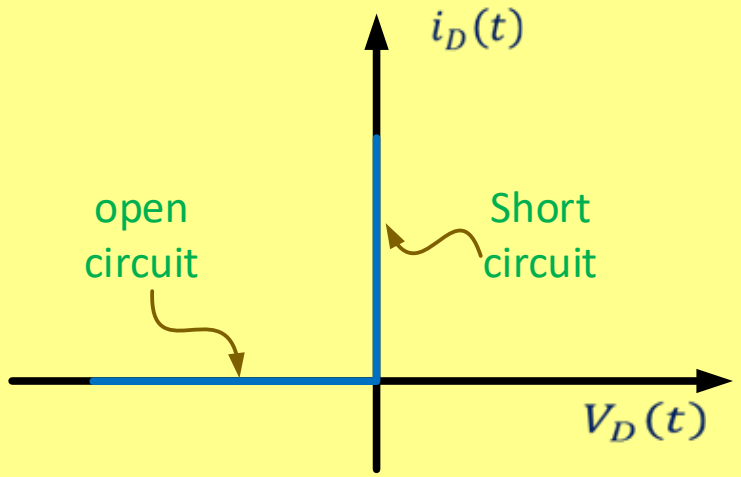
The Use of Diode Model

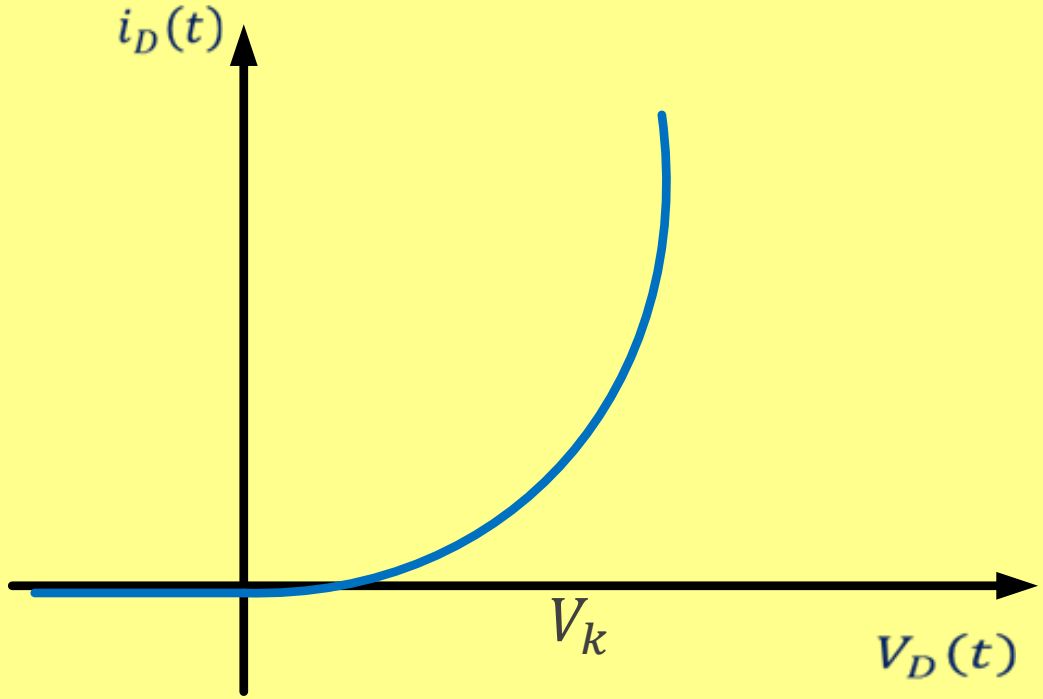
3) The use of models

- A piece wise linear models is an electrical equivalent circuit of a nonlinear electronic device

- It is composed of linear circuit elements arranged to approximate the characteristics of the electronic device .

