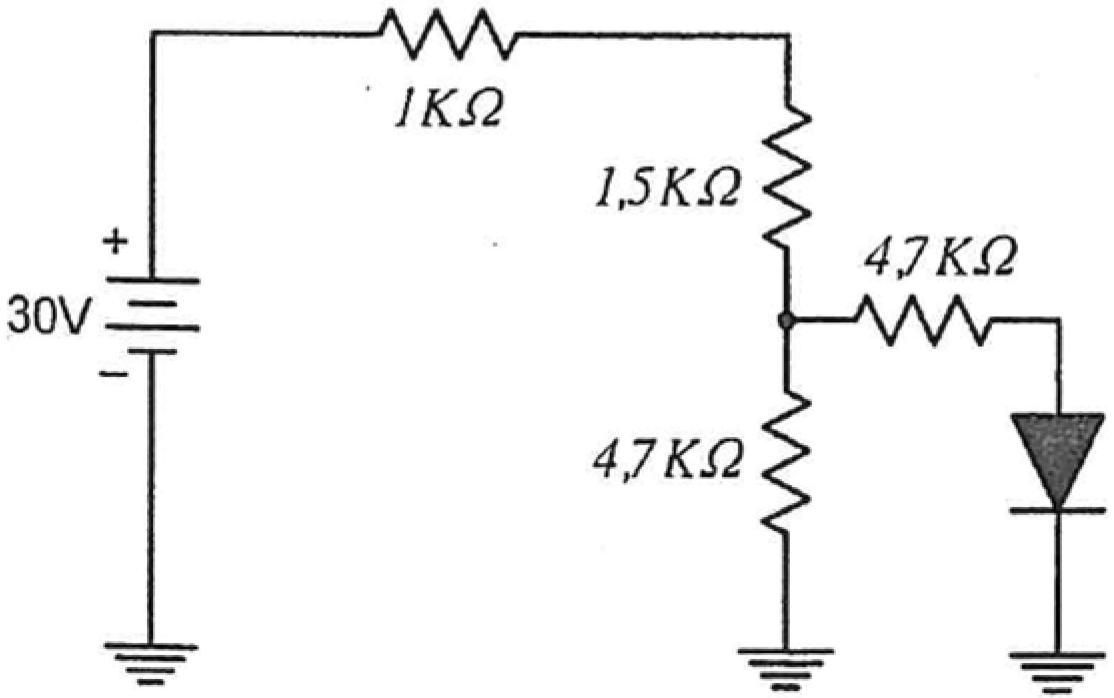
Electronic Circuits

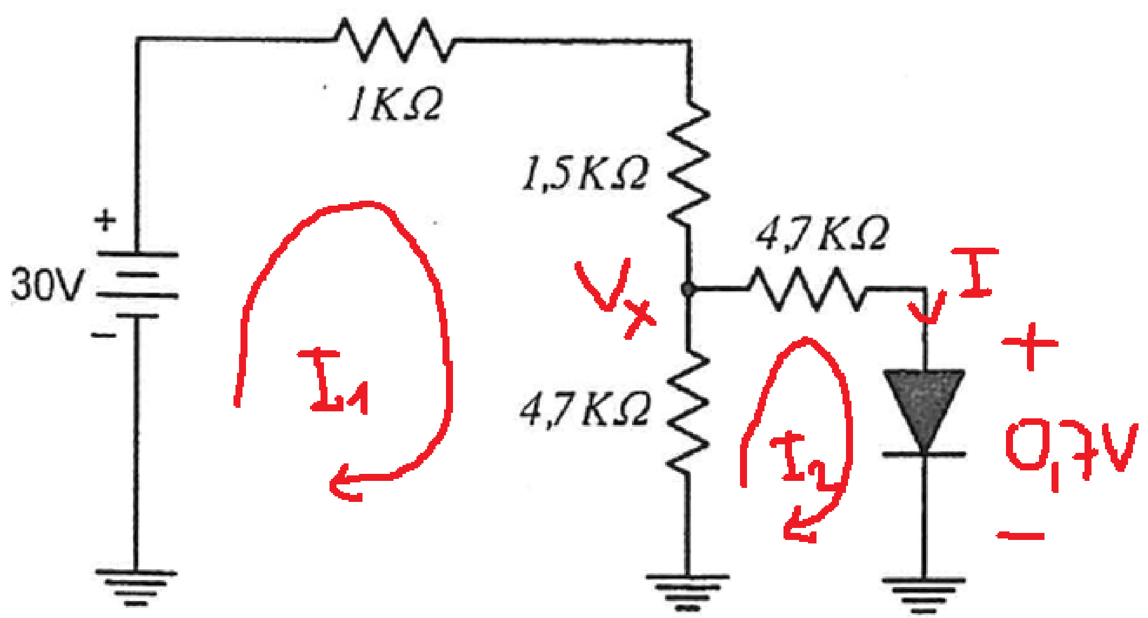
Lecture 7.1: Diode Examples

Example 1: Diode Application



- If the diode is Silicon-based, what is the current flown through the diode?

Solution 1: Diode Application (Alternative 1)



Using Nodal Analysis, thanks to Ohm's Law,

$$I = \frac{V_x - 0.7}{4K7}$$

The sum of all leaving currents is 0,

