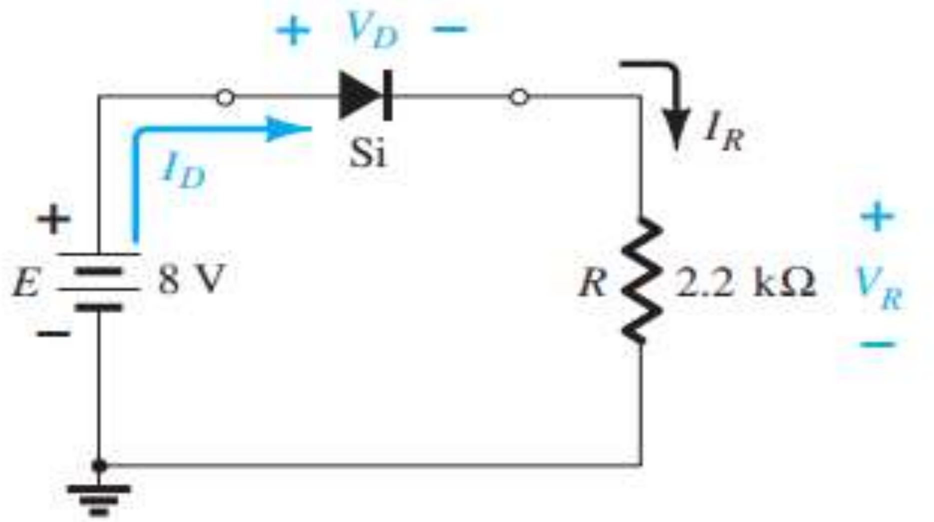
- Always keep in mind that under any circumstances dc, ac instantaneous values, pulses, and so on Kirchhoff's voltage law must be satisfied.

Example 1

For the series diode configuration of Figure below determine:

(a) VD, VR, and ID.

(b) repeat with the diode reversed.



Circuit for Example 1

Solution

(a)

$$V_D = \mathbf{0.7\ V}$$

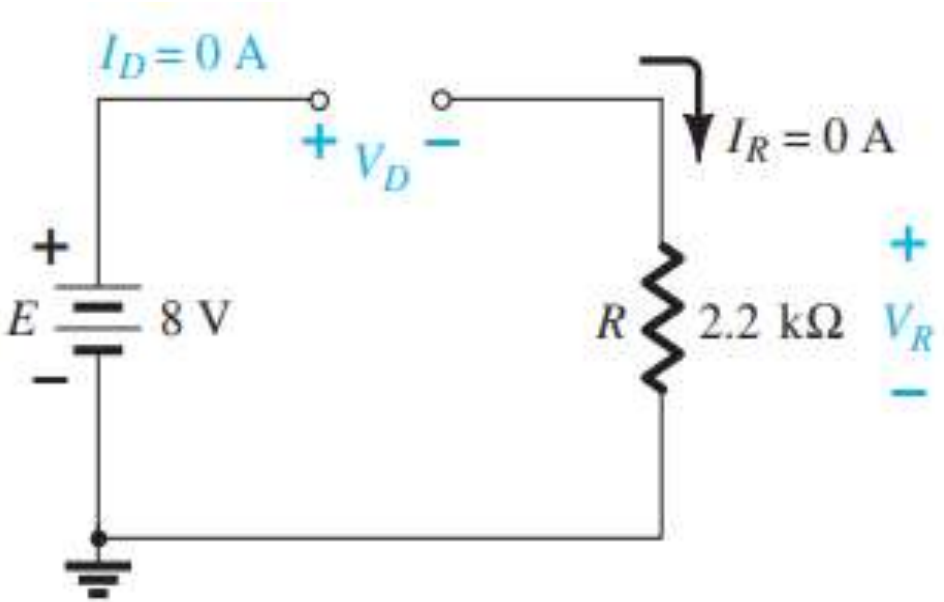
$$V_R = E - V_D = 8\ \text{V} - 0.7\ \text{V} = \mathbf{7.3\ V}$$

$$I_D = I_R = \frac{V_R}{R} = \frac{7.3\ \text{V}}{2.2\ \text{k}\Omega} \cong \mathbf{3.32\ mA}$$

(b)

$$E - V_D - V_R = 0$$

$$V_D = E - V_R = E - 0 = E = 8\ \text{V}$$



Determining the unknown quantities for Example 1.

