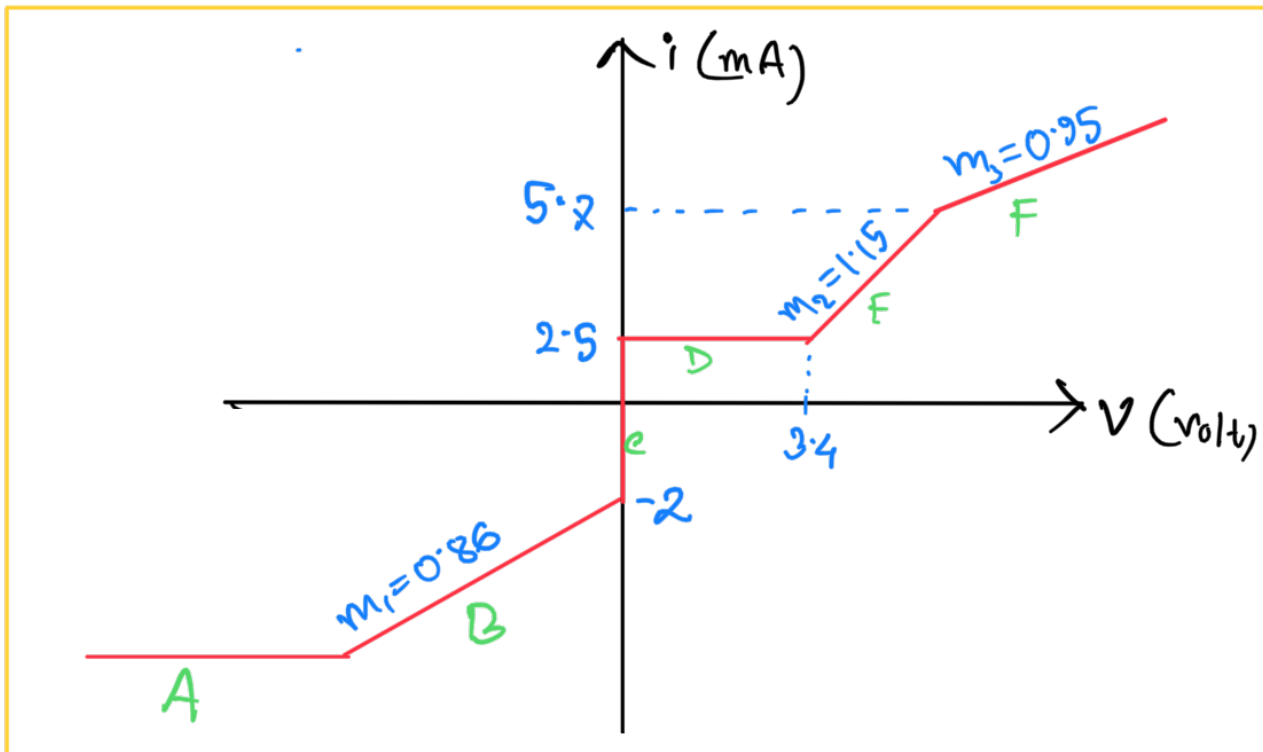


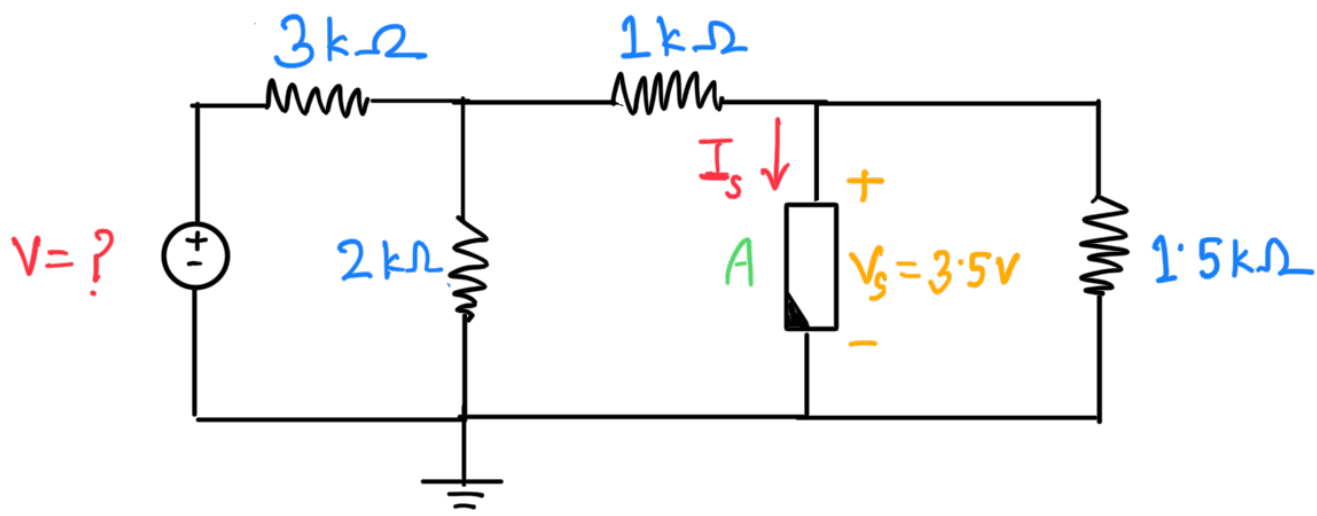
Question 1

The i - v curve of a piecewise linear device is as follows:

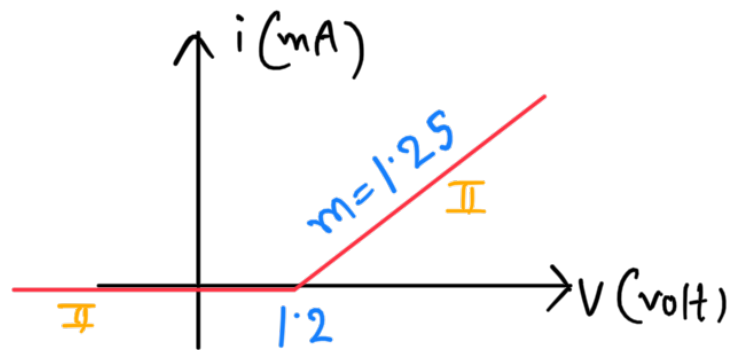


1. Draw the circuit symbol of a generic non-linear device. Clearly label the anode and cathode.
2. Find the equivalent linear circuit model and the corresponding device parameters for segments B, C, D, E, and F.
3. Find the current when the voltage across the device is 2.45 V.

Question 2



A piecewise linear device **A** is connected to a circuit as shown in the figure above. The voltage across the device is $V_s = 3.5\text{V}$. The i - v graph of the device is given below:

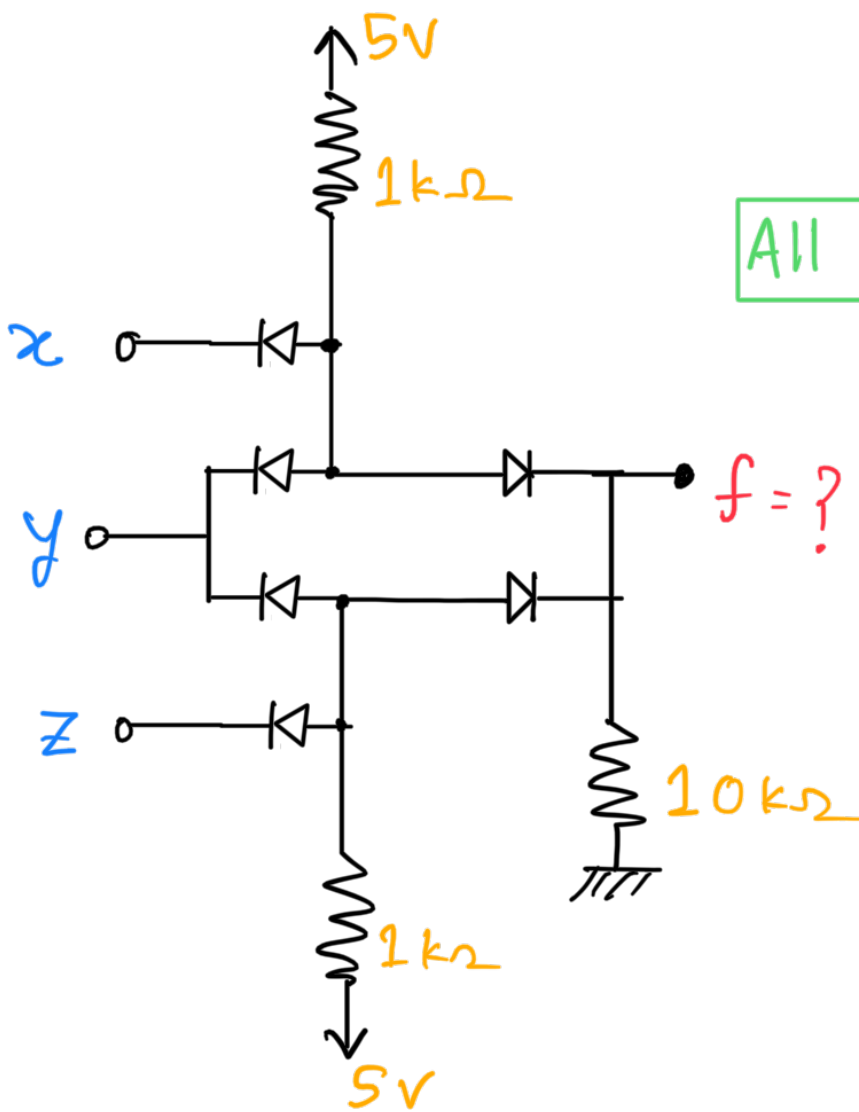


1. Find the equation for segment **II** of the i - v graph of the device **A**.
2. Find the current I_s through the device
3. Find the voltage of the source V .

Hint: $I_{1.5k} = ?$ $I_{1k} = ?$ $V_{1k} = ?$ $V_{2k} = ?$ $I_{2k} = ?$ $I_{3k} = ?$ $V = ?$

use KCL, KVL and Ohm's law.

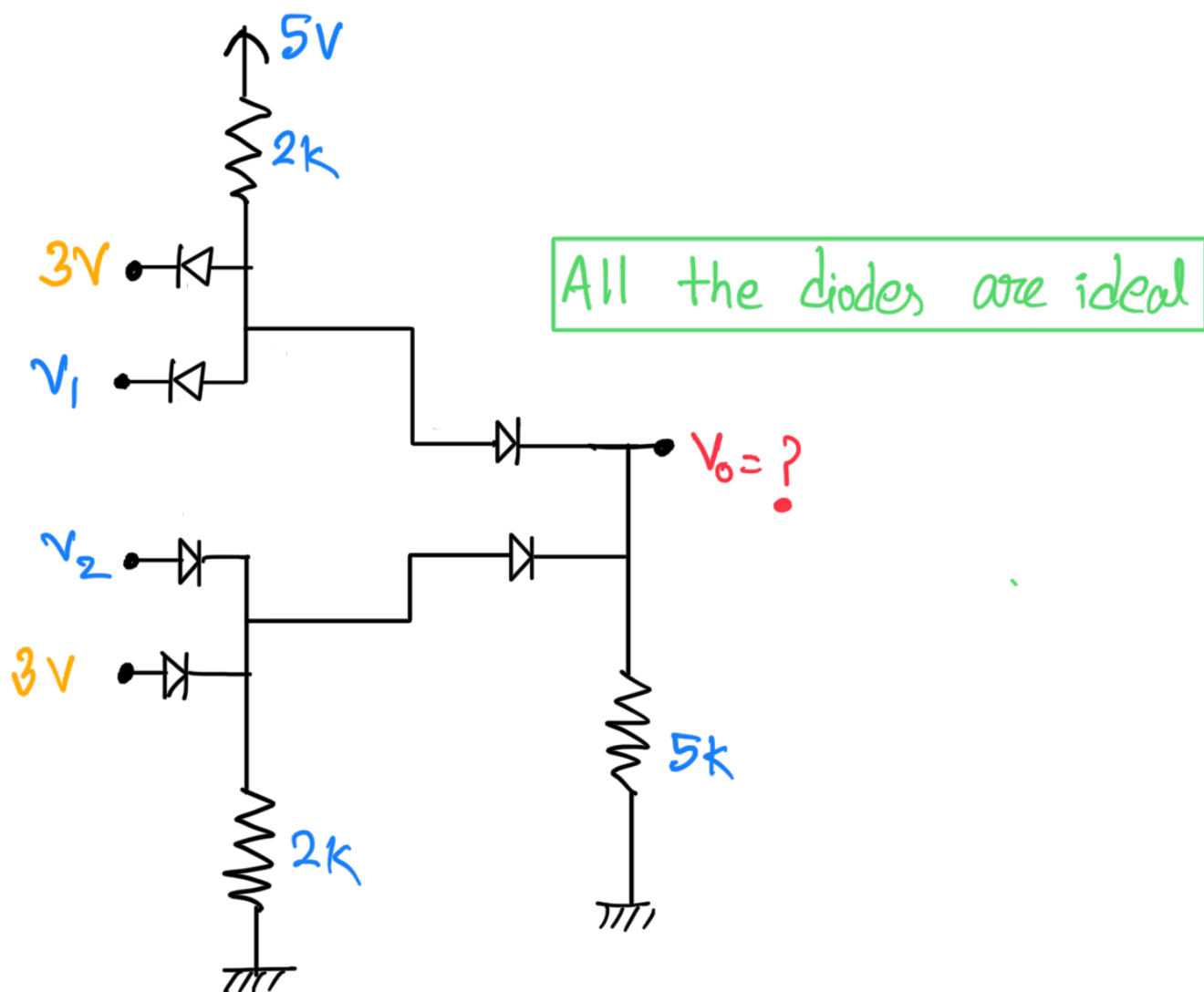
Question 3



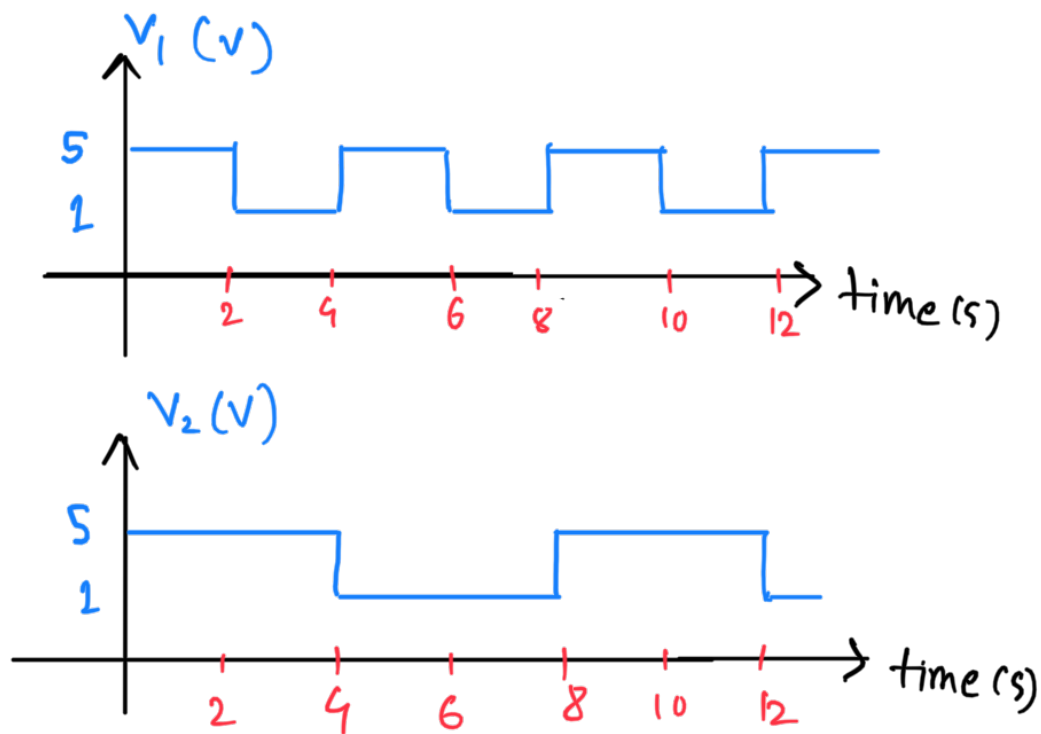
① Assuming x, y, z are boolean variables, find the logical function (operation) f that the above circuit performs.

② Implement the same logical operation f using 4 diodes only.

Question 4



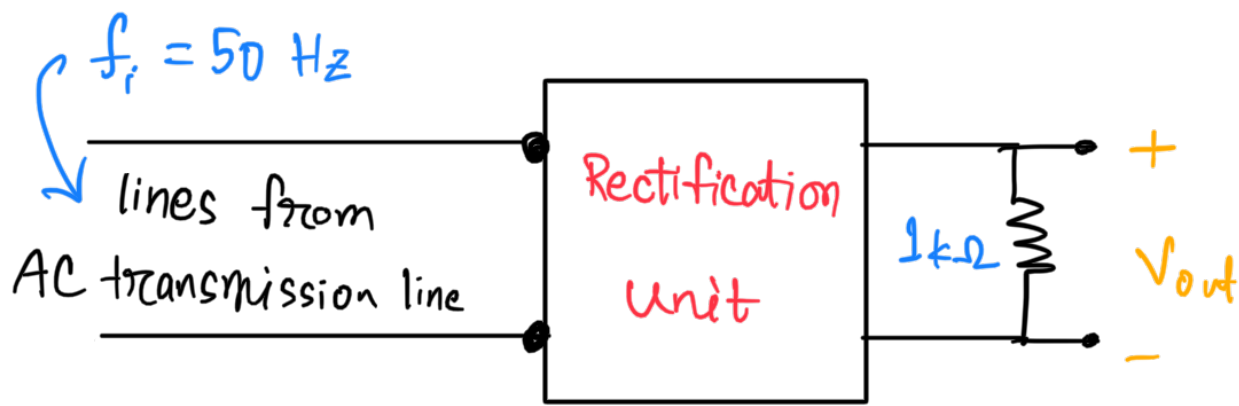
Here V_1 and V_2 are two square waves, and the change with time is as follows:



Draw the output voltage waveform $V_0(t)$, that is, how the output voltage V_0 changes as a function of time. Clearly label the voltage levels and time instances.

Hint: Diode AND gate \Rightarrow min, OR gate \Rightarrow max.

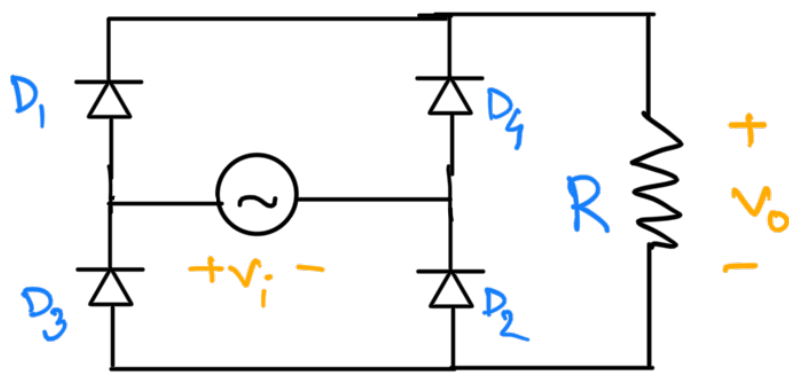
Question 5



The output frequency of the voltage waveform of the rectification unit is same as the input.

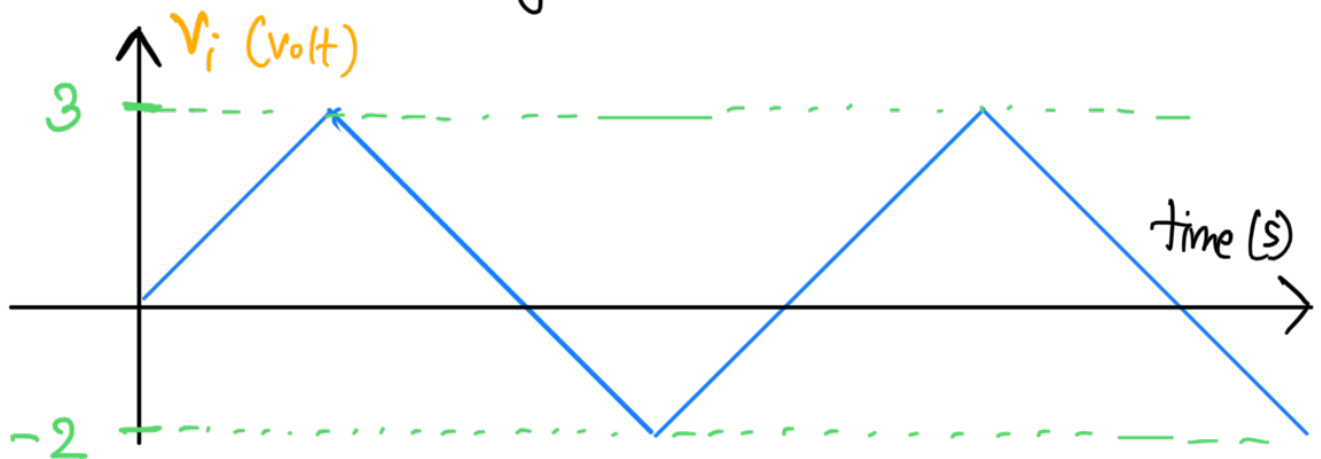
- What kind of rectifier is used here? Why?
- If the peak value of the input voltage is 15V , find the output peak voltage and the output average voltage [$V_o = 0.7\text{V}$].
- Given the information in (b), sketch the input and output waveforms. Also sketch the voltage transfer characteristics and comment.
- If we want to restrict the output ripple voltage (peak to peak) to be 4% of the input peak voltage, find the value of the smoothing capacitor required. Draw the rectifier with the capacitor and clearly label the input/output ports.

Question 6 Part 1



CkT-1

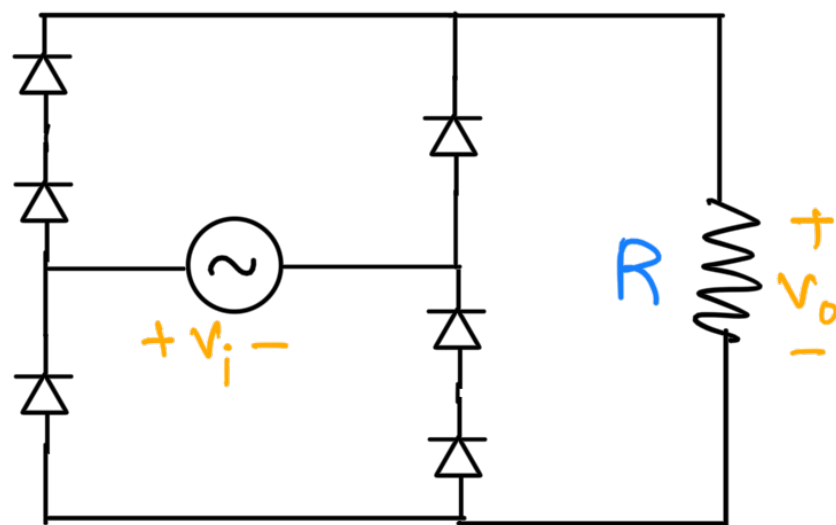
- a. Write down two names of the above rectifier.
- b. If the following is the input voltage waveform $v_i(t)$ of the CkT-1, draw the output voltage waveform $v_o(t)$ assuming $v_{D0} = 0.7\text{ V}$. Clearly label the voltage levels.



- c. Find the output peak voltage.
- d. Now if we want the output peak voltage to be 90% of the input peak voltage, what kind of diode do we need to use, i.e., what should be the value of v_{D0} ?

Question 6 Part 2

Consider the following slightly modified full wave rectifier:

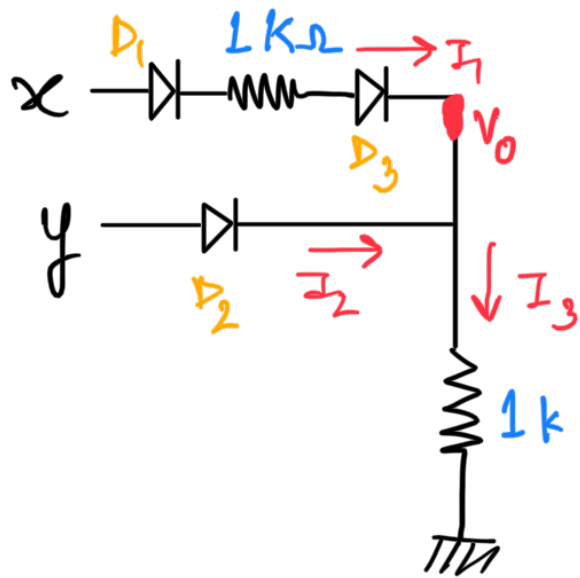


If the input waveform $v_i(t)$ is a sine wave with a peak voltage of $10V$ and frequency of $60Hz$, sketch the input and output voltage waveform ($v_i(t)$ and $v_o(t)$).

Also draw the voltage transfer characteristics of the circuit. Given $V_{D0} = 0.5V$ for all the diodes.

Hint: Two diodes in series will act like a single diode with $V_{D0}' = 2V_{D0}$. They will turn on and off at the same time.

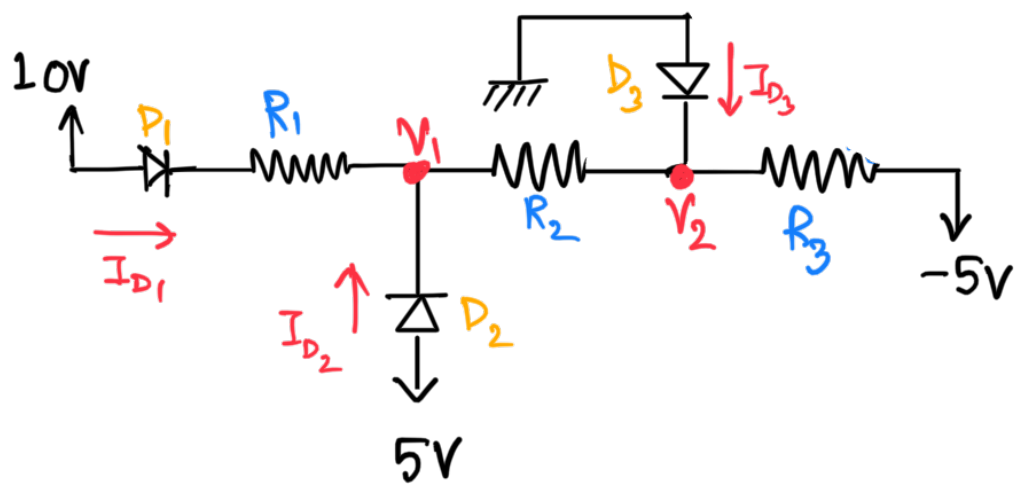
Question 7



Using method of assumed state, find I_1 , I_2 , I_3 , and V_0 . Use CVD model for the diode with $V_{D0} = 0.7V$. You must verify your assumptions. Consider two cases: ① $x = y = 5V$, and ② $x = 5V$, $y = 4V$.

Hint: D_1 and D_3 are in series, so they would turn ON or OFF together, at the same time. Hence you can consider them to be a diode with $V_{D0} = 1.4V$.

Question 8



For this problem, use CVD model of diodes with $V_{D0} = 0.6V$. Note that you must verify your assumptions.

1. Given $I_{D1} = 0.2mA$, $I_{D2} = 0.3mA$, and $I_{D3} = 0.5mA$, find the values of R_1 , R_2 , and R_3 .

Hint: What are the states of the diodes D_1 , D_2 , and D_3 ? $V_1 = ?$ $V_2 = ?$ $I_{R1} = ?$ $I_{R2} = ?$ $I_{R3} = ?$

Use KCL, KVL and Ohm's law.

2. Find I_{D1} , I_{D2} , I_{D3} , V_1 , and V_2 for $R_1 = 3k\Omega$, $R_2 = 6k\Omega$, $R_3 = 2k\Omega$.

Hint: Whatever the resistances are, D_1 will be always ON. Why?