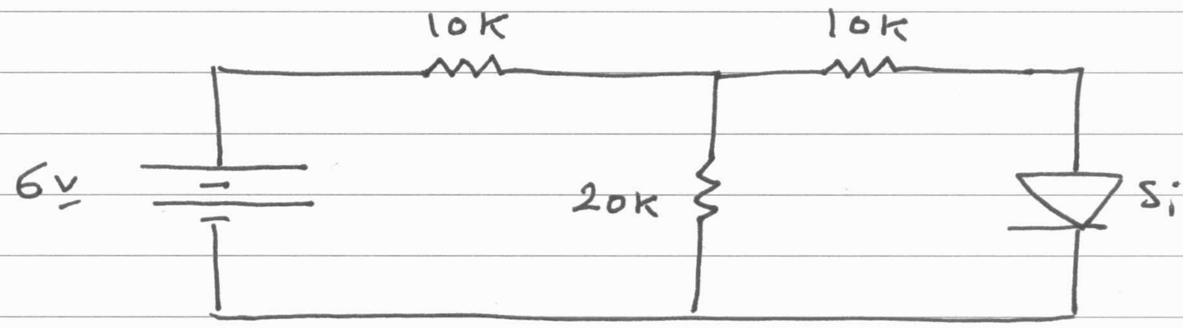
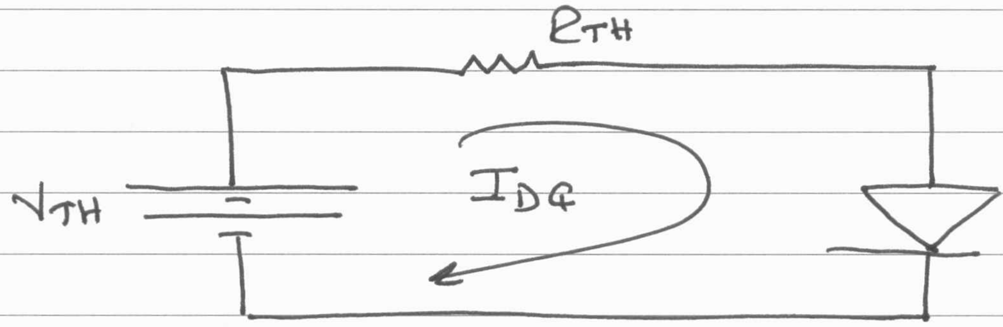
Example



