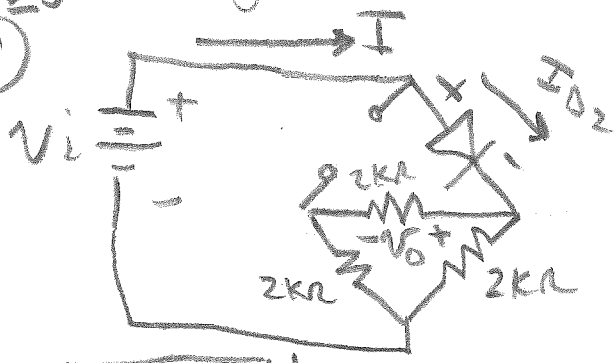
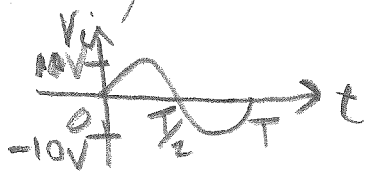
2.17 Determine output & PIV for each diode using IDEAL DIODE

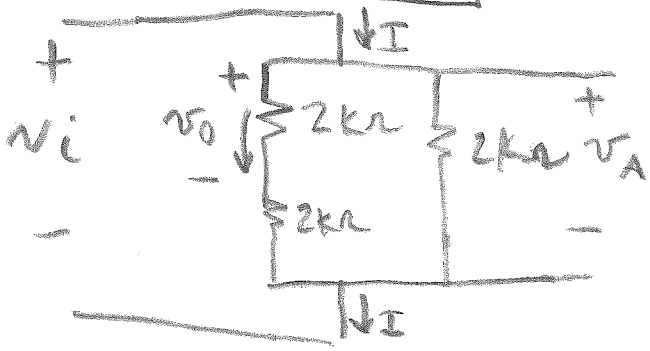
$v_i \geq 0$

(a)





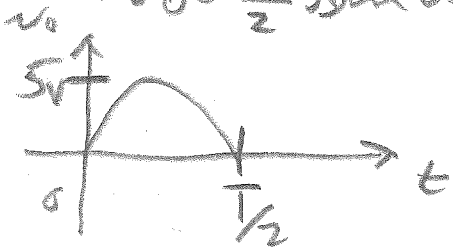
Since I is in the same direction as I_{D2}, I_{D2} is ON



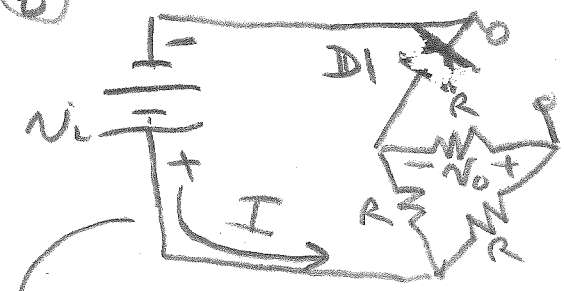
v_A is equal to v_i = $10 \sin \omega t$, 0, T/2 Volts positive

since the left-side R's are equal, ½ v is across each one ∴

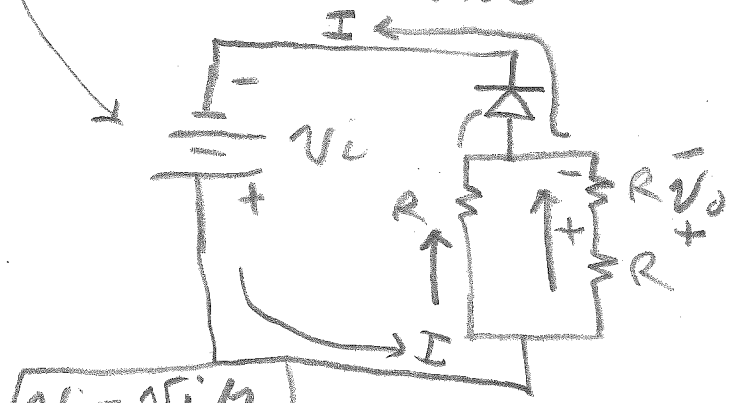
$v_o = \frac{10}{2} \sin \omega t \Big|_{0 \text{ to } T/2}$



(b) $v_i \leq 0$



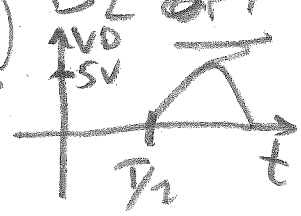
I leaves + side of v_i and travels THROUGH THE R's and IN THE SAME DIRECTION OF A FORWARD-BIASED (ON) D1. THE CURRENT IS IN THE OPPOSITE DIRECTION OF I_D FOR D2 → making D2 OFF



$\boxed{v_o = v_i/2}$

$v_o = -\frac{v_i}{2} \sin \omega t$ for T/2 to T

(sign of v_i same position as sign v_o)



2.17 (cont)

