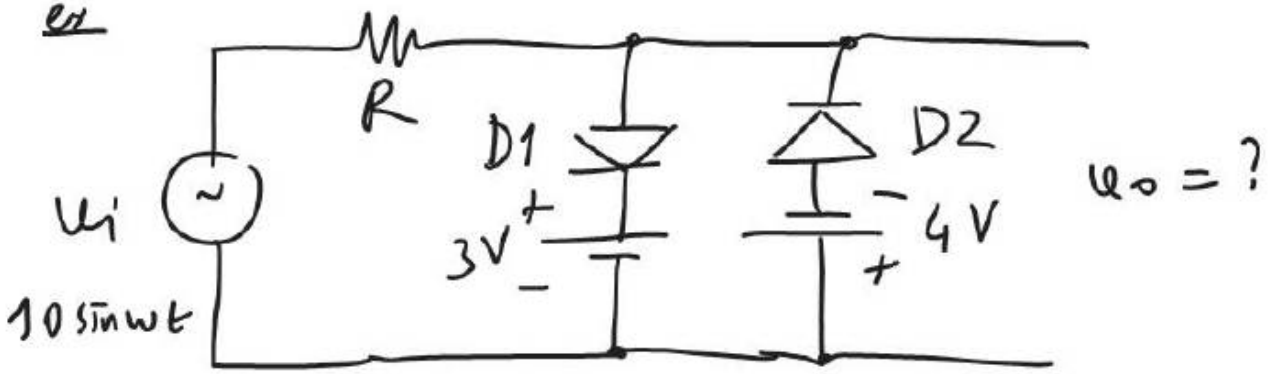
01.03.2011
Tuesday

ex

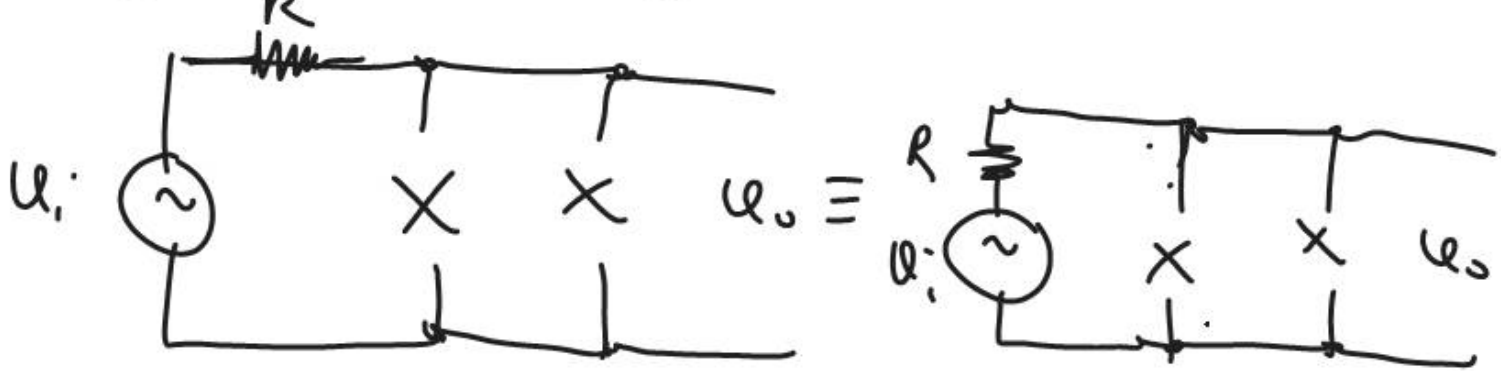


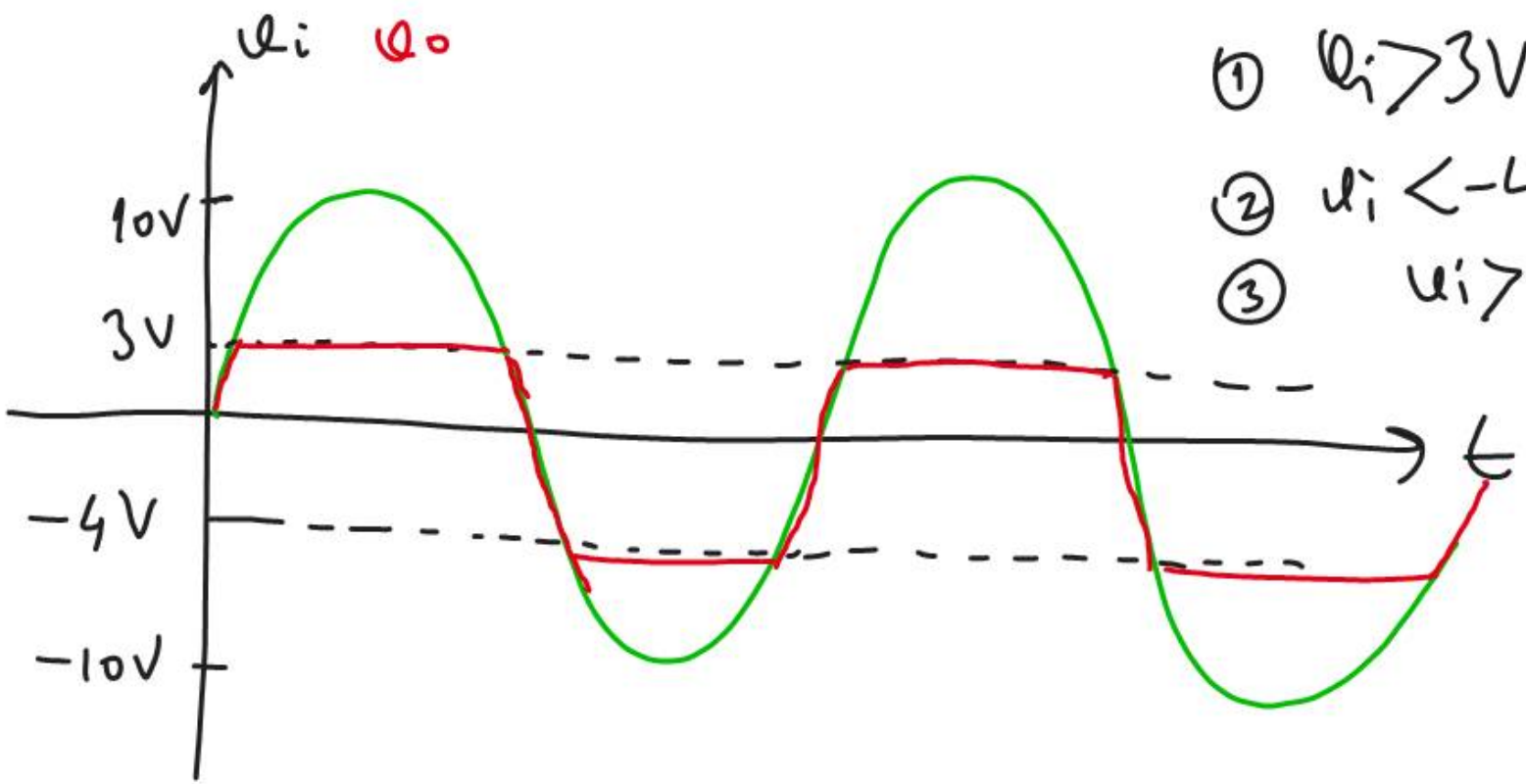
D1: Forward-biased when $v_i > 3V \Rightarrow$ $\boxed{v_o = 3V}$

