Georgia Institute of Technology

Introduction to Electronics

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An introduction to linear electric components and a study of circuits containing such devices.

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Assumed States Method

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Introduce ideal diode circuits with multiple diodes

Previous Lesson

- Circuit Analysis with a single ideal diode

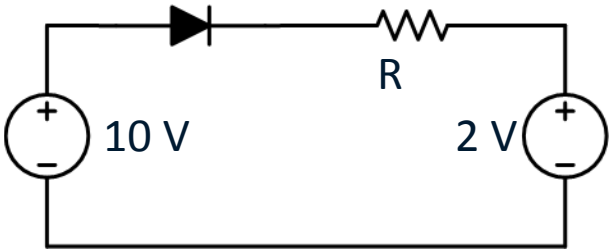
Lesson Objective

- Describe the procedure for handling multiple diodes in a single circuit

Assumed States Procedure

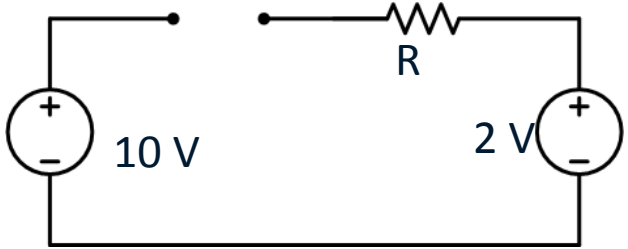
1) Identify all possible diode state combinations
   - 1 diode $\Rightarrow$ 2 states
   - 2 diodes $\Rightarrow$ 4 states
   - 3 diodes $\Rightarrow$ $2^3 = 8$ states
2) Analyze each state by replacing the diodes with the corresponding open or short.
3) Determine which state is consistent:
   - ON: $i_D > 0$
   - OFF: $V_D < 0$

Example



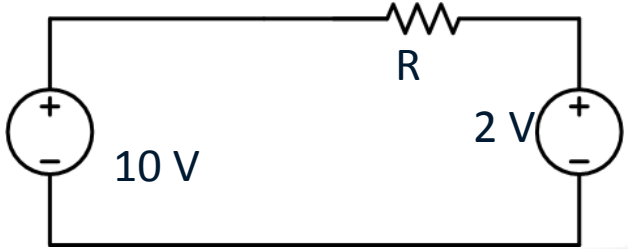
States	D1	Consistent?
A	OFF	
B	ON	

A) OFF:



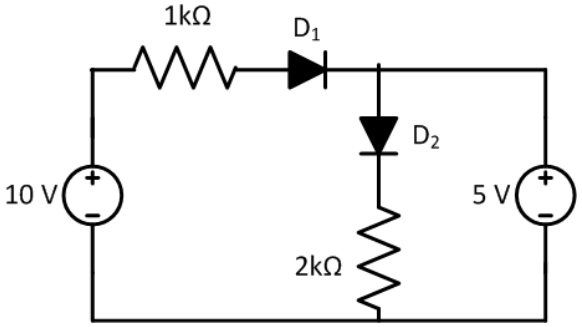
$-10 + V_D + 2 = 0, V_D > 0$
(not consistent)

B) ON:



$-10 + i_D 1k + 2 = 0, i_D = 0.008A > 0$
(consistent)

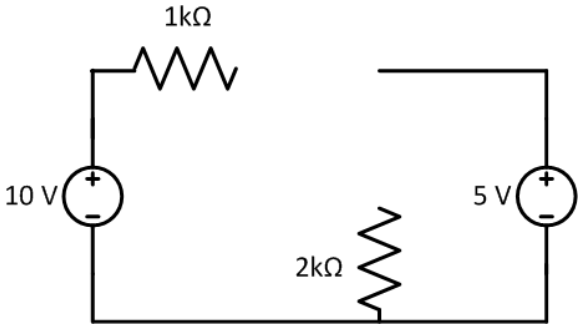
Two Diode Example



Find V_1

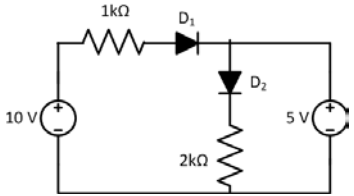
States	D1	D2	Consistent?
A	OFF	OFF	
B	OFF	ON	
C	ON	OFF	
D	ON	ON	

A)



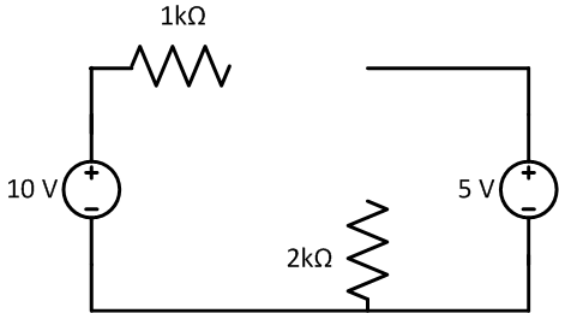
KVL: $-5 + V_{D2} = 0$ → $V_{D1} = 5 > 0$
(Not consistent)

Example continued



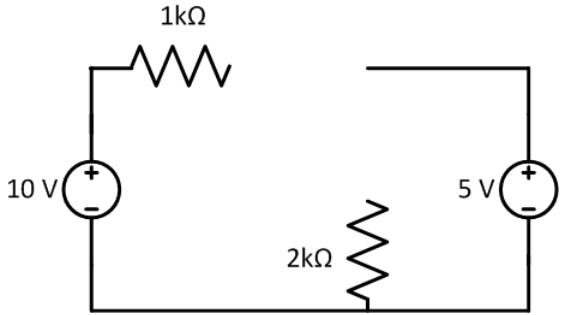
States	D1	D2	Consistent?
A	OFF	OFF	No
B	OFF	ON	
C	ON	OFF	
D	ON	ON	

B)



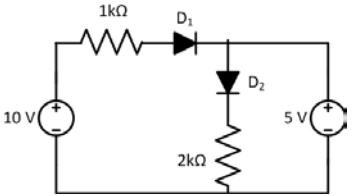
KVL: $-10 + V_{D1} + 5 = 0$, $V_{D1} = 5V > 0$
(Not consistent)

C)



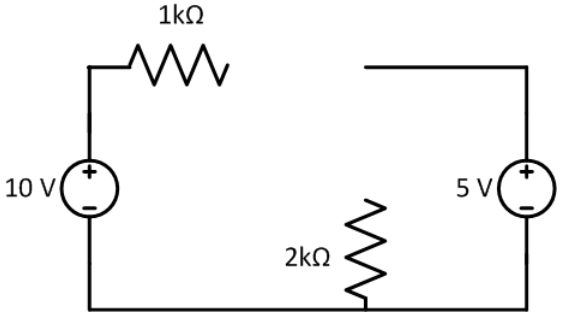
$V_{D2} = 5V > 0$
(Not consistent)

Example continued



States	D1	D2	Consistent?
A	OFF	OFF	No
B	OFF	ON	No
C	ON	OFF	No
D	ON	ON	

D)



KVL: $-10 + 1000i_{D1} + 5 = 0$
$i_{D1} = 0.005A > 0$
$i_{D2} = 5/2000 > 0$
(Consistent)

Operating state:
D_1 and D_2 are ON
$V_1 = 1000(0.005) = 5V$

Summary

- Diodes act as a short or an open, depending on the bias
- When solving a circuit, assume each possible state, and check to see if the behavior is consistent with that state

Next Lesson

- Ideal Diode with a Voltage Source