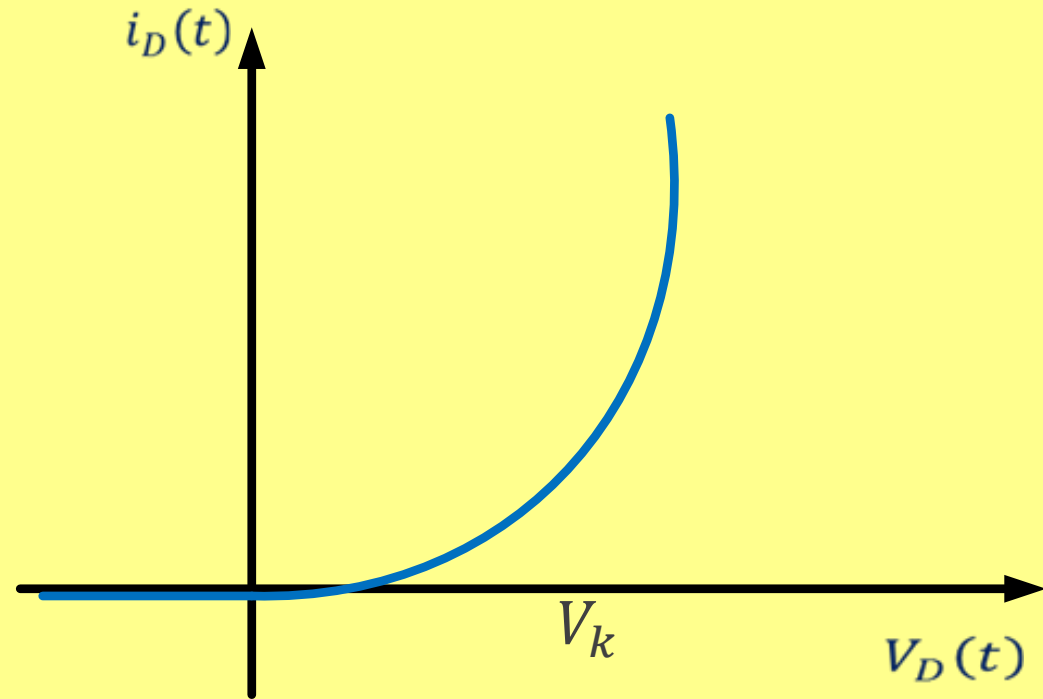
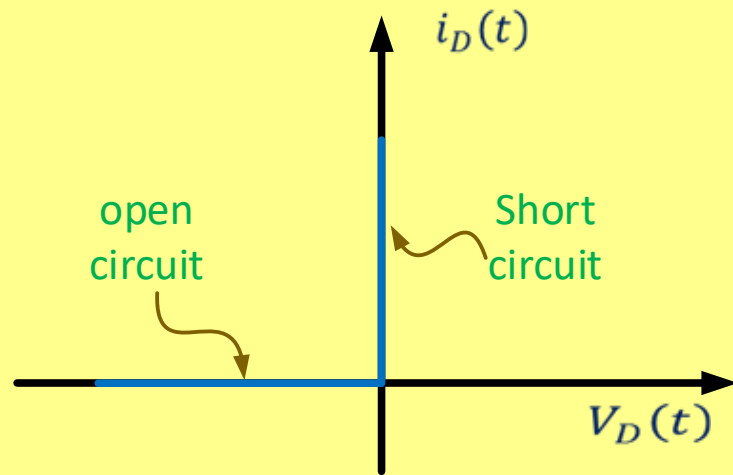