D2: Forward-biased when $v_i < -4V \Rightarrow$ $\boxed{v_o = -4V}$

Beyond these regions, both diodes are <u>reverse biased.</u>

$\boxed{v_o = v_i}$





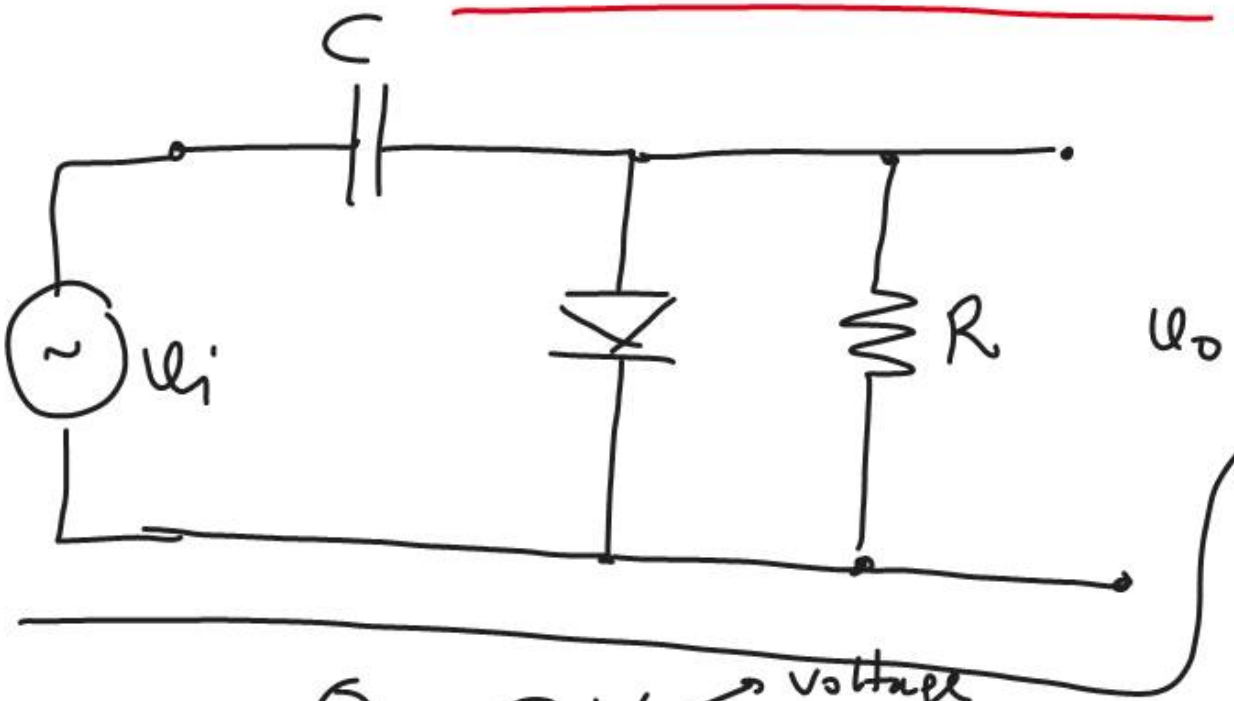
① $v_i > 3V$ $v_o = 3V$

② $v_i < -4V$ $v_o = -4V$

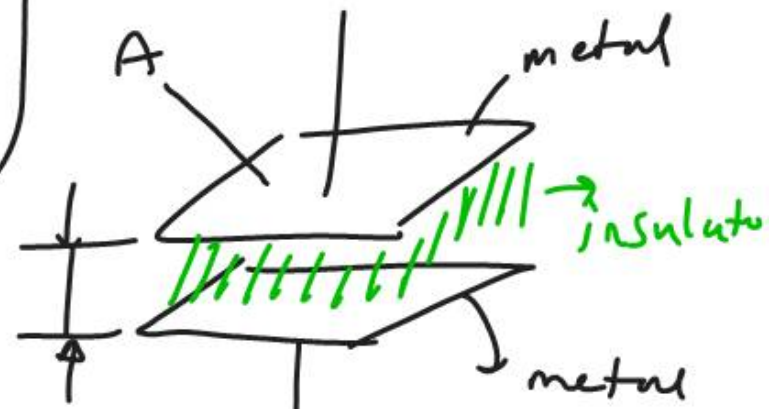
③ $v_i > 3$, and $v_i < -4V$

$v_o = v_i$

CLAMPERS



A parallel plate capacitor



$Q = C V$ → voltage (V)

Q: electrical charge stored in the capacitor (Coulomb)

C: Capacitance (F)

$\frac{dQ}{dt} = \boxed{i = C\frac{dv}{dt}}$

$C = \epsilon \cdot \frac{A}{d}$

ϵ = permittivity of the insulator (F/m)

$\epsilon = \epsilon_0 \cdot \epsilon_r$

ϵ_0: permittivity of free space

ϵ_r: Relative permittivity of insulator

$$i = C \cdot \frac{du}{dt}$$

$$du = \frac{1}{C} \int i \, dt$$

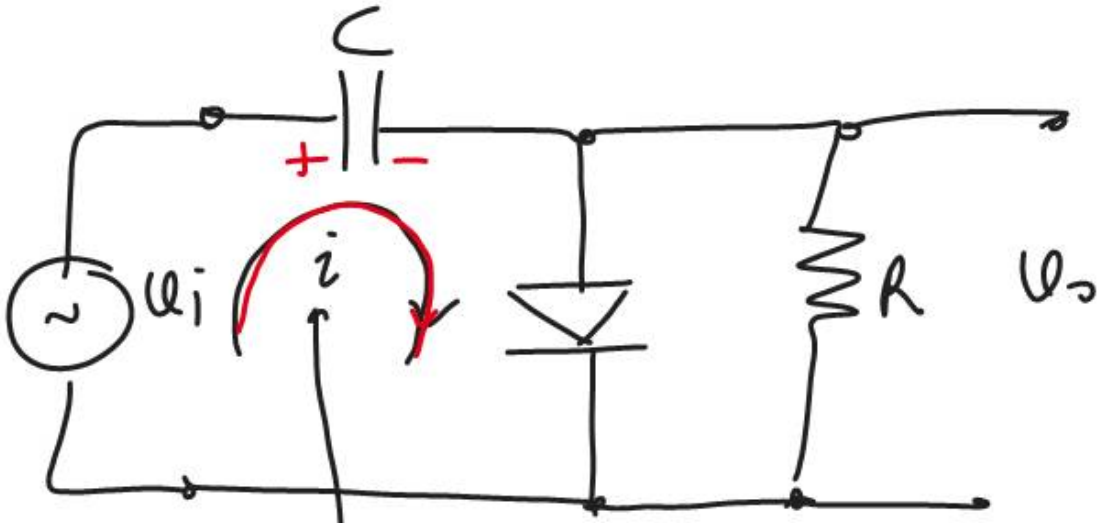
a time dependence between u and i in a capacitor

Remember:

