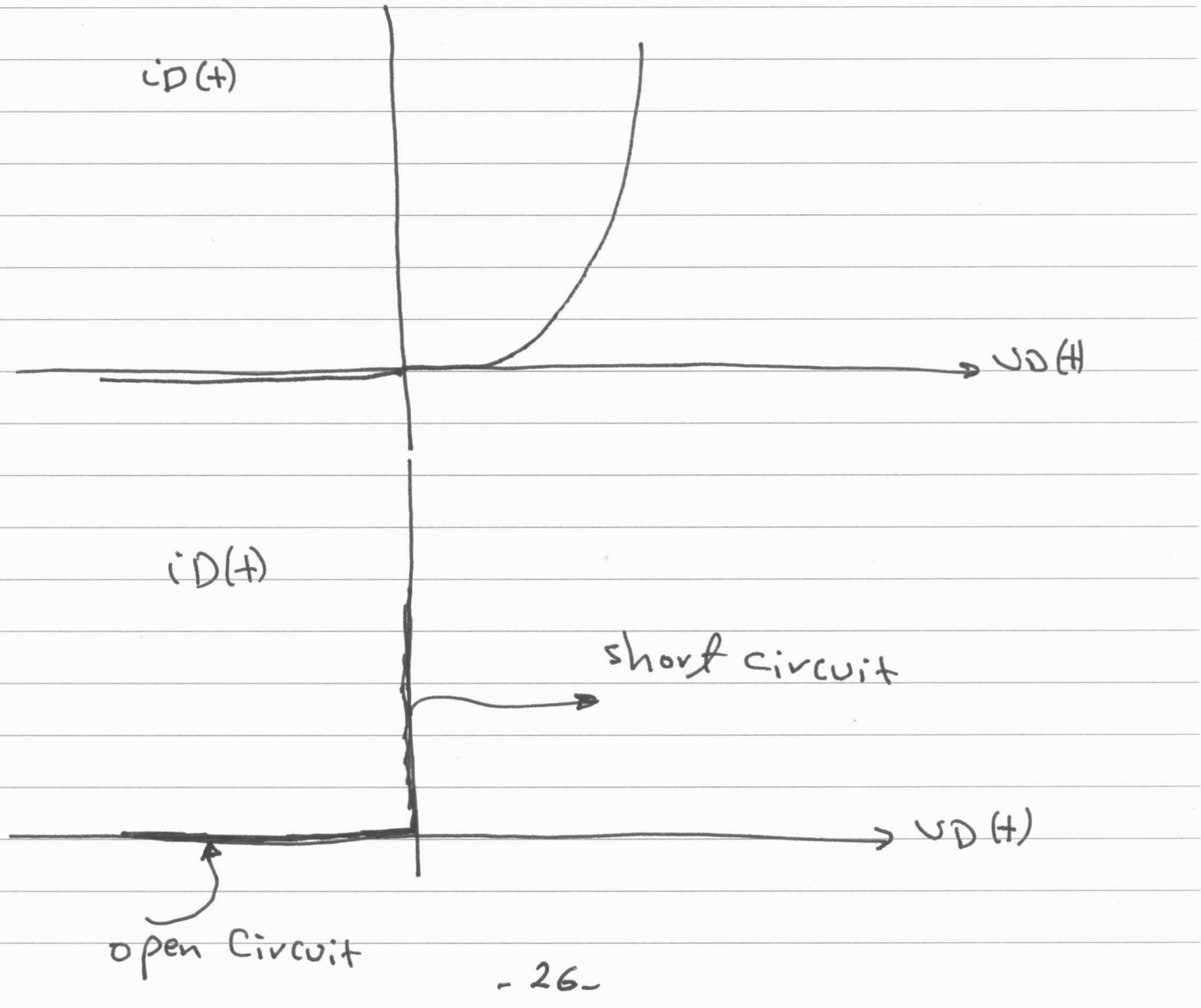
3) The use of models

A piece wise Linear models is an electrical equivalent Circuit of a non Linear electronic device. It is composed of Linear Circuit elements avranged to approximate the chavactevistics of the electronic device.