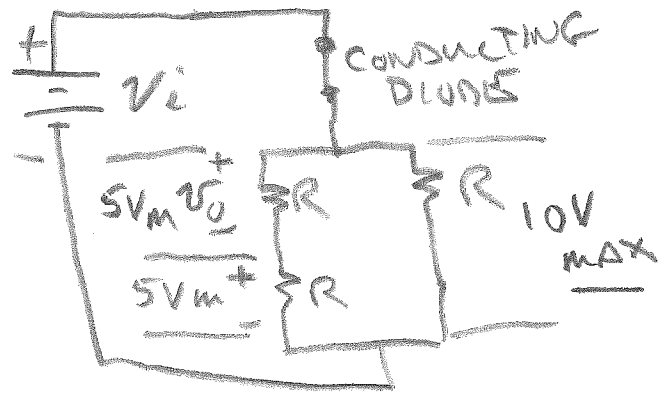
$v_{dc} = (0.636)(5V) = 3.18V$

PIV = max voltage across R,

which is 5V

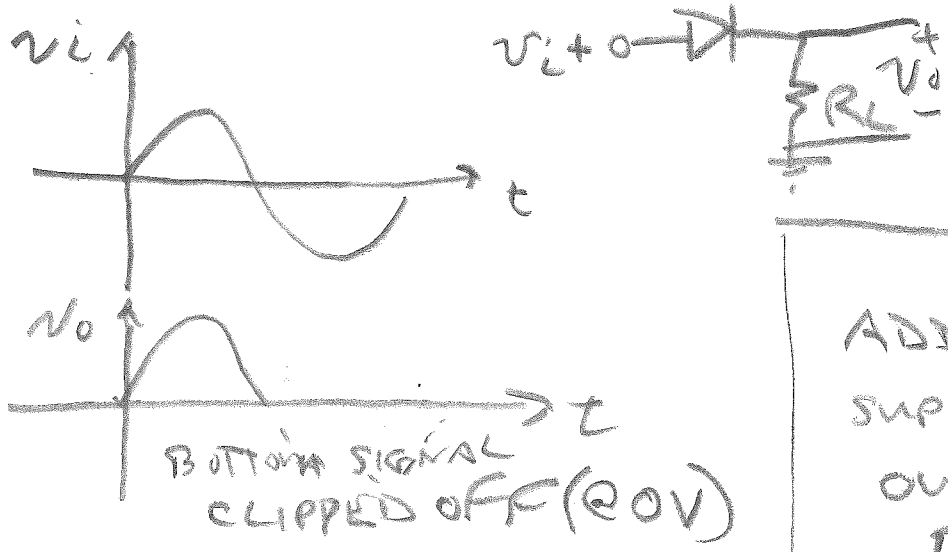
$v_{i_M} = 10V$

$v_{o_M} = \frac{10}{2} V$



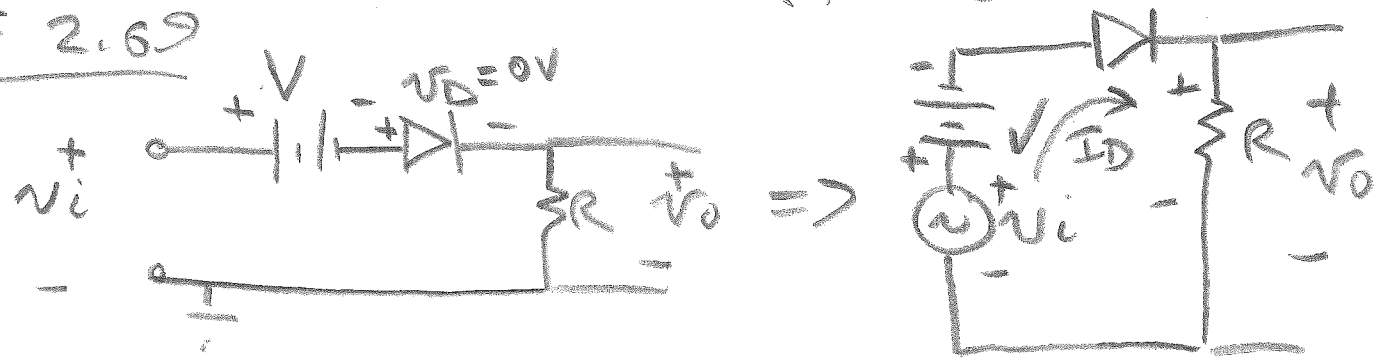
2.8 Clippers - clip away a portion of an input signal

EX- HALF-WAVE RECTIFIER



ADDING A DC SUPPLY CAN CHANGE OUTPUT GREATLY [IDEAL DIODE]

FIG 2.69



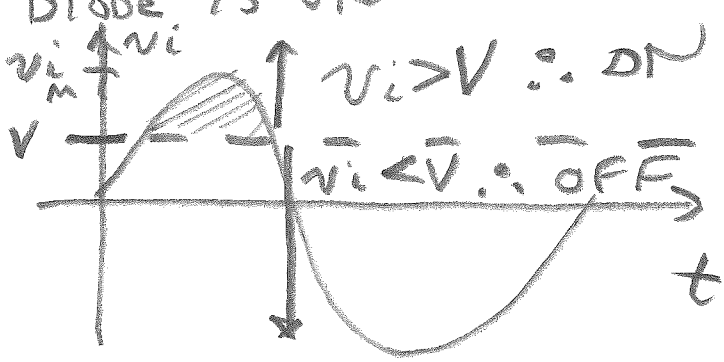
$\Sigma V = 0$

$V_D + I_D R - v_i + V = 0$ SINCE $V_D = 0$ IDEAL

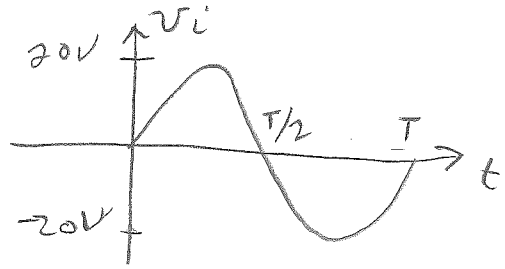
$\boxed{\frac{v_i - V}{R} = I_D}$ as long as I_D +, DIODE IS ON