The Use of Diode Model

3) The use of models

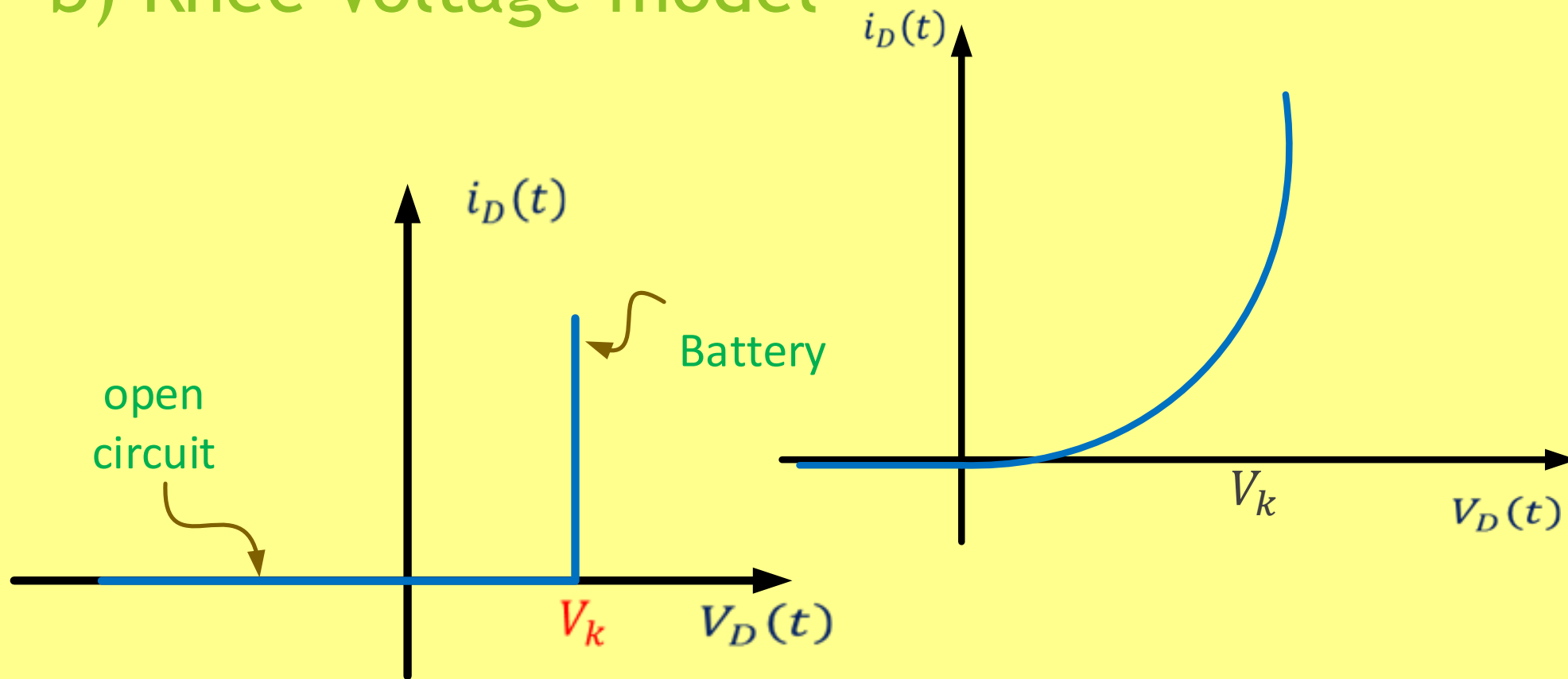
- ▶ A piece wise linear models is an electrical equivalent circuit of a nonlinear electronic device
- ▶ It is composed of linear circuit elements arranged to approximate the characteristics of the electronic device .