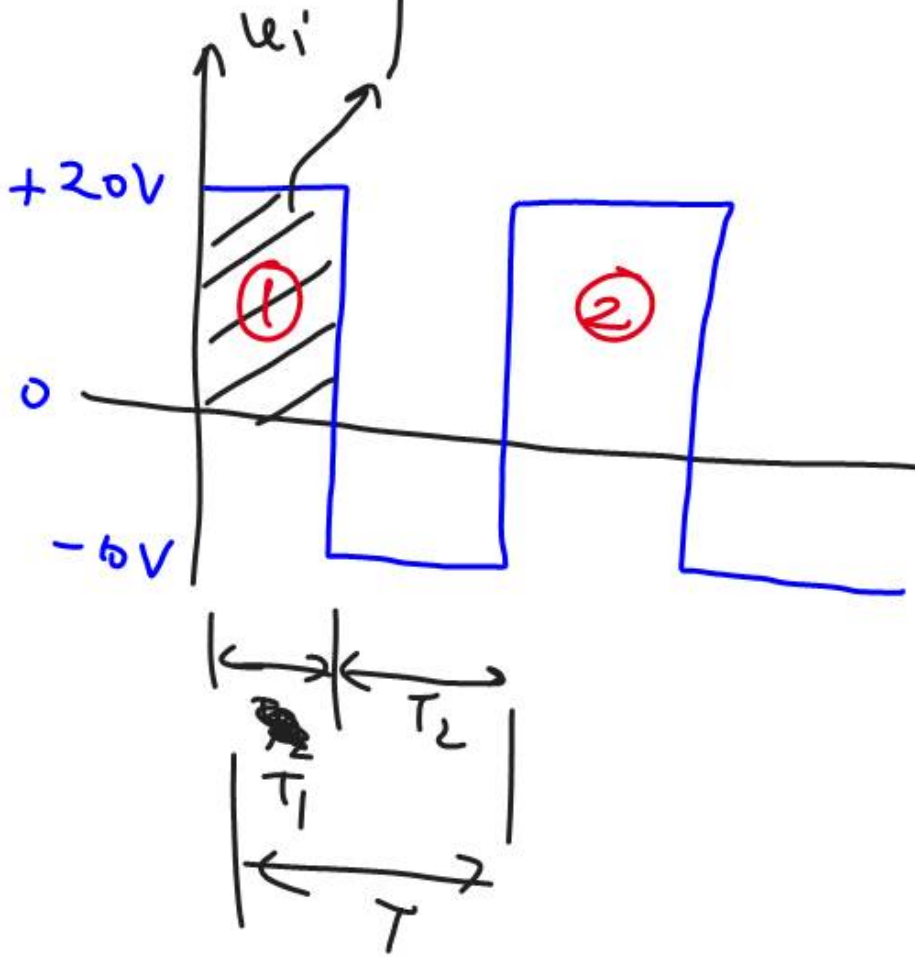
$$u = i \cdot R$$

No time dependence between i and u

This is general culture! not Olampus



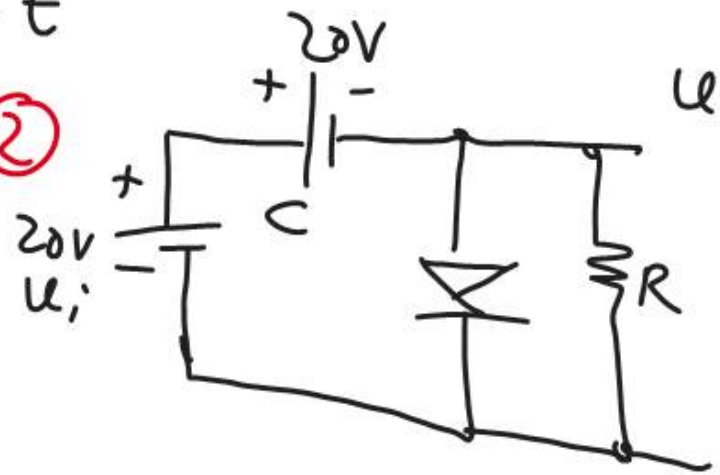
a clamper



When $v_i > 0$, the diode is forward biased. ✓

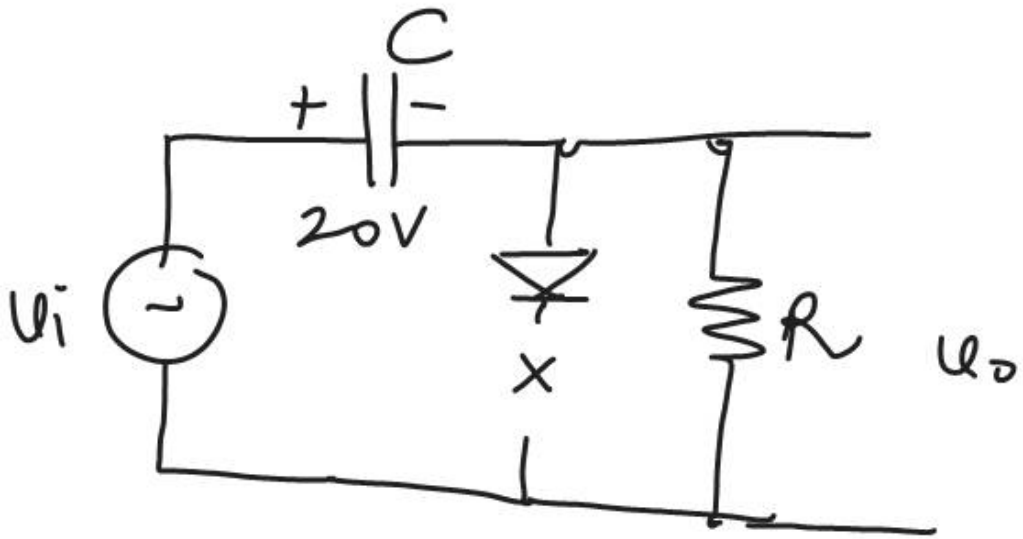
In ①, the capacitor is charged to +20V.