Find the Q point

Using thevenin's theorem, the circuit is simplified to

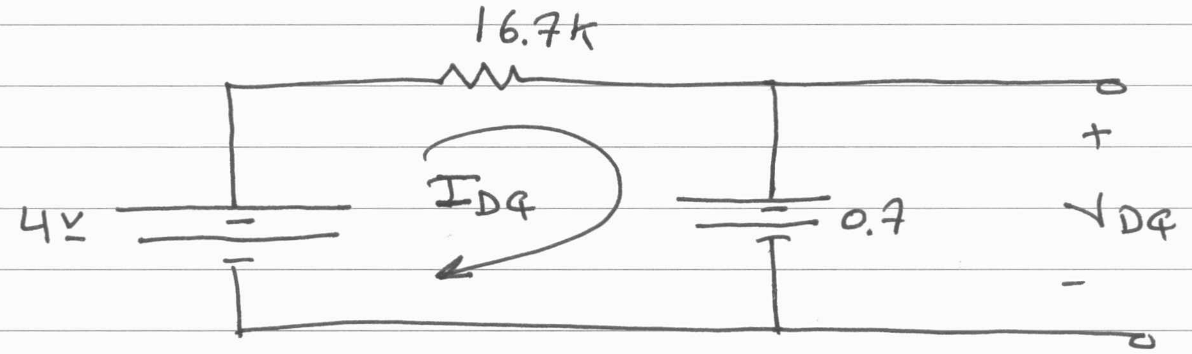


$$R_{TH} = 10K + 10K \| 20K = 16.7 K$$

$$V_{TH} = \frac{20K}{20K + 10K} \cdot 6 = 4 V$$

Since $V_{TH} \gg V_K$, the diode is on

Since $V_{TH} < 10 V_K$, we must use the Knee Voltage model

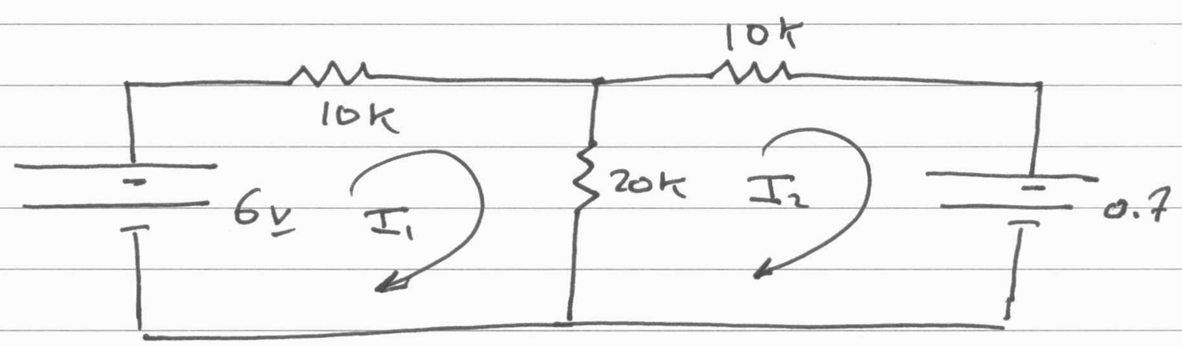


$$I_{DQ} = \frac{4-0.7}{16.7k} = 0.198\ mA$$

$$V_{DQ} = V_K = 0.7\ v$$

Second method

assume the diode is on, replace it with $V_K = 0.7\,v$



$$6 = 30 I_1 - 20 I_2$$
$$-0.7 = -20 I_1 + 30 I_2$$