a) ideal diode model



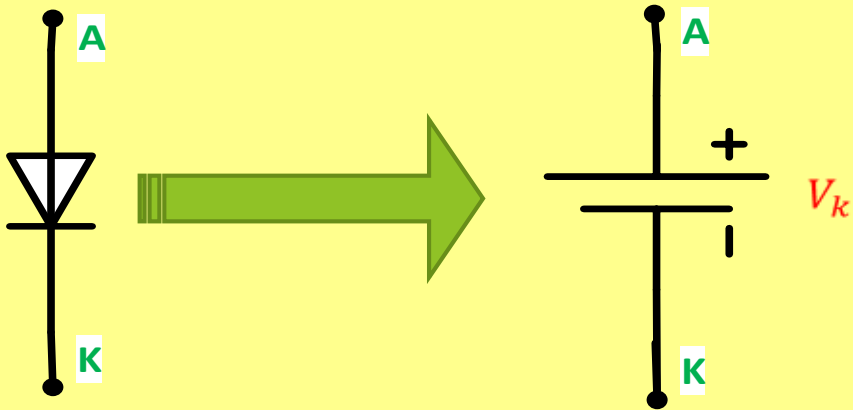
- ▶ When $V_s \geq 0$; the Diode is on, and replaced with short circuit
- ▶ When $V_s < 0$; the Diode is off, and replaced with open circuit

b) Knee Voltage model

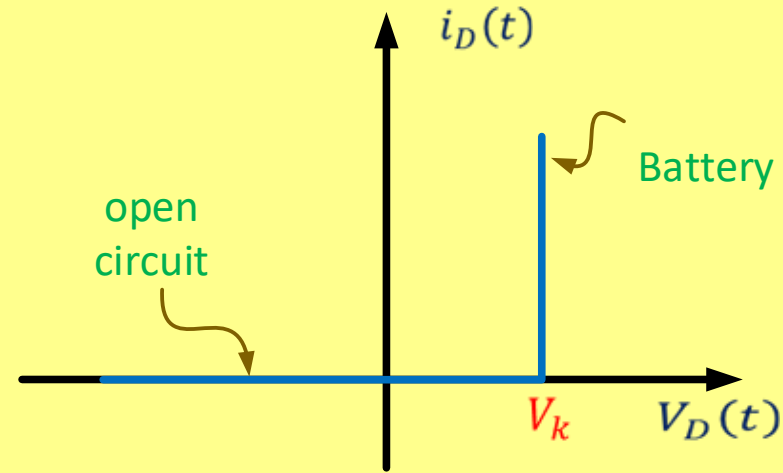
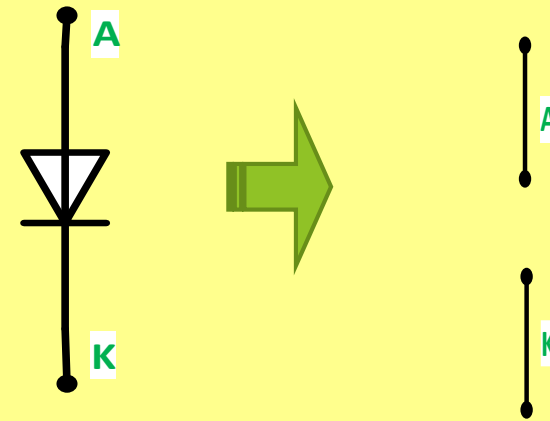