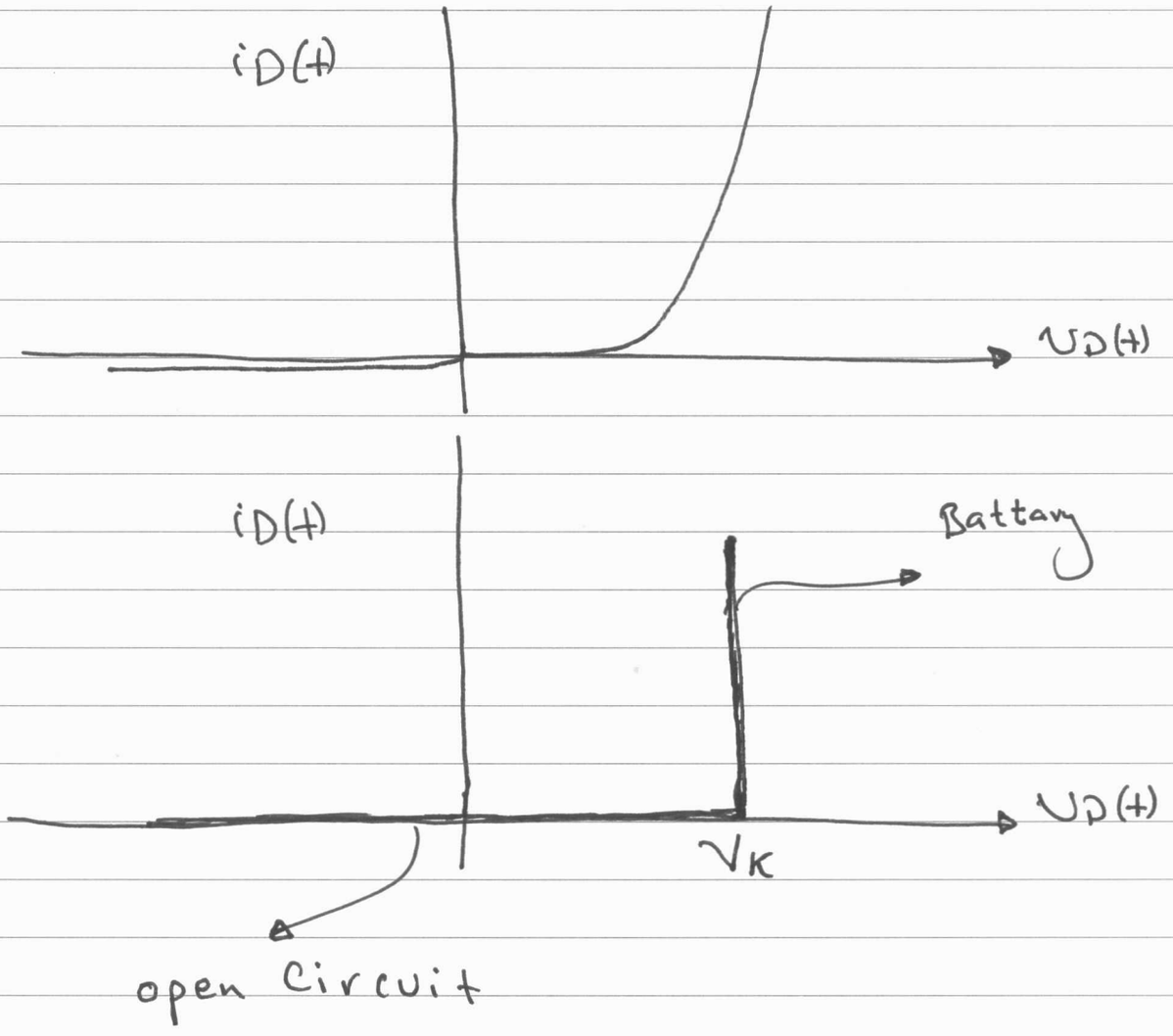
a) ideal diode model



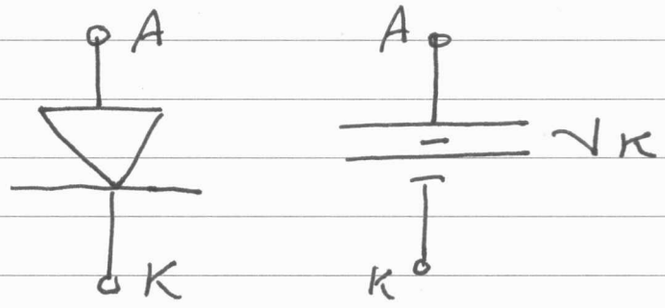
* when $V_s \geq 0$; the Diode is on, and replaced with short Circuit

* when $V_s < 0$; the diode is OFF, and replaced with open Circuit