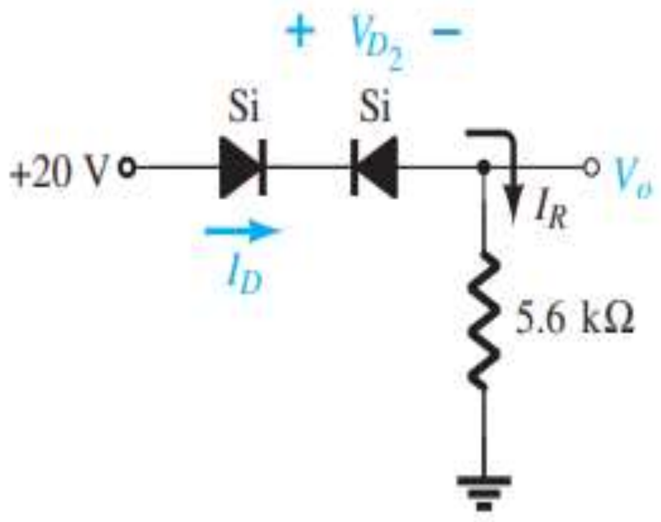
Example 2

Determine ID, VD2, and Vo for the circuit of Figure below.

$$I_D = 0\ A,\ V_D = 0\ V$$

$$V_o = I_R R = I_D R = (0\ A)R = 0\ V$$

$$V_o = \mathbf{0\ V}$$



Circuit for Example 2.

Solution

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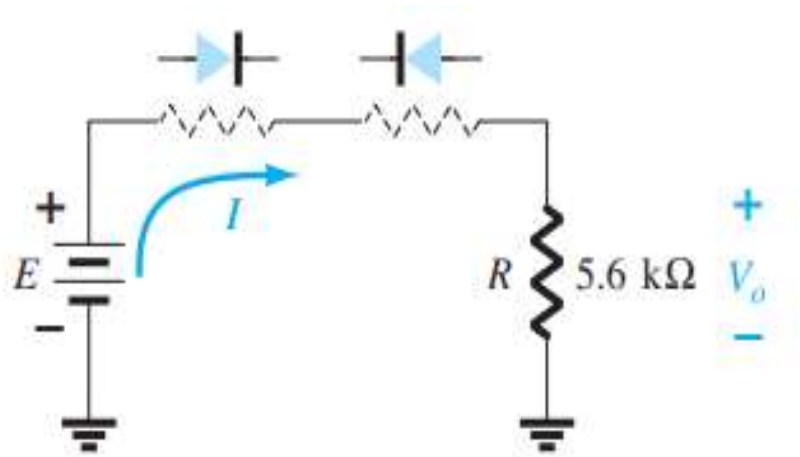
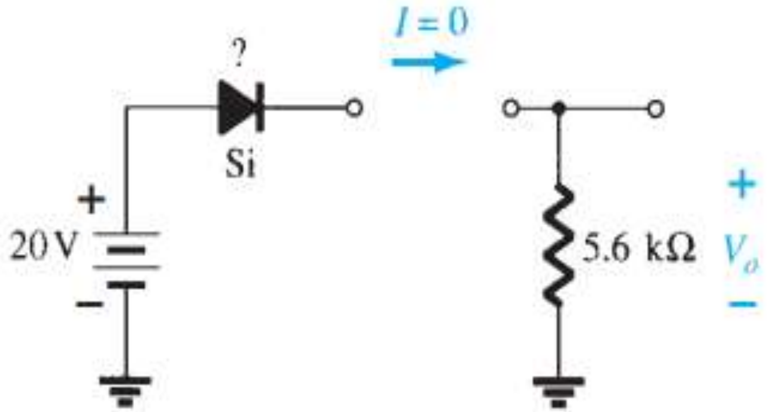
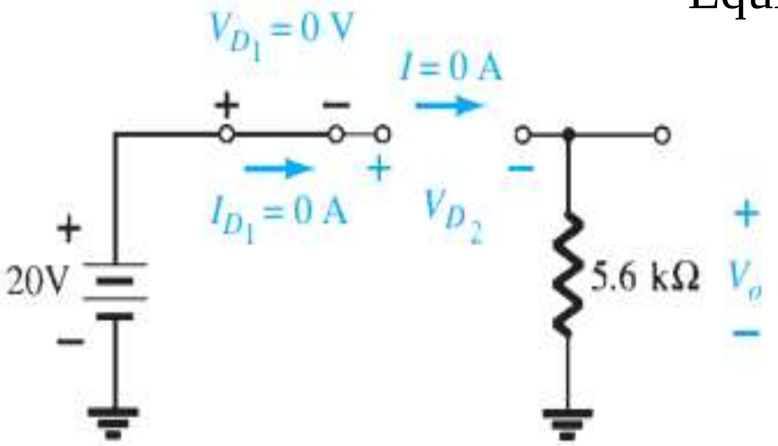