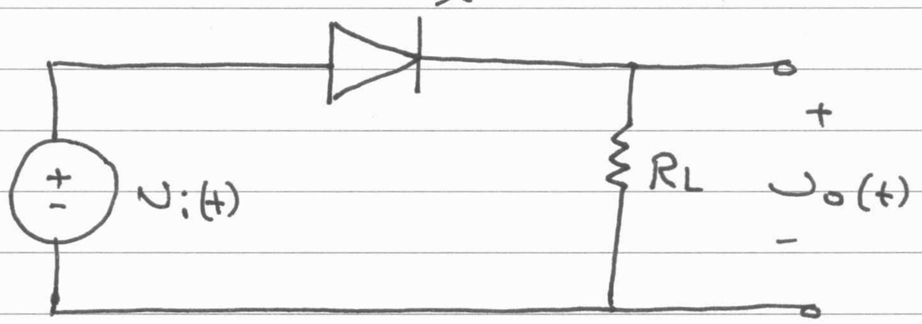
Solve for $I_2 = 0.198\ mA$

$\therefore\ I_D = I_2 = 0.198\ mA$

Since $I_D > 0$, $\therefore$ our assumption is ok

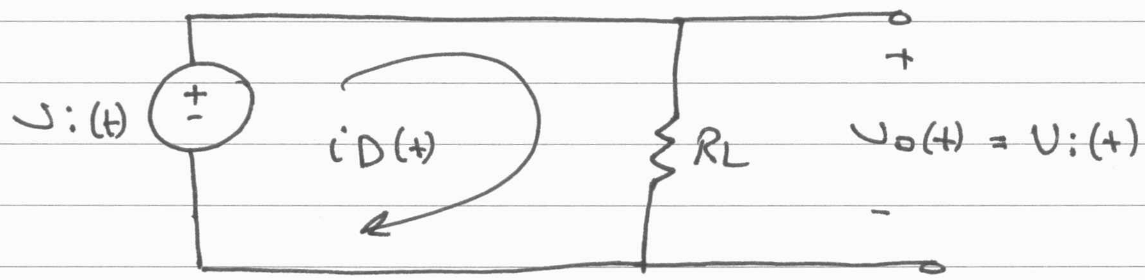
Diode Large-Signal Applications

1) Diode Clipper Circuit



a) assume the diode is on

b) replace it with short circuit



c) $i_D(t) > 0$

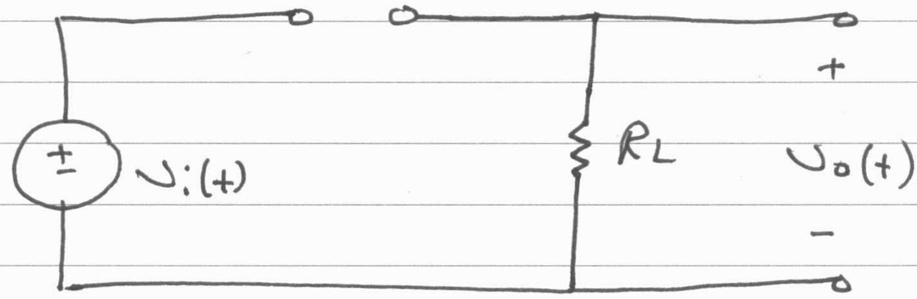
$$i_D(t) = \frac{v_i(t)}{R_L} > 0$$

$\therefore \; v_i(t) > 0$

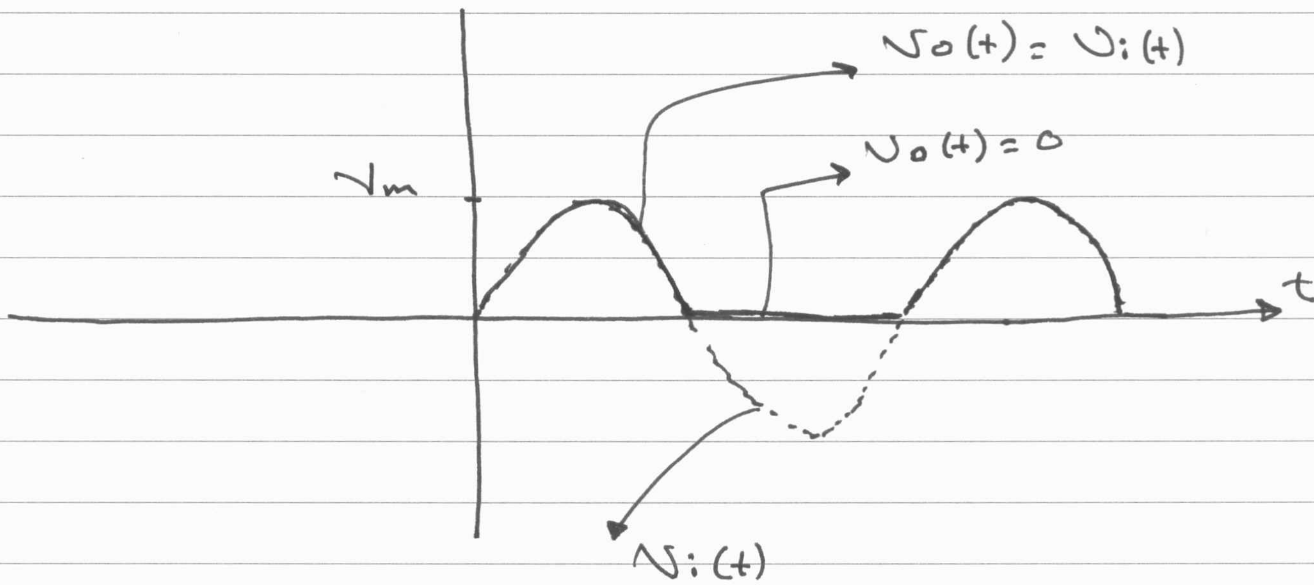
$\therefore$ when $v_i(t) > 0$, the diode is on