b) Knee Voltage model

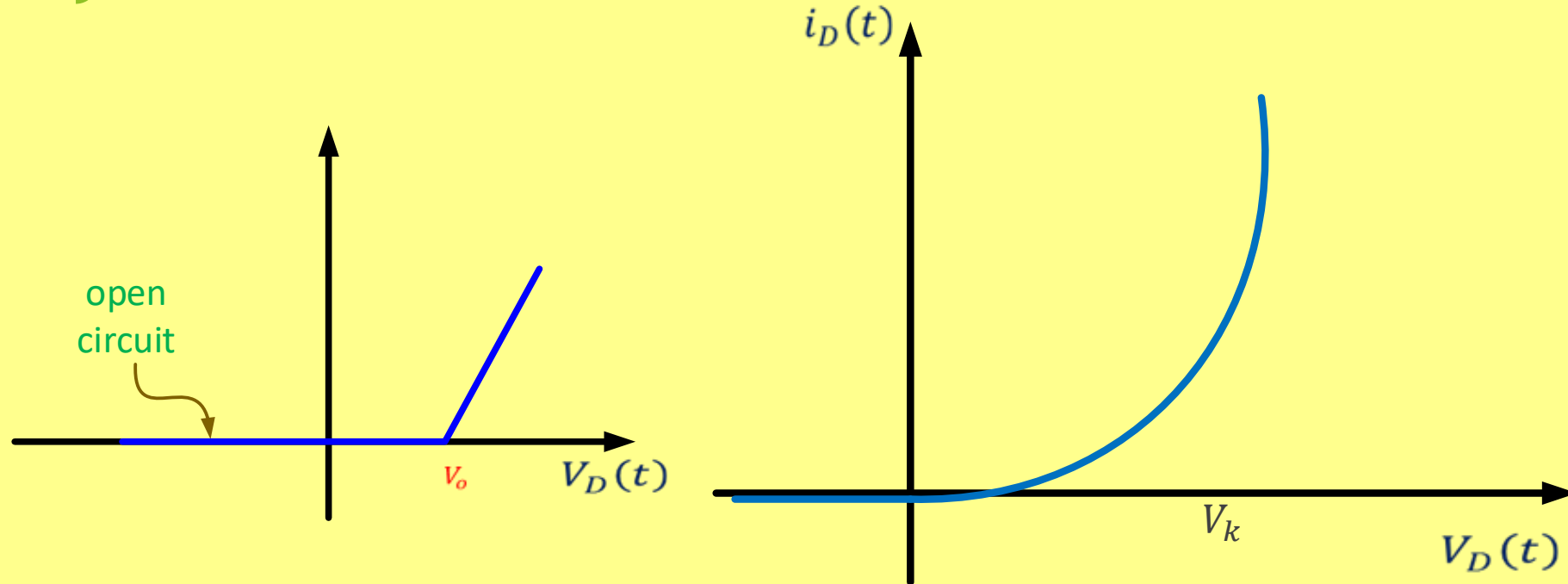
- ▶ When $V_S \geq V_k$; the Diode is on, and replaced with a constant voltage source



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



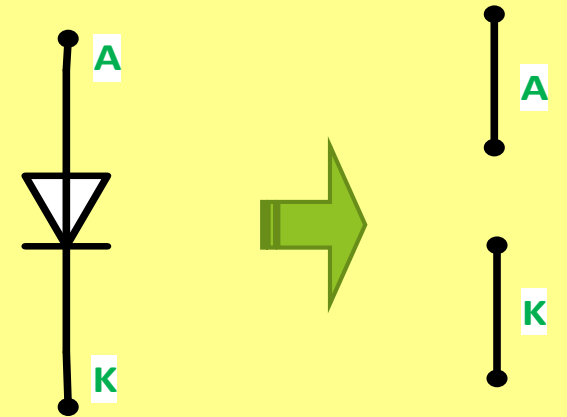
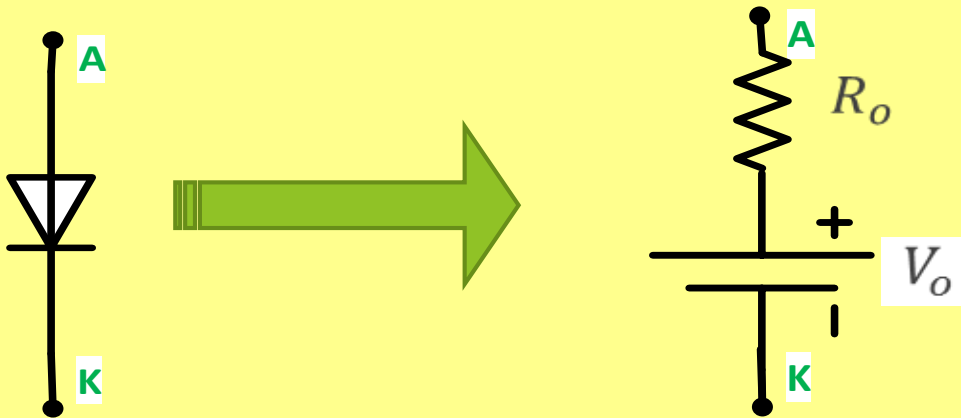
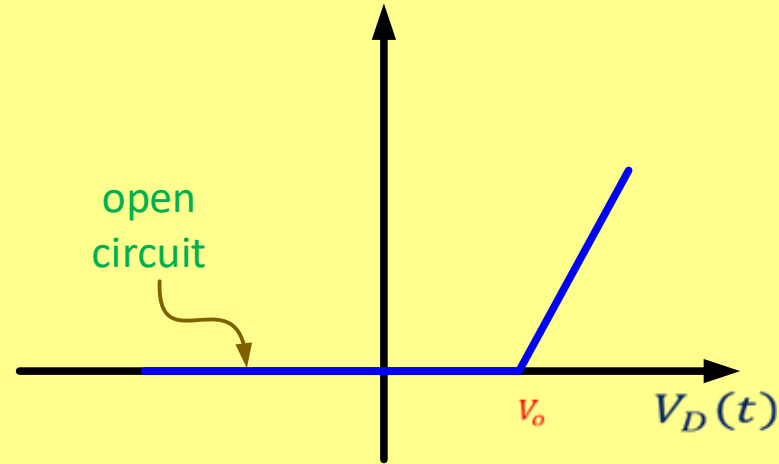
c) Dynamic resistance model