State of the diodes



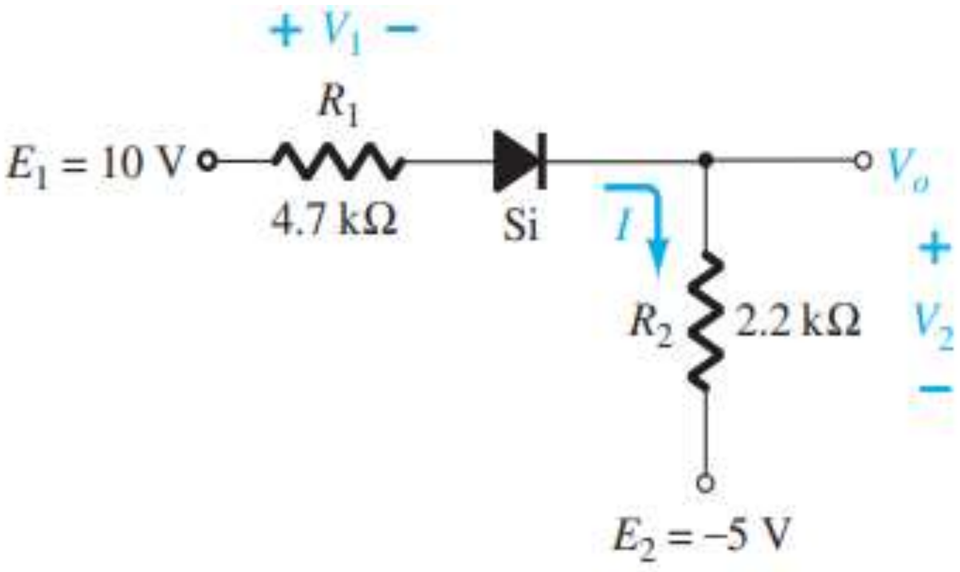
Equivalent state for the open diode



Determining the unknown quantities for the circuit of Example 2.