$$\frac{V_x - (+30)}{1K + 1.5K} + \frac{V_x - (+0.7)}{4K7} + \frac{V_x}{4K7} = 0$$

$$\frac{V_x - 30}{2500} + \frac{V_x - 0.7}{4700} + \frac{V_x}{4700} = 0$$

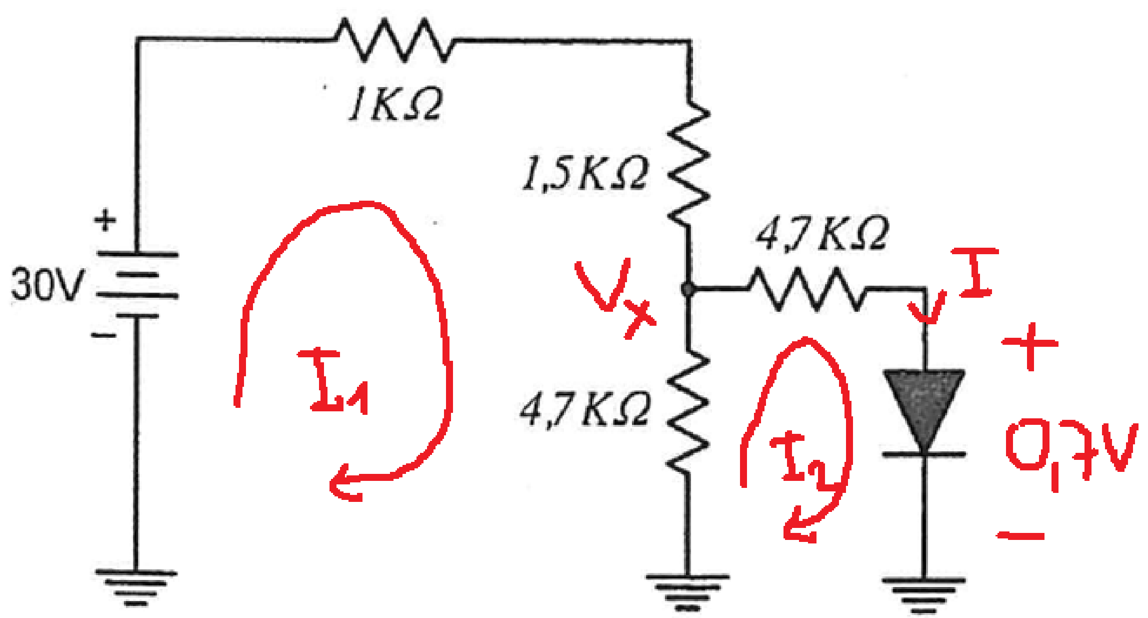
$$\frac{V_x}{2500} + \frac{V_x}{4700} + \frac{V_x}{4700} = \frac{30}{2500} + \frac{0.7}{4700}$$

$$V_x = 14.72V$$

Hence,

$$I = \frac{14.72 - 0.7}{4700} = 3.0mA$$

Solution 1: Diode Application (Alternative 2)