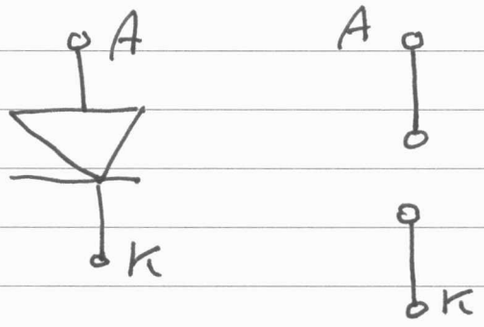
b) Knee Voltage model



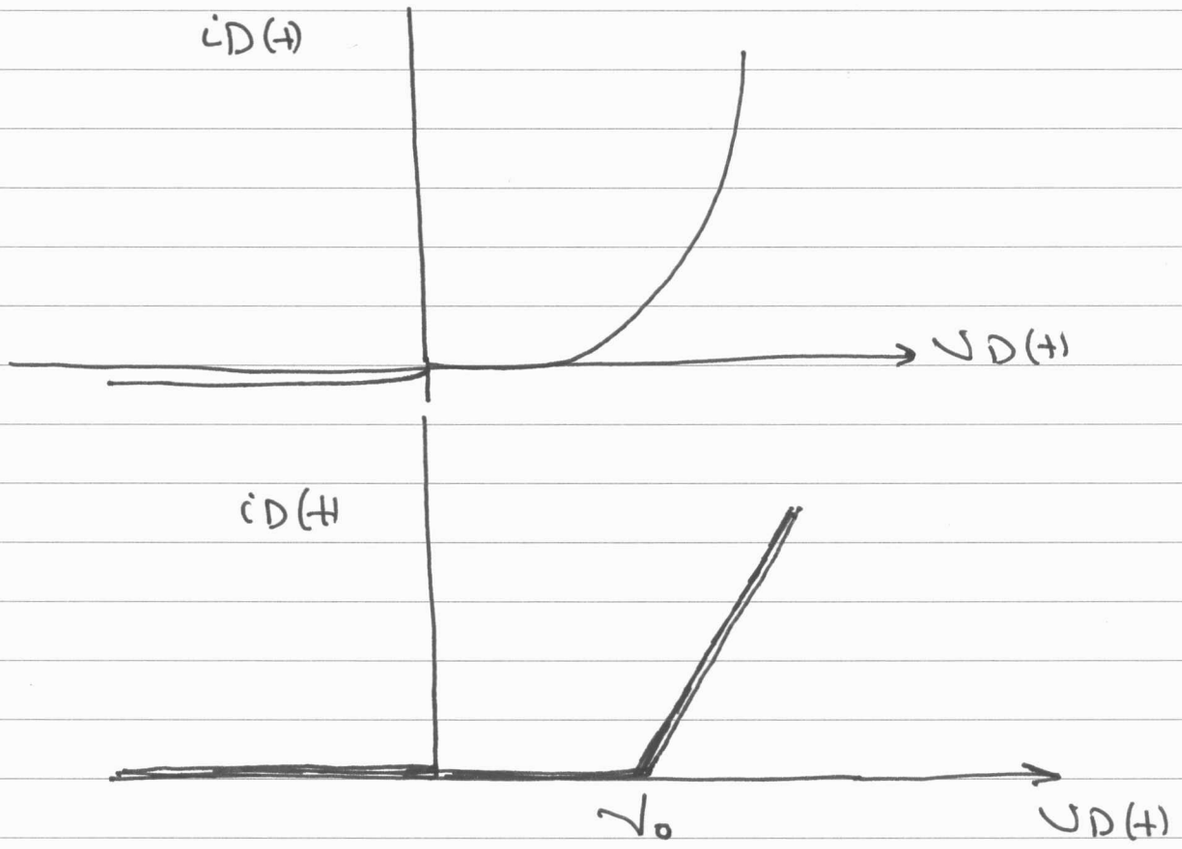
* When $V_s \geq V_K$, the diode is on and replaced with a Constant Voltage Source



