DC ANALYSIS OF DIODE CIRCUITS

SEMICONDUCTOR DIODE

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TOPIC OUTLINE

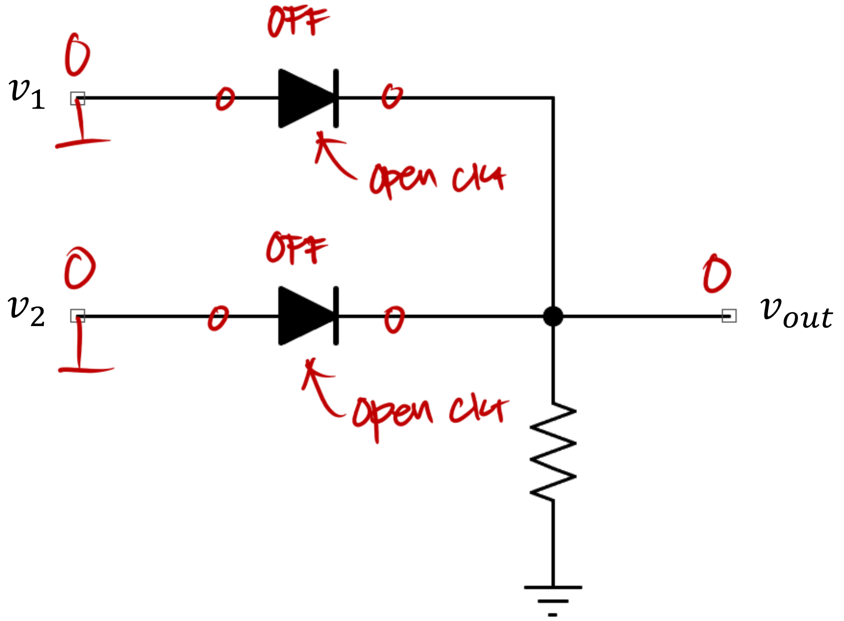
Diode Logic

- **OR Gate**
- **AND Gate**

Analyzing Diode Behavior in DC Circuits

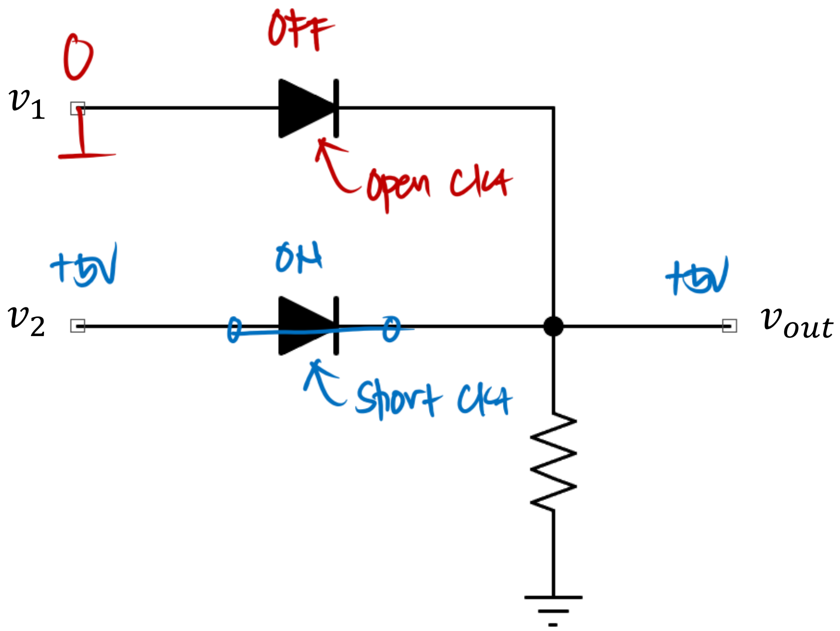
DIODE LOGIC

POSITIVE LOGIC OR GATE



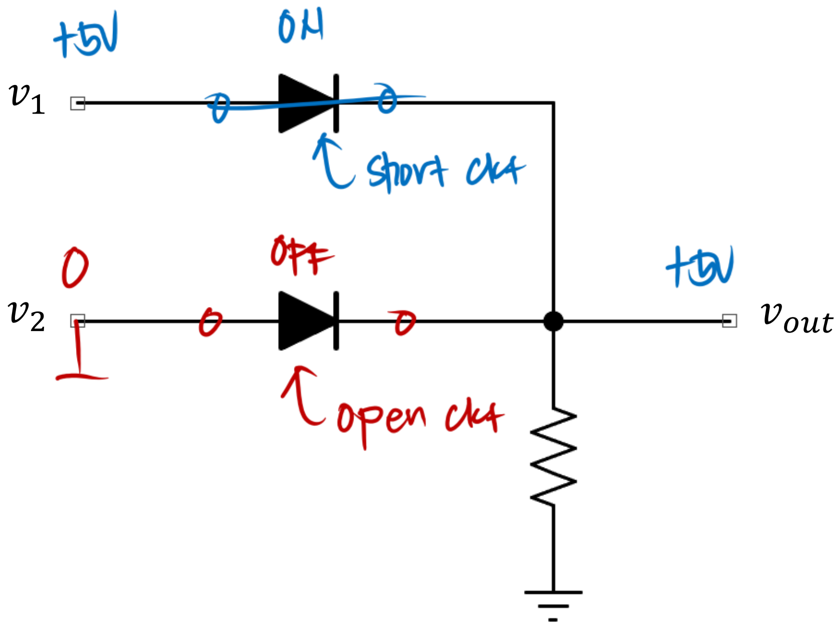
v_1	v_2	v_{out}