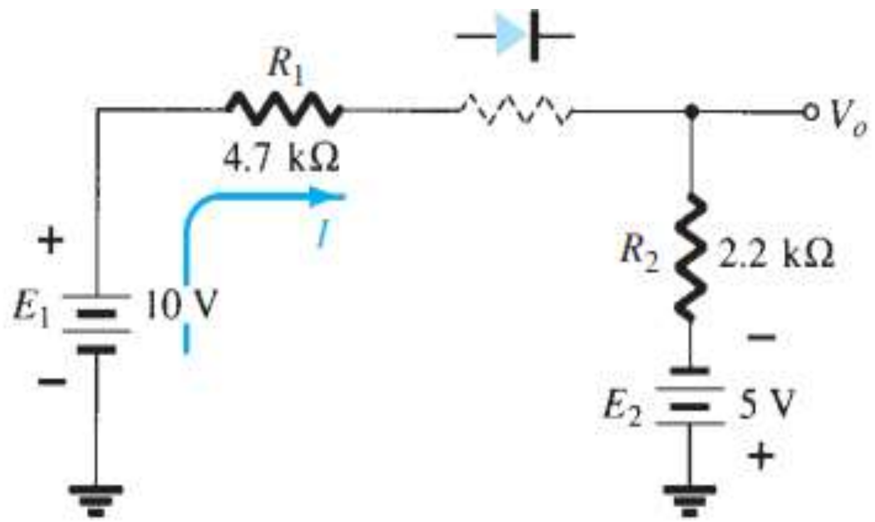
Example 3

Determine I, V1, V2, and Vo for the series dc configuration of Figure below.

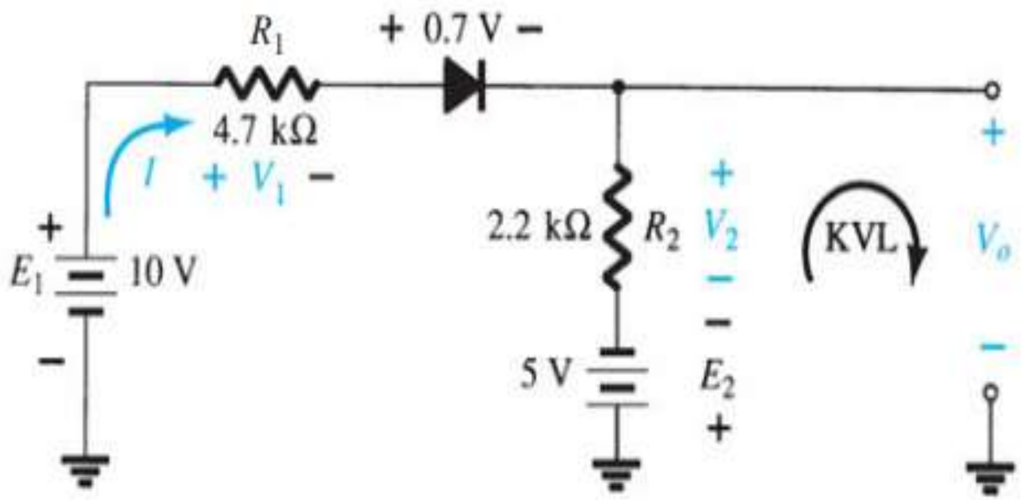


Circuit for Example 3.

Solution



State of the diode



KVL, Kirchhoff voltage loop.

Solution

The resulting current through the circuit is

$$I = \frac{E_1 + E_2 - V_D}{R_1 + R_2} = \frac{10\text{ V} + 5\text{ V} - 0.7\text{ V}}{4.7\text{ k}\Omega + 2.2\text{ k}\Omega} = \frac{14.3\text{ V}}{6.9\text{ k}\Omega}$$

$$\cong \mathbf{2.07\ mA}$$

and the voltages are

$$V_1 = IR_1 = (2.07\text{ mA})(4.7\text{ k}\Omega) = \mathbf{9.73\ V}$$
$$V_2 = IR_2 = (2.07\text{ mA})(2.2\text{ k}\Omega) = \mathbf{4.55\ V}$$