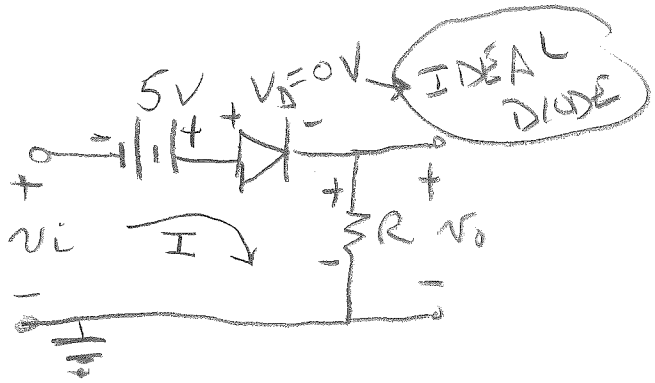
when $V_i = V$, $I_D = 0$

$V_i < V$ $I_D = 0$



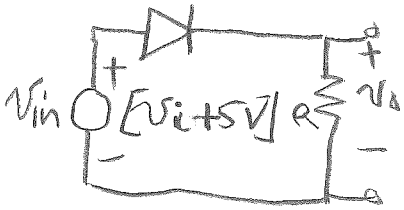
EX 2.18



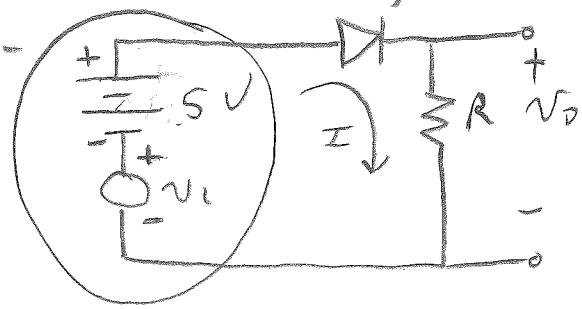


(a) For v_{in} positive, DIODE CONDUCTS, where $v_{in} = v_i + 5V$

If we redraw CKT -

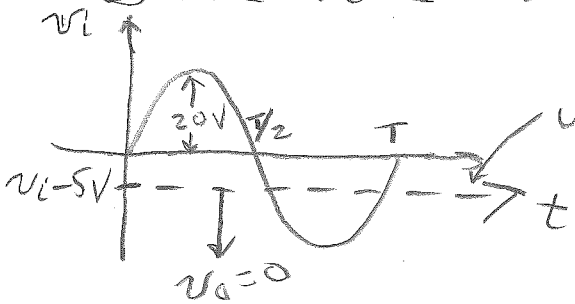


$\Leftarrow v_{in}$

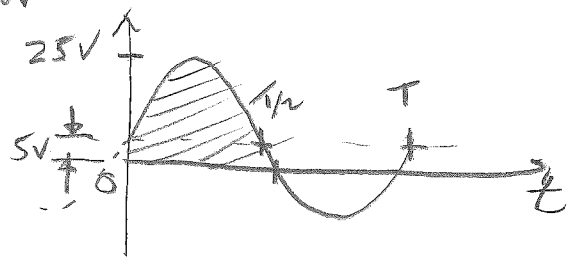


This means $v_{in} = 0$ when $v_i = -5V$ when $v_i > -5V$, DIODE CONDUCTS

(b) For $v_i < -5V$, DIODE IS OPEN, $I = 0A$, $v_o = 0$



use this as X-axis



OR

IDEAL DIODE

$\Sigma V = 0 \qquad -5V + V_D + IR - v_i = 0$

$\cancel{V_D}^{0V} + IR = v_i + 5V = IR = v_o$

$I = 0A$ when $[v_i + 5V] \leq 0$

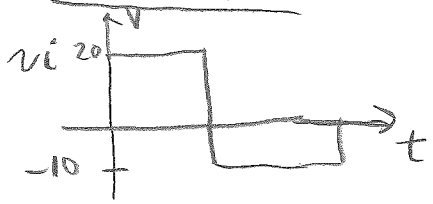
$\hookrightarrow$ when $\boxed{v_i \leq -5V}$, $I = 0A$

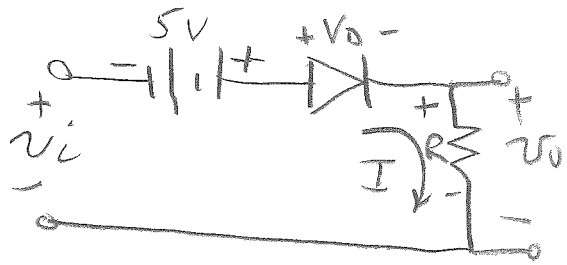
(1) DRAW WAVEFORM

(2) Shift X-AXIS $-5V$ volts

(3) OUTPUT IS ABOVE THE X-AXIS

EX 2.19



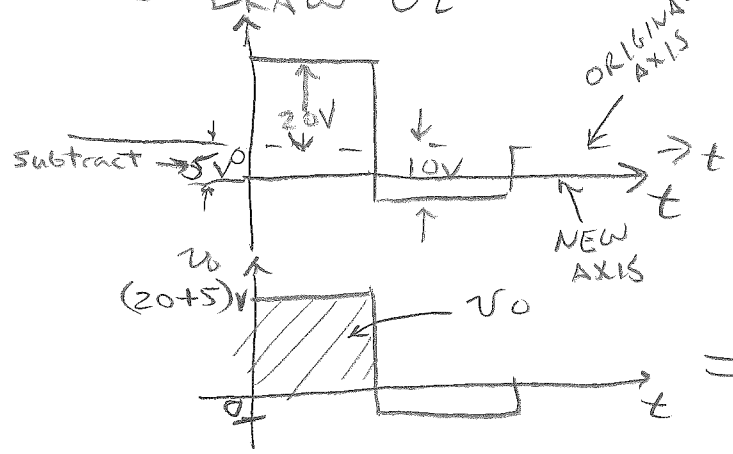


SERIES

① $\Sigma V = 0$ ASSUME IDEAL DIODE, $V_D = 0$

$-5V + \cancel{V_D}^{0V} + IR - v_i = 0$ $\quad IR = \boxed{v_o = v_i + 5V}$

② DRAW v_i

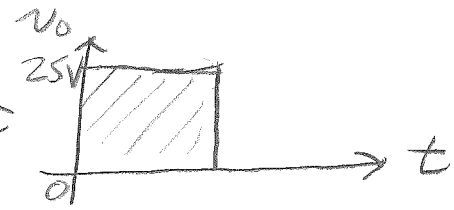


③ DIODE OFF WHEN $I = 0$

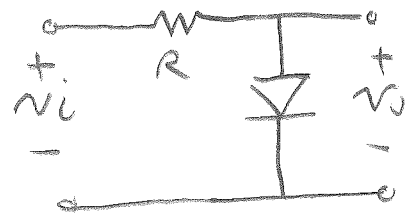
$v_i + 5V = 0$

$v_i = -5V$

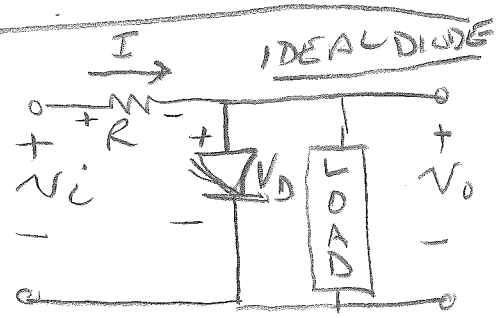
DRAW X-AXIS @ $-5V$



PARALLEL (DIODE // LOAD) LOAD ON OUTPUT



⇒



p. 82

$\Sigma V = 0$

① DIODE CONDUCTS → SHORT $v_o = 0$

② DIODE OPEN $v_o = I(\text{LOAD})$
$= v_i$ (LOAD = OPEN CKT)