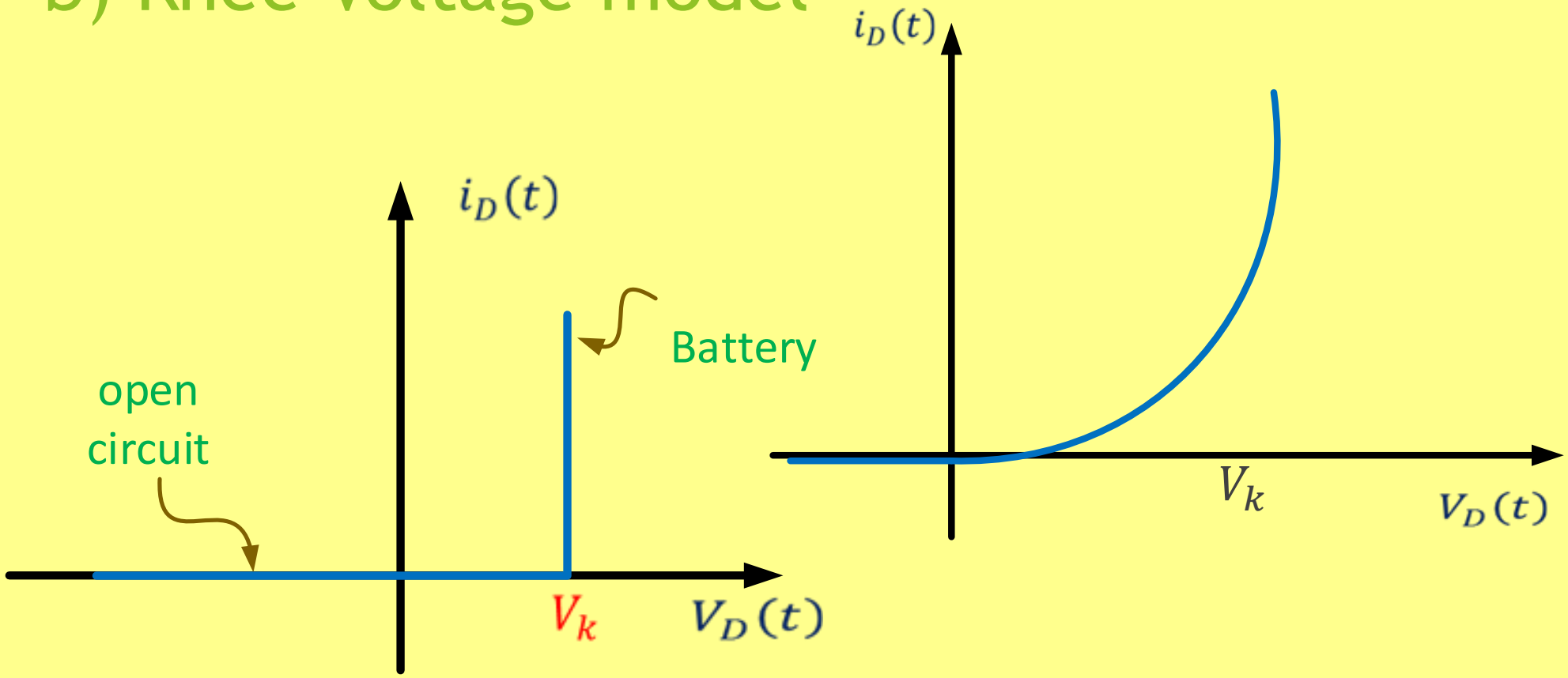
a) ideal diode model





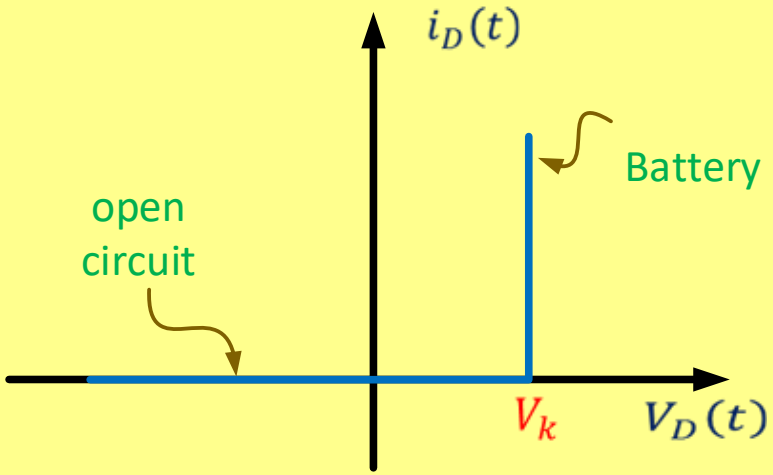
- When $V_s \geq 0$; the Diode is on, and replaced with short circuit
- When $V_s < 0$; the Diode is off, and replaced with open circuit

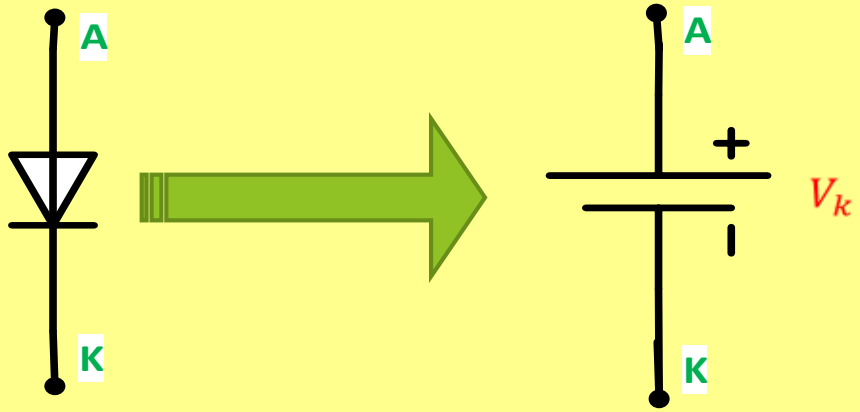
b) Knee Voltage model



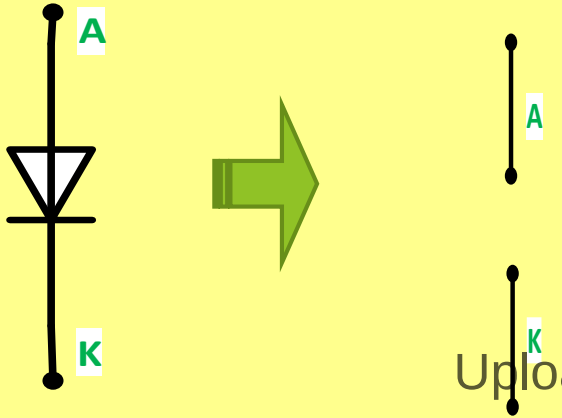
b) Knee Voltage model

- When $V_s \geq V_k$; the Diode is on, and replaced with a constant voltage source

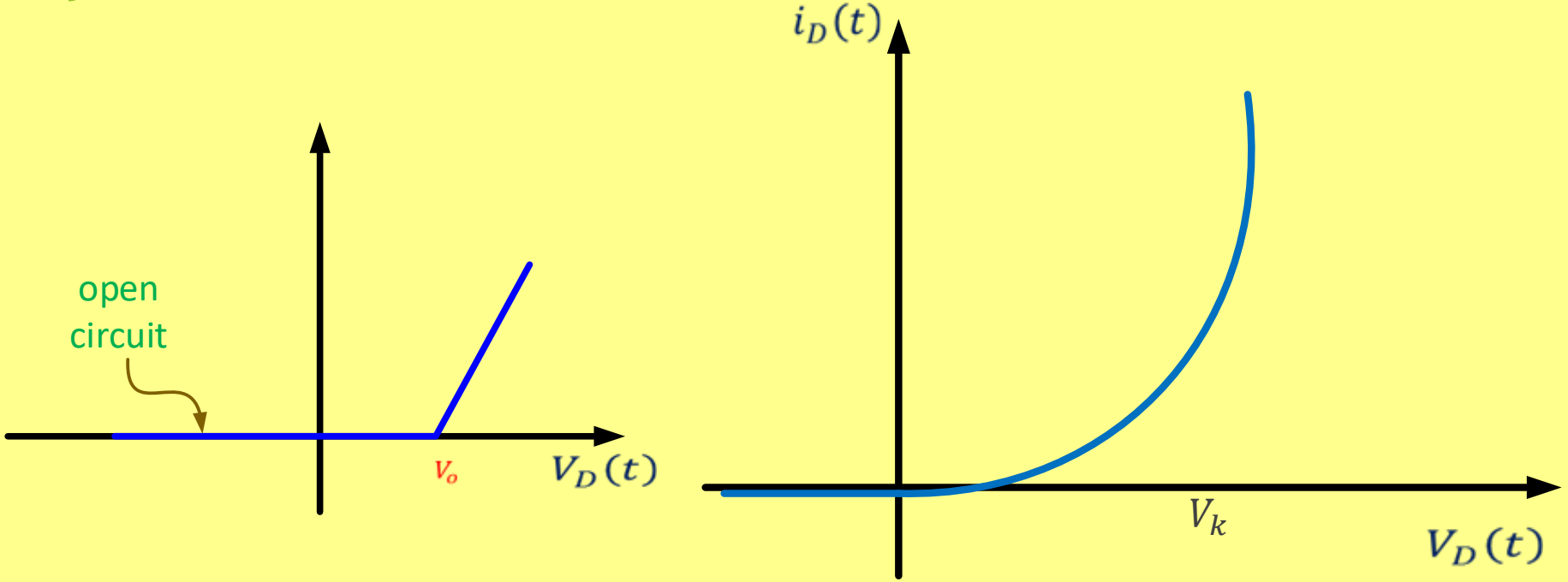




- When $V_s < V_k$; the Diode is off, and replaced with open circuit



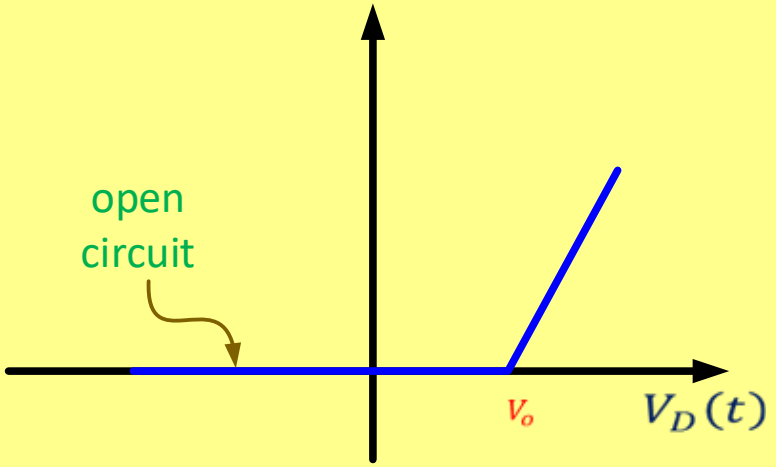
c) Dynamic resistance model

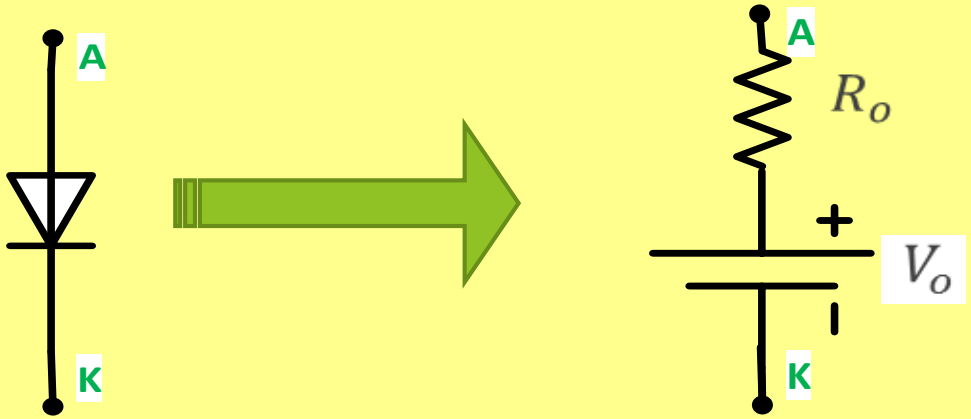


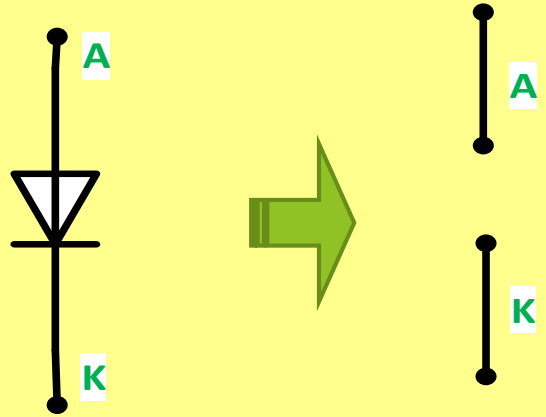
- When $V_s \geq V_o$; the Diode is on, and replaced with a constant voltage source V_o and resistance R_o
- When $V_s < V_o$; the Diode is off, and replaced with open circuit

c) Dynamic resistance model

- When $V_s \geq V_o$; the Diode is on, and replaced with a constant voltage source V_o and resistance R_o



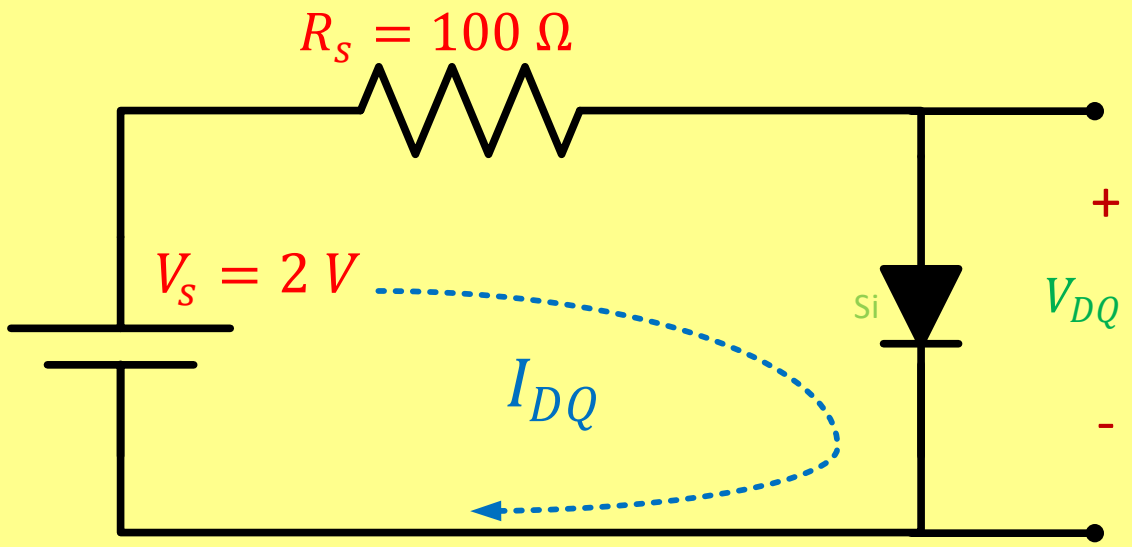




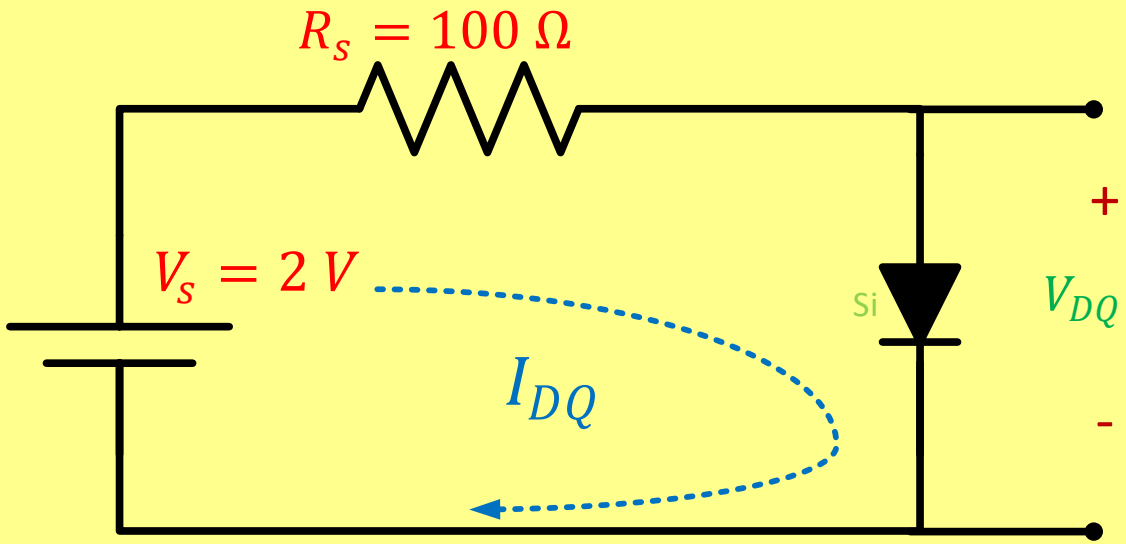
- When $V_s < V_o$; the Diode is off, and replaced with open circuit

Example

- Find the Q point (I_{DQ} , V_{DQ}) using
  - a) ideal diode model
  - b) knee voltage model



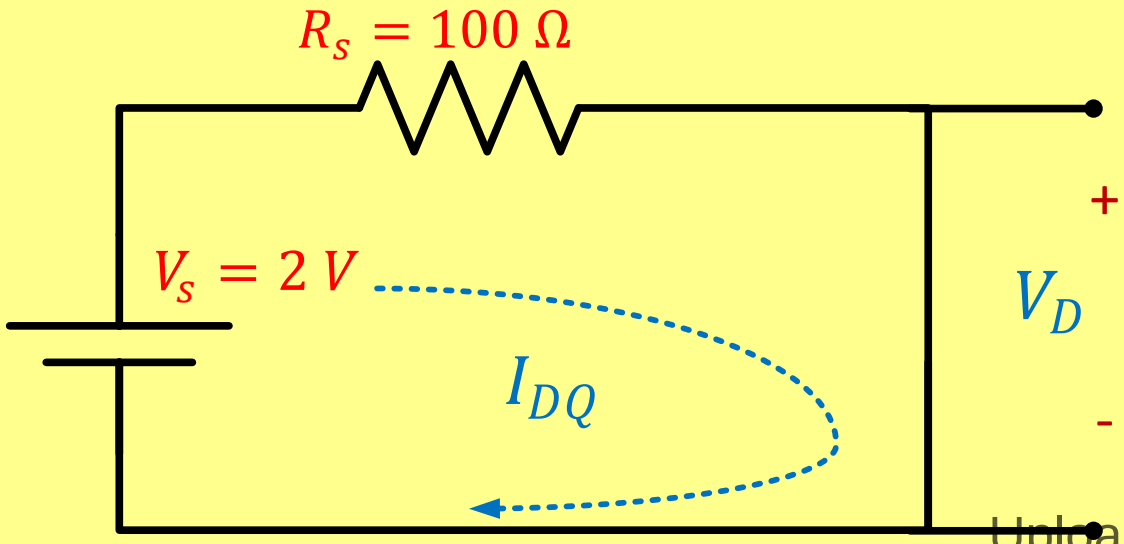
a) using ideal diode model



since $V_S \geq 0$, the diode is on and replaced with short circuit .