Using Mesh Analysis,

$$I = I_2$$

The sum of all voltages in a closed loop is 0,

$$-30 + 1K * I_1 + 1K5 * I_1 + 4K7 * (I_1 - I_2) = 0$$

$$4K7 * (I_2 - I_1) + 4K7 * I_2 + 0.7 = 0$$

$$7K2 * I_1 - 4K7 * I_2 = 30$$

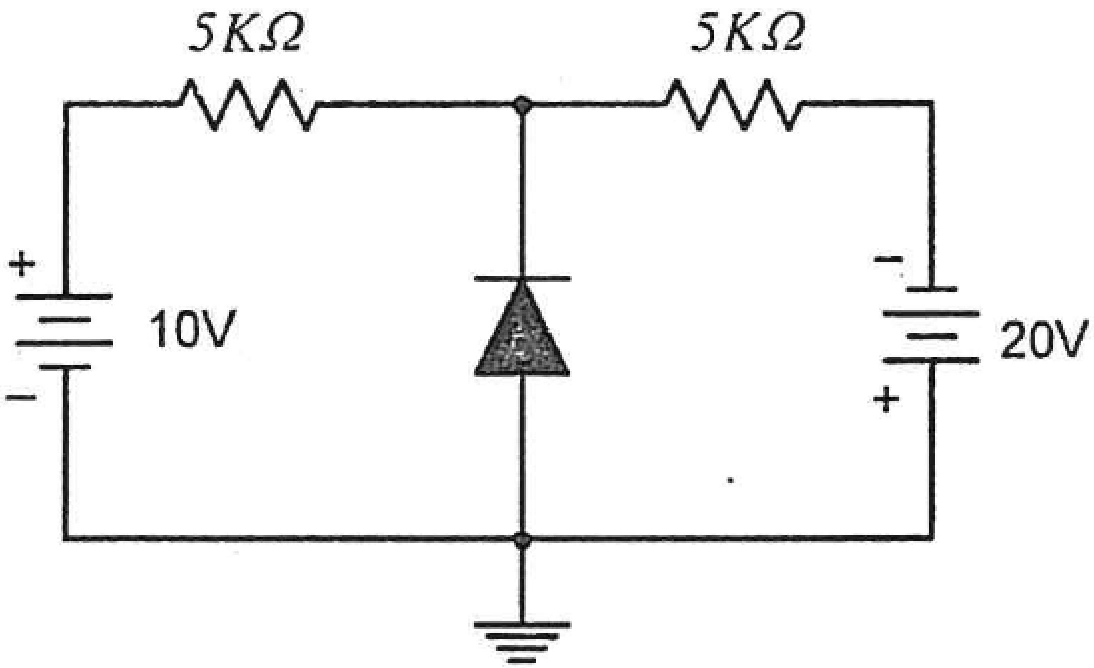
$$-4K7 * I_1 + 9K4 * I_2 = -0.7$$

$$I_1 = 6.1mA$$

$$I_2 = 3.0mA$$

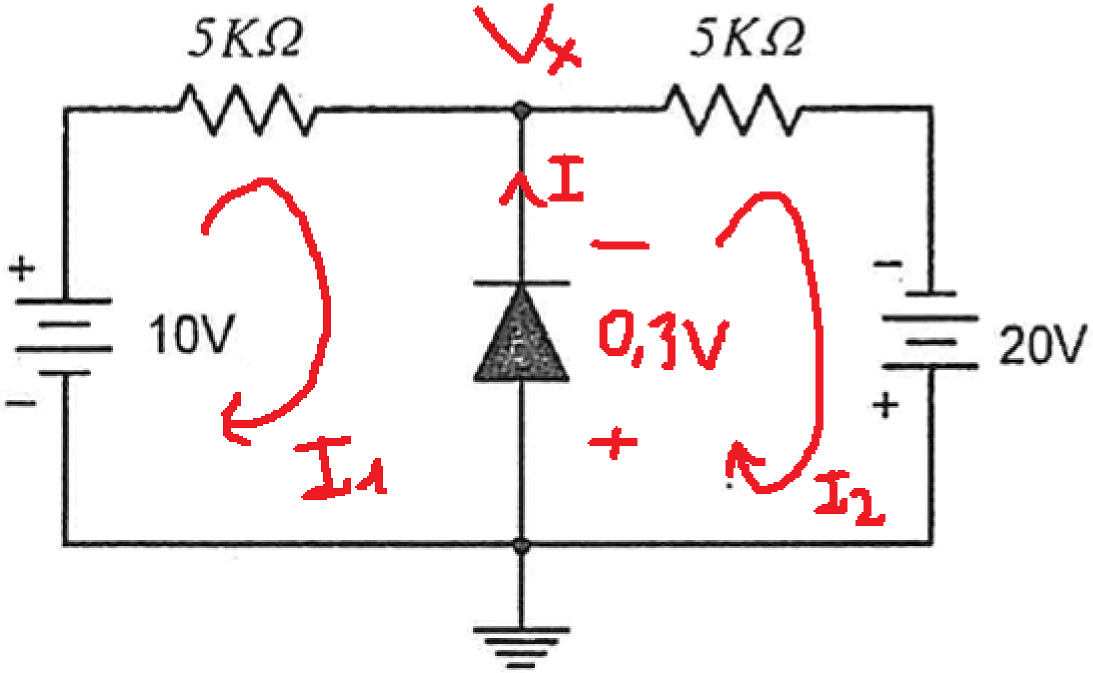
$$I = I_2 = 3.0mA$$

Example 2: Diode Application