and $v_o(t) = v_i(t)$

∴ When $v_i(t) < 0$; the diode is OFF

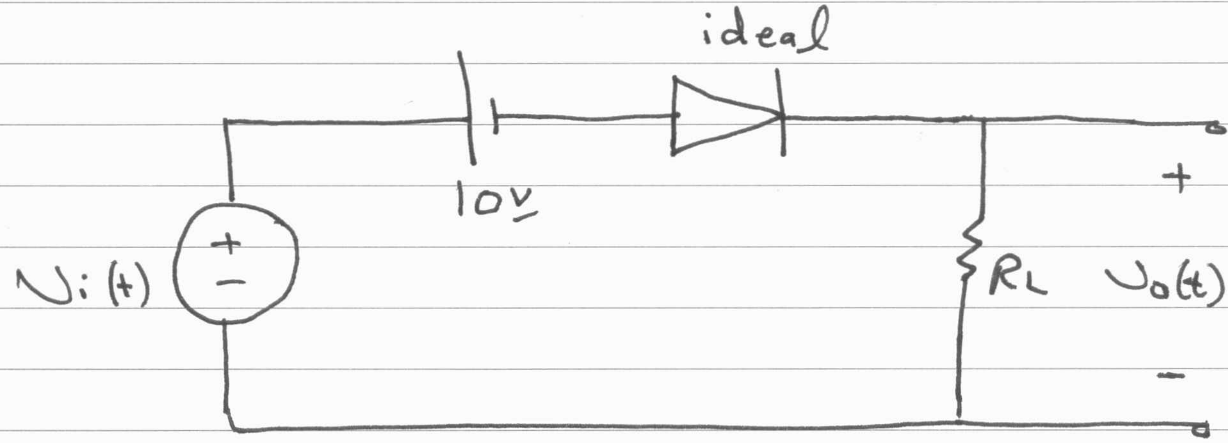


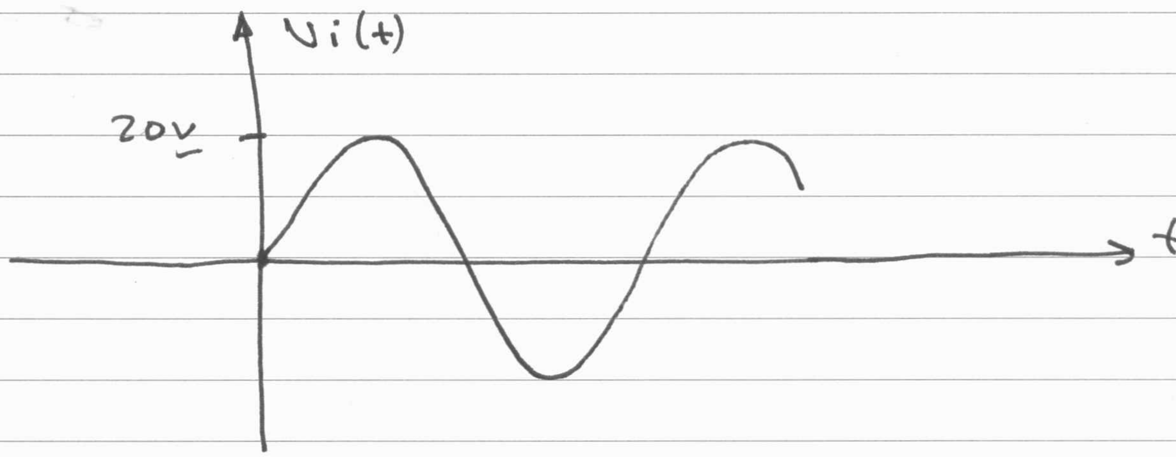
$v_o(t) = 0$



∴ The clipper circuit used to eliminate portion of the input signal.