- ▶ 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

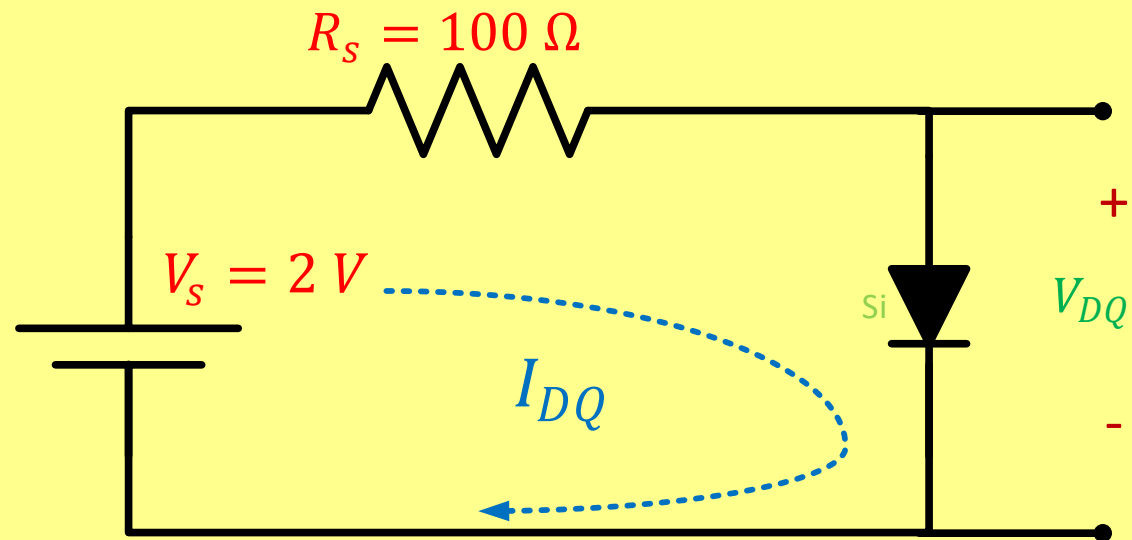
- ▶ When $V_s \geq V_o$; the Diode is on, and replaced with a constant voltage source V_o and resistance R_o