$$\therefore \quad I_{DQ} = \frac{2}{100} = 20\ mA$$

$$\therefore \quad V_{DQ} = 0\ V$$

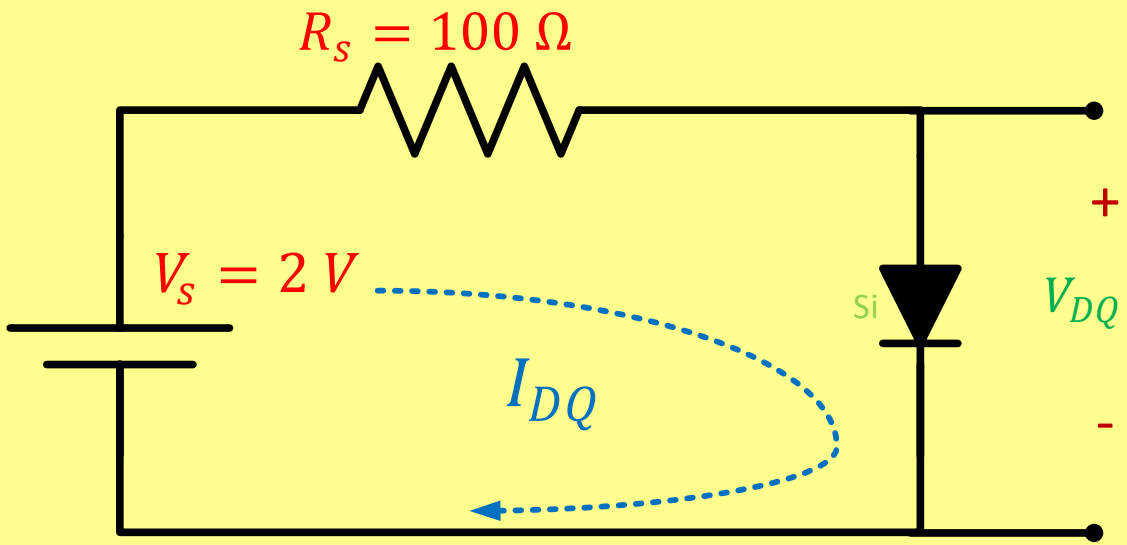


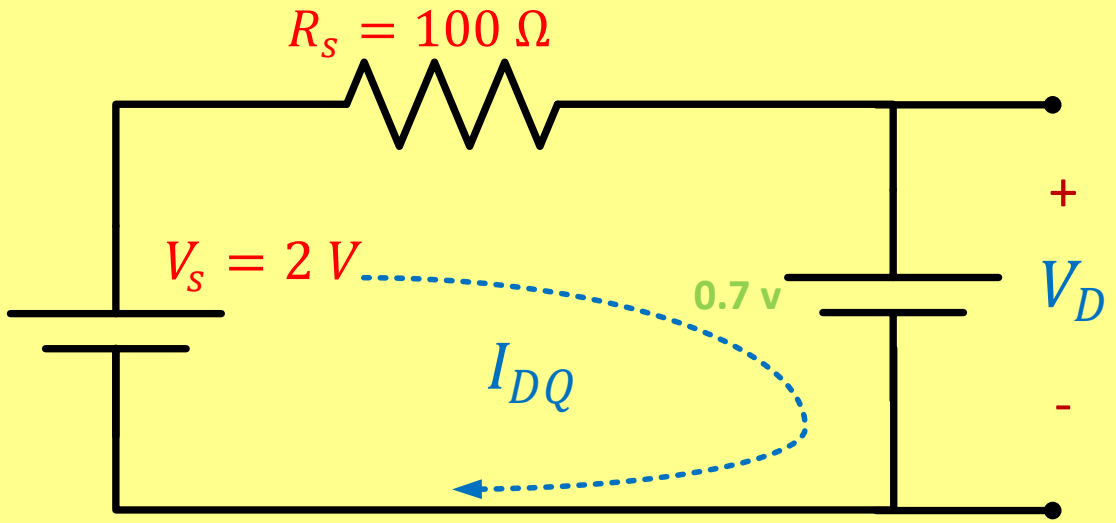
b) Using knee voltage model

since $V_S \geq 0.7$, the diode is on and replaced with $V_k = 0.7$.

$$\therefore \quad I_{DQ} = \frac{2-0.7}{100} = 13\ mA$$

$$\therefore \quad V_{DQ} = 0.7\ V$$





c) using nonlinear mathematic

$$I_{DQ} = 12.137\ mA$$

$$V_{DQ} = \ 0.7863\ V$$

Taking the knee voltage into a count

- If $V_S \geq 10\, V_k$, we could use ideal diode model .

- If $V_S < 10\, V_k$, we must use knee voltage model .