0	0	0
0	5	
5	0	
5	5	

POSITIVE LOGIC OR GATE



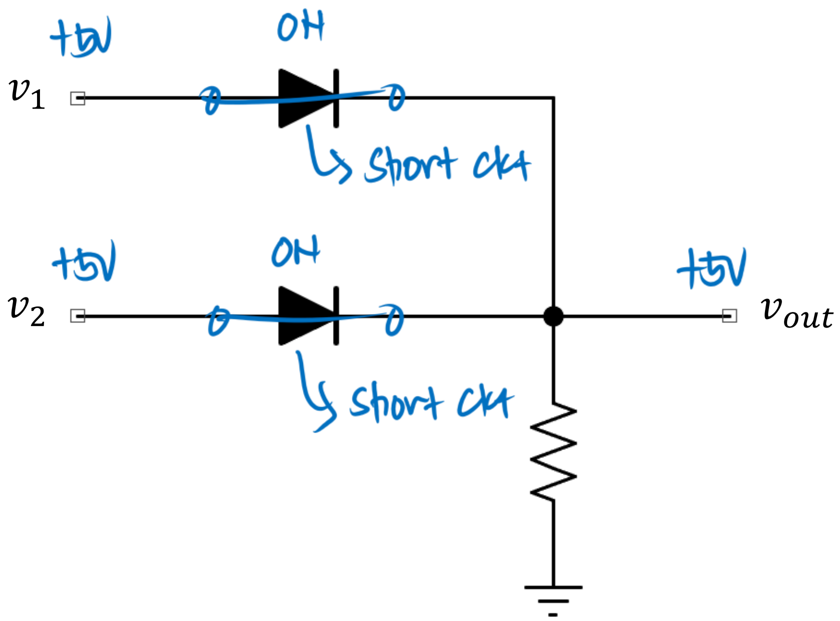
v_1	v_2	v_{out}
0	0	0
0	5	5
5	0	
5	5	

POSITIVE LOGIC OR GATE



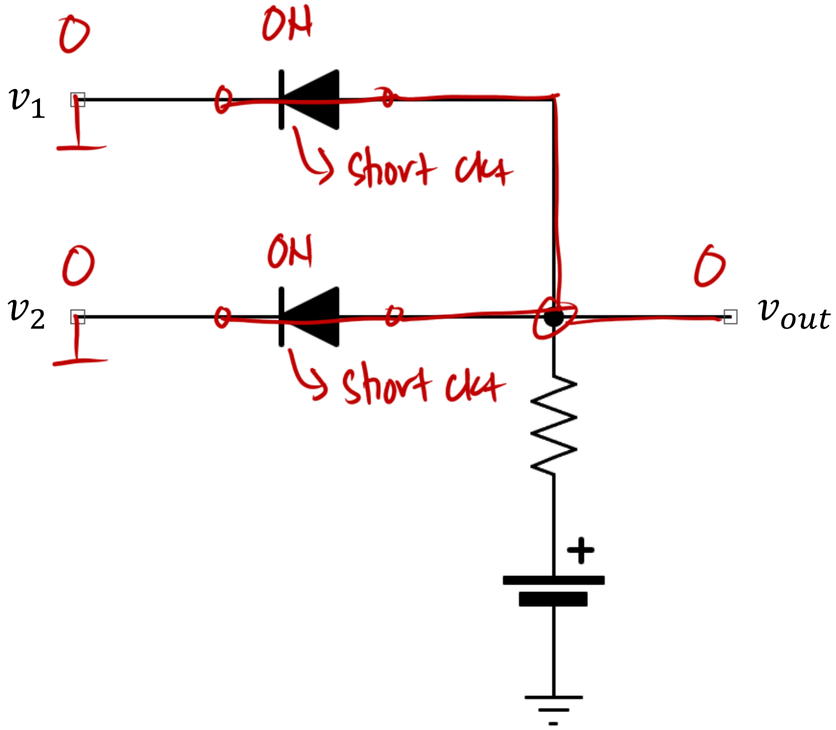
v_1	v_2	v_{out}
0	0	0
0	5	5
5	0	5
5	5	

POSITIVE LOGIC OR GATE



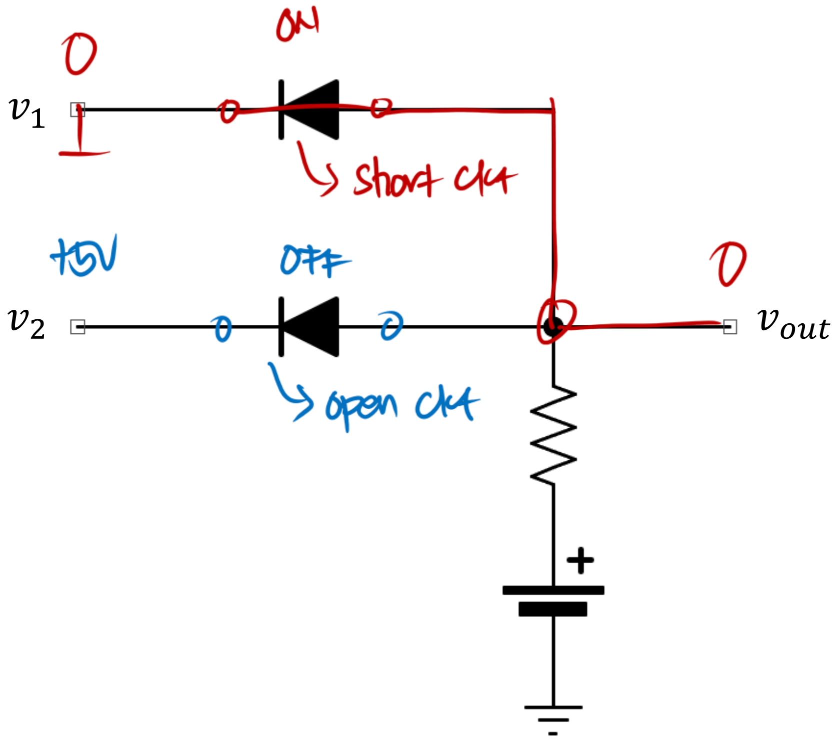
v_1	v_2	v_{out}
0	0	0
0	5	5
5	0	5
5	5	5

POSITIVE LOGIC AND GATE