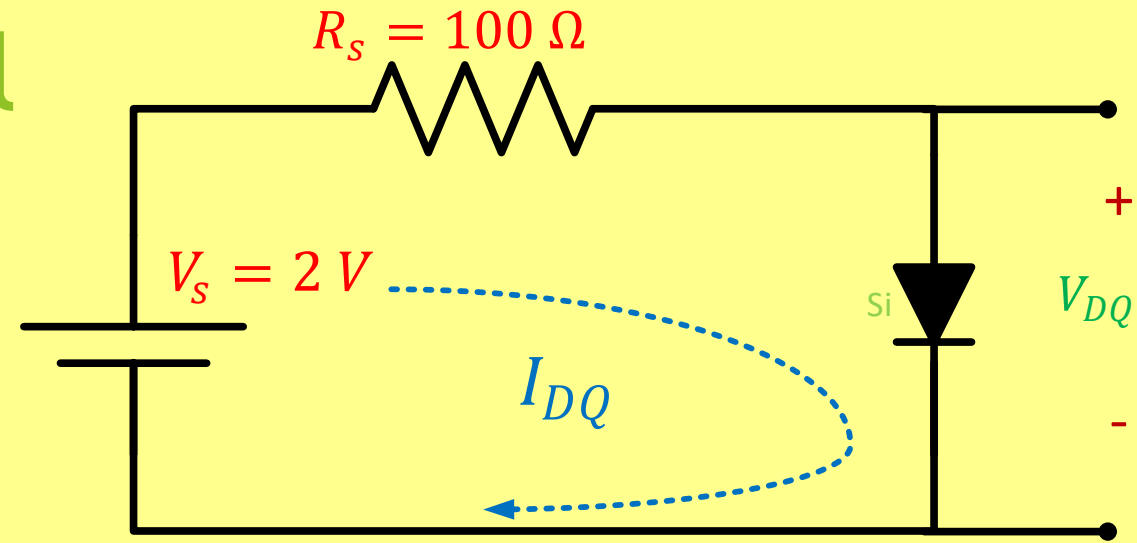
- ▶ When $V_s < V_o$; the Diode is off, and replaced with open circuit

Example

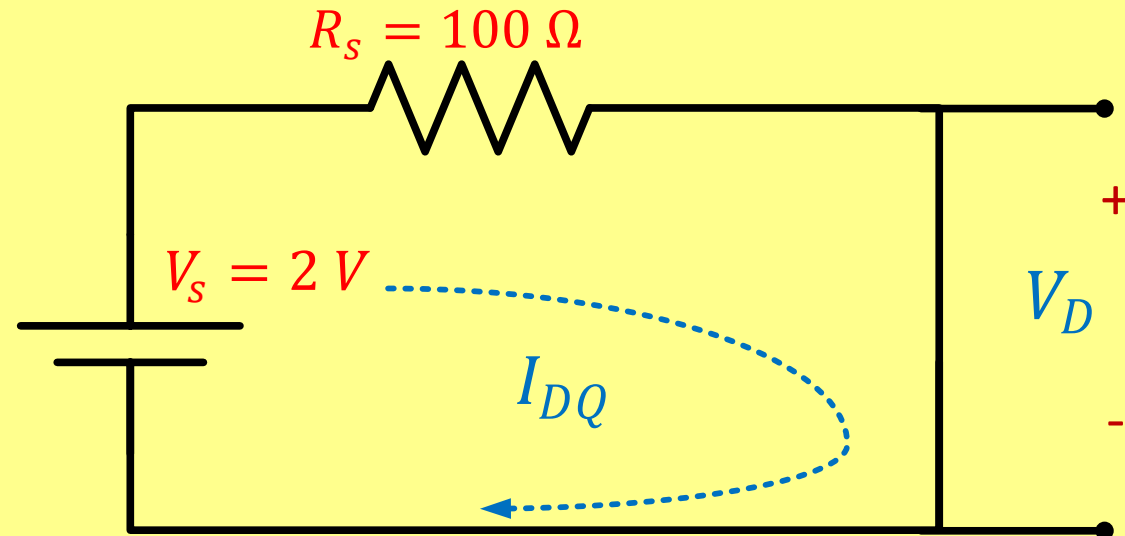
- Find the Q point (I_{DQ} , V_{DQ}) using
 - ideal diode model
 - knee voltage model



