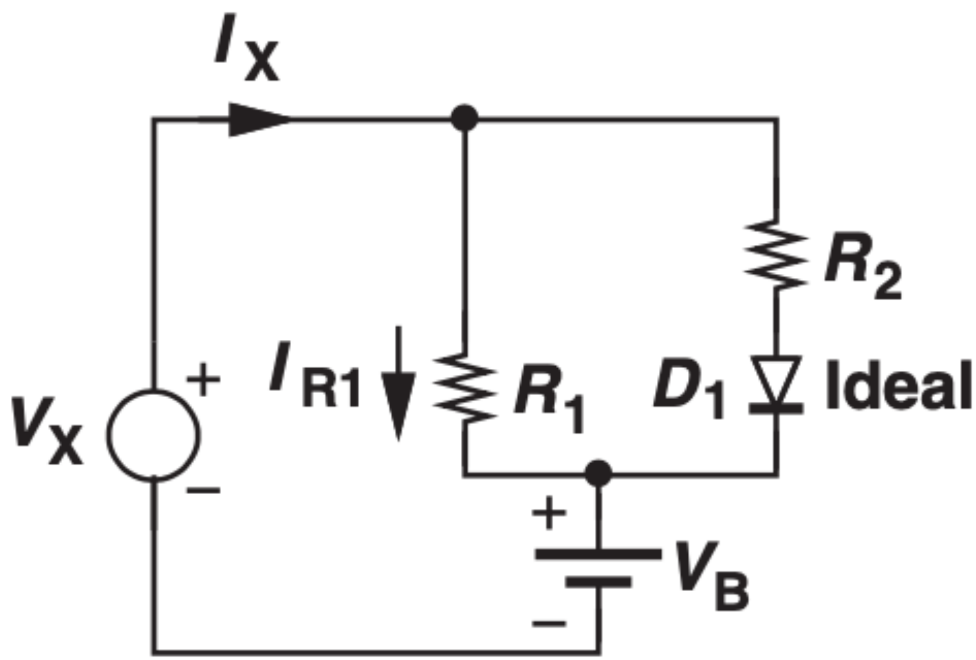
# Problem 1

- For the circuit depicted in Fig. below, plot $I_X$ and $I_{R1}$ as a function of $V_X$ for two cases: $V_B$=−1V and $V_B$=+1V.