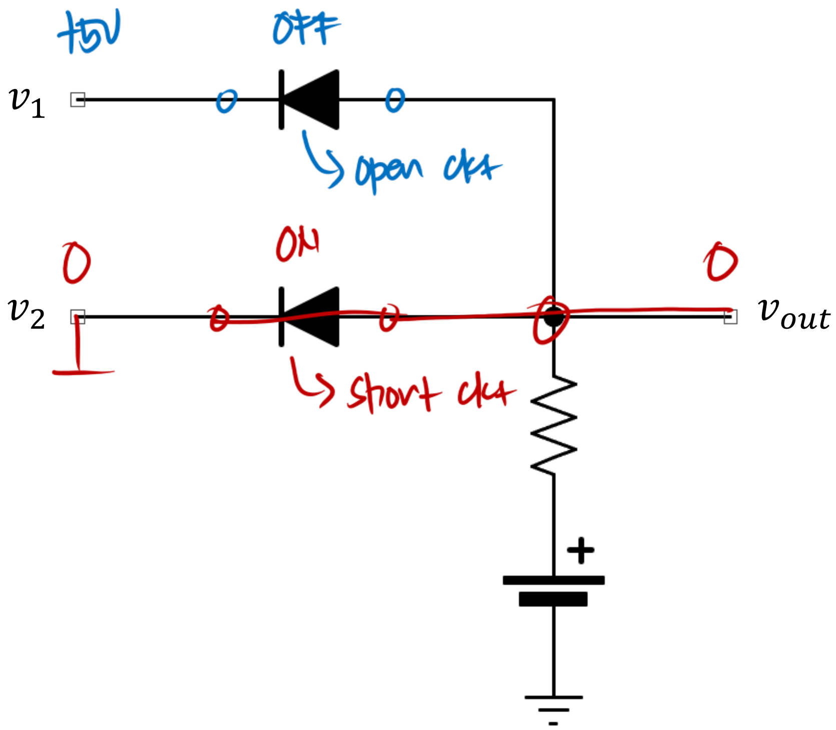
v_1	v_2	v_{out}
0	0	0
0	5	
5	0	
5	5	

POSITIVE LOGIC AND GATE



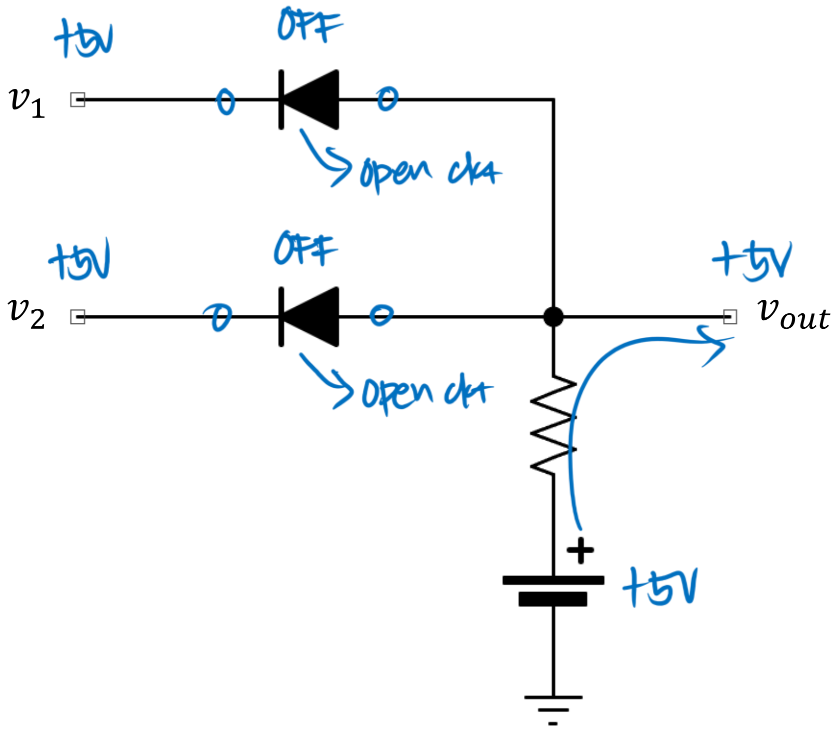
v_1	v_2	v_{out}
0	0	0
0	5	0
5	0	
5	5	

POSITIVE LOGIC AND GATE



v_1	v_2	v_{out}
0	0	0
0	5	0
5	0	0
5	5	

POSITIVE LOGIC AND GATE

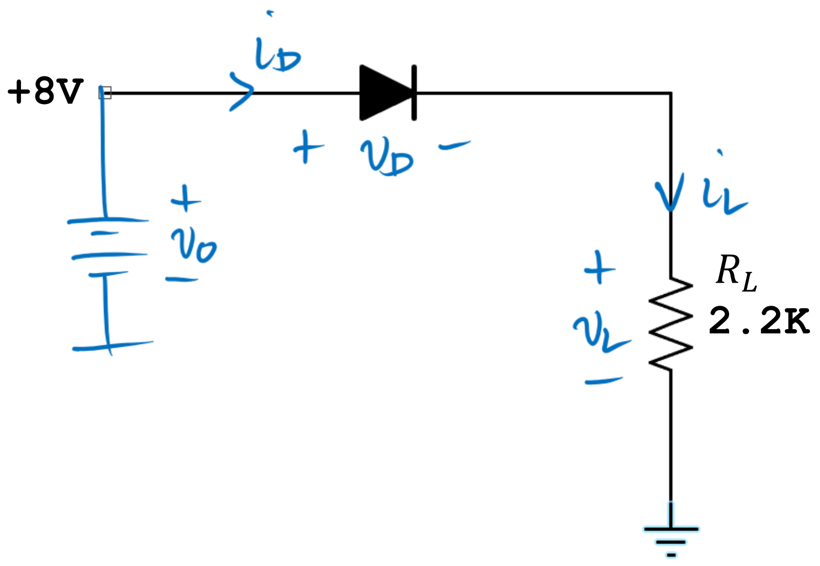


v_1	v_2	v_{out}
0	0	0
0	5	0
5	0	0
5	5	5

ANALYZING DIODE BEHAVIOR IN DC CIRCUITS