Example

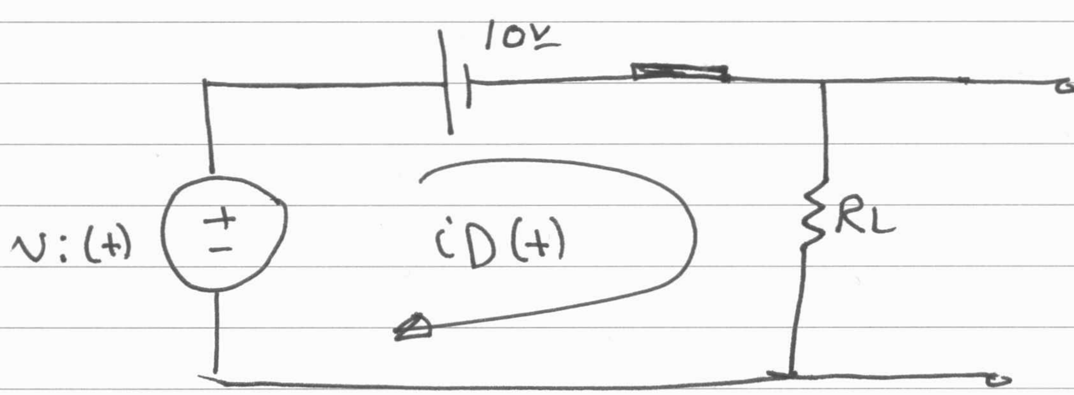




a) assume that the diode is on

b) replace it with short circuit

c) $i_D(t) > 0$



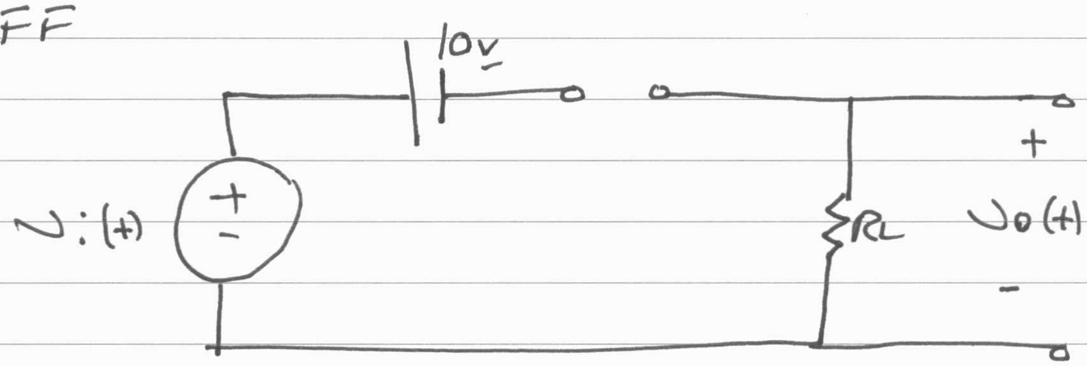
$$i_D(t) = \frac{v_i(t) - 10}{R_L} > 0$$