FOR DIODE CONDUCTING — $IR + V_D - v_i = 0$

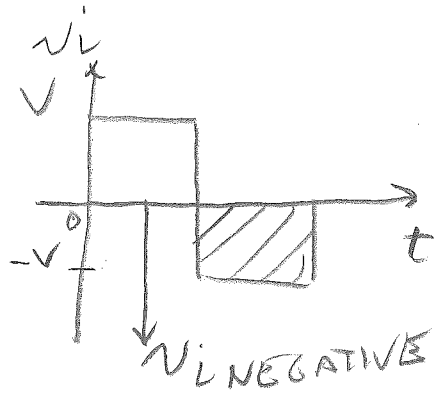
$IR = v_i - \cancel{V_D}^{0} = v_i$ ① when $I > 0$ DIODE CONDUCTS

$\therefore v_i > 0$

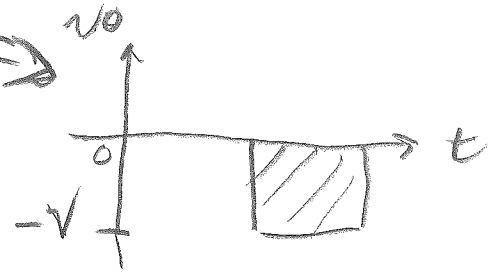
② when $I < 0$ I_D is NEG.

$\therefore$ DIODE OPEN $v_o = v_i$

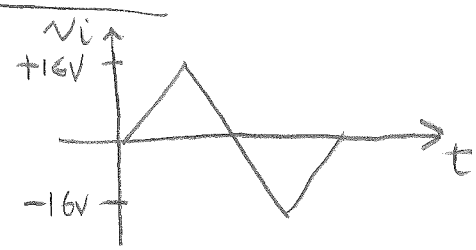
and v_i is NEGATIVE

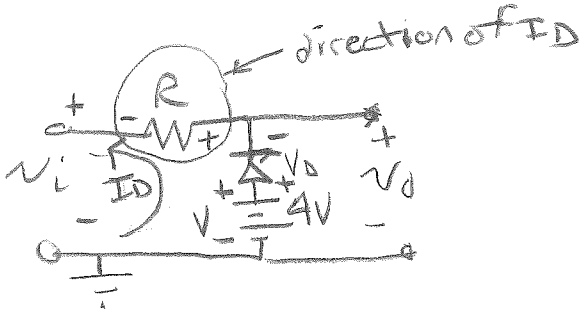


⇒



EX 2.20





① DRAW I_D for on direction of diode

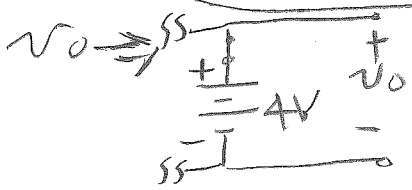
② $\Sigma V = 0$ CCW direction

$$v_i - 4V + V_D + I_D R = 0$$

$$I_D R = 4V - v_i - \cancel{V_D}$$ IDEAL DIODE

③ I_D positive WHEN $4V - v_i > 0$

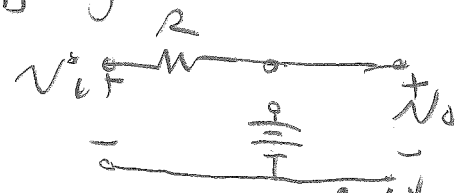
OR $4V > v_i$ ∴ when $v_i < 4V$, diode ON



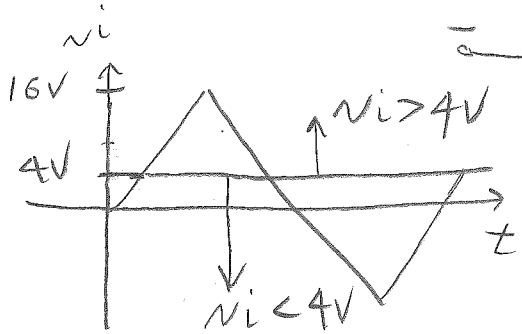
$$\boxed{v_o = 4V}$$

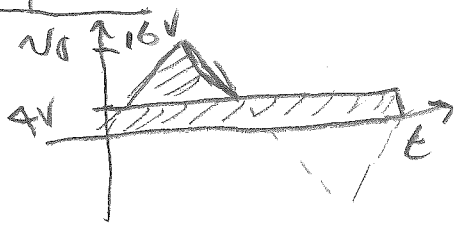
when $v_i > 4V$

I_D negative → DIODE IS "OPEN"



$$\boxed{v_o = v_i}$$



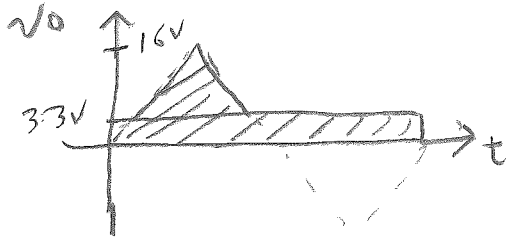


EX 2.21 use $V_D (V_K) = 0.7V$ FOR EX 2.20

$\Sigma V = 0$ $I_D R = 4V - v_i - 0.7V = 3.3V - v_i$

I_D pos when $3.3V - v_i > 0$

$3.3V > v_i \Rightarrow v_i < 3.3V$

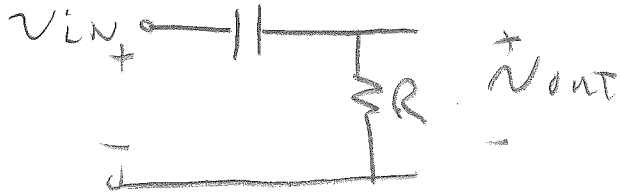


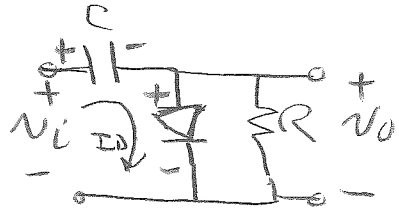
2.9 Clamper - uses a capacitor to DC-shift a waveform.