EXERCISE

Determine the voltage across the load (v_L), the current flowing through the load (i_L), and the power dissipated by the load resistor (P_L) in the given circuit. note: Always assume silicon diode ($v_D = 0.7V$) if not stated



Solution

Node Analysis Method

$$v_D = v_O - v_L$$

$$v_L = v_O - v_D$$

$$v_L = 8 - 0.7$$

$$\boxed{v_L = 7.3V}$$

ans

$$i_L = \frac{v_L}{R_L}$$

$$i_L = \frac{7.3}{2.2K}$$

$$\boxed{i_L = 3.32mA}$$

ans

$$P_D = i_D v_D$$

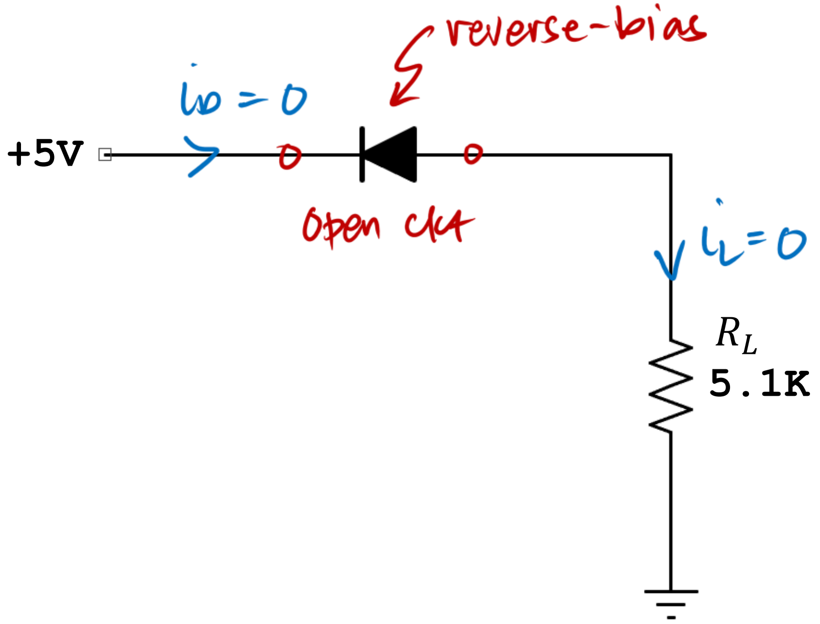
$$P_D = 3.32m(0.7)$$

$$\boxed{P_D = 2.32mW}$$

ans

EXERCISE

Determine the voltage across the load (v_L), the current flowing through the load (i_L), and the power dissipated by the load resistor (P_L) in the given circuit.