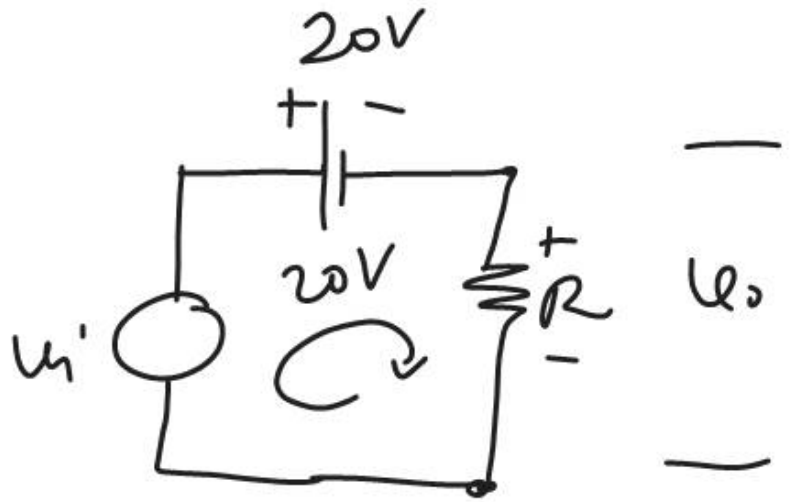
②



$v_o = 0$ V.

After the capacitor is charged to +20V and the diode will never be forward biased again