$\tau = RC >>$ DISCHARGE TIME FOR C

C is connected directly from input to output

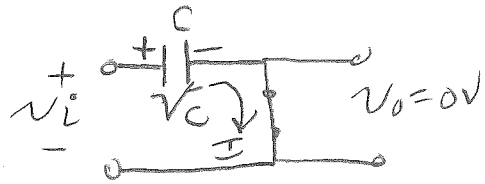
R // output





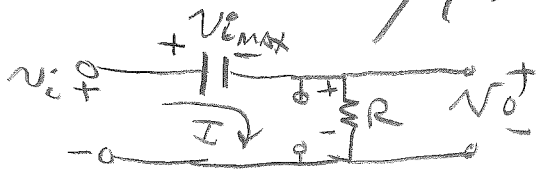
① Begin when $I_D > 0$, DIODE ON

C will charge instantaneously



$\boxed{V_i = V_C}$ and $\boxed{I = 0}$

② when diode is off, $V_C = V_{i\,MAX}$



$\Sigma V = 0$

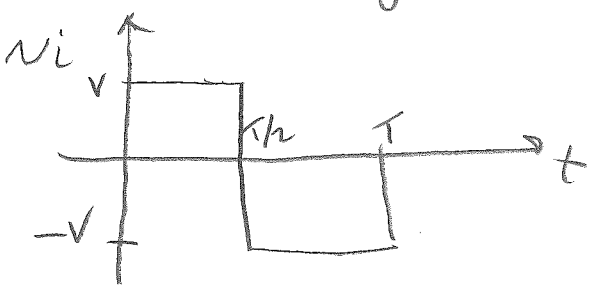
$V_{i\,MAX} + IR - V_i = 0$

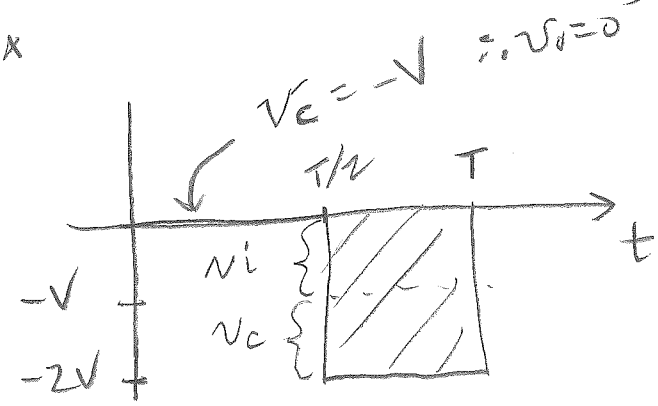
$IR = \boxed{V_o = V_i - V_{i\,MAX}}$

OR

V_o is V_i shifted by $-V_{i\,MAX}$

③ ON THE NEXT PERIOD OF THE WAVEFORM, V_o is shifted by $-V_{i\,MAX}$

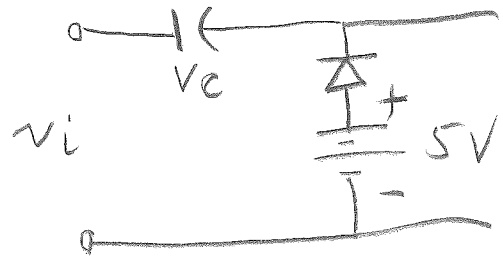




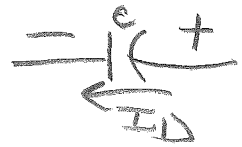
EX 2.22

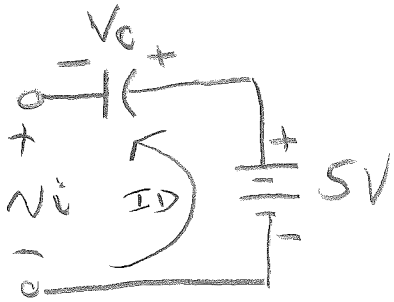
$F = 1000\,Hz$ $\quad \tau = RC = 10^5 \times 10^{-6} = 0.1\,sec$ $\quad T = \frac{1}{F} = 0.001\,sec$

$\boxed{\tau >> T}$



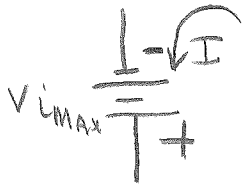
DIODE I_D CCW, MEANS





SINCE DIODE I_D FLOWS INTO THE TOP OF v_i, THIS MEANS

v_{imax} LOOKS LIKE ⟹



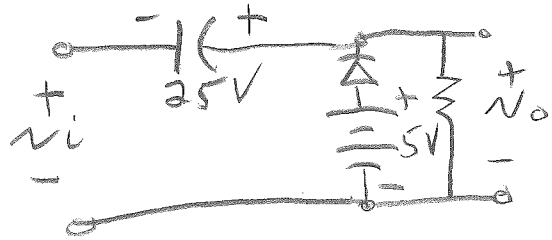
WHICH IS THE NEGATIVE PART OF THE INPUT SIGNAL (t_1)

$$+v_i - 5V + V_c = 0$$

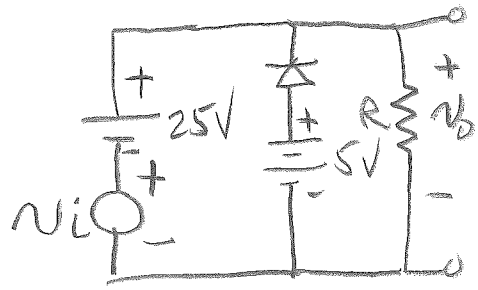
$$V_c = 5V - v_i \qquad \text{SINCE } v_{i_m} = -20V$$

$$V_c = 5V - (-20V) = 25V$$

FINAL CKT



⟹

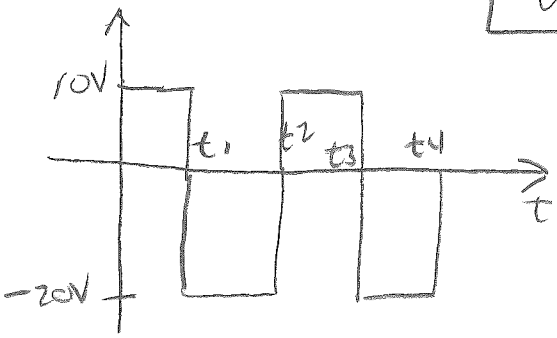


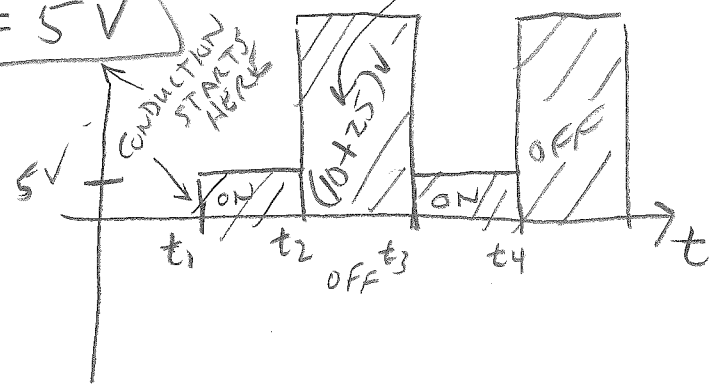
when DIODE IS OFF

$$\boxed{v_o = v_i + 25V}$$

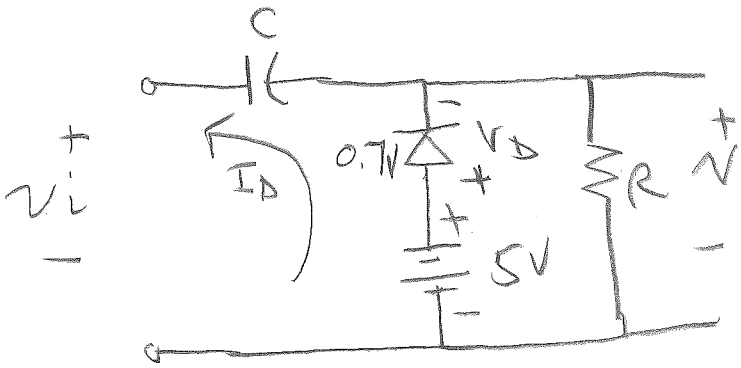
WHEN DIODE IS CONDUCTING

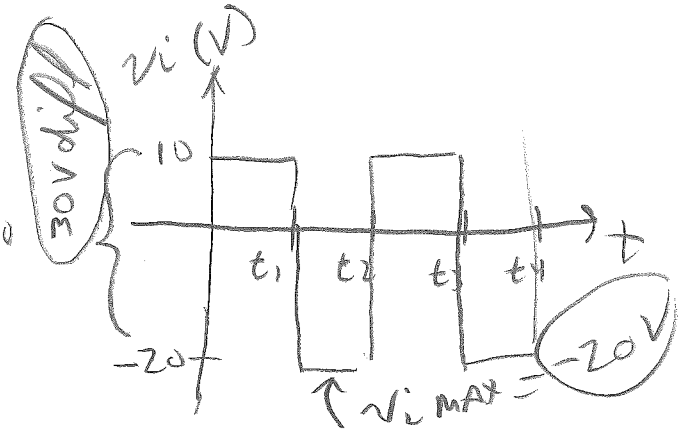
$$\boxed{v_o = 5V}$$



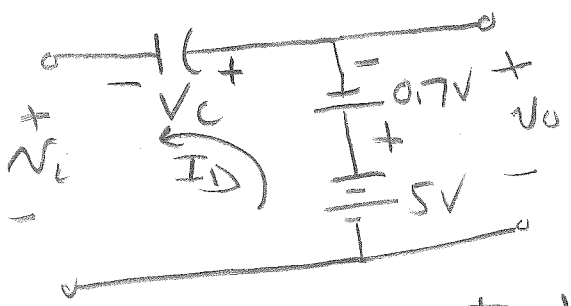


EX 2.23





when DIODE "ON"



$\Sigma V = 0$

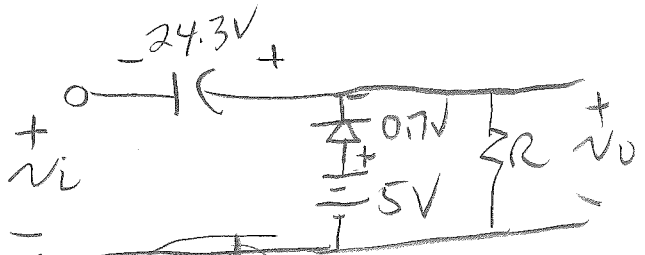
$V_C + v_i - 5V + 0.7V = 0$

$V_C = -v_i + 5V - 0.7V$

SINCE I_D goes into + of v_i, this means negative portion of curve

[I_D HAS TO COME OUT OF THE + SIDE OF THE SOURCE]

$V_C = -[v_{i_{MAX}} @ t_1 - t_2] + 4.3V = -(-20) + 4.3V = +24.3V$ (VC)

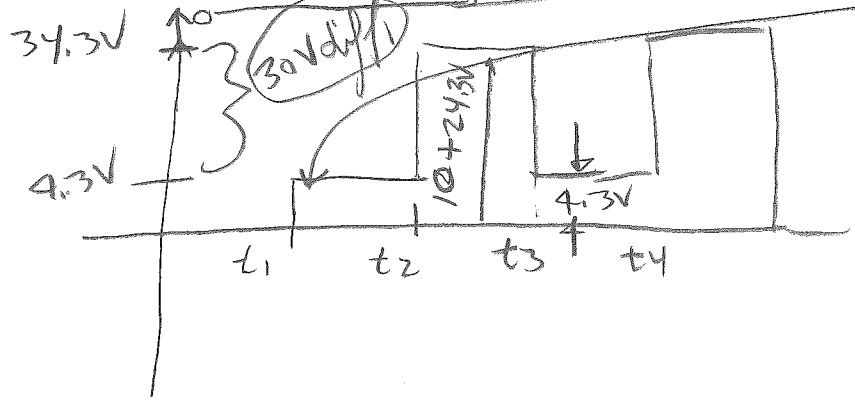


WHEN DIODE IS CONDUCTING

$v_o = 5V - 0.7V$

$v_o = 4.3V$

START @ t_1



2.09 (cont)

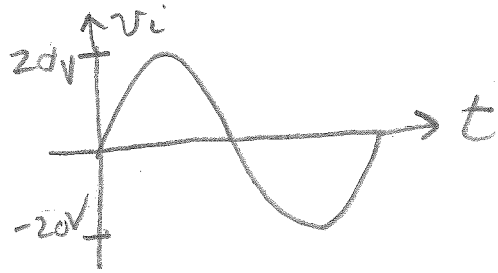
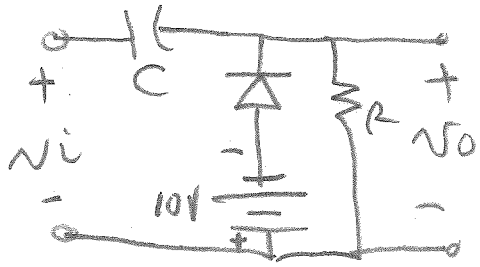
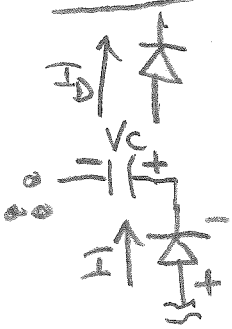


FIG 2.101

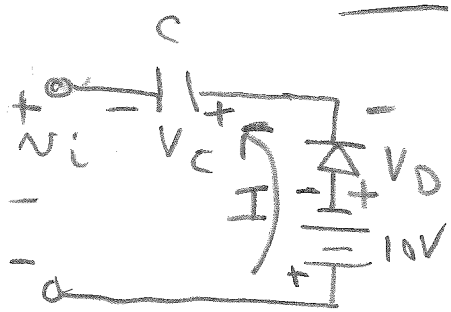


DIODE ON WHEN:



IF I_D GOES CCW then v_i IS NEGATIVE WHEN C charges

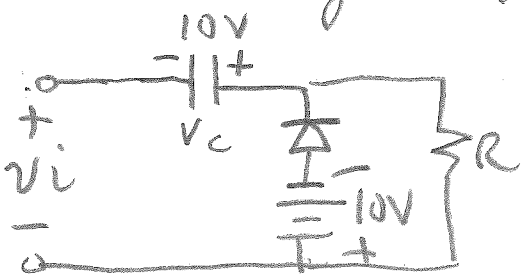
OR



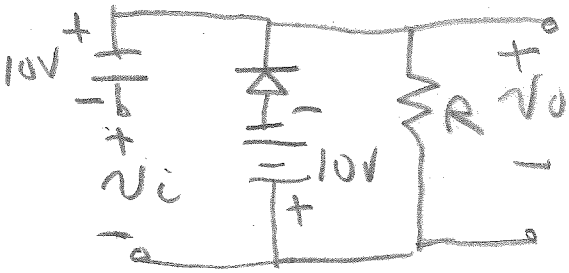
$\Sigma V = 0$ CCW $+V_C + v_i + 10 + V_D = 0$

$V_C = -10 - v_i - V_D \Rightarrow V_{C_{max}}$ when v_{i_m} (-20V)

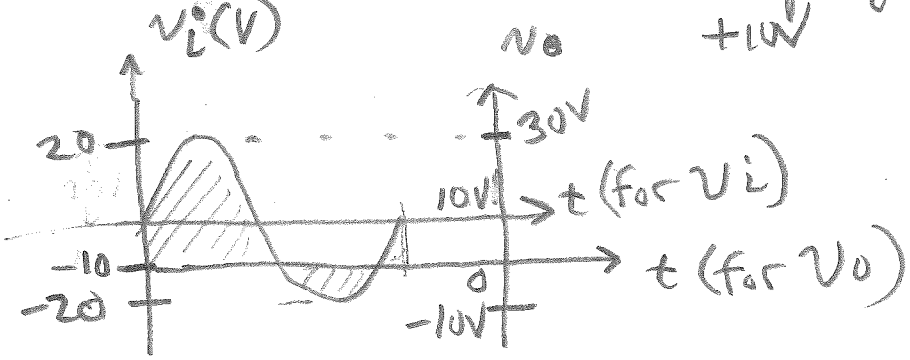
Let DIODE BE IDEAL, then C charges to $V_C = -10 - (-20V) = 10V$



$\Leftarrow$ SO CIRCUIT LOOKS LIKE

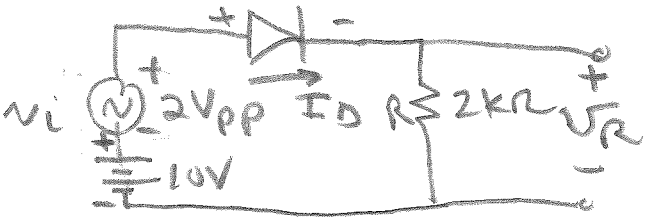


v_o is $[v_i + 10V] \Rightarrow$ shifts v_i up by +10V



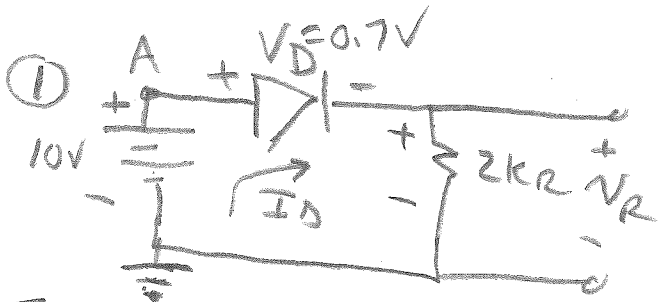
2.10 NETWORK WITH AC + DC SOURCE

Use superposition



① Short AC source & calc. v_R, I_D

② $r_d = \frac{26mV}{I_D}\Big|_{Room\ T}$



③ using peak v_i, calc $v_{R\,peak}$, $v_{D\,peak}$

④ $V_{RQ} = V_R$ from ①

$\Sigma V = 0$ CW

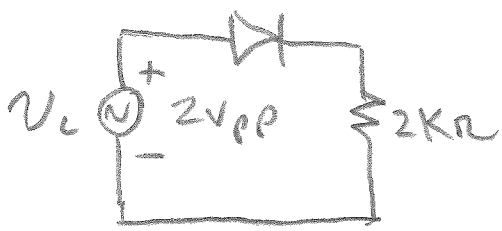
$V_D + I_D R - 10 = 0$

$I_D R = v_R = 10 - 0.7V$

$\boxed{v_R = 9.3V}$

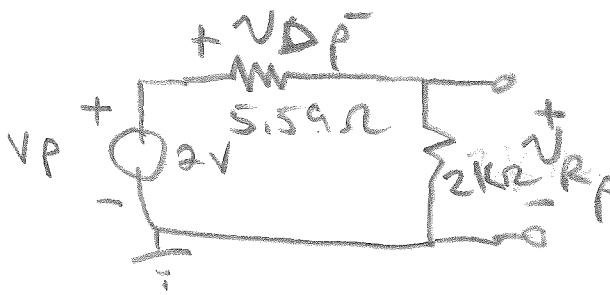
$I_D = \frac{9.3V}{2k\Omega} = \boxed{4.65mA}$

②



REPLACE DIODE WITH $r_d = \frac{26mV}{4.65mA}$

$r_d = 5.59\ \Omega$



[using Voltage Divider Rule]

$v_{Rp} = v_p \frac{(2k)}{(2k + 5.59\Omega)}$

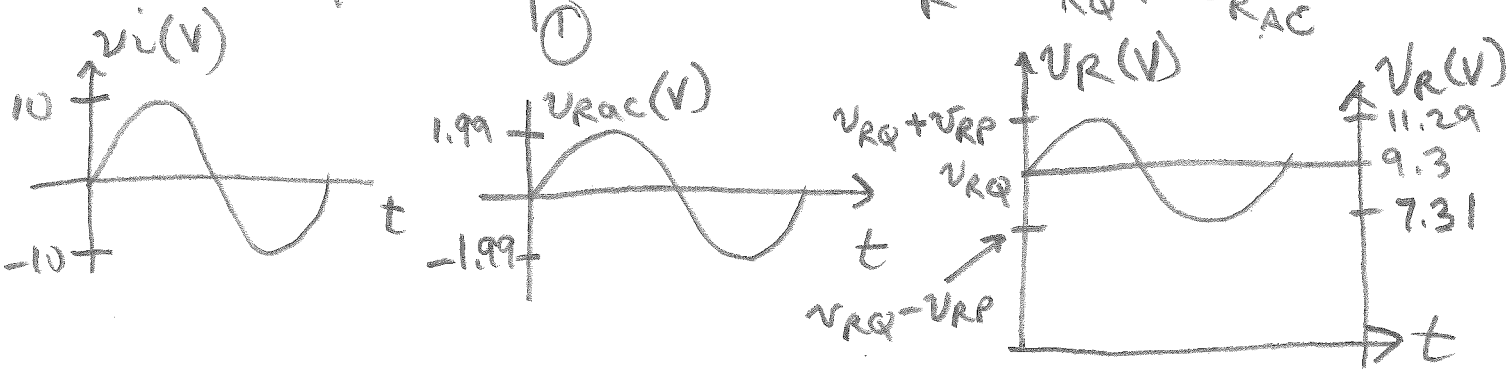
$\boxed{v_{Rp} = 1.99V}$ and

$v_{Dp} = v_p\left[\frac{5.59}{2k + 5.59}\right] = v_p - v_{Rp}$

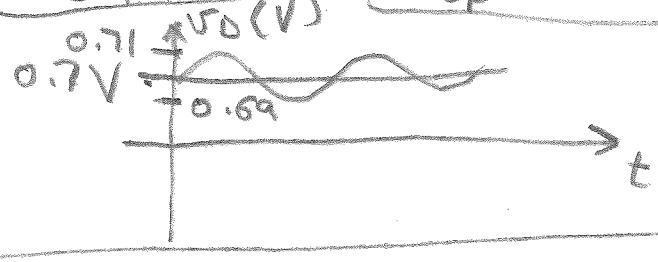
$= 0.01V = \boxed{10mV = v_{Dp}}$

Combine DC + AC

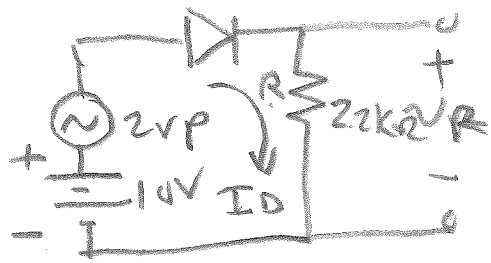
$v_{RQ} = v_R\big|_{①} = 9.3V$ $\quad v_R = v_{RQ} + v_{R_{AC}}$



$\boxed{V_{DQ} = 0.7V}$ $\boxed{v_{Dp} = 0.01V}$



GRAPHING —



① DC

WITH DIODE SHORTED

$I_D = \frac{10V}{2k\Omega} = 5mA$

WITH DIODE OPEN

$V_D = 10V$

DRAW LOAD LINE

② DC ± AC peak

$I_{Dp+} = \frac{10+2}{2K} = 6mA$

$I_{Dp-} = 4mA$