Solution

$$\boxed{i_L = 0}$$

ans

$$v_L = \cancel{i_L}^{\,0} R_L$$

$$\boxed{v_L = 0}$$

ans

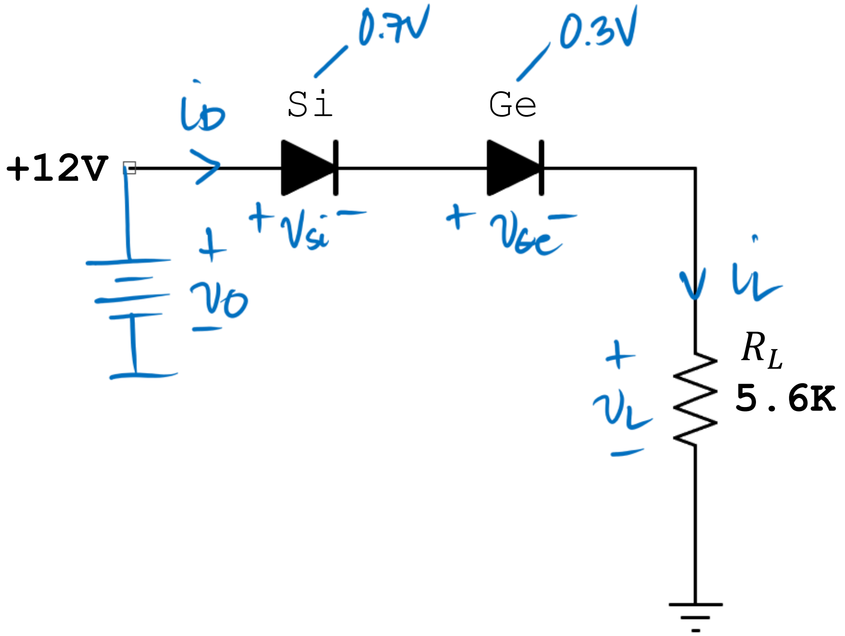
$$P_D = \cancel{i_D}^{\,0} v_D$$

$$\boxed{P_D = 0}$$

ans

EXERCISE

Determine the voltage across the load (v_L), the current flowing through the load (i_L), and the power dissipated by the load resistor (P_L) in the given circuit.