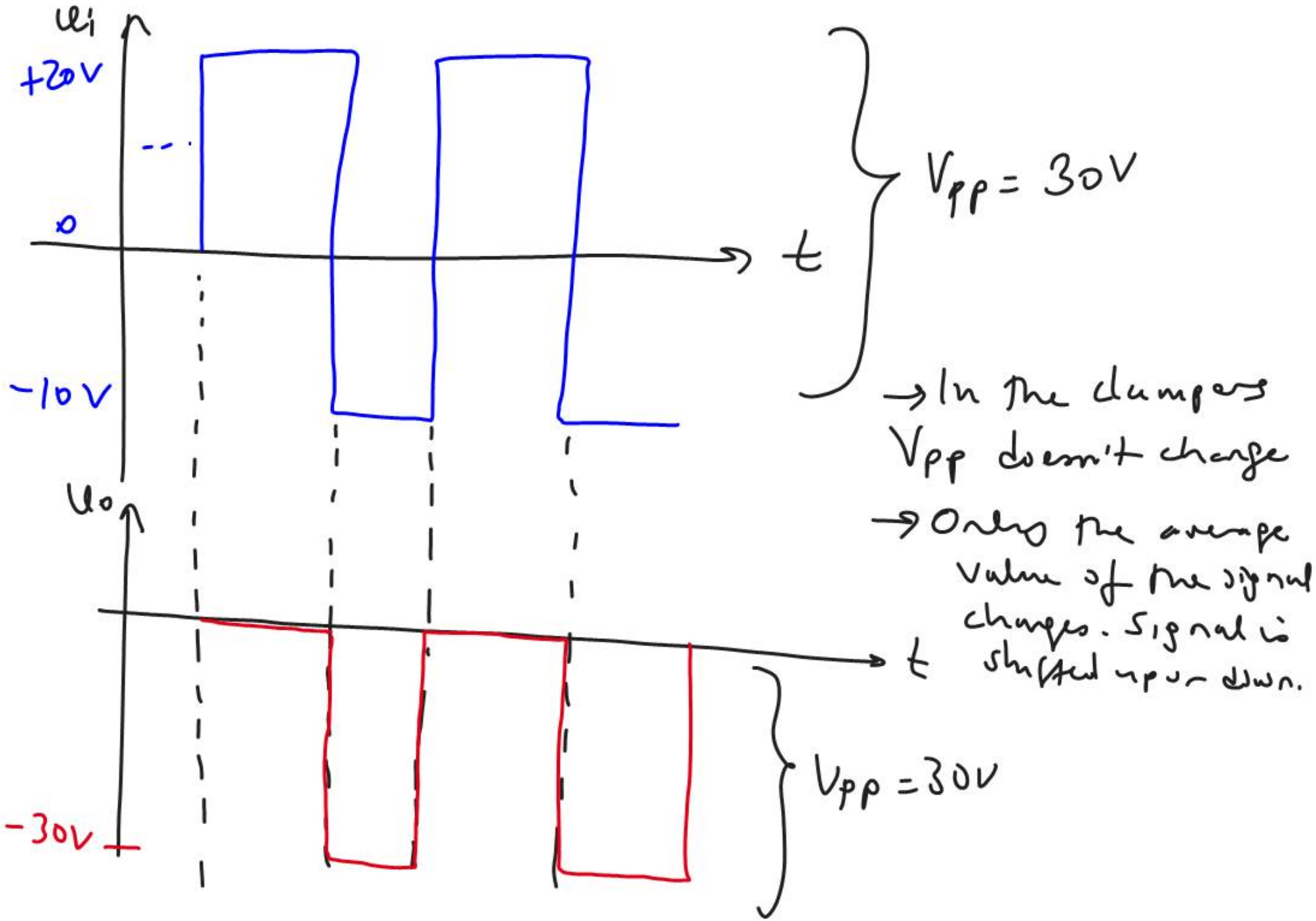


$v_i - 20V - v_o = 0$

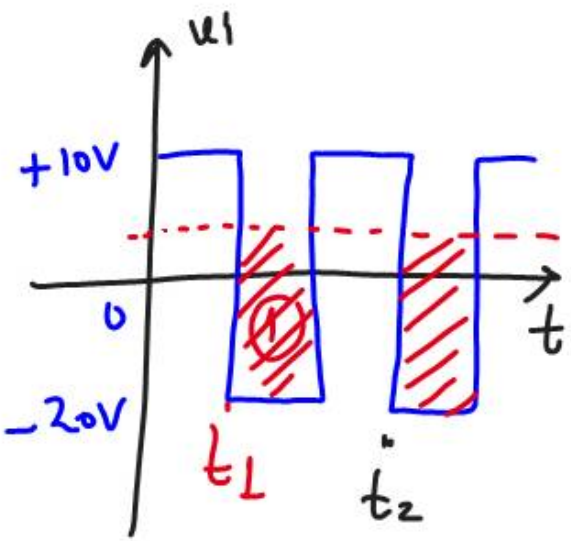
$v_o = v_i' - 20V$

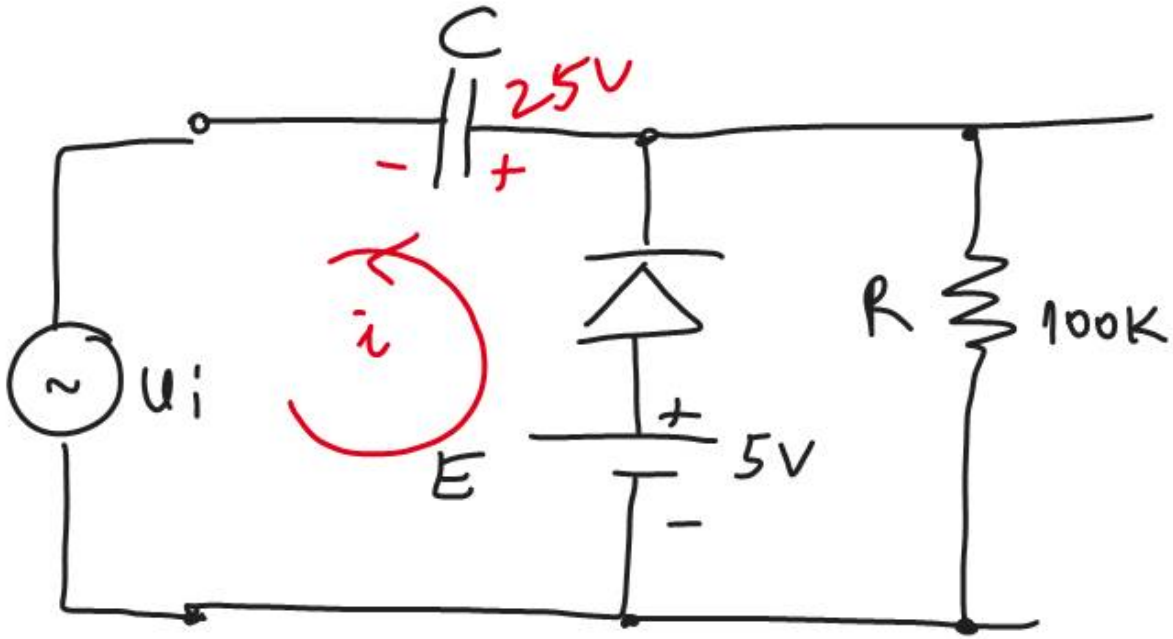
- when $v_i = 0 \Rightarrow v_o = -20V$
- When $v_i' = -10V \Rightarrow v_o = -30V$
- when $v_i' = 20V \Rightarrow v_o = 0V$.

↳ Draw


u_i
+20V
0
-10V
t
$V_{pp} = 30V$
→ In the clampers V_{pp} doesn't change
→ Only the average value of the signal changes. Signal is shifted up or down.
u_o
-30V
t
$V_{pp} = 30V$

ex:



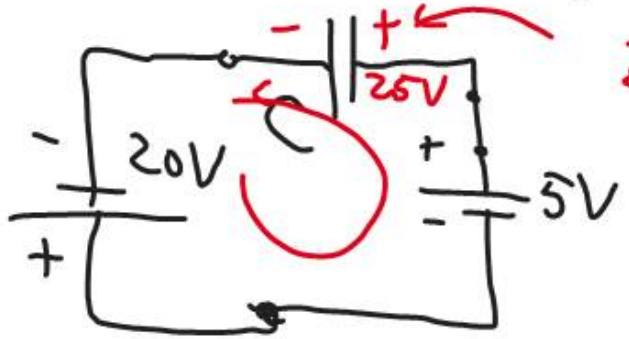


* When the diode is forward biased?

When $u_i < 5V$ the diode is forward biased.