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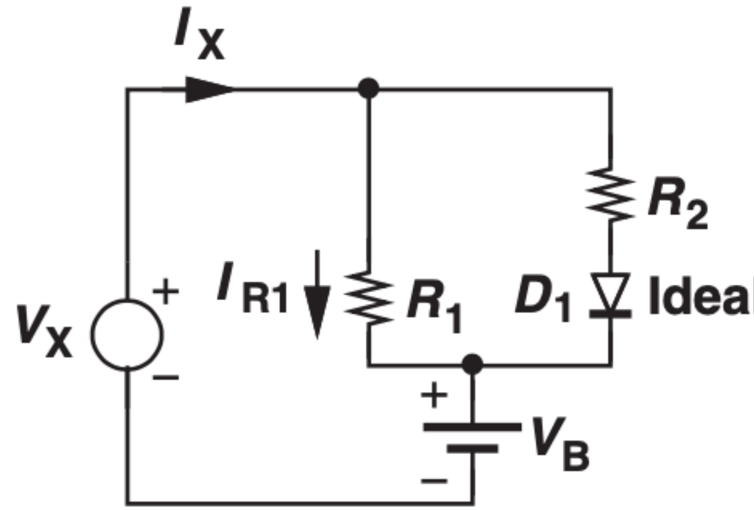
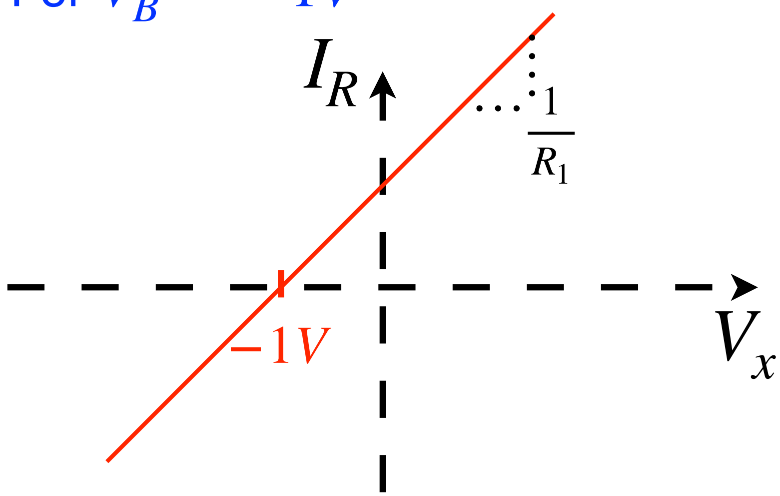
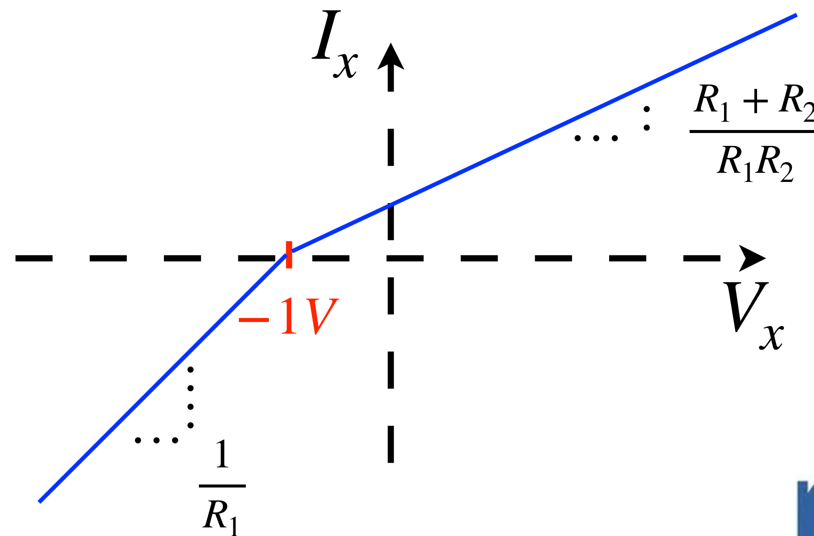
# Problem 1: solution



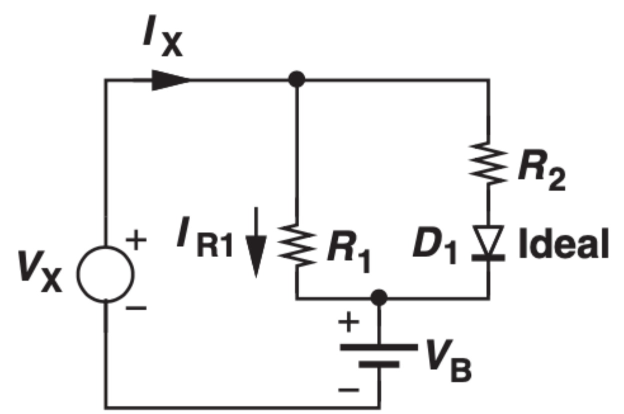

- $D_1$ is off $\Rightarrow I_x = I_R = \dfrac{V_x - V_B}{R_1}$
- $D_1$ is on $\Rightarrow I_x = \dfrac{V_x - V_B}{R_1 // R_2} = \dfrac{R_1 + R_2}{R_1 R_2}(V_x - V_B)$
  - and $I_R = \dfrac{I_x \times R_2}{R_1 + R_2} = \dfrac{V_x - V_B}{R_1}$
- Intersection of both equations occurs at $V_x = V_B$
- For $V_B = -1V$

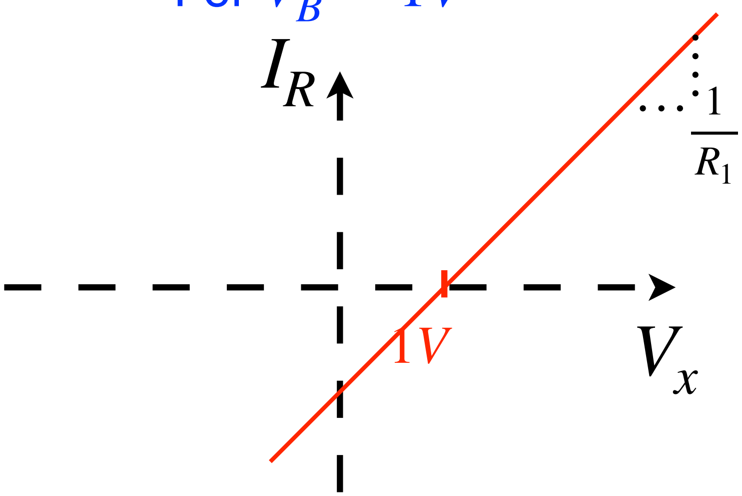


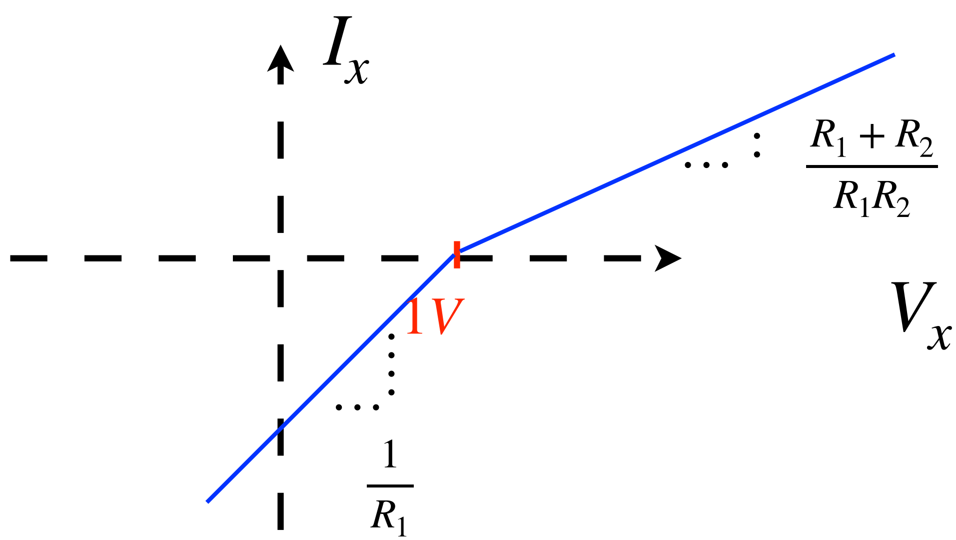



# Problem 1: solution

- $D_1$ is off $\Rightarrow I_x = I_R = \dfrac{V_x - V_B}{R_1}$
- $D_1$ is on $\Rightarrow I_x = \dfrac{V_x - V_B}{R_1//R_2} = \dfrac{R_1 + R_2}{R_1 R_2}(V_x - V_B)$
  - and $I_R = \dfrac{V_x - V_B}{R_1}$
- Intersection of both equations occurs at $V_x = V_B$
- For $V_B = 1V$

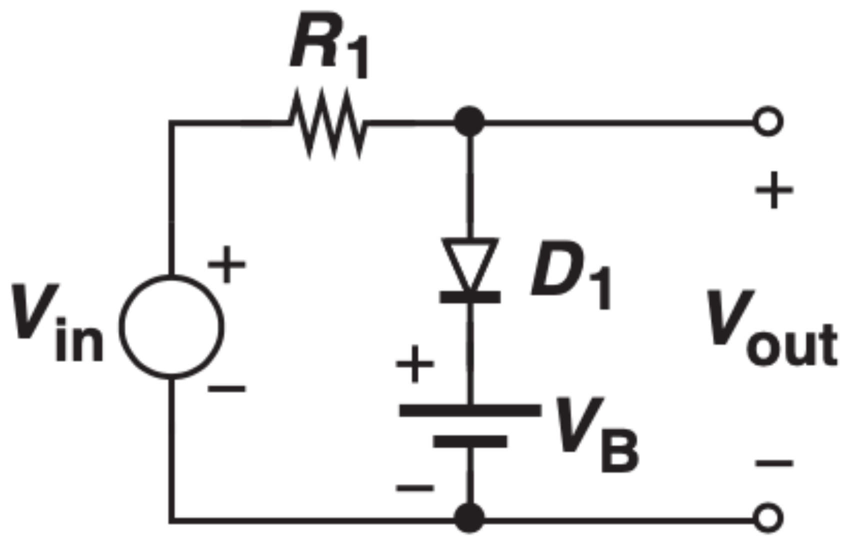


# Problem 2

- Plot the input/output characteristics of the circuits shown in Fig. below using an ideal model for the diodes.