- If the diode is Germanium-based, what is the current flown through the diode?

Solution 2: Diode Application (Alternative 1)



Using Nodal Analysis,

$$V_x = -0.3V$$

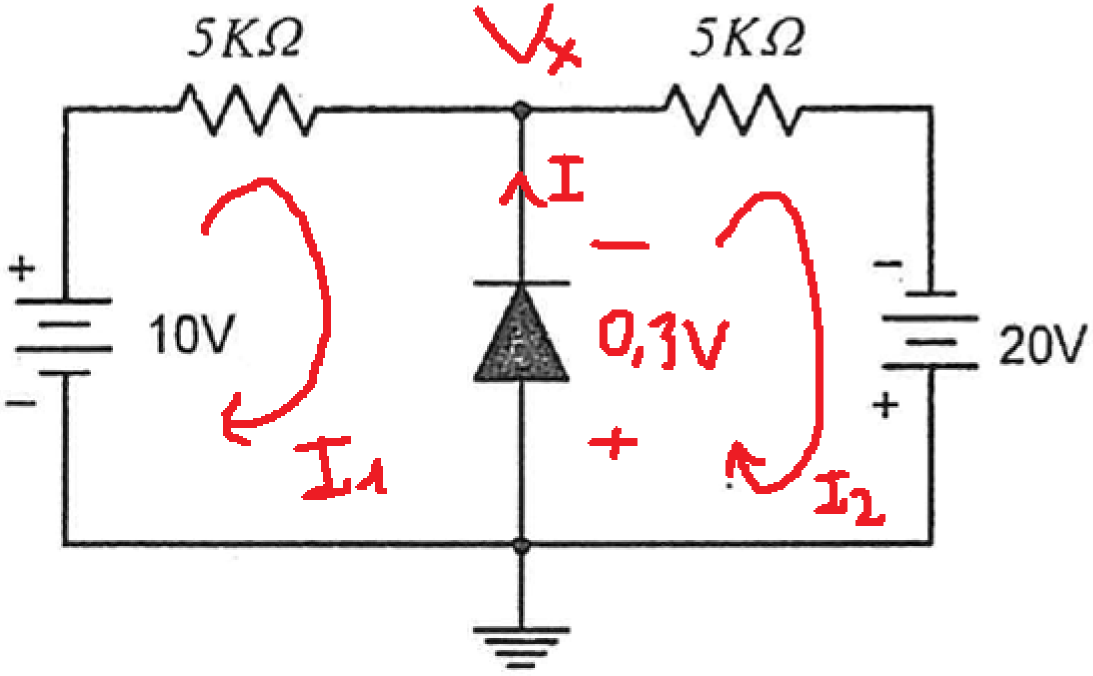
The sum of all leaving currents is 0,

$$\frac{V_x - (+10)}{5K} + (-I) + \frac{V_x - (-20)}{5K} = 0$$

$$\frac{-0.3 - 10}{5000} - I + \frac{-0.3 + 20}{5000} = 0$$

$$I = \frac{-10.3}{5000} + \frac{19.7}{5000} = \frac{9.4}{5000} = 1.88mA$$

Solution 2: Diode Application (Alternative 2)



Using Mesh Analysis,

$$I = I_2 - I_1$$

The sum of all voltages in a closed loop is 0,

$$-10 + 5K * I_1 - 0.3 = 0$$

$$0.3 + 5K * I_2 - 20 = 0$$

$$5K * I_1 = 10.3$$

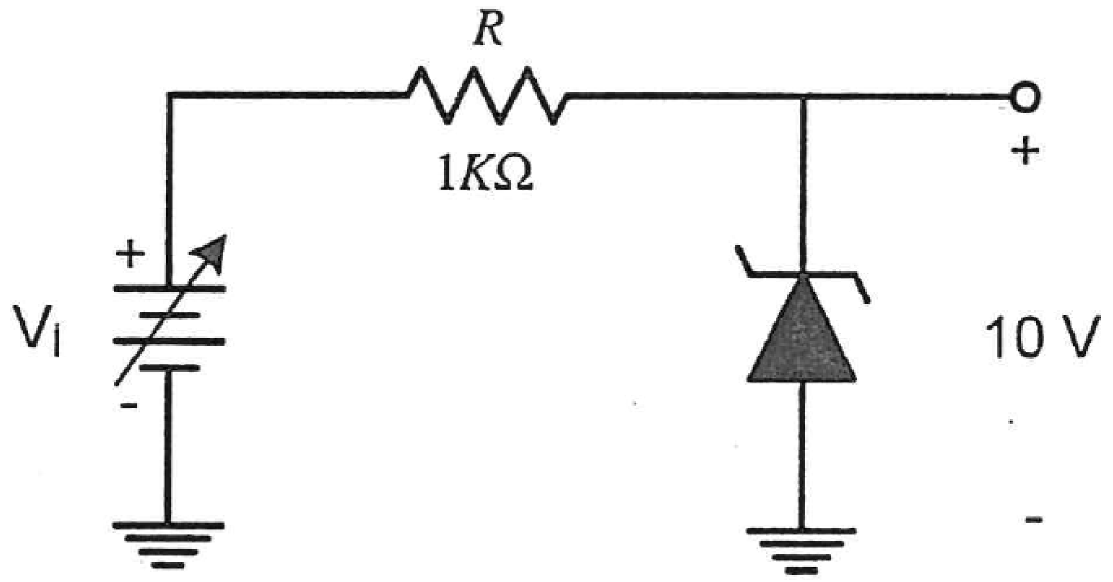
$$5K * I_2 = 19.7$$

$$I_1 = 2.06mA$$

$$I_2 = 3.94mA$$

$$I = I_2 - I_1 = 1.88mA$$

Example 3: Zener Diode Application



- If 10-Volt Zener Diode allows its current 4-40 mA, please find the input voltage range.

Solution 3: Zener Diode Application

R and Z are in series; therefore, their currents are equal: $I_R = I_Z$

Hence,

$$V_{R,min} = I_{R,min} * R = 4mA * 1K = 4V$$

and

$$V_{R,max} = I_{R,max} * R = 40mA * 1K = 40V$$

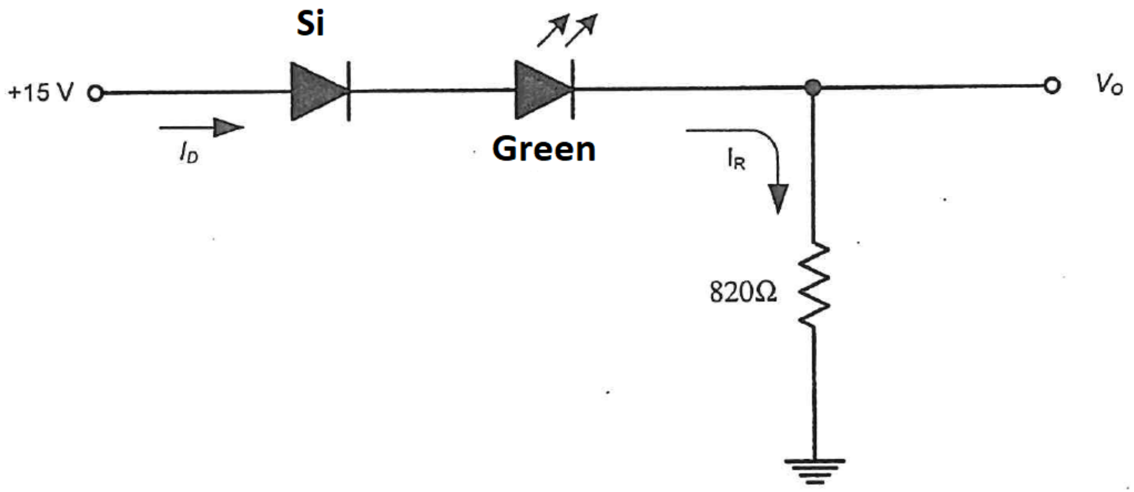
Since $V_i = V_R + V_Z$,

$$V_{i,min} = V_{R,min} + V_Z = 4V + 10V = 14V$$

and

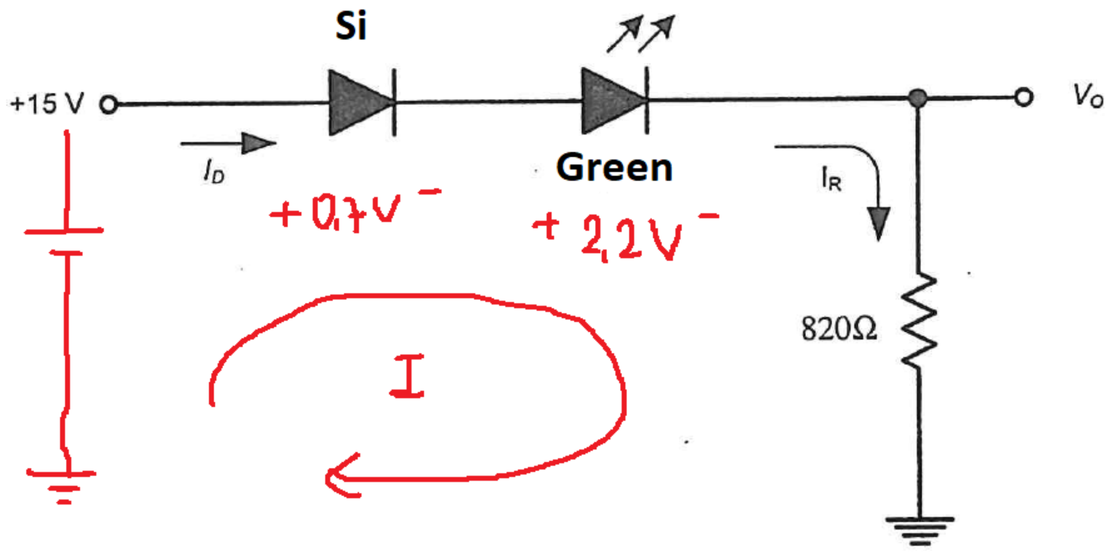
$$V_{i,max} = V_{R,max} + V_Z = 40V + 10V = 50V$$

Example 4: LED Application



- Please find the output voltage (V_O) and the diode current (I_D) where $V_{LED,Green}$ = 2.2 Volts.

Solution 4: LED Application



Using Mesh Analysis,

$$I = I_D = I_R$$

$$V_O = 820 * I_R$$

The sum of all voltages in a closed loop is 0,

$$-15 + 0.7 + 2.2 + 820 * I_R = 0$$

$$I_R = \frac{15 - 0.7 - 2.2}{820} = 14.8mA$$

$$I_D = 14.8mA$$

$$V_O = 12.14V$$

Thanks for listening ☺

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