The capacitor starts to charge at t_1 where:

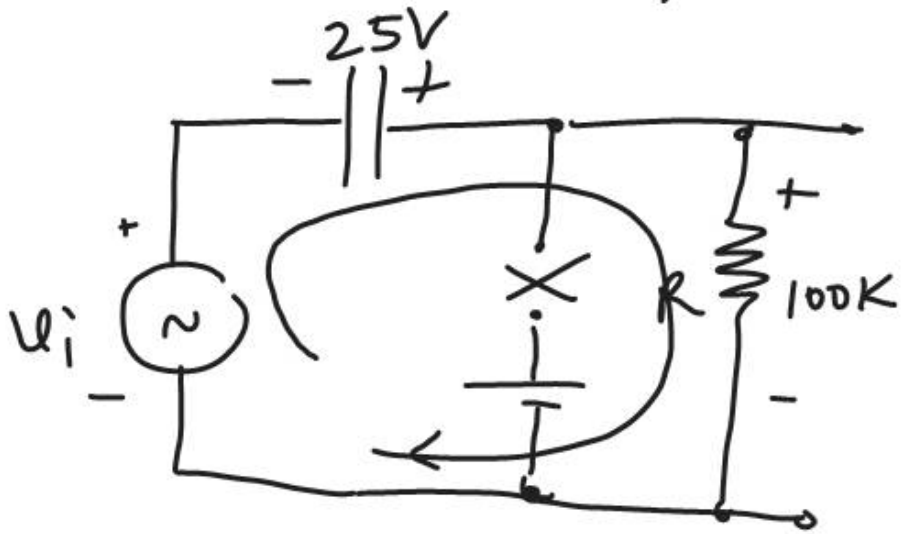
at $t = t_1$



25V will be charged into the capacitor

after this voltage (25V) is stored in the capacitor the diode will never be forward-biased again.

at $t=t_2$ and further ...