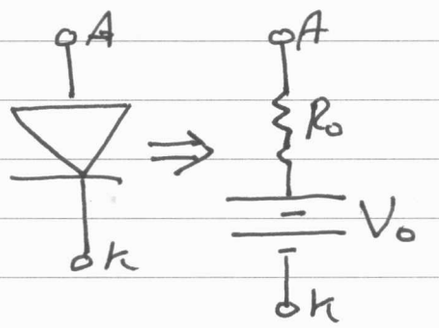
* When $V_s < V_K$, the diode is OFF and replaced with open Circuit



c) Dynamic resistance model

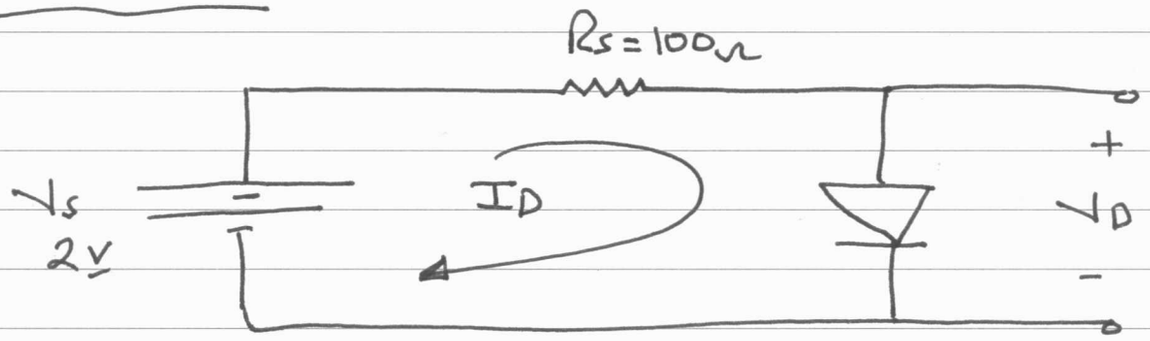


* When $V_s \geq V_o$, the diode is on, and replaced with



* When $V_s < V_o$, the diode is OFF, and replaced with open circuit

Example



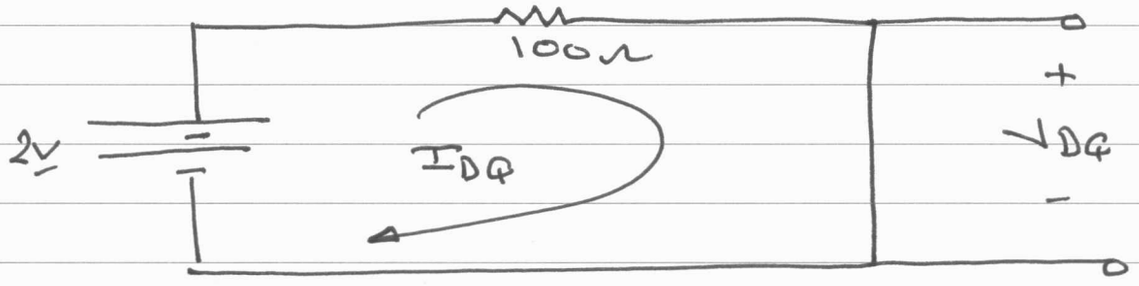
Find the Q point (I_{DQ}, V_{DQ}) using

a) ideal diode model

b) Knee Voltage model

a) using ideal diode model

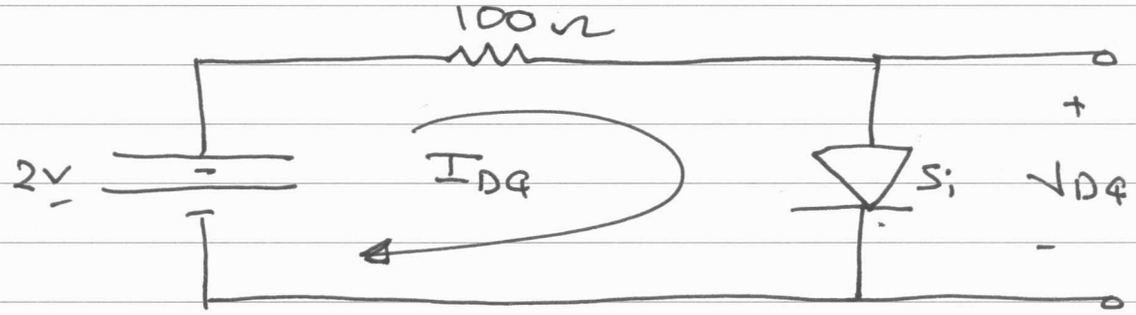
Since $V_s > 0$, the diode is on and replaced with short circuit.



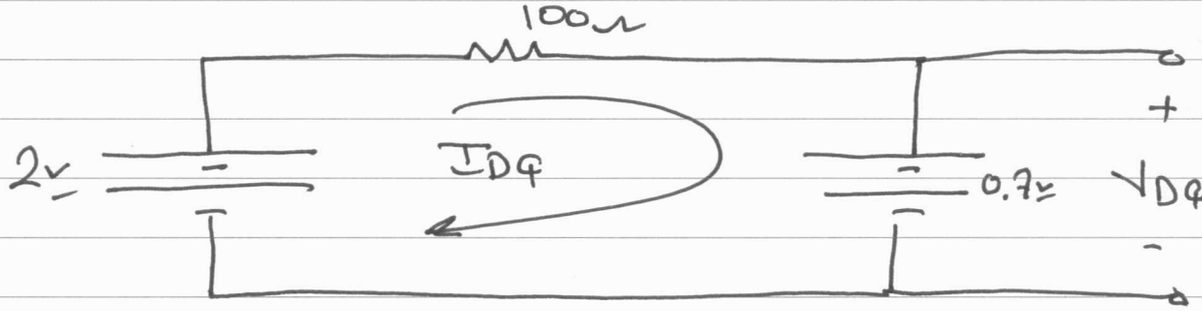
$$\therefore \quad I_{DQ} = \frac{2}{100} = 20\,mA$$

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

b) using knee voltage model



Since $V_s > 0.7$, the diode is on, and replaced with $V_K = 0.7V$



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

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

c) using non Linear mathematic

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

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

Taking the knee voltage into account

* If $V_s > 10V_K$, we could use ideal diode model

* If $V_s < 10V_K$, we must use the knee voltage model.