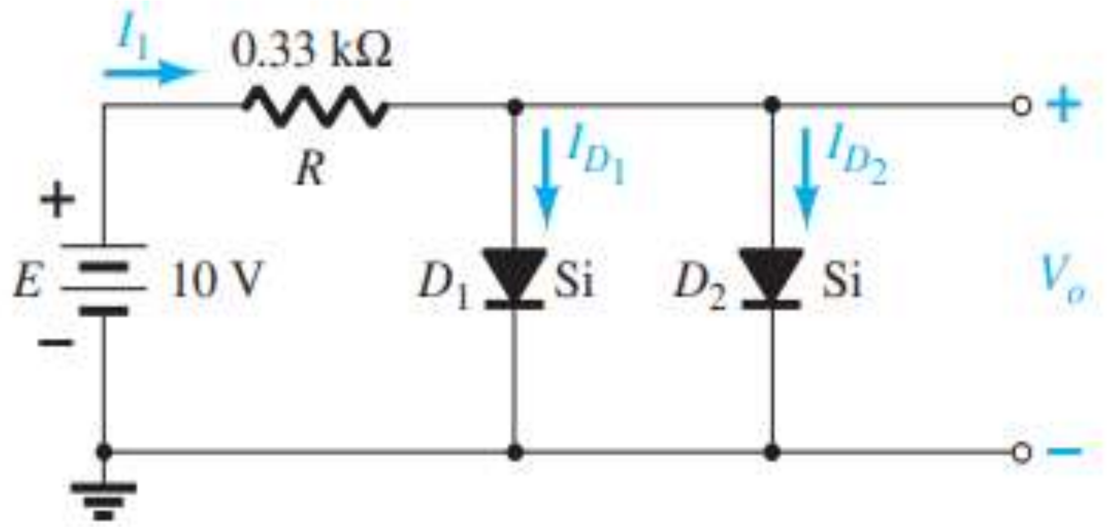
Applying Kirchhoff's voltage law to the output section in the clockwise direction results in

$$-E_2 + V_2 - V_o = 0$$
$$V_o = V_2 - E_2 = 4.55\text{ V} - 5\text{ V} = \mathbf{-0.45\ V}$$

The minus sign indicates that Vo has a polarity opposite to that appearing in Circuit for Example 3.

Example 4

Determine Vo , I1 , ID1 , and ID2 for the parallel diode configuration of Figure below.



Circuit for Example 4.

Solution

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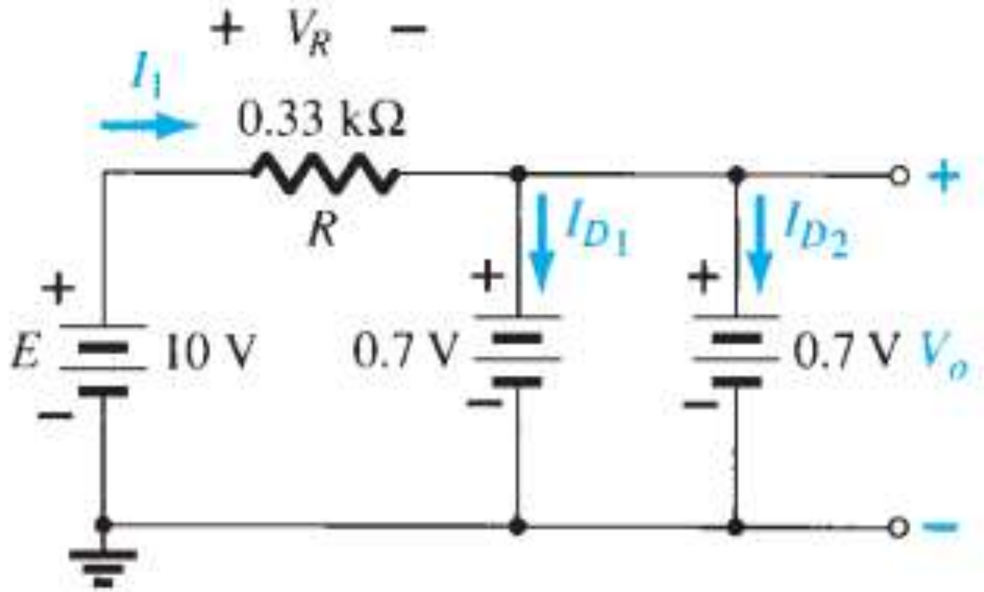
$$V_o = \mathbf{0.7\ V}$$

The current is

$$I_1 = \frac{V_R}{R} = \frac{E - V_D}{R} = \frac{10\ \text{V} - 0.7\ \text{V}}{0.33\ \text{k}\Omega} = \mathbf{28.18\ mA}$$

Assuming diodes of similar characteristics, we have

$$I_{D_1} = I_{D_2} = \frac{I_1}{2} = \frac{28.18\ \text{mA}}{2} = \mathbf{14.09\ mA}$$



The unknown quantities for the network of Example 4