∴ $v_i(t) - 10 > 0$

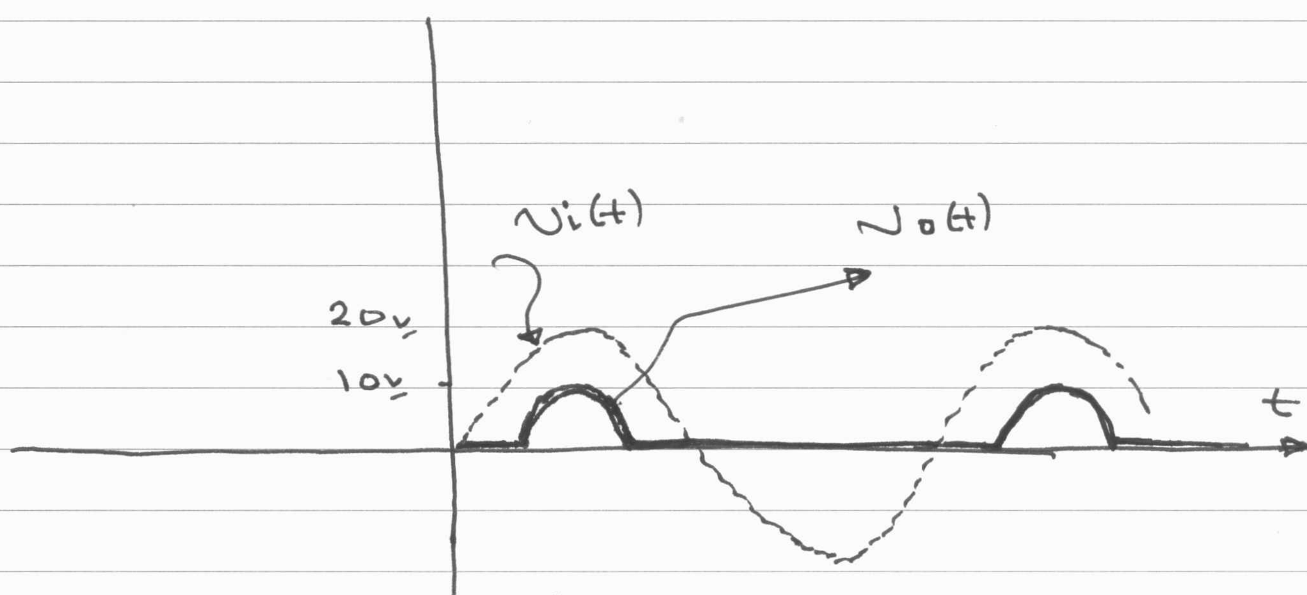
∴ $v_i(t) > 10\,V$

∴ when $v_i(t) > 10\,V$, the diode is on and $v_o(t) = v_i(t) - 10$

and also we can prove that when $v_i(t) < 10\,V$, the diode is OFF



∴ $v_o(t) = 0$

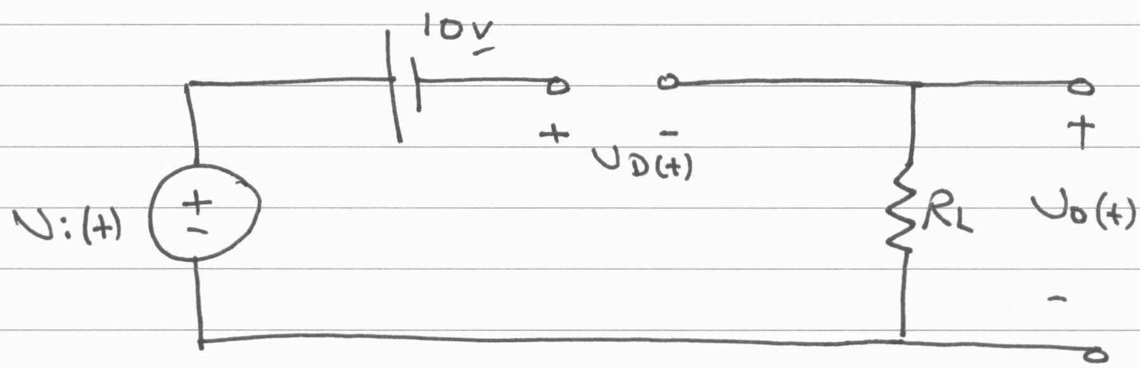


Second method

a) assume that the diode is OFF

b) replace it with open circuit

c) $v_D(t) < 0$



$$v_D(t) = -10 + v_i(t) < 0$$

$$\therefore \quad v_i(t) < 10\ V$$

$\therefore$ when $v_i(t) < 10\ V$, the diode is OFF, and $v_o(t) = 0$