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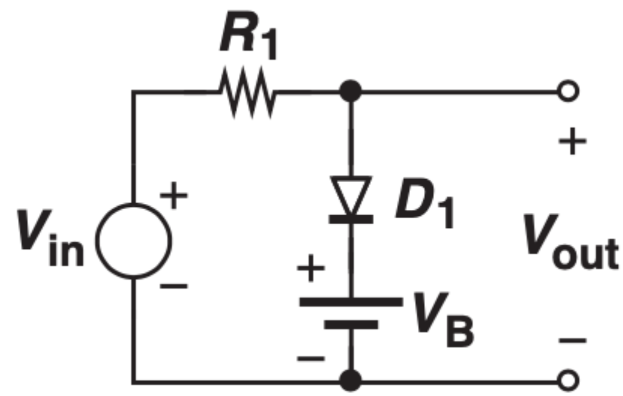
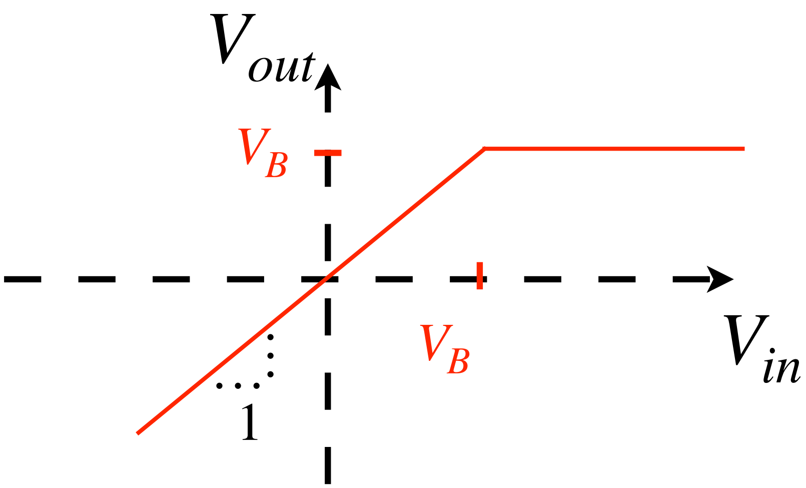
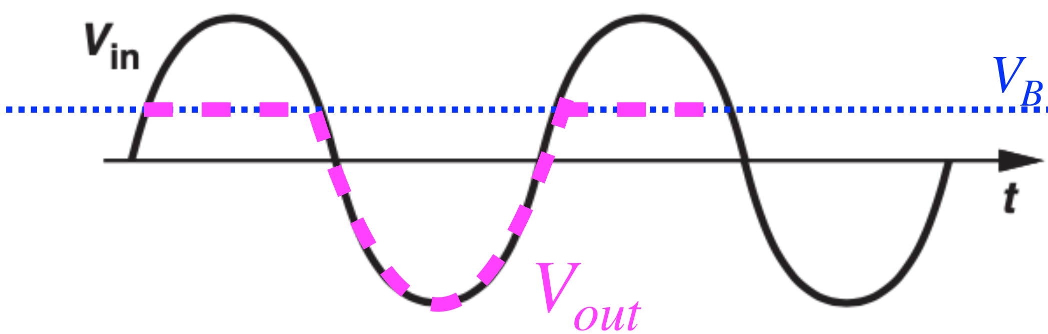
# Problem 2:solution

- $D_1$ is off $\Rightarrow V_{out} = V_{in}$
- $D_1$ is on $\Rightarrow V_{out} = V_B$
- intersection of both equations $@V_{in} = V_B$
- $V_{out} = \begin{cases} V_{in} & \text{if } V_{in} < V_B \\ V_B & \text{if } V_{in} > V_B \end{cases}$