a) using ideal diode model



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



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

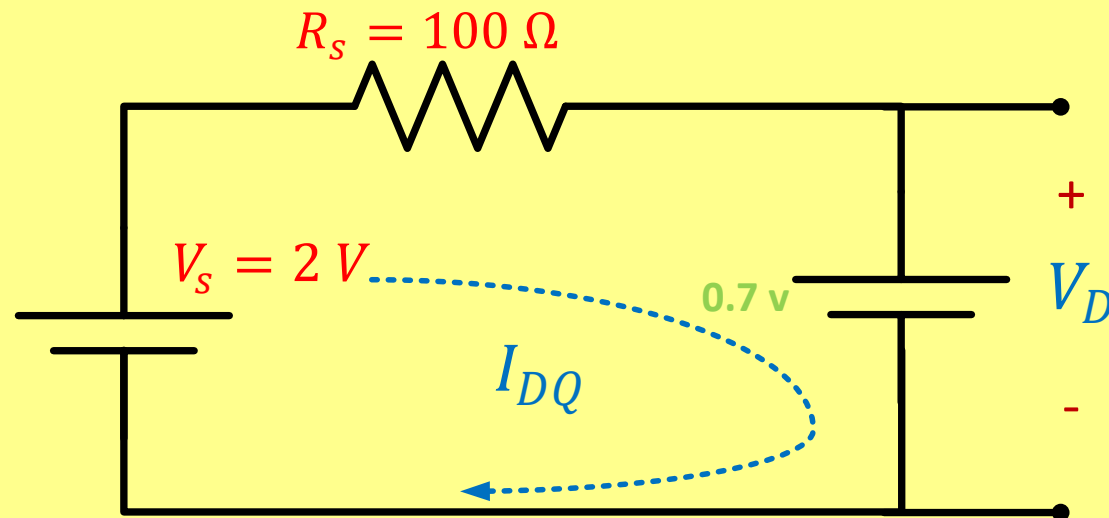
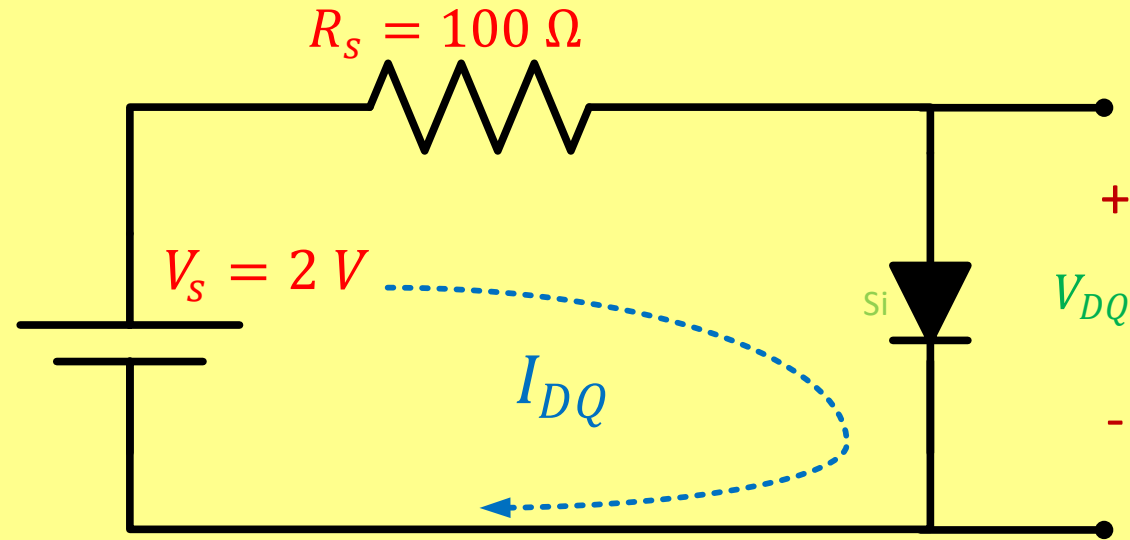
$$\therefore V_{DQ} = 0\text{ V}$$

b) Using knee voltage model

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

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

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



c) using nonlinear mathematic

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

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

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 .