Solution

Node Analysis Method

$$V_{Si} + V_{Ge} = V_D - V_L$$

$$V_L = V_D - V_{Si} - V_{Ge}$$

$$V_L = 12 - 0.7 - 0.3$$

$$\boxed{V_L = 11\ V}$$ ans

$$i_L = \frac{V_L}{R_L}$$

$$i_L = \frac{11}{5.6K}$$

$$\boxed{i_L = 1.96\ mA}$$ ans

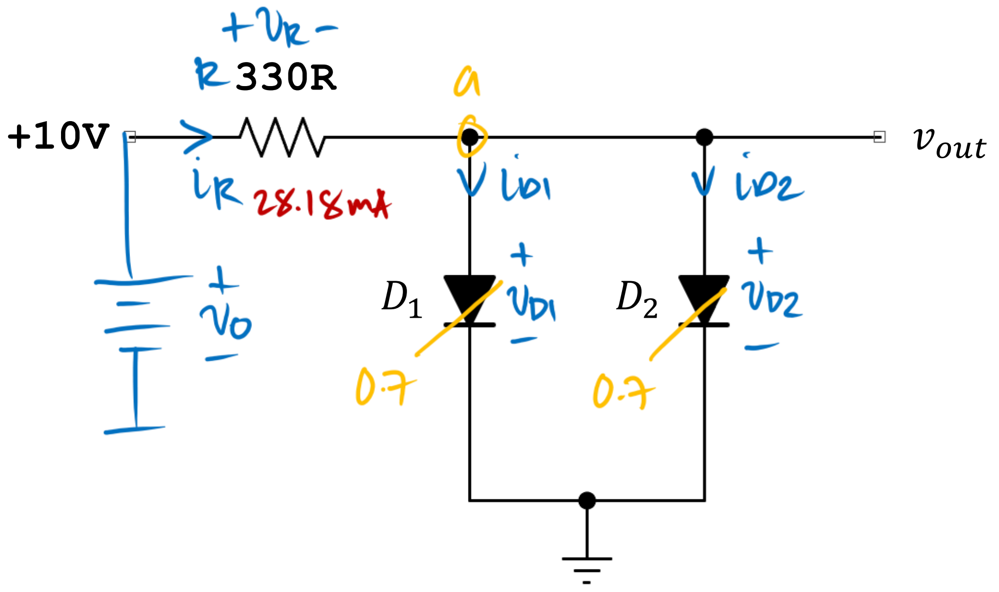
$$P_L = i_L V_L$$

$$P_L = 1.96m(11)$$

$$\boxed{P_L = 21.56\ mW}$$ ans

EXERCISE

Determine the output voltage (v_{out}), the current flowing through the resistor (i_R), and the currents flowing through diodes D_1 and D_2 (i_{D1} and i_{D2}) in the circuit.



Solution

Node Analysis Method

$v_R = v_o - v_a$

$v_R = 10 - 0.7$

$v_R = 9.3V$

$i_R = \frac{v_R}{R}$

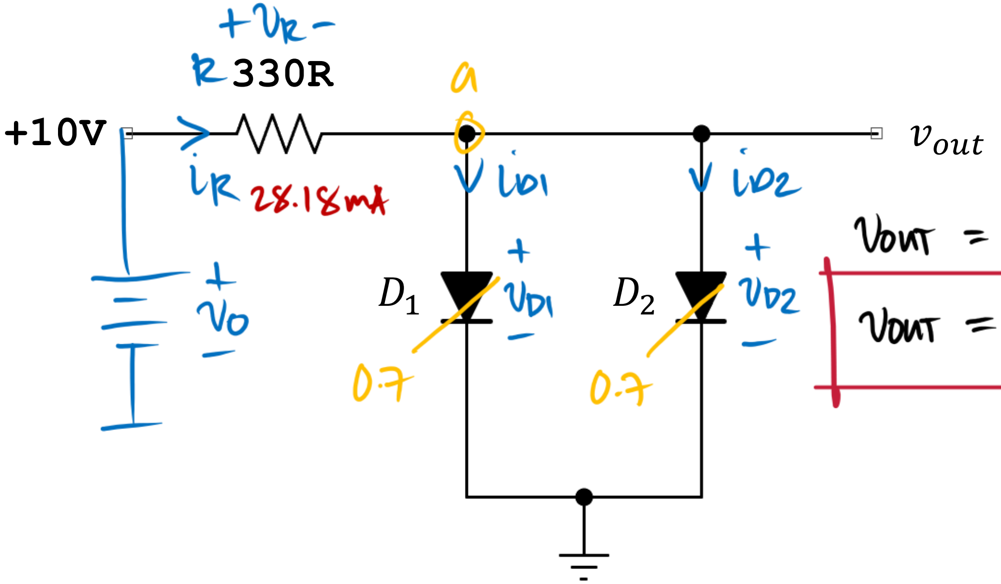
$i_R = \frac{9.3}{330}$

$\boxed{i_R = 28.18mA}$

ans

EXERCISE

Determine the output voltage (v_{out}), the current flowing through the resistor (i_R), and the currents flowing through diodes D_1 and D_2 (i_{D1} and i_{D2}) in the circuit.



$V_{OUT} = V_D - 0$

$$\boxed{V_{OUT} = 0.7V}$$

ans

Solution

KCL @ a

$-i_R + i_{D1} + \cancel{i_{D2}} = 0$

i_{D1}

assume identical diodes

$i_{D1} = i_{D2}$

$$\frac{\cancel{2}i_{D1}}{\cancel{2}} = \frac{i_R}{2}$$

$$i_{D1} = \frac{28.18m}{2}$$

$$\boxed{i_{D1} = 14.09\text{ mA}}$$

ans

$$\boxed{i_{D2} = 14.09\text{ mA}}$$

ans

LABORATORY