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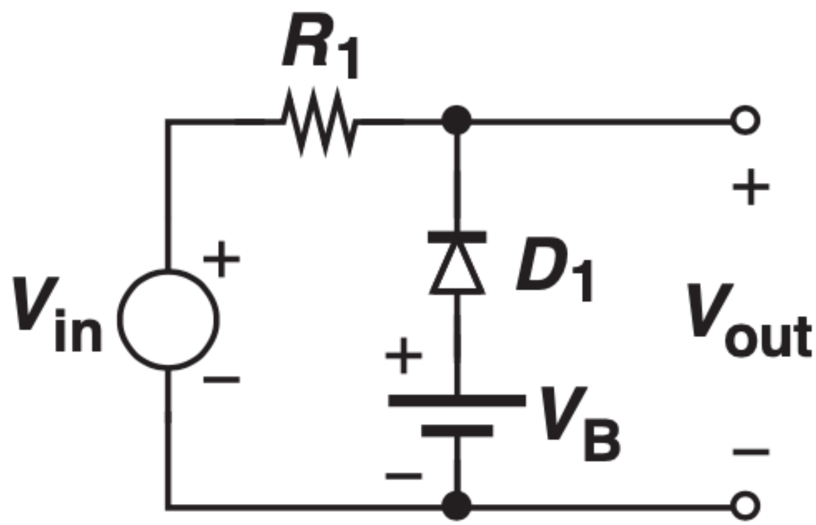
# Problem 3

- Plot the input/output characteristics of the circuits shown in Fig. below using constant-voltage model for the diodes.

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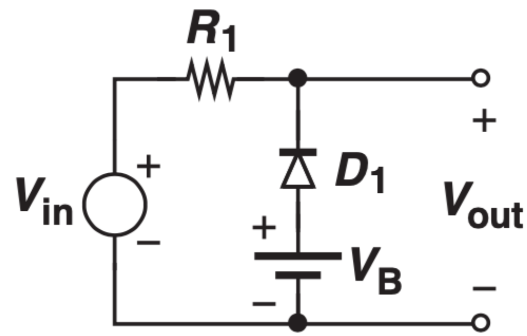
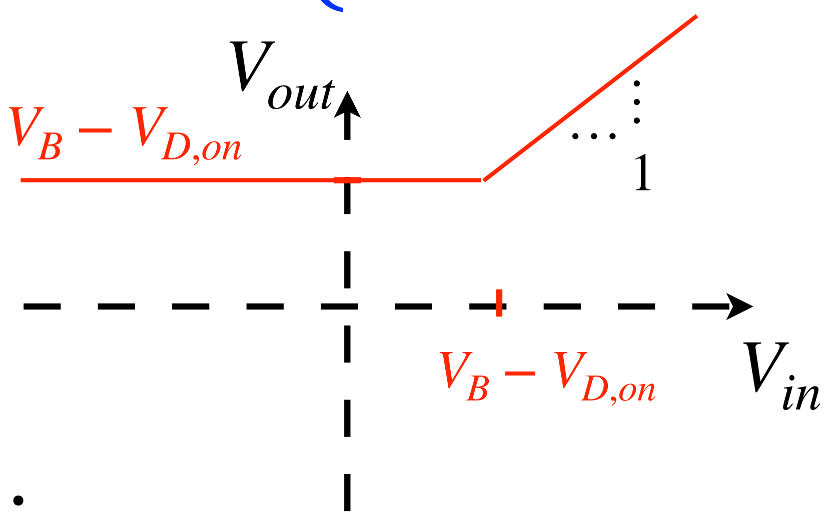
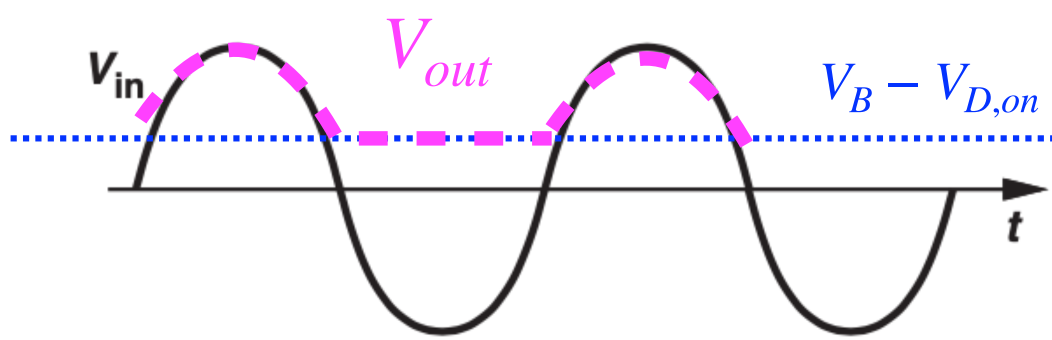
# Problem 3:solution




- $D_1$ is off $\Rightarrow V_{out} = V_{in}$
- $D_1$ is on $\Rightarrow V_{out} = V_B - V_{D,on}$
- intersection of both equations @$V_{in} = V_B - V_{D,on}$
- $$V_{out} = \begin{cases} V_{in} & \text{if } V_{in} > V_B - V_{D,on} \\ V_B - V_{D,on} & \text{if } V_{in} < V_B - V_{D,on} \end{cases}$$

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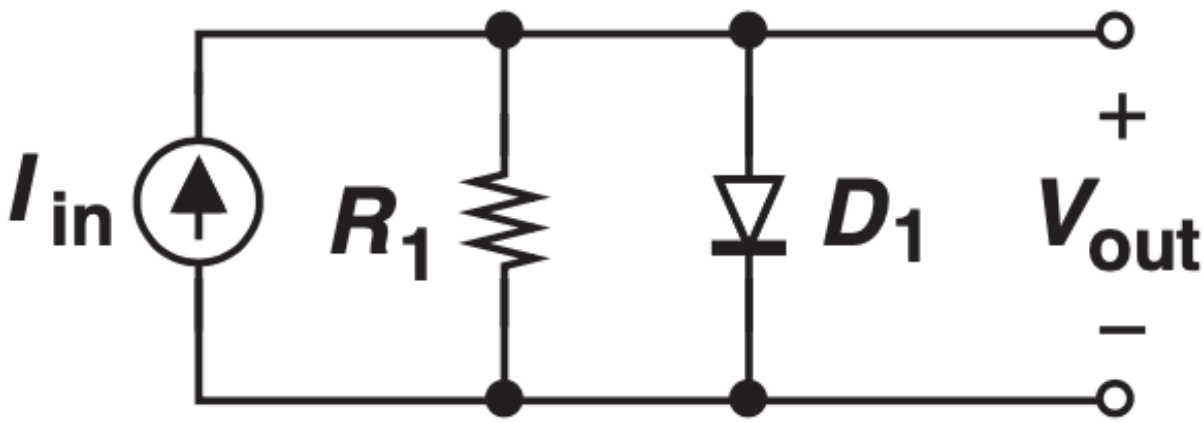
# Problem 4

- Plot $V_{out}$ as a function of $I_{in}$ for the circuit shown in figure below. Assume constant-voltage model. $I_{in} = I_0 cos(\omega t)$.

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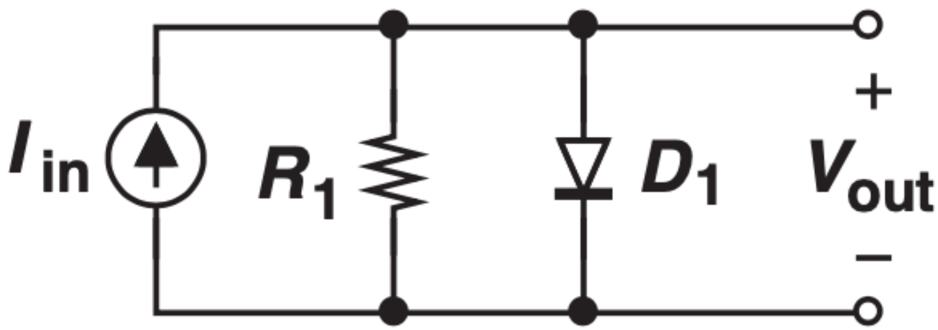
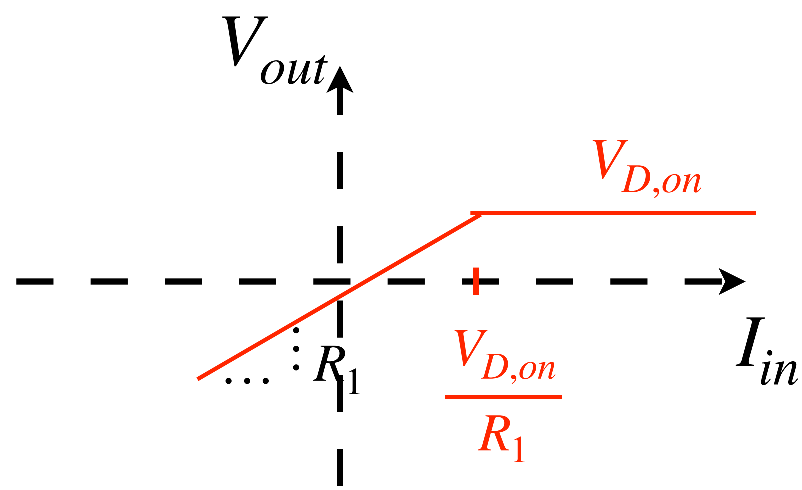
# Problem 4:solution

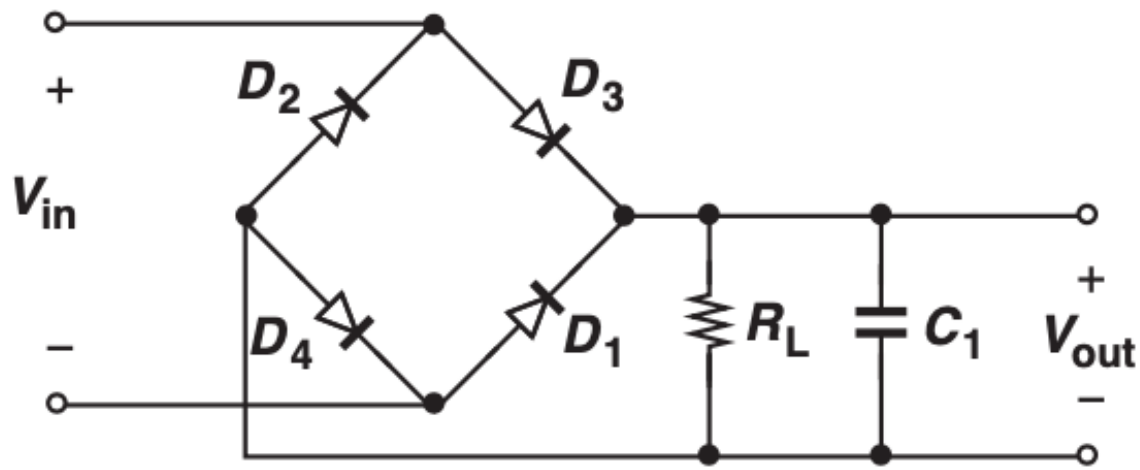



- $D_1$ is off $\Rightarrow V_{out} = R_1 I_{in} = R_1 I_0 cos(\omega t)$
- $D_1$ is on $\Rightarrow V_{out} = V_{D,on}$
- Intersection @ $I_{in} = \dfrac{V_{D,on}}{R_1}$
- $$V_{out} = \begin{cases} R_1 I_{in} & \text{if } I_{in} < \dfrac{V_{D,on}}{R_1} \\ V_{D,on} & \text{if } I_{in} > \dfrac{V_{D,on}}{R_1} \end{cases}$$



# problem 5

- A full-wave rectifier is driven by a sinusoidal input $V_{in} = V_0 \cos\omega t$, where $V_0 = 3V$ and $\omega = 2\pi$ (60 Hz). Assuming $V_{D,on}$ = 800 mV, determine the ripple amplitude with a 1000-μF smoothing capacitor and a load resistance of 30 Ω.



# problem 5: solution

- A full-wave rectifier is driven by a sinusoidal input $V_{in} = V_0 \cos\omega t$, where $V_0 = 3V$ and $\omega = 2\pi$ (60 Hz). Assuming $V_{D,on} = 800$ mV, determine the ripple amplitude with a 1000-µF smoothing capacitor and a load resistance of 30 .
- $$V_R = \frac{1}{2}\frac{V_0 - 2V_{D,on}}{R_L C f_{in}} = 0.389V$$
- If half-wave rectifier is used:
- $$V_R = \frac{V_0 - V_{D,on}}{R_L C f_{in}} = 2.55V$$