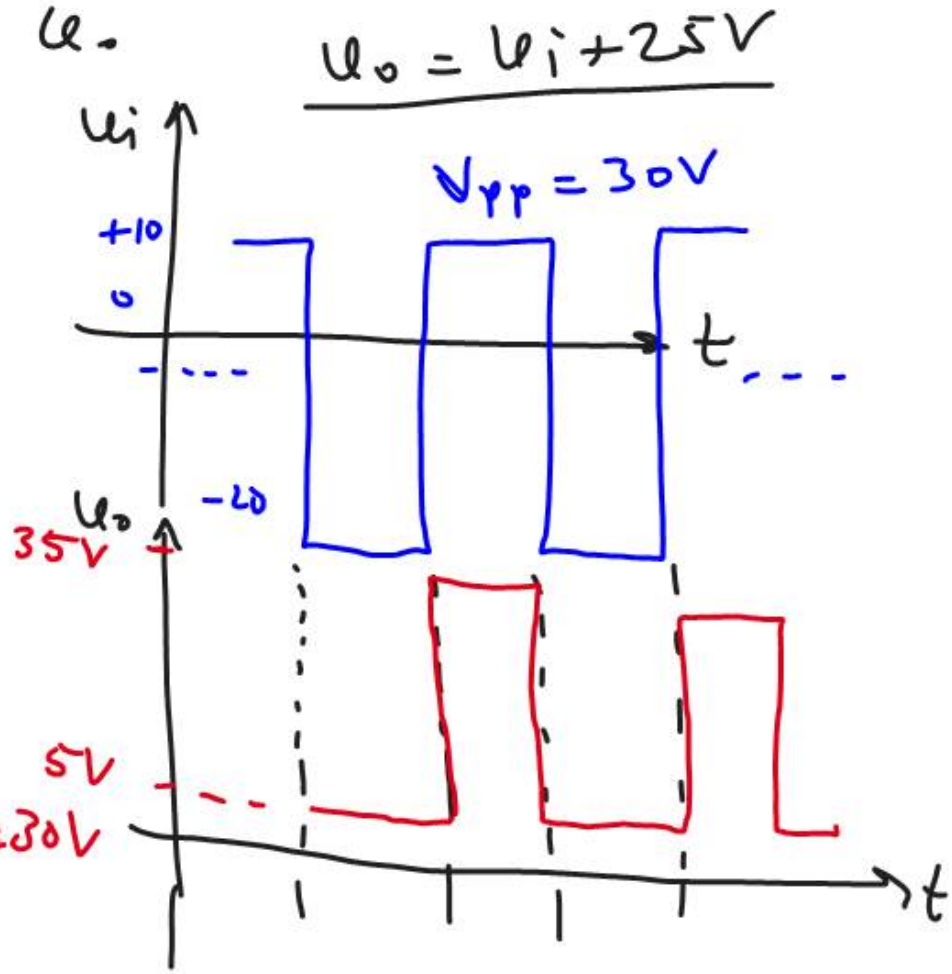
$u_i = 10V \rightarrow u_o = 35V$

$u_i = 0 \rightarrow u_o = 25V$

$u_i = -20V \rightarrow u_o = 5V$

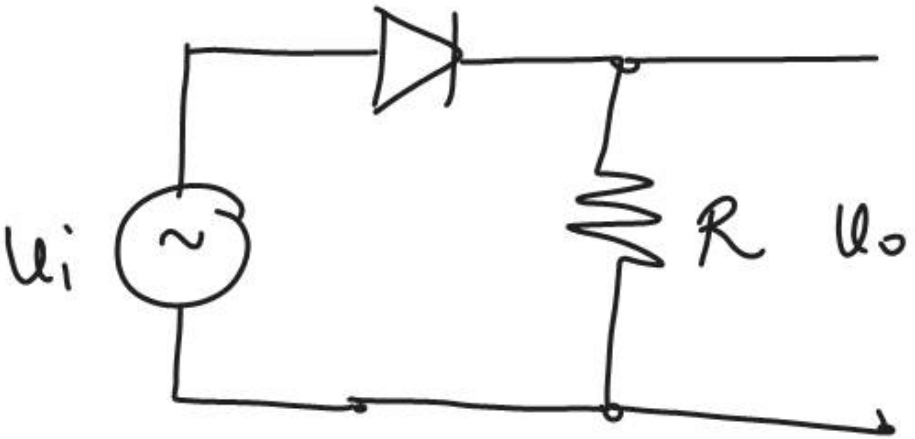
$u_i + 25V - u_o = 0$

$u_o = u_i + 25V$

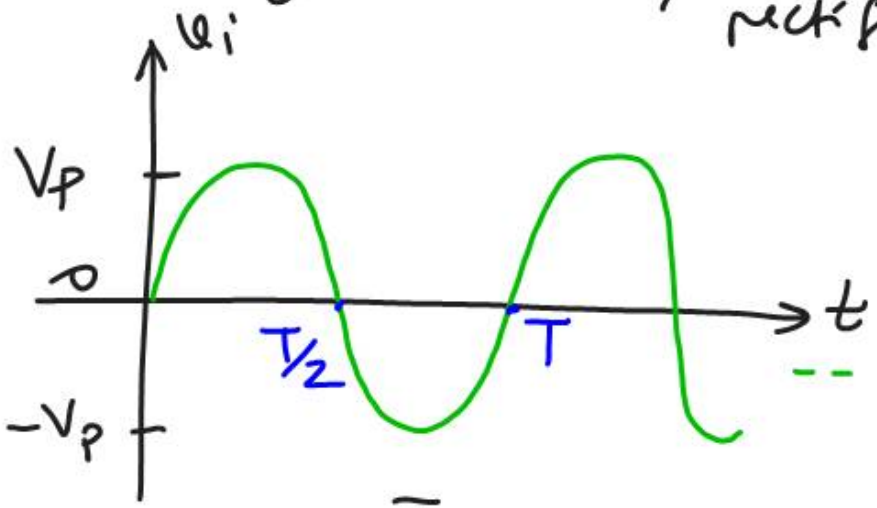


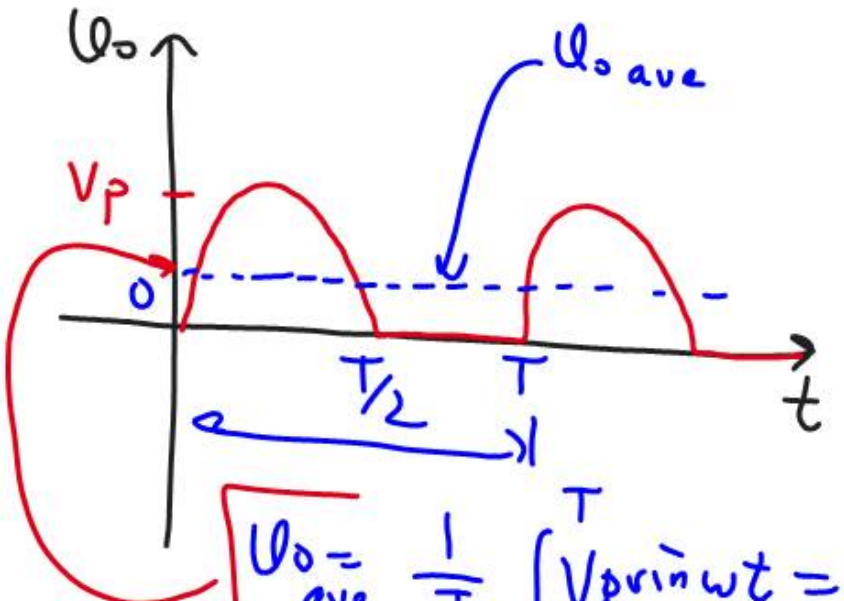
RECTIFICATION

simplest rectifier:



a one-way rectifier / Half wave rectifier





$$v_{i\,av} = \frac{1}{T}\int_0^T V_p \sin\omega t\, dt = 0$$

$$v_{i\,eff} = v_{rms} = \sqrt{\frac{1}{T}\int_0^T (V_p \sin\omega t)^2 dt} = \frac{V_p}{\sqrt{2}}$$

$$v_{o\,ave} = \frac{1}{T}\int_0^T V_p \sin\omega t = \frac{1}{T}\left[\int_0^{T/2} V_p \sin\omega t\, dt + \int_{T/2}^{T} 0\, dt\right] = \frac{V_p}{\pi} = 0{,}318\, V_p$$

In the one way rectifier we loose half of the signal.

a Full-wave rectifier: