Diode Applications

Property of diode :-

It conducts current in one direction while blocking in the other direction

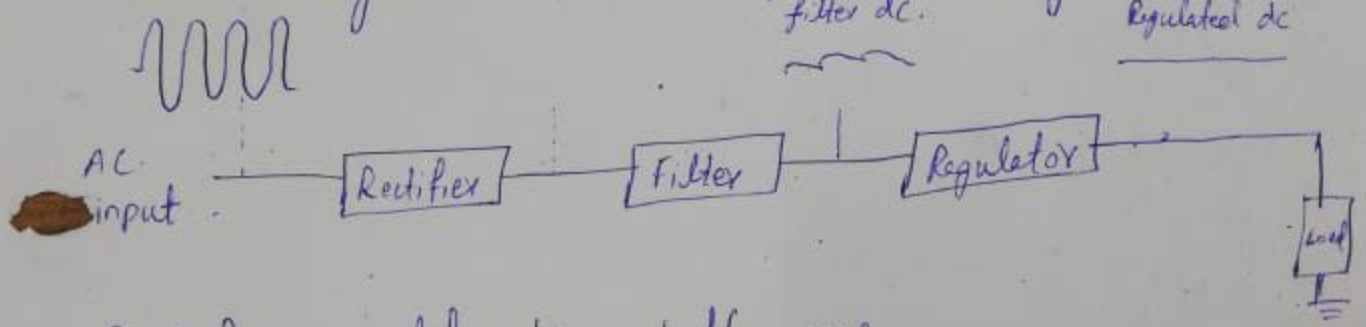
Diodes are used in

(a) DC power supply.

It converts AC into constant DC voltage.

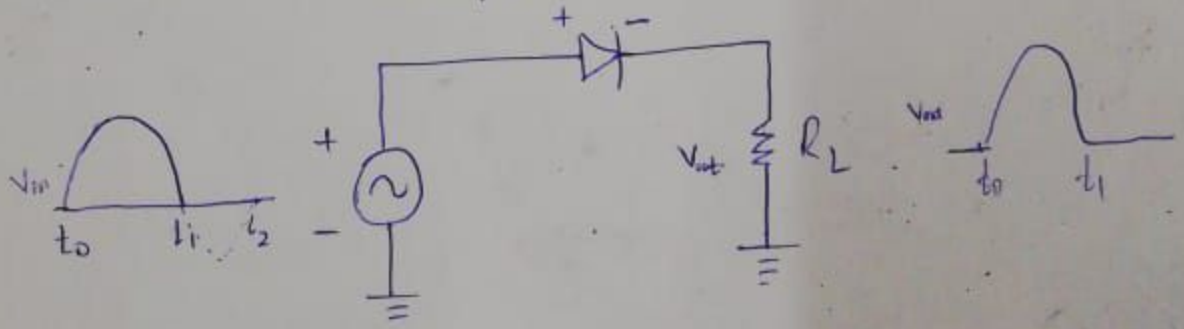
This DC voltage is used into television, CD players and most laboratory equipment.

Block diagram of DC power supply :-

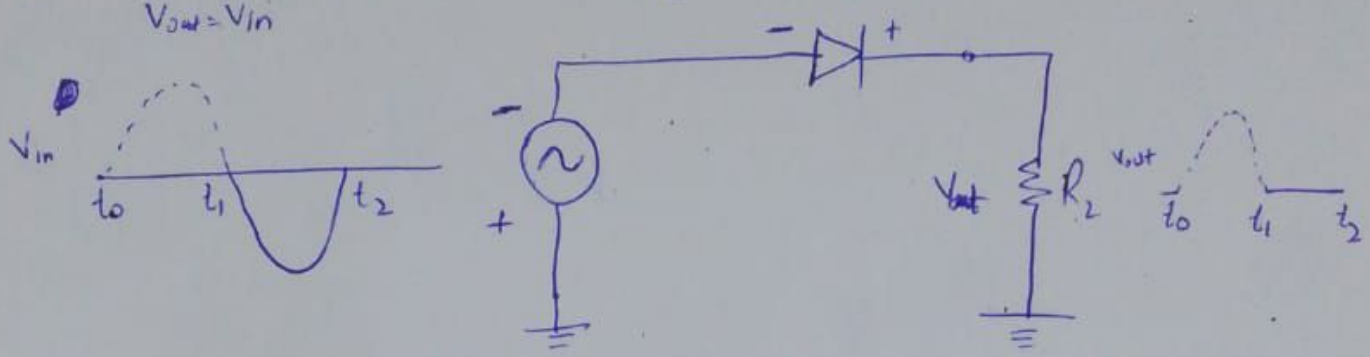


Rectifier could be half wave
Full wave

Half wave Rectifier :-

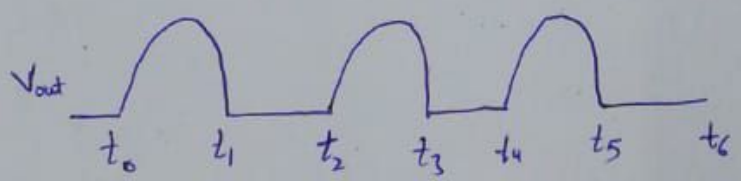


Considering the ideal model of diode. when the input is positive half cycle diode behave as forward bias and conducts current through the load resistor R_L.

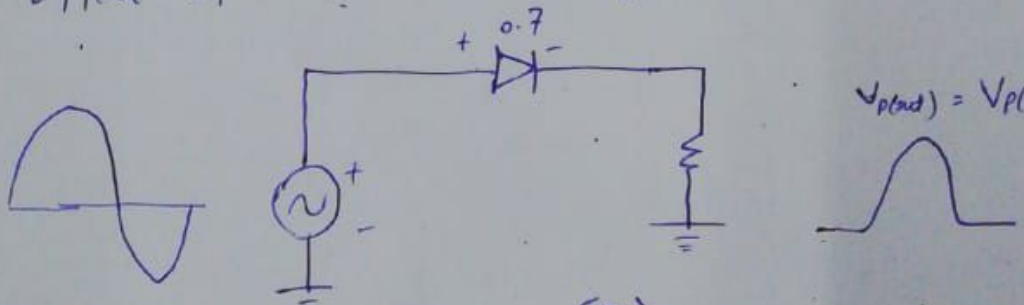


During the negative half cycle diode act as reverse bias and no current will flow through R_L. And voltage across R_2 is zero. so $V_{out} = 0$ during negative half cycle.

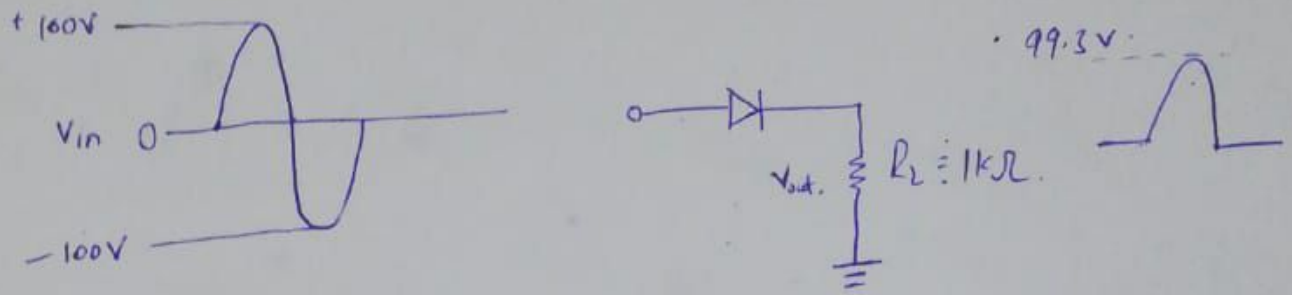
Complete output voltage for HW rectifiers. for three cycles.



Effect of the barrier potential in case of practical diode.

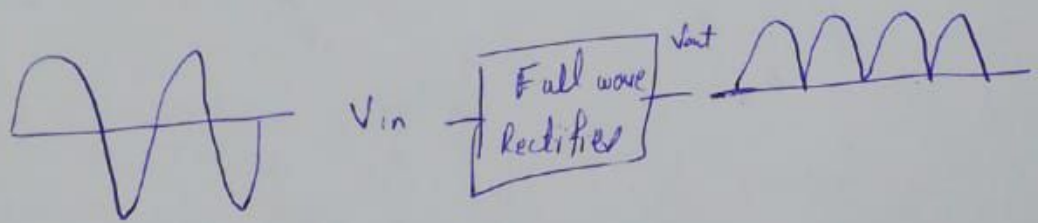


Example 2-2 :- Draw the output voltage of ~~each~~ the rectifier for the indicated input voltages ? consider practical diode



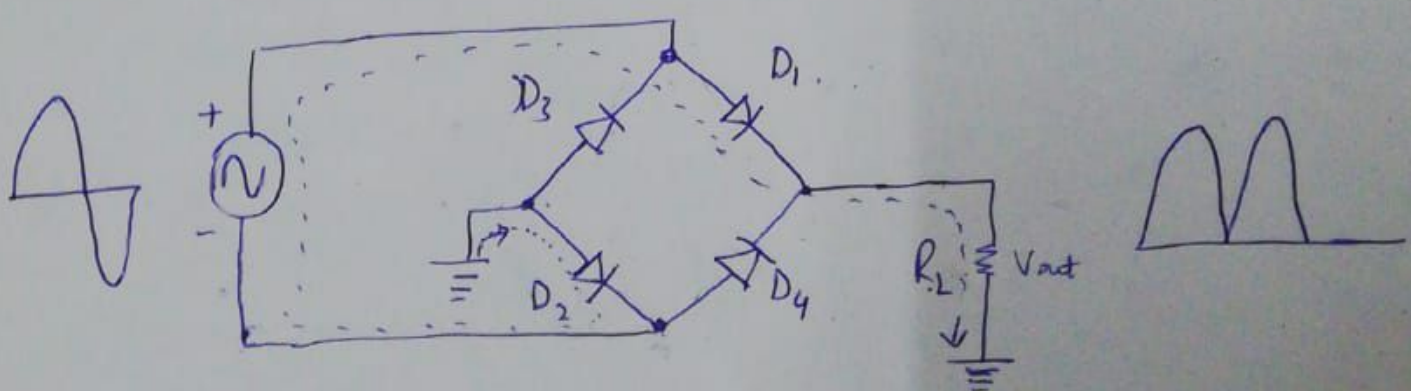
Full wave Rectifiers :-

A full wave rectifiers allows current through the whole cycle.



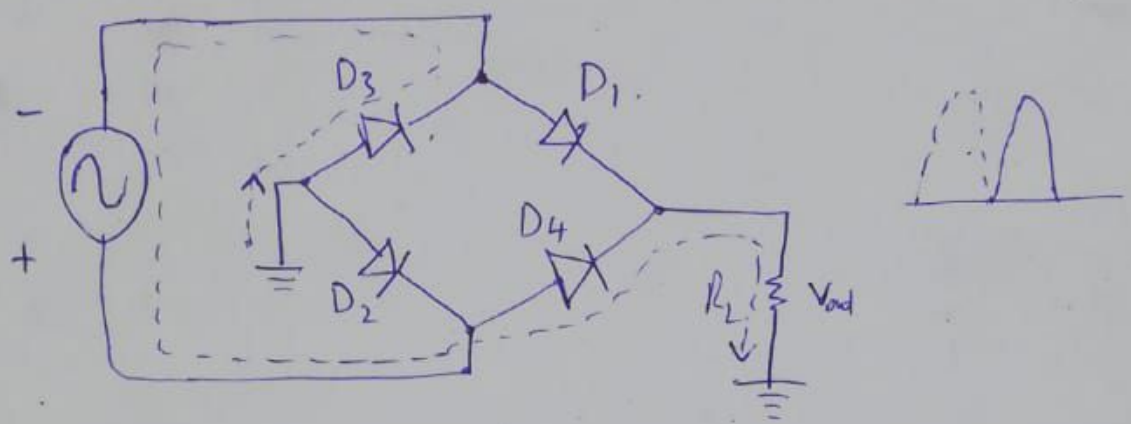
Bridge Full-wave Rectifier :-

It uses four diodes



During positive cycle D_1 & D_2 act as forward bias and conduct current. D_3 & D_4 act as reverse bias.

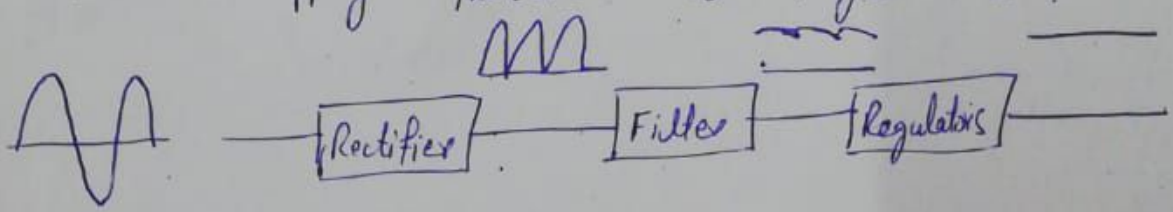
During negative cycle D_3 & D_4 act as forward bias and conduct current in the same direction as it was during positive half cycle.



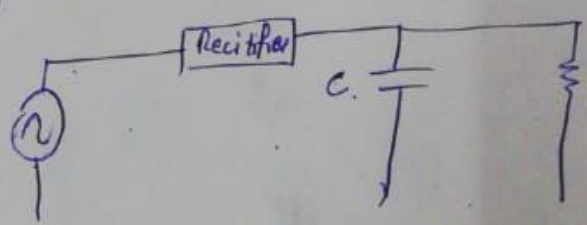
Practical model output of full wave Rectifier.

$V_{out} = V_{in} - 1.4$.

Power Supply filters and Regulators :-



Filters :- Capacitor input filter,



% reduces ripples <10%.

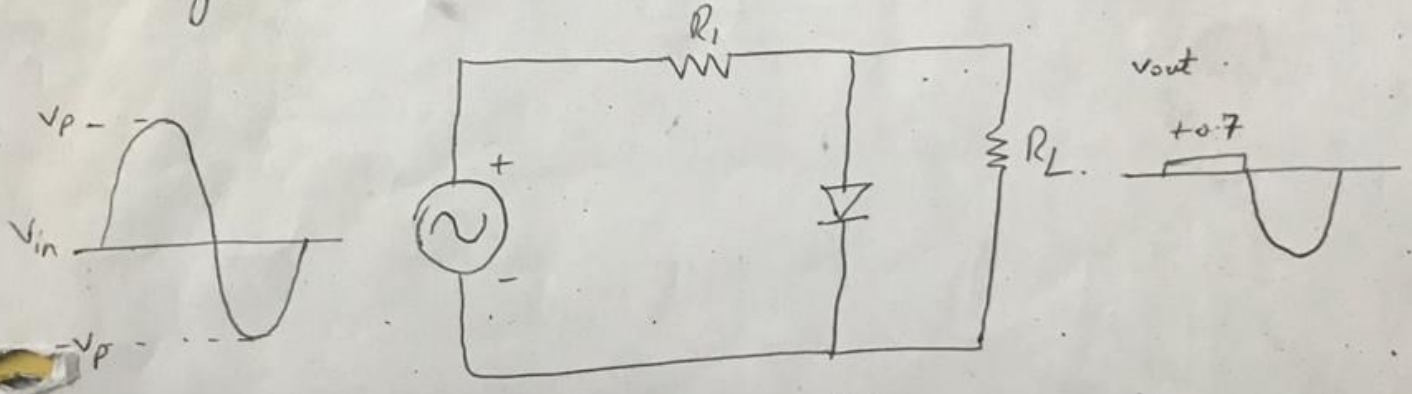
Diode Limiting and clamping circuits :-

Diode limiter circuits are used to clip off some portion of signal.

Diode Limiters :-

clips Positive half cycle :-

Diode become forward biased for +ve half cycle after 0.7V (silicon). For -ve half cycle diode become reverse biased.

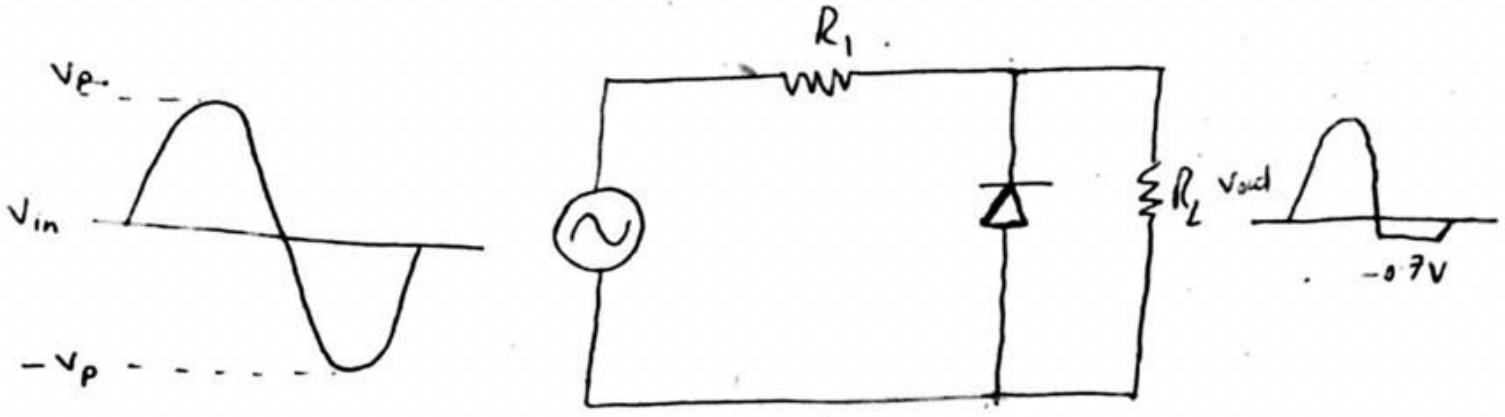


$$V_{out} = V_{in}\left(\frac{R_L}{R_1 + R_L}\right)$$

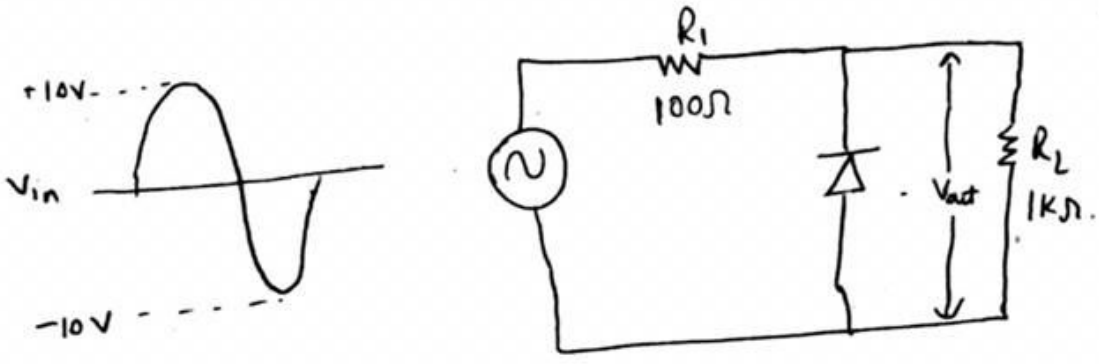
$R_1 << R_L$ $V_{out} = V_{in}$.

clips negative half cycle :-

Diode become reverse biased for +ve half cycle. For -ve half cycle diode become forward biased after -0.7V.

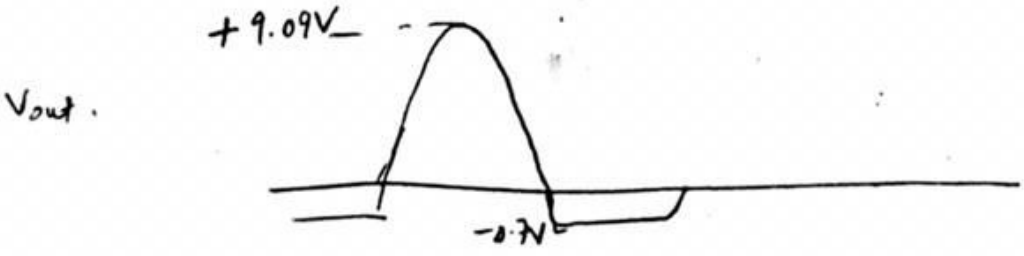


Example What would be output against R_L ?



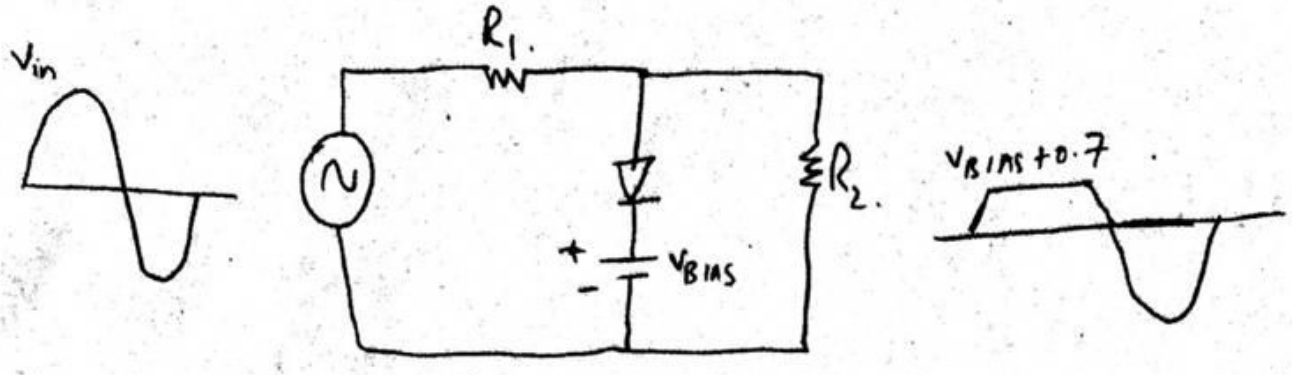
Diode is forward biased and conducts when the input voltage goes below $-0.7V$.

$$V_{p(out)} = \left(\frac{R_L}{R_1 + R_L}\right) \cdot V_{p(in)} = \left(\frac{1k\Omega}{1{:}1k\Omega}\right) \times 10 = 9.09V$$

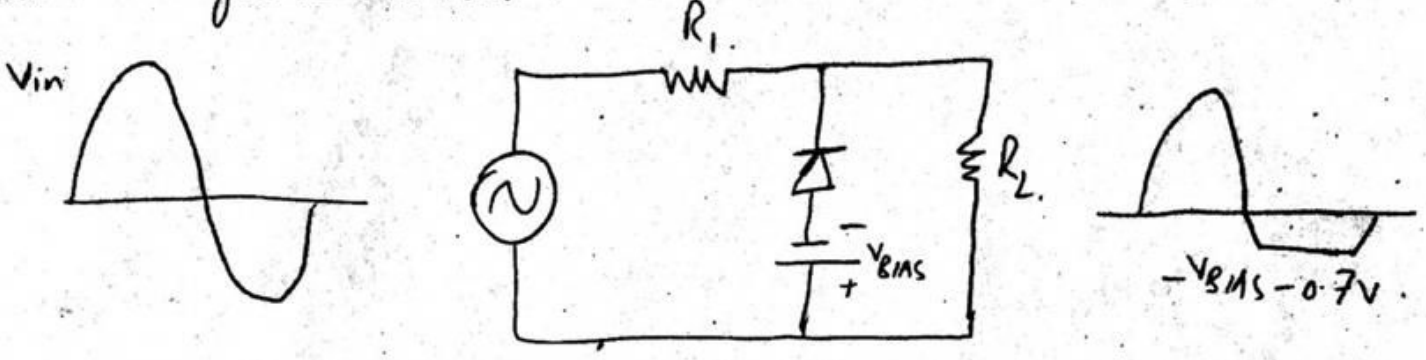


Biased Limiters :-

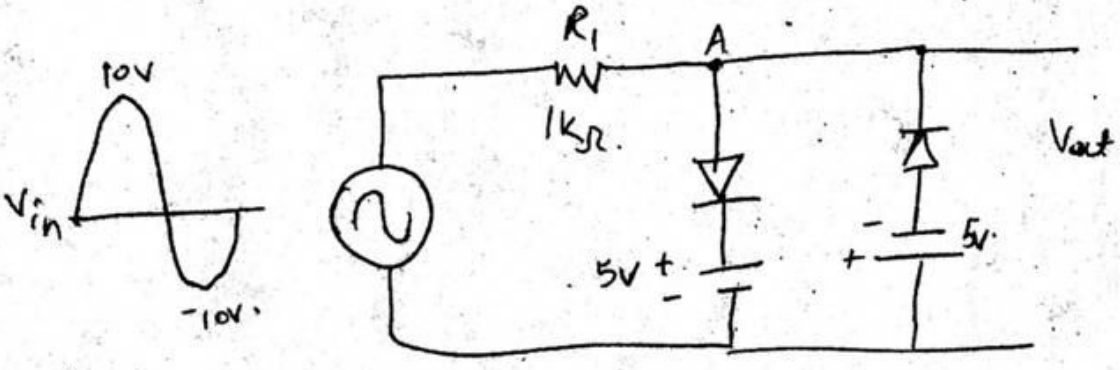
Positive limiter.



Negative limiter.

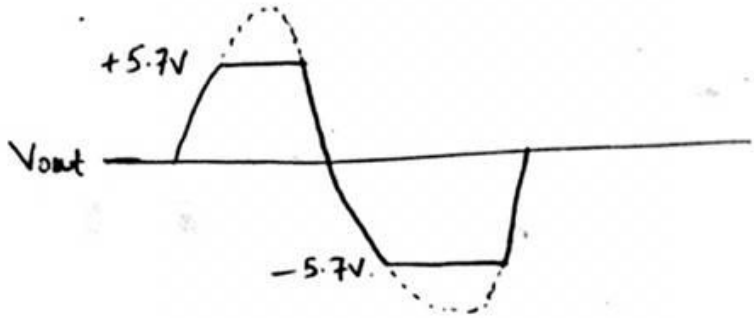


Example : Circuit combining a positive limiter with a negative limiter.

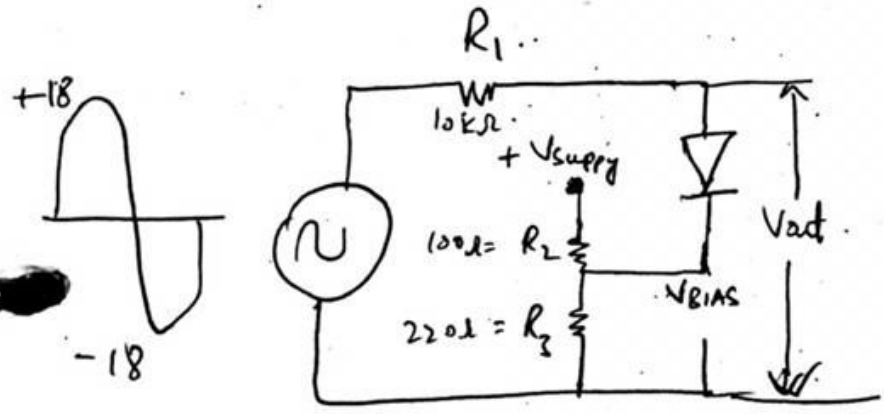


Voltage at point A reaches +5.7V.
diode D1 conducts and limits the +ve waveform.

Voltage at point B reaches -5.7V.
diode D2 conducts and limits the -ve waveform.



Voltage divider bias :-
Positive limiter.



$$V_{BIAS} = \left(\frac{R_3}{R_2 + R_3}\right) V_{supply}$$

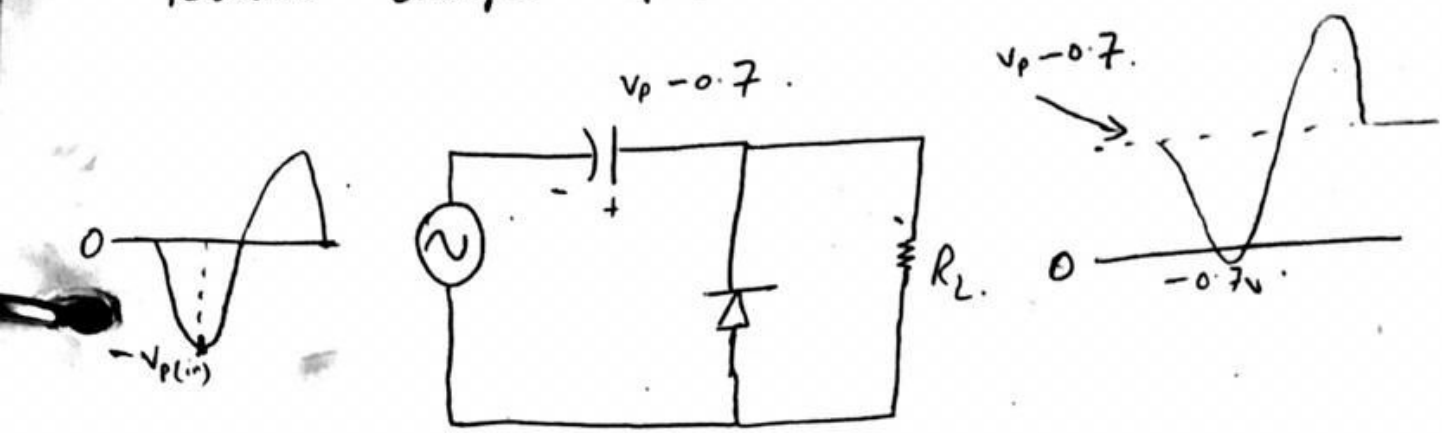
$$V_{BIAS} = \left(\frac{220}{100 + 220}\right) 12 = 8.25V$$

$V_{BIAS} + 8.25$

Diode clampers :-

clampers adds a dc level to an ac voltage.

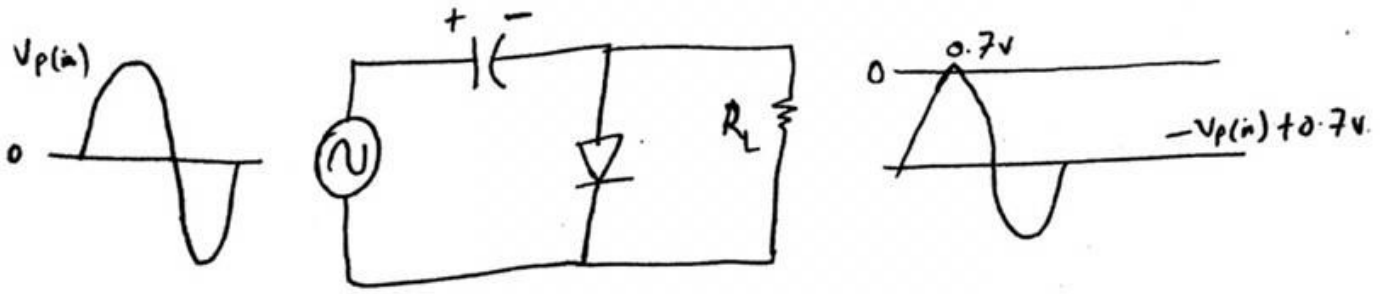
Positive clamper operation :



First half of negative peak diode act as F.B and capacitor gets charged.

As second half of ~~negative~~ positive peak diode act as R.B and capacitor start discharging. Capacitor become a battery source in series with ac signal and the value of this battery source offset the signal.

Negative clamper operation :-



Special purpose diodes :-

Zener diodes, Varactor diodes, optical diodes.